

The E4Kids study: Assessing the effectiveness of Australian early childhood education and care programs

Overview of findings at 2016

Final report to the Partner Organisations of the Effective Early Educational Experiences (E4Kids) study.

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Education
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Postgraduate Diploma of Teaching (Early Childhood)
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Preface



The Effective Early Educational Experiences (E4Kids) study was conceived almost a decade ago, after the release of *Starting Strong II: the OECD Thematic Review of Early Childhood Education and Care (ECEC) provision* (Organisation for Economic Co-operation and Development, 2006). Since then, governments across Australia expanded investments in early childhood provision, both to promote the development of young children and to address women's labour market participation. Since 2007, Australia also transformed its policy approach through the implementation of a National Quality Framework (NQF). The NQF aims to improve educational and developmental outcomes for children through their participation in ECEC programs. Longitudinal evidence on the transformative power of high-quality programs to raise the outcomes of young children, especially of children living in disadvantaged circumstances, was a key driver.

This five-year longitudinal study commenced recruitment and data collection in 2010. E4Kids contributes to the early childhood field internationally, representing one of a few studies to comprehensively assess the impact of participation within everyday ECEC programs on children's learning and development outcomes. E4Kids provides new evidence of the functioning and quality of everyday ECEC programs, and the trajectory of learning and development of the 2,494 Australian E4Kids children and 157 control group participants who participated from age three to four years through to age eight. The ECEC programs experienced by the E4Kids participants were directly observed between 2010 and 2013.

In 2009, the National Early Childhood Development Strategy and the National Partnership Agreement set out a range of ECEC reforms, including increasing the level of structural quality standards, implementing a new National Quality Standard from 2012, and the provision of 15 hours of preschool-kindergarten education to all children (scaling up participation over several years). While the E4Kids longitudinal study cohort represents a point-in-time sample of children experiencing everyday ECEC programs, and while there may be some differences in experiences of children enrolled in programs in 2016, it is also clear from empirical evidence that an educator's pedagogy and practices and the educator-child interaction behaviours are not easy to change.

E4Kids evidence suggests there is real need for a further program of policy reform if all children are to reap benefits from policy investments related to a 'good start in life'. E4Kids describes the functioning of the Australian ECEC market and its impact on the development of different groups of children. The evidence underscores some policy reform directions, interventions and program initiatives that, if pursued, would lead to significant improvements in children's outcomes. There are few social justice issues more vital than building a better life for all children, and a more prosperous nation.

Catherine Taylor

The E4Kids research program

Effective Early Educational Experiences (E4Kids) is a five-year longitudinal study designed to assess the impact of everyday, approved^a early childhood education and care (ECEC) programs on children's learning and developmental outcomes to age eight. A cluster randomised sample of 2,494 children who attended ECEC programs at three to four years of age were recruited from programs delivered in Victoria and Queensland in 2010. In addition, 157 children who did not access such programmes in 2010 were identified through Commonwealth Government sources and were recruited as a control group to the study. The programme and control groups did not differ significantly in terms of gender, community and family SES or the language spoken at home. The study adopted a multi-level design¹ with parents, centre directors, educators and carers answering questions on children's prior life experiences, demographics, and the children's progress. The nature and organisation of ECEC programs and the schools that children attended were recorded and the quality of adult-child interactions within the programs was directly assessed. Direct testing of children's cognitive abilities and achievements was undertaken over three years, and linked with the children's NAPLAN scores at age eight years.

The E4Kids study provides evidence about everyday ECEC programs in a diverse range of Australian communities, including remote, regional and urban locations. The E4Kids participants were a diverse group, including Indigenous children, and a wide range of children experiencing risk factors that may inhibit optimal developmental progress. The study addresses key components of quality that were distilled from the literature and analyses program quality within and across the Australian subsidised ECEC program types, including long-day care, family day care, kindergarten/preschool, and occasional (or limited hours) day care. The contributions of each of these different programs to children's learning and developmental outcomes was tracked longitudinally, and may be compared to a sample of Australian children who did not access ECEC programs when the study commenced in 2010.

The study had four aims:

- To identify and define quality in ECEC by measuring and assessing the independent contributions of program scope, structure and pedagogical practices;
- To evaluate the independent effects of ECEC programs, at three to four years, on children's learning, cognitive and social development, social inclusion and well-being, by controlling for family background, family learning environment, prior non-parental care, and community;
- To evaluate the independent effects of ECEC programs on family participation, social inclusion and well-being, controlling for family background, home learning environment, prior non-parental care, and community;
- To evaluate investment in ECEC programs by understanding the contribution of program components that add value to child outcomes and to assess, through comparison of relative effectiveness, the returns on those investments to children, families and the community.

1 For details of the **study design** refer to:

Taylor, C., Cloney, D., Adams, R., Ishimine, K., Thorpe, K., & Nguyen, C. (2016). Assessing the effectiveness of Australian early childhood education and care experiences: study protocol. *BMC Public Health*, 16, 352. doi: <http://10.1186/s12889-016-2985-1>

a. A children's program offered within an ECEC service that is licensed and in receipt of government subsidy (e.g. for fee discount, or to enable access for a time-specific period to some children for free.)

Overview of findings

This overview draws together the core and related E4Kids study findings for the period 2010-2016, corresponding with the lodgement of a final report to the Australian Research Council (ARC). The findings summarised in this document have been published in academic journals and through other media including book chapters, public lectures, conference presentations and symposia (see Appendix). Further analyses and the preparation of manuscripts that address the aims of E4Kids and related studies are underway at the time of this report. It is expected that findings will continue to flow from the E4Kids study after the final report to the ARC. A small core team continues to use the dataset, collaborating with key partner agencies on further questions to address through analysis of the collected evidence, and achieving further data linkages to inform early childhood policy developments that are important to the Partner Organisations. (see Ongoing and future work, p.26)

To demonstrate that everyday programs are a significant contributor to children's outcomes is a complex challenge. There is an extensive literature from prior international studies concluding that early childhood programs must be of "high-quality" if they are to guarantee positive effects on children's development, and "model" programs (such as the Abecedarian program) continue to be customised and tested for their effectiveness in new communities, including sites across Australia. The idea that there may be program-quality thresholds (a priori standards) that when implemented ensure significant growth in child development outcomes also continues to be theoretically and empirically tested internationally. The E4Kids research program studied, at scale, key quality dimensions of Australian ECEC programs to empirically test the contribution of everyday ECEC programs independent of other family and community factors such as socio-economic status and a child's home learning environment. A core priority was to resolve the question of how much value to children's learning and development is there to be gained from participation in everyday ECEC services.

Implications of the summarised E4Kids research program findings are also included in this text. This is to assist policy makers determine how best to invest in initiatives that can positively influence children's present and future outcomes, and improve children's lives now and over the life course. Promoting the development of human potential and a sense of connection, agency, responsibility and contribution is paramount to children, and to the nation's future.

Overall, the E4Kids findings underscore a need in policy setting for more sensitive consideration of the functioning of the Australian ECEC market and its impact on the development of different groups of children. There

is much potential to address and further investigate some of the key themes that are highlighted within this report, collaborate with communities and continue to research the progress of diverse groups of children, especially those who within this evidence base seem most poorly served by the generalised ECEC services marketplace. Not all children benefit from everyday ECEC provision. Additional program investments and research initiatives should address aspects of program quality that significantly improve children's outcomes, and should deeply engage the communities least well served by everyday programs so that the promise of high-quality early education and care for all can be realised.

The following sections summarise findings related to key themes of interest to the E4Kids research program, including program quality, access, selection and attendance, and the independent effects of programs on children's development. Each theme is more fully addressed in the published papers that are listed as endnotes, and available for further reading, with some papers pertinent to more than one of the themes reviewed.

Program quality²

The E4Kids study verifies the complex nature of ECEC programs and their effects on child development. The study adopted standard scales to measure different dimensions of quality, attesting that ECEC program quality is multidimensional. Different dimensions of program quality had strong positive effects on children's outcomes, and quality dimensions were correlated when assessing the pathway of program quality to child development outcomes. E4Kids separated out the contribution of ECEC programs relative to other child development inputs such as the amount of program children receive within prior-to-school settings, the child's own characteristics, the home learning environment, child and family health, family socio-economic status and characteristics of the community where the child lives and programs are provided.

Because of the multidimensional and co-dependent relationships among the different dimensions of quality, and the differential amounts of program that children receive, E4Kids found no independently verifiable collective level of quality and dosage that assured the production of certain levels of child outcome. However, the findings confirm that certain teaching and learning dimensions within a program make a significant difference to children's achievement outcomes, having controlled for other influences such as home learning environment, child and community characteristics and family SES.

E4Kids makes a unique contribution to the measurement of the ECEC *program process quality* in Australia, focusing systematically on the behaviours of teachers and their interactions with children. This aspect of process quality has been found elsewhere to be of greatest influence on children's learning and development (see for example, Sabol *et al*, 2013). Interactions within the ECEC programs were measured through direct observation in the rooms inhabited by the study children over a three-year period using the Classroom Assessment Scoring System (CLASS). The CLASS enabled scoring on three domains: The Emotional Support for children, the organisation of activities that facilitate children's learning and engagement, and the level of Instructional Support provided by the educators during the play-based program (Figure 1, page 8). Instructional Support refers to support given (during children's free-play, guided play and adult-led activities). Instructional Support includes promoting an understanding of everyday concepts through analysing, creating, and integrating previous knowledge; connecting to the child's real world; having back and forth exchanges with children where scaffolding, giving encouragement and affirmation feature; probing children's thinking and providing information; and modelling language through frequent conversations, open-ended questions, the use of advanced vocabulary and language, repetitions and extensions, and self and parallel talk.

The most significant finding for program quality as a driver of child development was the *quality of adult-child engagements* measured within daily programs. These do make a difference. There are key teacher-child interaction behaviours that characterise high-quality processes and improve child achievement outcomes. The study found *high and moderately high levels of emotional support* being provided within ECEC programs, and *moderate levels of room organisation that facilitates children learning and participation* in a range of stimulating activities, and *low levels of instructional support*. This finding points toward follow-up actions that may have real capacity to close developmental differences, especially associated with children experiencing greater risk and vulnerability, by paying detailed attention to the nature and focus of adult-child interactions during play-based programs.

The everyday ECEC programs observed within long-day care, family day care and preschool/kindergarten settings provided most children with *low levels of the interactions that are known to promote young children's thinking* (conceptual understanding), challenge their ideas and understandings and enrich their language capability. These findings suggest that there is an opportunity to make a substantial difference to children's cognitive development well before school by having early childhood educators further develop skills in *promoting children's learning*. This finding is especially significant to the children living with a range of risk factors, and who are known to benefit most from high-quality early childhood programs. Effort to focus professional learning investments more directly on interactions that promote learning is likely to pay off. The NQF reform activity included the requirement for ECEC services to nominate a Lead Educator for the service. This role offers potential for engaging at service level on

optimal techniques to promote young children's learning. Now, when the ECEC field is developing professionally and is motivated to make a difference to children's learning, the role of 'educator' and 'lead educator' is salient.

E4Kids evidence suggests, as illustrated above, that certain dimensions of quality align with improving children's cognitive achievement. These findings suggest that if overall quality thresholds such as those established by the Australian NQS system (a generalised service rating) are to accurately *predict* child outcomes then there is a need to measure more specific dimensions of quality within the process of everyday engagements, as well as characterise the general climate, settings and service through the NQS quality areas. For example, within the E4Kids study specific aspects of the Instructional Support that are subsumed within NQS Quality Area 1 (educational program and practice) were the drivers of child achievement outcomes. The current NQS quality ratings may serve usefully to classify and improve the overall quality of services generally, but they cannot guarantee positive achievements for the children who are participating in the programs within specific rooms. There are unique opportunities to conduct experimental research on quality factors and the link to children's outcomes via the NQS rating process, for example by applying complementary, specific probing tools alongside the overall rating tool and by assessing children's development (pre- and post) to learn more about the effect of teaching and learning behaviours on children's development.

In summary, regarding process quality:

1. Most settings were rated as providing children with a high-level of Emotional Support, and the substantial remaining group of settings was found to provide moderate levels of Emotional Support. Examples of providing low levels of Emotional Support were rare.
2. The organisation of activities that facilitated children's learning and engagement was rated as moderate in most rooms, with a minority facilitating children's learning opportunities at higher-levels of quality. There is room to improve room organisation including making clear the expectations for children's participation and engagement, affirming positive child behaviours, maximising learning time through effective materials preparation, routines and transitions, the conduct of activities to facilitate children's interest, attention and engagement, and through opportunities within professional networks and teams to review purpose, practice and what it means to promote young children's learning.
3. A significant finding was the low level, across service types, of teaching behaviours that encourage or promote learning during play activities: no services were scored in the high range, and 87 per cent of services were rated in the low-quality range for the active level of Instructional Support provided to the children within the play environment. At the time of data collection in ECEC rooms (2010 and 2011), kindergarten programs were typically focused on the provision of 'education' through short-duration

programs, usually led by university-trained educators; whereas long-day care and family day care programs catered for a more diverse population, focused on broader imperatives, and were operating full-day programs for children with a broader range of ages.

4. Although preschool or kindergarten programs were found to demonstrate significantly more of the kind of educational support for learning that is known to improve achievement outcomes than long-day care or family-day care classrooms; the level of instructional support was still low. Nevertheless, kindergartens and preschools were rated higher on the composite of three CLASS dimensions of quality (Emotional Support, Room Organisation, and Instructional Support) than long-day and family day care settings. Kindergartens and preschools scored higher by about 0.55 on the seven-point scale (nearly three quarters of a standard deviation). This gap is significant: in a related study, improving quality scores by one standard deviation caused up to 0.65 and 1.2 months of growth in children's verbal ability and early mathematical ability respectively. Since the collection of E4Kids ECEC data Australian jurisdictions have increased the supply of kindergarten programs, including kindergarten programs within long-day care settings, nevertheless the E4Kids 2011 data did include a sample of kindergarten programs that were operated within long-day care settings.

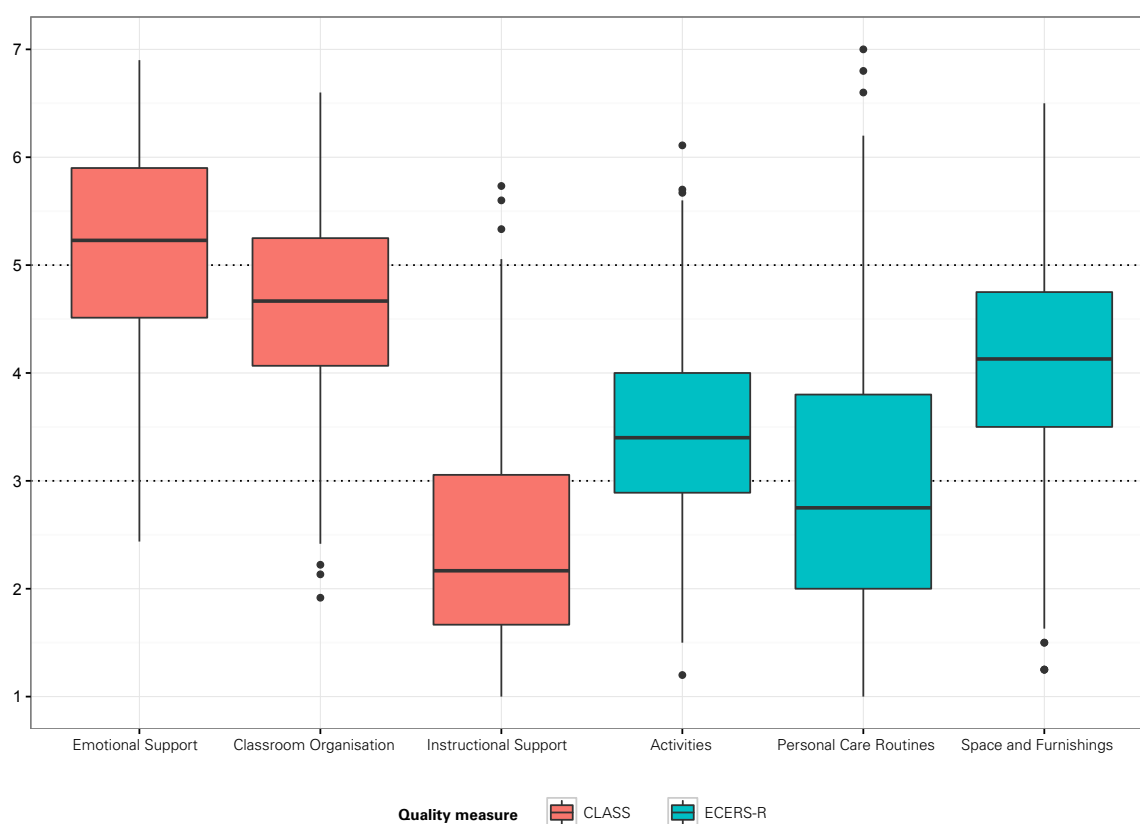


Figure 1: Distribution of CLASS and ECERS-R scores in ECEC services. [Source: Tayler, C., Ishimine, K., Cloney, D., Cleveland, G., & Thorpe, K. (2013). The quality of early childhood education and care services in Australia. *Australasian Journal of Early Childhood*, 38 (2), 13-21.

5. Across the observed settings within E4Kids, free-play and play based education were the programs observed, with observations made during both mornings and afternoons. Notably, throughout the study all ECEC classrooms within the lowest SES areas were found to consistently be lower in the level of Instructional Support provided to children than those in the highest SES areas by approximately 0.5 standard deviations (see Figure 3, p.13). In a related study, such differences cumulated across pre-kinder and kinder programs and led to children being approximately 3.3 to 4.9 months behind their peers in more advantaged neighbourhoods (on measures of verbal ability). This is in addition to a general effect for family SES causing children from families experiencing low SES characteristics to be, on average, 1.6 months of development behind their peer on the same measure.
6. Across all ECEC settings in all locations only one per cent of children experienced 'high-quality' rated Instructional Support within the play environments. This element of interaction quality is most closely associated with cognitive and academic growth.

These E4Kids findings suggest a need to improve the elements of process quality that promote cognitive development. Australian ECEC policy over the past decade has reflected two basic aims that were expressed in the COAG Communique (February 2006): promoting child development and facilitating the workplace engagement of the children's caregivers. Based on the E4Kids findings the child development (particularly cognitive development) aim is still underserved, especially for children facing high levels of disadvantage. Further, an historical division between 'preschool' and 'childcare' is still evident, as noted in the findings above. There is long-standing history in Australia that preschool/ kindergarten programs are associated with *education* and long-day and family day care programs are associated with *childcare*.

There is an opportunity now to re-address system-level policy intent by promoting critical review of the purpose and function of ECEC programs through professional networks, educator development workshops and policy bulletins. No prior Australian study has specifically assessed at scale, the effects of everyday programs on children's learning outcomes, and the E4Kids findings raise questions about the nature of *educational* facilitation within everyday play-based programs, and the role of adults within the settings. At a practical level, the *orientation* of early educators toward their work affects the way educators engage (or not) with children, hence the merit of critical review. It is assuring, and perhaps not surprising that the overall levels of Emotional Support provided to children was high, yet this finding does not overcome the need for concurrent provision of learning support that extends children's conceptual and linguistic understandings and promotes intellectual achievement, especially for children living in disadvantaged circumstances. The E4Kids systematic ratings of the level of Instructional Support within Australian programs are below the quality *thresholds* for Instructional Support that were found to be necessary in large-scale US based studies that achieved positive cognitive effects. Furthermore, the *Early Years Learning Framework* for Australia (2009) asserts the need for intentional teaching within play settings to ensure nationally agreed learning outcomes, and to that end sets the scene for the refinement of pedagogy within early childhood programs, and this is well underway in many services.

Room quality and room composition was also found to matter for children's individual cognitive abilities. In rooms with higher quality Instructional Support and routines and in rooms with greater average intelligence of the children attending, the children showed better outcomes. Children with lower individual intelligence scores are found to

be more affected by room quality and composition in comparison to children with greater individual intelligence who performed well in cognitive tasks independent of the room quality and composition. The proportion of children speaking a language other than English and the average family SES in a room were not significantly associated with child outcomes after the average intelligence within a room was considered. These findings indicate that while all children should receive the support they need, it is especially important for children starting with weaker cognitive abilities. These children are most susceptible to positive room qualities and compositions.

E4Kids also recognised that *structural factors* (including adult-child ratios, teaching qualifications, physical space, personal care/hygiene routines, and materials) have distal effects on the program process. E4Kids collected evidence of these factors using subscales of the ECERS-R and selected survey items. The study has not determined a clear result for the relative, independent contribution of individual structural factors to children's outcomes. However, E4Kids did confirm the association of higher-level *educator/teacher qualifications* with better process quality, and subsequently improved child cognitive outcomes. Settings that had university qualified directors had rooms which scored more highly on all process quality (CLASS) domains, with the settings led by post-graduate qualified directors scoring more highly again. The effects for teachers was less pronounced, however, degree qualified teachers did score more highly on Instructional Support. ECEC classrooms that included more children (e.g., those that use booked hours and therefore include more than one child in each licenced space) scored lower on all CLASS measures.

On other structural factors (see Figure 1) a small percentage (8%) of the services were rated as high quality on the *personal care/hygiene routines*, with 38% rated medium quality and 54% low quality (inadequate). Regarding *physical space and furnishings*, some 19% demonstrated high quality, and the majority (69%) were rated medium quality with few programs (12%) being rated as low quality. Regarding *the activities* provided, 6% of ECEC services were rated high quality, 66% medium quality and 28% were measured as providing low quality activities. This finding may be a signpost for some of the pedagogical issues raised above, regarding the evidence of mostly 'moderate' organisation of activities to facilitate engagement and learning. If the activities available, in themselves, don't provide sufficient challenge to actively engage children's minds there is opportunity for staff to leverage the power of early childhood programs by considering the curriculum content and the challenges available that may actively engage children's interests.

E4Kids also assessed the *process quality of school programs*, including preparatory class and primary grades one and two. Although most observations were conducted in the ECEC/ kindergarten (n= 766) and preparatory (n = 1126) rooms, observations in grade one (n= 515) and grade two programs (n=198) illustrate the relative ratings of process quality across these years. (Figure 2, page 10). All rooms were rated similarly in their provision of Emotional Support, whereas the ECEC and kindergarten rooms scored relatively lower on the organisation of activities for engagement and learning, and in the provision of Instructional Support to children within the program. However, the ECEC and kindergarten rooms were rated significantly higher than school classrooms in the item which assessed 'regard for the child/student's perspective', and significantly lower than school classrooms in the item that assessed the level of concept development within the programs. The overall presence of intentional teaching that focused on the development of children's understanding of concepts and language concepts, in an absolute sense, was still relatively low within the school programs with the lowest presence found to occur in ECEC/kindergarten programs. This finding may also reflect the relatively low scores reported in other countries for this factor; however related studies in Victoria (ongoing) and empirical research conducted in the United States confirms the capacity of further professional training, combined with mentoring and coaching to change the presence of Instructional Support within play and play-based learning activities, and a subsequent significant growth in the children's achievement outcomes.

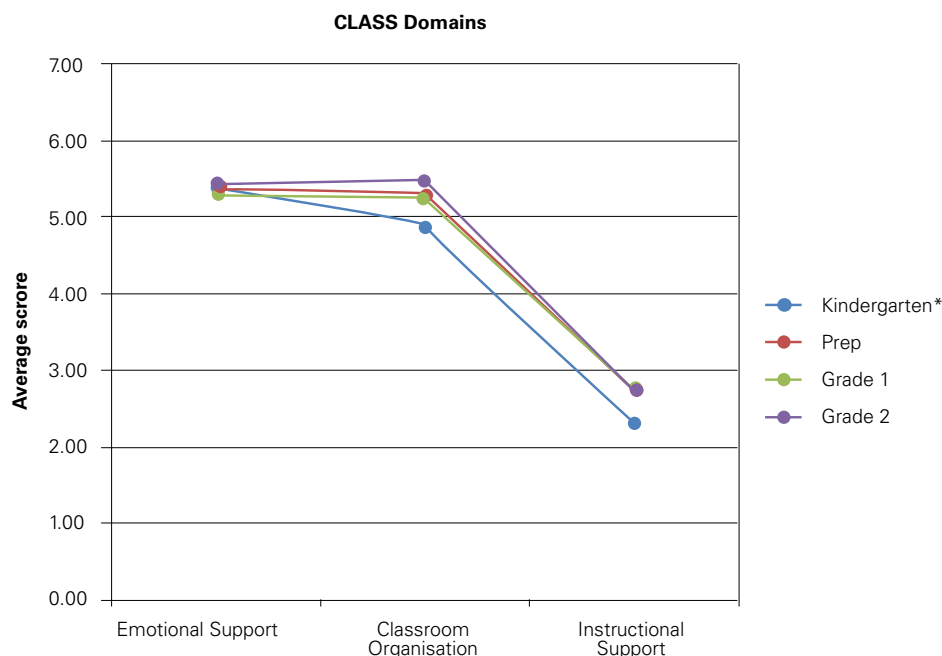


Figure 2: Relative ratings of ECEC/kindergarten, Preparatory, Grade 1 and Grade 2 classes on domains of process quality.

* Kindergarten includes ECEC programs in long-day care settings, kindergartens and preschools, not including family day care.

The *National Quality Framework* was introduced in 2012 to help to drive continuous quality improvement and consistency across ECEC programs, regardless of whether programs are labelled as 'kindergarten' or 'childcare'. For the policy intent of the NQF to be realised it is important that national ratings of ECEC quality (through the National Quality Standard - NQS) adequately capture interaction quality, given its critical importance to improving child outcomes. By ensuring interaction quality is better measured, governments can be more confident that 'high-rated' programs under the NQS are likely also to make a positive difference to children's achievement outcomes. A small piece of research by the E4Kids study team comparing NQS ratings with CLASS assessments in Victoria suggests that even programs rated as meeting or exceeding the NQS may provide very low levels of Instructional Support, well below the threshold levels needed to shift children's outcomes. A comparison for a 104 ECEC services using the ratings of Quality Area 1 (Educational Program and Practice) and Quality Area 5 (Relationships with Children) and CLASS ratings (Emotional Support, Room Organization and Instructional Support), found that CLASS ratings were consistently lower than the relative NQS ratings, with few settings demonstrating practices rated at the higher levels of process quality. Although not a perfect comparison this finding suggests that further research is warranted. It seems possible for ECEC programs to have, for example, an 'exceeding the standard' and a CLASS rating below the level where it is likely to have an impact on children's learning outcomes. There would be merit in designing specific research that further investigates the relationship between process quality and children's outcomes.

2 For journal papers on the **assessment of quality and the rated quality of ECEC provision** refer to:

- Cloney, D., Cleveland, G., Hattie, J., & Tayler, C. (2015). Variations in the availability and quality of early childhood education and care by socioeconomic status of neighbourhoods. *Early Education and Development*, 27(3), 384-401. doi: 10.1080/10409289.2015.1076674
- Cloney, D., Nguyen, C., Adams, R., Tayler, C., Cleveland, G & Thorpe, K. (2016). Psychometric properties of the Classroom Assessment Scoring System (Pre-K): implications for measuring interaction quality in diverse early childhood settings. *Journal of Applied Measurement*. (Accepted 16/6/2016).
- Cloney, D., Page, J., Tayler, C., Church, A. (2013) Assessing the Quality of Early Childhood Education and Care. *Centre for Community and Child Health, Royal Children's Hospital Policy Brief*, 25, pp. 1-4.
- Davis, E., Eivers, A. & Thorpe, K. (2012). Is quality more important if you're quirky? A review of the literature on differential susceptibility to childcare environments. *Australasian Journal of Early Childhood*, 37(4), 99-106.
- Ishimine, K. & Tayler, C. (2013) Assessing quality in early childhood education and care, *European Journal of Education: Research Development and Policy*, DOI:http://10.1111/ejed.12043
- MGSE & DEECD Research Partnership. (2014). *Comparing ratings of quality in National Quality Standard assessments and the E4Kids study*. Melbourne: MGSE.
- Niklas, F., & Tayler, C. (2016). Room quality and composition in Australian early childhood settings and children's literacy and numeracy abilities. (under revision)
- Sabol, T.J, Soliday Hong, S.L, Pianta, R.C. & Burchinal, M.R. (2013). Can rating children's programs predict children's learning? *Science*, 341, 845-846. 23 August.
- Tayler, C., Ishimine, K., Cloney, D., Cleveland, G., & Thorpe, K. (2013). The quality of early childhood education and care services in Australia. *Australasian Journal of Early Childhood*, 38(2), 13-21.
- Weston, K. & Tayler, C. (2016). A policy frame on early learning and teaching, In J. Page & C. Tayler (Eds.), *Learning and Teaching in the Early Years*, Cambridge University Press. (pp.26-46).

Program selection, attendance and non-attendance³

Unlike schools and unlike many other countries, within Australian ECEC settings parents decide on the timing and amount of their children's attendance. ECEC provision is not compulsory, and operates through a mixed-market economy. The assumptions underpinning this model of systemic provision include that the market responds to family demand for services by providing approved program places in areas of demand, and at levels of quality sought by families in the market.

The E4Kids study analysed the *patterns of children's attendance* and whether those found were likely to be of advantage for children's learning and development. The likelihood of child attendance patterns translating into improved child outcomes, or moderating adverse behavioural effects, is also dependent on the quality of the program attended. The findings from model/high-quality ECEC programs (e.g., Perry/High-Scope, Abecedarian...) are that the greatest positive impact for children from highly disadvantaged backgrounds is when attendance starts early (in the first year of life) and is full-time rather than part-time. The findings from an evaluation of everyday programs in the UK in the EPPE study are that no advantage is accrued for full-time over part-time attendance or for children two years of age or younger. These findings underscore likely differences in effect between model and everyday programs.

Age of entry: The E4Kids study found that Australian children's attendance in ECEC programs followed an expected pattern in each of the years before school: it is less common for very young children to attend ECEC settings, and increasingly likely that children take part in ECEC programs as they approach school age. Thus, the proportion of children in formal ECEC settings increases with age; being highest for the year before school and lowest for four years before school. (see Table 1)

Years before school	State location of ECEC	Formal ECEC program usage	%	No formal ECEC % program usage	%	Total	%
1 year before school	QLD	649	82.5	113	14.8	762	100
	VIC	545	94.3	33	5.7	578	100
	Total	1,194	89.1	146	10.9	1,340	100
2 years prior to school	QLD	564	71.7	223	28.3	787	100
	VIC	567	81.5	129	18.5	696	100
	Total	1,131	76.2	352	23.8	1,483	100
3 years prior to school	QLD	459	58.4	327	41.6	786	100
	VIC	440	63.1	257	36.9	697	100
	Total	899	60.6	584	39.4	1,483	100
4 years prior to school	QLD	366	46.7	417	53.3	783	100
	VIC	318	46.3	369	53.7	687	100
	Total	684	46.5	786	53.5	1,470	100

NB: Data collected in this study indicate that some informal non-parental care is also common, averaging 63% across the 4 years before school and decreasing as children get older; being 75% 4 years before school reducing to 48% in the year before school.

Source: Gilley, T., Tayler, C., Niklas, F. & Cloney, D. S. (2015). Too late and not enough for some children: Early childhood education and care (ECEC) program usage patterns in the years before school in Australia. *International Journal of Child Care and Education Policy*, 9 (9) 1-15. DOI: <http://10.1186/s40723-015-0012-0>

3 For journal papers on **program selection and attendance**, refer to:

Cloney, D., Cleveland, G., Tayler, C., Hattie, J., & Adams, R. (2016). The selection of ECEC programs by Australian families: Quality, availability, usage and family demographics. *Australasian Journal of Early Childhood* 41 (4), 16-27.

Cloney, D., Cleveland, G., Hattie, J. & Tayler, C. (2015). Variations in the availability and quality of early childhood education and care by socioeconomic status. *Early Education and Development*. 27(3), 384-4 DOI:<http://10.1080/1040289.2015.1076674>

Gilley, T., Tayler, C., Niklas, F. & Cloney, D. S. (2015). Too late and not enough for some children: Early childhood education and care (ECEC) program usage patterns in the years before school in Australia. *International Journal of Child Care and Education Policy*, 9 (9), 1-15. DOI: <http://10.1186/s40723-015-0012-0>

Note: While Queensland children's kindergarten program participation was relatively low in 2010 (the outset of E4Kids data collection), and has increased significantly since then, it is also noted that Queensland children's scores on NAPLAN tests have increased recently, aligning with the increased access and usage of kinder programs. The improved NAPLAN results cannot be causally attributed to kindergarten participation, yet the association is notable.

Dosage: Younger children are also likely to attend for fewer hours. For example, the average weekly hours of attendance increase from about 10 hours per week four years before school entry to about 25 hours per week in the year before school. Even among those children (E4Kids participants) attending ECEC programs at age three and four years there remains a significant group of children either who did not attend ECEC programs in the formative first three years of life or who attended at a level (under 10 hours per week) which is unlikely to lead to significant developmental growth unless the children experience high-level home learning environments. Of those children attending some hours of ECEC in any given year, just under a quarter (23 per cent) attended for fewer than 10 hours of ECEC three and four years before school with this percentage reducing to just under one-fifth two years before school and fewer than one in 10 children (7 per cent) in the year before school. Both at home and in ECEC settings it is apparent that young children benefit from both consistency and high-quality.

Regarding *selection into, and participation in ECEC programs* across the age-three-to-five period, the E4Kids study found that as children grow older (and move into later programs) they experience relatively higher levels of program quality. This corresponds with the provision of more education-focused programs (in preschool and preparatory) prior to age six (primary year one). This finding also reflected a family SES influence: children from low SES backgrounds were found to experience lower quality programs in their earlier years, and steeper quality gradients as they moved to school.

Family SES plays an important role in influencing the level of ECEC program quality experienced by Australian children. It is only the children from low SES backgrounds who happen to live in the highest SES neighbourhoods who experience levels of program quality comparable to their more advantaged peers. Children from low SES families (who stand most to gain) are not sufficiently exposed to quality factors that are likely to make differences to child outcomes.

Families were also found to travel short distances (median = 2.9km) to access ECEC programs, with families living in low-SES areas having more limited choices of program or facing higher transport costs than families in advantaged neighbourhoods. These effects were found when child, family, and community contexts were controlled for; indicating that family SES is a strong predictor of *selection into different levels of ECEC program quality*.

There was a positive relationship between process quality scores and the neighbourhood SES of the service, this relationship being most pronounced for the Classroom Organization and Instructional Support areas (see Figure 3)^b. In particular, classrooms in the lowest SES areas are consistently lower in Instructional Support quality than those in the most advantaged areas.

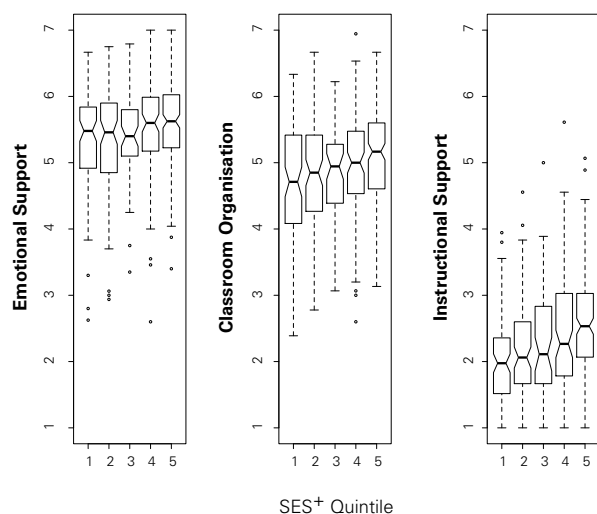


Figure 3: Distribution of Classroom Assessment Scoring System domain scores by neighbourhood SES. SES = socioeconomic status as measured by the Socioeconomic Index for Areas Index of Relative Socio-economic Advantage and Disadvantage. Note that each quintile is weighted to represent an equal number of children. [Source: Cloney, D., Cleveland, G., Hattie, J. & Tayler, C. (2015). Variations in the availability and quality of early childhood education and care by socioeconomic status. *Early Education and Development*. 27(3), 384-401. DOI: <http://10.1080/10409289.2015.1076674>]

b. Each box represents the middle 50% of observations. The solid black line in each box indicates the median. When comparing each box, there is strong evidence that the medians are significantly different (at the .05 level) when the notches do not overlap. There is good evidence that in high-SES areas, Instructional Support and Classroom Organization are significantly higher than in low-SES areas. The dotted lines (whiskers) extending out of each box represent the dispersion of the distribution of observations. Values outside this range are considered outliers. For Emotional Support there are some observations relatively far below the median, and for Instructional Support some observations are relatively far above the median. The number outlier observations is low and not of concern for this analysis.

These findings beg detailed policy-to-practice re-consideration within the Australian 'mixed-market' model of provision. The prevalent policy rhetoric is around an ECEC system that enables early intervention and the opportunity for children living in disadvantaged circumstances to 'catch-up' through participation in 'high-quality' ECEC programs. There is a strong justification to prioritise increasing program quality in the least advantaged neighbourhoods, and to pay much higher attention to the programs experienced by toddlers. This is when the quality gap is largest.

There are several *factors that predict more hours of ECEC participation* and these are, in order of the strength of their association, higher family income, having two parents in paid work, having fewer children in a family, lower ratings on the home learning environment, being in receipt of a Health Care Card and having an easier child temperament. However, there were no child or family predictors of using one year versus two years of program before school, although higher parental education predicted the earlier entry of children into ECEC programs three and four years before school, and a home learning environment that was rated low-quality, alongside having both parents in the paid workforce, also predicted earlier ECEC program usage. Raising the quality of interactions encountered in these ECEC settings (see quality findings above) is attractive as a counterbalance to the relatively low-quality home learning environments associated with the use of two years of program before school. In addition, the total hours of attendance of the higher quality kinder programs was predicted by parental education and income as well as by living in a higher quality home learning environment and in a suburb of higher socio-economic status (SEIFA).

In specific relation to kindergarten, there is a notable equity issue that emerged from the E4Kids findings. The predictors of higher hours of kindergarten attendance were family advantage factors – for example employment, and SEIFA (SES). Children from more advantaged households were more likely to receive the benefit of kindergarten programs in the years 2010 and 2011, the time in which the E4Kids cohort was at the expected age for attendance. Three-year-old kindergarten programs (typically two years before school entry) largely remained the preserve of more advantaged families as fees do not usually attract a public subsidy. The E4Kids data reviewed also includes the likelihood of attending four-year-old kindergarten as the population participation rates in Queensland at the time of the first data collection in 2010 was around 30 per cent.

Impact of programs on children's learning and development⁴

The ability for ECEC programs to intervene on children's learning and development is important in Australia because of clear evidence of early differences between children. E4Kids shows that differences emerge early (by age three for cognitive outcomes) and persist two years later (see Figure 4^c).

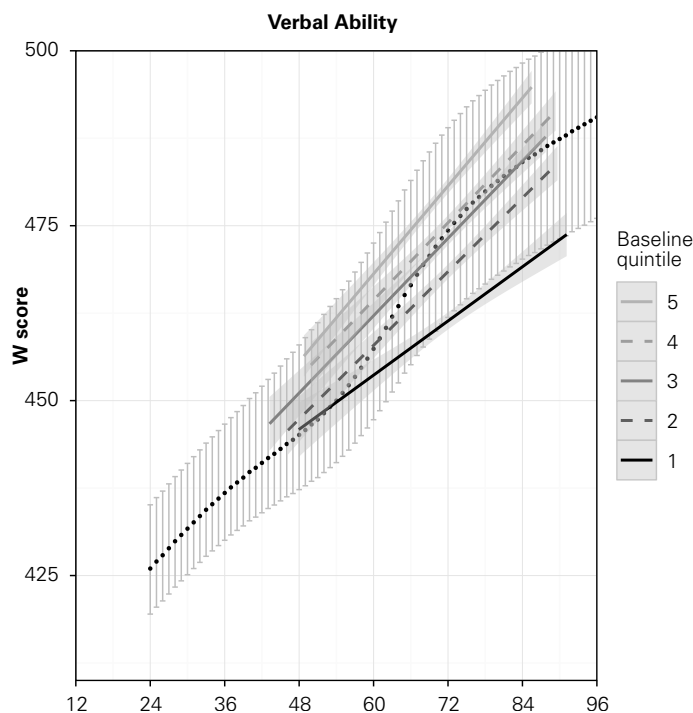


Figure 4: Average relationship between child age and WJIII W score of verbal ability in 2012 with each quintile group conditioned on 2010 (baseline) W score [SOURCE: Tayler C., Cloney, D., & Niklas, F. (2015). A bird in the hand: understanding the trajectories of development of young children and the need for action to improve outcomes. *Australasian Journal of Early Childhood*, 40 (3), 51-60.

For early exposure to process quality that focuses on promoting learning through intentional teaching, there are statistically significant differences between exposure to low vs relatively higher levels of Instructional Support (although the higher levels were still quite low in an absolute sense). For example, for verbal ability, children who experienced higher-quality Instructional Support early were, on average, 5.51W^c above children who experienced lower levels of Instructional Support at entry to the study (the gap representing five and a half months of development). At the end of the study the difference was 4.85W (five months of development). The differences persisted. In conditional models the effects are smaller as other factors also explain children's growth. After controlling for contextual factors the effect of exposure to one standard deviation higher ECEC program quality (CLASS Instructional Support) on verbal ability was 0.8 to 0.9 months of growth per year. Family SES and community SES both play a significant role in children's verbal ability development. A one SD increase in family SES was associated with 1.6 months of additional growth at the end of the study. Living in higher SES neighbourhoods (relative to the lowest quintile) is related to higher achievement at the end of the study: estimates for all quintiles range between approximately 3.3 (fourth quintile) to 4.9 (fifth) months of growth. Child characteristics are also related to increased development: initial IQ, and temperament (persistence) are related to higher verbal ability at exit from the study. A one SD increase in IQ at entry the study was associated with an additional 7.6 months of growth at exit to the study and a one SD increase in persistence was associated with an additional 1.1 months of development.

Initial analysis of the relationship between ECEC experiences and children's school achievement have been conducted, extending the work published to date. Two latent classes of development trajectories for early cognitive development are estimated: one (starting the study with high levels of verbal ability) represents high achievement, and the other (starting the study at the expected level of ability) average or lower achievement. Belonging to the higher achieving group is associated with significantly higher NAPLAN outcomes. Children who had higher cognitive capabilities in preschool scored, on average, more than 90 points higher on NAPLAN (spelling): this is more than 1.5 standard deviations, and is highly significant. Family SES is the strongest predictor of belonging to the high cognitive capability group; however, ECEC program quality is yet to be considered in the model.

There are also correlations between the Home Learning Environment (HLE) and Grade three NAPLAN scores. Both the direct and indirect HLE indices were examined. There was a small positive correlation between HLE and Grade 3 NAPLAN achievement across all domains. The direct HLE index had a higher correlation with NAPLAN scores than the indirect index (although for Spelling the correlations were essentially the same).

Overall, the study found that everyday ECEC programs deliver small effects for children, and yet small-scale experiments involving younger children in E4Kids related studies, and using specific teaching and learning strategies from model ECE programs, demonstrate large effects. This study found clear evidence of SES achievement gaps in Australia for children from the age of three and four. Differences in children's verbal ability persist while some narrowing is seen for children's early mathematical knowledge. ECEC programs play a small role in contributing to the development of children's cognitive abilities. There is, however, no evidence that ECEC programs acted to narrow SES achievement gaps. Much can be done to reduce the observed differences between children. Well-designed and specific educational programs can positively change the trajectories of children and close gaps in achievement, rather than merely maintaining a standard rate of growth in achievement. In everyday programs, children exposed to higher levels of Instructional Support during play experiences subsequently scored higher on verbal ability and had better early quantitative knowledge.

The E4Kids findings suggest the importance, within ECEC programs, of developing children's language and thinking, especially for those demonstrating low performance: building vocabulary, having language-rich back-and-forth exchanges between adult and child and promoting the expressive aspects of children's language usage. Developmental differences among the study children, in effect, grew larger in the years before school, despite the presence of engagement in the ECEC programs, and not including special interventions. These findings may also relate to insufficient program dosage, insufficient match and specificity in the chosen pedagogy relative to children's needs and interests, or other factors. The causes of these findings cannot be fully verified because of correlations among family SES, program quality, attendance, and participation variables.

c. WJIII tests are scored on a continuous Rasch-like scale (W), The asymmetrical standard deviations (SD) for the age norm for each month of age (within the age range of this study (min = 12 months, max = 68 months) is 8.2 (lower) and 12.2W (upper) for VA and 29.9 (lower) and 21.6W (upper) for AP. The mean change in expected W score for increasing by one month in age is 0.98W for VA and 2.14W for AP.

Regarding specialist subgroups, young bilingual children in the E4Kids sample, for example, started with lower achievement scores in WJIII verbal comprehension and yet the bilingual children who attended more hours of kindergarten program before their transition to school showed greater gains in verbal comprehension in comparison to bilingual children attending fewer hours, or no kindergarten program. No such difference was found for the attendance of bilingual children in other types of ECEC setting. As kindergarten settings, in comparison to other formal ECEC settings, provide a significantly greater program quality, bilingual children seem to benefit most from attending kindergarten programs. This finding also underscores the importance of raising the levels of teaching and learning interaction quality in long-day and family-day care settings.

There are two major challenges to emerge from the study if ECEC programs are to make an independent contribution to improving children's learning and development outcomes. The first is how to improve the quality of programs, the Instructional Support provided to children during play programs, so that all children benefit. The second is how to ensure that children from disadvantaged backgrounds enter programs that demonstrate high-quality teacher-child interactions at an early age, and with a high enough dosage to make a major difference. Interactional quality between educators and children, age of entry into programs and dosage emerge as the key predictors of effects on children in the research literature. It appears that the interactional quality of everyday ECEC programs may generally support children's socio-emotional development yet is not high enough in these Australian settings to make a significant difference to children's cognitive outcomes. Furthermore, the lack of evidence of 'high-quality' learning promotion processes taking place within play settings (the majority, including kindergartens, were rated low-quality on these constructs) was also confounding since the research team could not undertake the detailed testing of dosage effects of high-quality in its absence across the ECEC programs sampled.

Based on study findings, there is a strong case to be made for: (1) specific initiatives to improve the kind of Instructional Support within play settings that children experience directly, and at home: this requires educators and family members to actively interact with children during play, and where relevant engage in intentional teaching, and (2) comprehensive targeted services operating in the least advantaged areas, in the first case for adult-child interaction quality improvement, and (3) to focus on access to and the quality of programs delivered to youngest-aged children from disadvantaged backgrounds. This is far beyond the present policy scope of universal preschool provision for 15 hours per week at age four years. Model interventions can and do make a significant difference to children's linguistic, behavioural and intellectual development outcomes, especially when they are implemented within the first three years of life. These interventions are required if ECEC programs are, in fact, to ensure growth in children's achievement outcomes as a direct result of their participation, rather than a result of other factors such as family SES, home learning environment and a sufficient level of exposure to programs.

4 For journal papers and chapters on the **child outcomes, and impact of programs on child development** refer to:

Brookes, I. & Tayler, C. (2016). Effects of an evidence based intervention on the language development of young Aboriginal children, *Australasian Journal of Early Childhood*, Special Issue. October, 41 (4), 4-15.

Cohrssen, C., Niklas, F., Logan, D., & Tayler, C. (2016) The self-reported academic self-concept of four-year-old children: global and fixed, or nuanced and changing in the year before school? *Australasian Journal of Early Childhood*. 41(3), 4-10.

Tayler, C. & Page, J. (2016). Learning and teaching in the early years, In J. Page & C. Tayler (Eds.), *Learning and Teaching in the Early Years*, Cambridge University Press. (pp.5-25).

Tayler C., Cloney, D., & Niklas, F. (2015). A bird in the hand: understanding the trajectories of development of young children and the need for action to improve outcomes. *Australasian Journal of Early Childhood*, 40 (3), 51-60.

The E4Kids nested and related studies

Sleep patterns in early childhood⁵

In 2010-2011 the sleep studies research group at QUT, observing the quality of ECEC in Australia, identified sleep practice as an issue of concern and instigated the formation of the Sleep in Early Childhood Research Group (SECRG) bringing together expertise in sleep science, developmental science and early education policy and practice. The observation study of 2400 preschool children in 30 ECEC services found that 80% were subject to mandated sleep yet only 30% of children slept at any time with evidence of distress and behavioural difficulty for non-sleepers (QUT- IHBI additional contribution to E4Kids to facilitate observation of sleep). The findings raised concerns about opportunity cost for children's learning, health and wellbeing. The studies demonstrated that mandated sleep practices in ECEC served to habituate children's sleep patterning with effect on concurrent and ongoing 24-hour sleep patterning and night sleep duration. Children who were in centres with long mandated sleep times had later bedtimes and poorer quality sleep. Once these children entered school and were constrained by start times and no longer had opportunity to nap they had, on average, 30 minutes less sleep across 24-hours. This is significant; 30 minutes less sleep per day has been linked to risk for obesity while Australian data suggests increased health risks associated with total sleep duration. The survey study of 750 parents (Masters – Sinclair – 2011 E4Kids data) found that 79% preferred that their child not sleep in ECEC citing concern for their children's health and development and disruption to family functioning. The study measuring cortisol levels (stress hormone) of sleepers and non-sleepers who attended ECEC services with either mandated or flexible sleep practice found that non-sleepers experiencing mandated sleep periods had higher levels of cortisol at night bedtime (Financial Markets Foundation for Children- Grant No: 12-213). The imperative for translation of findings into changed policy and practice was published and the Queensland Government commissioned SECRG to develop and trial professional development resource packages for 1) peak provider organisations, 2) Authorised Officers responsible for assessment of quality under the National Quality Standard and 3) to guide a film production for parent audiences (Queensland Department of Education and Training). These studies have developed multimodal training resources (print, podcast, webinar, workshop) that have been trialed on 120 leaders from provider organizations and 80 Authorised Officers with highly positive responses. Ongoing work is examining sleep practices in ECEC for children aged 0-three and sleep problems associated with ECEC attendance.

5 For journal papers on **sleep and sleep patterns** refer to:

Pattinson, C., Staton, S., Smith, S. Sinclair, D, & Thorpe, K. (2014). Emotional climate and behaviour management during sleep-time in early childhood education settings. *Early Childhood Research Quarterly*, 29, 660-668.

Sinclair, D., Staton, S., Pattinson, C., Smith, S., Marriott, A., & Thorpe, K. (2016.) What parents want: Parent preference regarding sleep for their preschool child when attending Early Care and Education. *Sleep Health*, 2(1), 12-18.

Staton, S., Marriott, A., Pattinson, C., Smith, S. & Thorpe, K. (2016) Supporting Sleep in Early Care and Education: An assessment of observed sleep-times using a sleep practices optimality index. *Sleep Health*, 2(1), 30-34.

Staton, S., Smith, S., Pattinson, C. & Thorpe, K. (2016). Mandatory naptimes and group napping trajectories in childcare: An observational study. *Behavioural Sleep Medicine*. 00:1-15, <http://10.1080/15402002.2015.1120199>

Staton, S., Irvine, S., Pattinson, S., Smith, S. & Thorpe, K. (2015). The sleeping elephant in the room: Practices and policies regarding sleep-rest time in early childhood education and care. *Australasian Journal of Early Childhood*, 40(4), 77-86.

Staton, S., Smith, S. & Thorpe, K. (2015). "Do I really need a nap? The role of sleep science in informing sleep practices in early childhood education and care settings. *Translational Issues in Psychological Science*, 1(1), 32-44.

Staton, S., Smith, S., Pattinson, C. & Thorpe, K. on behalf of the Sleep in Early Childhood Research Group. (2015). Mandatory naptimes in childcare and children's night-time sleep. *Journal of Developmental and Behavioral Pediatrics*, 36(4), 235-242.

Thorpe, K., Staton, S., Sawyer, E., Pattinson, C., Hayden, C. & Smith, S. (2015). Napping, development and health from 0 to 5 years: a systematic review. *Archives of Disease in Childhood*, 0:1–8. DOI: <http://10.1136/archdischild-2014-307241>

The home learning environment⁶

The 'home learning environment', for the purposes of this research program, was deemed to include all elements of the home environment that are associated with and influence child development. Analyses in the context of the E4Kids study clearly show that children who experience a higher quality home learning environment (HLE), with more frequent positive parent-child-interactions, outperform their peers on a range of linguistic and numerical tasks, demonstrate more behavioural competencies and show greater gains in these competencies over time.

The HLE can be analysed as a global construct, however it is useful to distinguish between a home *numeracy* environment that is closely associated with children's numerical competencies (characteristics include the frequency with which mathematical games are played at home, every day numerical activities in the household, etc.) and a home *literacy* environment that is closely associated with children's verbal competencies (including reading behaviour in the household, the number of books in general, the number of children's books, etc.). Depending on the research question, distinguishing between indirect activities occurring in the home (such as shared reading or playing games with a numerical content) and direct teaching enacted by parents when they explain the meaning of letters and numbers or teach a child to read, may also be helpful.

Differing from other countries, such as Germany, a migration background in Australia is not closely associated with lower rated HLE. However, like most other countries, the HLE is closely associated with the socio-economic status (SES) of a family. Here, families with a greater SES provided higher quality HLEs for their children.

The key aspect of the home literacy environment is shared reading with a child. Our findings indicate that shared reading should start early in a child's life (preferable well before six months of age) as the onset of shared reading proved to be a predictor of children's linguistic outcomes even when having controlled for family background, child age and sex. In addition, high quality shared reading should occur regularly (preferably every day). Dialogic reading strategies that are based upon the premise that children learn to read when they are actively involved in the book reading process rather than passive listeners, was identified as supporting the development of child competencies.

Non-intensive interventions in the family may positively influence the HLE and children's cognitive development. A small and non-intensive intervention had a positive influence on children's outcomes. Providing parents with information about the importance of the HLE and helping them (1) implement the principles of dialogic reading and

(2) the counting principles in everyday interactions with their children, resulted in significant improvement both in the HLE and child cognitive outcomes. In summary:

- The HLE matters: higher quality HLEs support children's cognitive and behavioural competencies and the further development of these competencies.
- Whilst the HLE can be regarded as a global construct, it often makes sense to differentiate between a home numeracy environment and a home literacy environment and between indirect activities and direct teaching done by parents.
- In Australia, the HLE is closely associated with family SES, and to a lesser degree with a migration background.
- Shared book reading with children is a critical element of the home literacy environment. Shared reading should start early in a child's life (preferable well before 6 months of age), should occur regularly (preferable every day) and the quality of book reading is enhanced by the application of dialogic reading strategies.
- Further research is required that includes participants reflecting a wider range of socio-economic and cultural conditions.

6 For journal papers and chapters on **home-learning environment** refer to:

Cohrssen, C. & Niklas, F. (2016). Partnering with families to promote learning, In J. Page & C. Tayler (Eds.), *Learning and Teaching in the Early Years*, Cambridge University Press. (pp.90-111).

Niklas, F., Nguyen, C., Cloney, D., Tayler, C. & Adams, R. (2016). Self-report measures of the home learning environment in large scale research: Measurement properties and associations with key developmental outcomes. *Learning Environments Research Journal*, DOI: <http://org/10.1007/s10984-016-9206-9>

Niklas, F., Cohrssen, C. & Tayler, C. (2015). Home learning environment and fluid reasoning: A family intervention study with kindergarten children. *Early Childhood Education Journal*, DOI: <http://10.1007/s10643-015-0726-1>

Niklas, F., Cohrssen, C. & Tayler, C. (2015). Improving pre schoolers' numerical abilities by enhancing the home numeracy environment. *Early Education & Development*. 27(3), 372-383. DOI: <http://10.1080/10409289.2015.1076676>

Niklas, F., Tayler, C. & Schneider, W. (2015). Home-based literacy activities and children's cognitive outcomes: A comparison between Australia and Germany. *International Journal of Educational Research*. DOI: <http://org/10.1016/j.ijer.2015.04.001>

Mathematics teaching and learning⁷

Early childhood educators have long requested guidance with early childhood mathematics pedagogy. A common thread running through early mathematics learning research studies that focus directly on mathematics teaching and learning is the importance of the intentional teaching of mathematical concepts within the context of a play-based, informal curriculum. Changes in early childhood education in Australia reveal a shift that has occurred from an essentially developmental approach, to an emphasis on effective early educational experiences. Every child has a right to the best possible education: this includes supporting children's numeracy skills. The focus on effective early education also reflects the importance of transitions through the stages of learning that characterise early childhood education: the home learning environment, formal early childhood education and the transition to school.

As part of this study program reconceptualisation of an early childhood mathematics university subject took place to equip pre-service teachers with both content knowledge and opportunities to rehearse practical teaching strategies. This re-composition was found to contribute to the knowledge and skills required to teach mathematics in early childhood as well as a growing sense of confidence in ability to do so.

In order to provide opportunities for children to consolidate knowledge and to extend children's thinking, teachers need to determine what it is that children already know. Assessment is a cornerstone of effective teaching and learning, and in an informal curriculum, effective teachers assess the evidence of children's mathematical thinking when it is demonstrated. This may be in what children do, say, draw, write or dance. To assess children's understanding, early childhood educators need to recognise mathematical understandings and know how to plan playful learning experiences that encourage problem solving and extend understanding. Children have been found to learn the most when they attend programs that are delivered by educators who possess mathematics content knowledge, know how to facilitate learning through playful activities, who systematically and purposefully provide children with such learning opportunities and who possess a strong sense of self-efficacy.

In summary:

- Play-based learning does not mean “free play”. Play-based learning requires purposeful and systematic observation, assessment, planning and evaluation on the part of teachers.
 - Learning occurs along a continuum, and concept acquisition commences very early in life (in the first year of life). Mathematical thinking is often embedded in what children do as well as what they say. Early childhood educators working with children aged under three years as well as kinder teachers require targeted professional learning to assist them to recognise and respond to mathematics teaching and learning opportunities with accuracy and confidence.
 - Increasing resources is not always the answer. Mathematics teaching and learning should be facilitated consistently across the whole curriculum and should include the explicit teaching of mathematical language: “If young children can see and understand ‘brontosaurus’, they can do the same for ‘octagon’” (Lee & Ginsburg, 2009, p. 39).
- 7 For journal papers and chapters on early childhood **mathematics teaching and learning** refer to:
- Cohrssen, C. & Church, A. (2017). Mathematics knowledge in early childhood. Intentional teaching in the third turn. In A. zBateman & A. Church (Eds.) *Children's Knowledge in Interaction. Studies in Conversational Analysis*. Singapore: Springer Singapore. (pp. 73-89).
- Cohrssen, C., Church, A., & Tayler, C. (2016). Play based mathematics activities as a resource for changing educator practice and behaviour, *Sage Open*, April-June, pp1-14. <http://10.1177/2158244016649010>
- Cohrssen, C., Church, A. & Tayler, C. (2014.) Pausing for learning: Responsive engagement in mathematics activities in early childhood settings. *Australasian Journal of Early Childhood*. 39(4) 95-102.
- Cohrssen, C., Church, A., & Tayler, C. (2014). Purposeful pauses: Teacher talk in early childhood mathematics activities. *International Journal of Early Years Education*. DOI: <http://10.1080/09669760.2014.900476>
- Cohrssen, C., Church, A., Ishimine, K. & Tayler, C. (2013). Playing with maths: Facilitating the learning in play-based learning. *Australasian Journal of Early Childhood*. 38(1) 95-99.
- Cohrssen, C., De Quadros-Wander, B., Page, J. & Klarin, S. (2016). Between the big trees: A project-based approach to investigating shape and spatial thinking in a kindergarten program. *Australasian Journal of Early Childhood*. 41,(3).
- Cohrssen C. & Page, J. (2016) Articulating a rights-based argument for mathematics teaching and learning in early childhood education. *Australasian Journal of Early Childhood*. 41(3), 104-108.
- Cohrssen, C. & Tayler, C. (2016). Early childhood mathematics: A pilot study in pre-service teacher education. *Journal of Early Childhood Teacher Education*. 73(1), 25-40. DOI: <http://10.1080/10901027.2015.1131208>
- Cohrssen, C., Tayler, C. & Cloney, D. (2015). Playing with maths: implications for early childhood mathematics teaching from an implementation study in Melbourne, Australia, *Education 3-13*, 43:6, 641-652, DOI: <http://10.1080/03004279.2013.848916>
- Deans, J., & Cohrssen, C. (2015). Young children dancing mathematical thinking. *Australasian Journal of Early Childhood*, 40(3), 61-67.
- Hildenbrand, C., Niklas, F., Cohrssen, C., & Tayler, C. (2015) Children's mathematical and verbal competence in different early education and care programs in Australia, *Journal of Early Childhood Research*. DOI: <http://org/10.1177/1476718X15582096>
- Lee, J., & Ginsburg, H. (2009). Early childhood teachers' misconceptions about mathematics education for young children in the United States. *Australasian Journal of Early Childhood*, 34(4), 37 45

Niklas, F. Cohrssen, C., & Tayler, C. (2016). Parents supporting learning: A non-intensive intervention supporting literacy and numeracy in the home learning environment. *International Journal of Early Years Education*, 24(2), 121-142. DOI: <http://10.1177/1468798415592008>

Niklas, F., Cohrssen, C. & Tayler, C. (2015). Improving pre schoolers' numerical abilities by enhancing the home numeracy environment. *Early Education & Development*. 27(3), 372-383. DOI: <http://10.1080/10409289.2015.1076676>

Pollitt, R., Cohrssen, C., Church, A. & Wright, S. (2015). Thirty one is a lot: Assessing four-year-old children's number knowledge during an open ended activity. *Australasian Journal of Early Childhood*, 40(1), 13-22.

Reading and early literacy learning⁸

In Australian early childhood programs, the importance of reading to children in order to support their emerging literacy skills receives much emphasis, and includes a focus on both the home environment and the early childhood education and care setting. Book reading presents opportunities for children to recognise the purpose of print, acquire advanced language, engage in back-and-forth conversations through the story, and it supports children learning to read. Dialogic reading strategies include specific interactional phenomena that position the child as the storyteller and the adult as the person who listens, thus encouraging children to be actively, rather than passively, involved in the book-reading event. This has been found to be particularly important within the home learning environments where children's English language skills may be limited by the English language skills of adults in the home causing these children to lag behind their peers in literacy and academic achievement within Australian education settings.

Most families in our core and related studies reported having started to read to their children before they were 15 months old; in many families, this begins within the first few months. Immigrant families and lower socio-economic status families were found to begin shared book reading later. Starting shared book reading before a child reaches six months of age appears to support children's linguistic development as it presents rich opportunities for the demonstration of the purpose of print media, encourages acquisition of new vocabulary and its use in extended conversations, and in general, encourages children to play with language. Children who are read to earlier were found to have stronger rhyming skills, stronger verbal comprehension and marginally stronger concept formation skills. The age at which a child is first read to also predicts the frequency of parent-child reading frequency in the year prior to starting school.

Turning our focus to the influence of different early education and care programs on children's mathematical and verbal competence, it emerged from the data gathered from 1314 children, prior to the introduction of improved educator: child ratios in line with the National Quality Framework, that whilst there was no relationship between children's verbal ability and the type of ECEC program attended, the mathematical competence demonstrated by children who attended only informal care exceeded that of children who either

consistently attended a formal ECEC service or attended a mix of formal and informal care after controlling for a range of child and family characteristics. However, regarding further development in the subsequent year, no differences in learning gains were observed between children who attended different types of ECEC care. These findings support the subsequent improvements made to educator: child ratios, as well as the current prioritisation of numeracy-related professional learning opportunities for early childhood professionals.

On the other hand, we found that in the case of bilingual children, gains in English language verbal abilities were significantly predicted by the total hours that they spent in kindergarten programs but not by all types of programs. In comparing formal ECEC settings, kindergarten programs provided higher quality programs than other formal ECEC settings for these children.

In summary:

- Encouraging early shared book reading between adults and children supports child linguistic development.
- Bilingual children and their families afford unique opportunities to support community participation and inclusion, and more broadly, to support Australia's role in the global community; however, little is currently known about the extent to which children from bi- and multi-lingual households maintain their home languages or on the extent to which early education experiences uphold Australia's language education policy agendas.
- Child age and intelligence proved to be important predictors of both children's initial verbal and numerical performance and the further development of these competencies with older and more intelligent children showing better outcomes. In addition, a child's main language and the frequency with which the child was read to were significant predictors of initial verbal abilities, as well as of the development of these abilities over time. Here, children with English as main language and children who were read to more frequently, showed better English language verbal abilities.

- 8 For journal papers on **reading and early literacy learning** refer to:

Cohrssen, C., Niklas, F. & Tayler, C. (2016). 'Is that what we do?' Using a conversation analytic approach to highlight the contribution of dialogic reading strategies to educator child interactions during storybook reading in two early childhood settings. *Journal of Early Childhood Literacy*, 16(3), 361-382. DOI: <http://10.1177/1468798415592008>

Hildenbrand, C., Niklas, F., Cohrssen, C., & Tayler, C. (2015) Children's mathematical and verbal competence in different early education and care programs in Australia, *Journal of Early Childhood Research*. DOI: <http://org/10.1177/1476718X15582096>

Niklas, F., Cohrssen, C. & Tayler, C. (2016). The sooner, the better: Early reading to children. *Sage Open*. 1-11. <http://dx.doi.org/10.1177/2158244016672715>

Niklas, F. Cohrssen, C., & Tayler, C. (2016). Parents supporting learning: A non-intensive intervention supporting literacy and numeracy in the home learning environment. *International Journal of Early Years Education*, 24(2), 121-142. DOI: <http://10.1177/1468798415592008>

Niklas, F., Tayler, C., Cahrssen, C. (2016, revision). Bilingual children's language learning in Australian early childhood education and care settings. *Research Papers in Education. Special Issue*. (invited paper)

Niklas, F., Tayler, C. & Schneider, W. (2015). *Home-based literacy activities and children's cognitive outcomes: A comparison between Australia and Germany. International Journal of Educational Research*. DOI: <http://org/10.1016/j.ijer.2015.04.001>

Risk and vulnerability⁹

Children's cognitive abilities and their behaviour is closely associated with the number of risk factors they experience. For instance, children with disabilities or a difficult temperament or who are read to only infrequently or who experienced several stressful life events or whose parents have a low education or income show more problem behaviour and lower achievement in tests measuring cognitive abilities than children who do not live in the context of one of these risk factors, or who experience only one or two of these risk factors.

Children's abilities and capabilities at age three-four years depend largely on their prior family, community and early children program experiences. Our results indicate that the gap between children with greater or lower cognitive baseline achievements widens over time (during ECEC enrolment) and that baseline abilities depend on a child's home-community SES, their home learning environment, the main language spoken at home and other family and community characteristics. In view of the powerful effects of model programs on children's learning an implication of this finding is for policy and provision effort to be shifted toward working closely with families and local communities, especially in the period (birth to age three) prior to the assessment of abilities and capabilities. Positively changing the trajectories of children at risk has been shown to be achievable, when validated early interventions are implemented with fidelity and with sufficient intensity in the years before school.

9 For journal papers on **risk and vulnerability** refer to:

Brookes, I. & Tayler, C. (2016). Effects of an evidence based intervention on the language development of young Aboriginal children, *Australasian Journal of Early Childhood*, Special Issue. October

Cloney, D., Cleveland, G., Hattie, J. & Tayler, C. (2016). Variations in the availability and quality of early childhood education and care by socioeconomic status. *Early Education and Development*. DOI: <http://10.1080/10409289.2015.1076674>

Niklas, F., Gilley, T. & Tayler, C. (2016). Vulnerability among Australian young children: A multiple risk factor model for cognitive and behavioral outcomes. *Australian Journal of Education*, Issue/pages tbc

Tayler C., Cloney, D., & Niklas, F. (2015). A bird in the hand: understanding the trajectories of development of young children and the need for action to improve outcomes. *Australasian Journal of Early Childhood*, 40 (3), 51-60.

Measurement development and developmental monitoring¹⁰

E4Kids generated a new measure (led by APDI Ishimine) – *the Improving Teaching Skills for Early Childhood Education* (ITSECE) instrument. This tool focuses on measuring core aspects of pedagogy within ECEC centres, specifically regarding the use of questioning, explaining and feedback in a play setting. The tool is designed to improve the teaching skills of early childhood education teachers, and is for application to professional development programs that address teaching skills and program quality in play settings. The tool may also be used for research purposes as an observational instrument by a non-participant observer to assess classroom teaching and to improve program quality, teacher training and program evaluation. The ITSECE places an especially strong emphasis on key items found to affect child outcomes within the National Quality Standard (NQS), Quality Area 1. Before using the measure, it is necessary to have participated in a training program conducted by an experienced ITSECE trainer. The ITSECE is currently developed to the field trials stage, with validation and standardization of the tool being a project open to further research either by a doctoral or postdoctoral candidate, in conjunction with Dr Ishimine.

E4Kids researchers also conducted the *first validation study of the CLASS* in Australian ECEC settings. This study constitutes the first scholarly report of the psychometric properties of the CLASS that accounts for repeated-measure design and adopts an analytic approach that utilizes the strengths of both factor analysis and item response modelling. The measurement model reported partitions the variance components within and between-classrooms and produces more reliable factor scores. The research team concluded that the CLASS is robust across national contexts and is a valid tool in international settings, and noted that the domain of Instructional Support also tends to have a lower range of scores in other (international) contexts.

The team also conducted a literature review of wellbeing assessment tools for use in early childhood settings. The review report is listed in the Endnotes for this section and is available through the Victorian Curriculum and Assessment Authority website.

An under-explored area of research is the *early detection of developmental problems* specifically addressing the cultural and linguistic context of young Indigenous children and families. Led by D'Aprano, this research is important for facilitating access to culturally relevant targeted intervention, and maximising its positive effects. Standardised developmental screening tools are known to improve detection rates of developmental problems compared to clinical judgement alone and are widely recommended for use with all children. However, mainstream developmental screening tools are not appropriate for rural and remote-dwelling Australian Aboriginal and Torres Strait Islander children. Furthermore, practitioners in remote settings have little, if any, child health or early childhood development training. Findings from a medical record audit, suggest

that there are gaps in the delivery of developmental monitoring services in remote health services, including the lack of a structured developmental screening tool for use in remote Aboriginal settings. Addressing a number of system-wide factors may facilitate improved delivery of these services.

Within the study, the researchers designed, implemented and evaluated training in early childhood development, and the qualitative findings demonstrated that mode of delivery was effective and valued by participants. The workshop process adopted improved practitioners' skills, knowledge, competence, and confidence to identify and manage developmental difficulties and promote child development, evidenced on self-report and workplace clinical observation. The team demonstrated that practical, culturally appropriate training leads to positive learning outcomes in developmental practice for Aboriginal Health Workers and other remote health practitioners.

Another related study focuses on a *specific Australian adaptation and validation of the Ages and Stages Questionnaire (ASQ-3)*. ASQ-3 is a tool that is widely used in Australia. We compared the culturally adapted ASQ-3 - the ASQ-TRAK - for Australian Aboriginal children to the Bayley Scales of Infant and Toddler Development (Bayley-III), a standardised, professionally administered developmental assessment, to determine the concurrent validity. The early findings suggest strong agreement between the ASQ-TRAK and Bayley-III. The ASQ-TRAK shows promise as a tool that can be used to improve developmental monitoring for remote dwelling Australian Aboriginal children.

In further measurement development work (led by Page), the *Early Literacy Engagement Assessment (ELEA)* tool assesses the emerging literacy of very young Aboriginal and Torres Strait Islander children living in remote and regional locations. The primary phase of this trial is complete, and concurrent validity testing is in progress. The items from ELEA are being assessed against the two relevant scales of the Clinical Evaluation of Language Fundamentals ®-Preschool-2 (CELF) – expressive vocabulary and basic concepts. The results of this study are expected to be forthcoming in late 2017.

In summary:

- The development and validation of measures for use in Australian early childhood settings constitutes important ongoing activity that serves the professional practice and research communities as they seek to provide attuned, specific interventions and responses to the developmental status of very young Australian children.
- Having measures for young Indigenous children that are culturally relevant and can be administered in first language (and/or English) warrants further and urgent attention.
- Having measures that test early learning (e.g., language engagement, joint attention) and align with pedagogical practices in early childhood services supports children, families and professionals to be at ease with an assessment process.
- Developing and validating measures for early childhood educators to assess young children's language within their settings can support educators in their data gathering, and help them to plan for and further assess children's literacy development prior to entering school.
- It is important to ensure testing enables researchers to establish the effectiveness, validity and reliability of any measure. Trialing has enabled the research teams to review the internal item consistency and cohesion of the particular test, including establishing items are in agreement, measuring a single trait underlying the items, the reliability of separate items, and checking if the items cover the ranges of child ability. It has also been critical to receive feedback on the cultural relevance of the test materials, and the appropriateness of questions for Indigenous children.
- Engaging Indigenous educators/health professionals and families in any trial is important to ensure cultural understandings and current language context is thoroughly considered, and supports researchers to make adaptations that speak to and better reveal young children's capabilities.

10 For journal papers on **measurement development and developmental monitoring** refer to:

Cloney, D., Nguyen, C., Adams, R., Tayler, C., Cleveland, G & Thorpe, K. (2016). Psychometric properties of the Classroom Assessment Scoring System (Pre-K): implications for measuring interaction quality in diverse early childhood settings. *Journal of Applied Measurement*. (Accepted 16/6/2016).

D'Aprano et. al., (2016). Challenges in developmental monitoring in remote Aboriginal health services: findings and recommendations for improving practice? *Rural and Remote Health*, 16 (3), 3852-3862.

D'Aprano, A. Silburn, S., Oberklaid, F., & Tayler, C. (2015). Culturally appropriate training for remote Australian Aboriginal Health Workers: Evaluation of an early child development training intervention. *Journal of Developmental and Behavioural Pediatrics*, 0, 1–9.

Marbina, L. Mashford-Scott, A., Church, A., & Tayler, C. (2015). *Assessment of wellbeing in early childhood education and care. Literature review*. Melbourne: Victorian Curriculum and Assessment Authority.

Niklas, F., Nguyen, C., Cloney, D., Tayler, C. & Adams, R. (2016). Self-report measures of the home learning environment in large scale research: Measurement properties and associations with key developmental outcomes. *Learning Environments Research Journal*, DOI <http://org/10.1007/s10984-016-9206-9>

Ishimine, K. & Tayler, C. (2014). *Improving Teaching Skills for Early Childhood Education*. A tool to review the use of questioning, explaining and feedback with interactions during play. Melbourne: MGSE.

Simpson, S., D'Aprano, A., Tayler, C., Khoo, S.T., & Highfold, R. (2016). Validation of a culturally adapted developmental screening tool for Australian Aboriginal children: early findings and next steps, *Early Human Development*, 103, 91-9.

Leadership, professional learning and coaching¹¹

Working to raise the quality of adult-child interactions within ECEC programs and in home-learning environments is valuable process activity for maximising young children's learning and development outcomes, and addressing disparities in child outcomes that are linked to disadvantage and marginalization. The type and intensity of adult-child interactions can determine the degree of impact that educators and other adults have on young children's learning and development. Generating evidence that tracks the effectiveness of professional learning on the quality of educator-child interactions over time is key to understanding the active ingredients that drive the process of continuous improvement, and counteracting the prevalence of low quality pedagogical practices in Australian ECEC settings. Leadership, professional learning and coaching studies can shed light on effective steps to positively change interaction behaviours.

The Victorian Advancing Early Learning study (VAEL, 2014-2017) was established in light of the E4Kids findings and upon departmental interest in interventions that can improve child outcomes at an early age. This study tests the effectiveness of a professional learning treatment model that focuses on the quality of educator-child interactions in settings where educators were trained and coached in the use of evidence-based teaching techniques. The study investigates:

- The impact of the professional learning program on educators' ability to change, and sustain improved pedagogical practice over time;
- The impact of ongoing implementation of the specific teaching techniques on young children's learning, and
- The range of strategies that educational leaders employ to improve the quality of pedagogical practices within their services.

The implementation study involves two stages of intervention. 1) An initial treatment year that incorporates a program of professional training for the educational leaders and educators, together with fortnightly interactive coaching to support the implementation of Abecedarian Approach Australia (3a) evidence-based strategies. 2) Up to two sustainability years with a reduction in implementation support by the external coach, and greater emphasis on the designated Educational Leader supporting the educators to continue to implement the teaching and learning strategies, and embedding them throughout their educational programs.

The study to date indicates that increasing the quality of educators' interactions with young children is a complex process that cannot be rushed. It requires timely, targeted and consistent support, management 'buy-in' and a set of 'threshold conditions' for the program to succeed. Furthermore, collaboration on the form of educational leadership, professional learning and coaching is vital to the success of early learning interventions. The professional culture of an ECEC setting counts: some settings are less focused on individual children's personal development and learning, rather they attend to basic health and safety and the supervision of children

- areas that are not unimportant but are insufficient to meet expectations of the NQF. Educational leadership is a key to promoting early education effectiveness and children's learning. Leaders need to establish and create a professional learning community that uses evidence to improve practice and advance children's learning. Targeted professional learning has been found to support educators to gain deeper theoretical, research-based and practical understandings of how children learn, their role in the learning process and what effective instruction looks like in practice.

Coaching and educational leadership characterised by regular, ongoing, individualised support assists the implementation and adaptation of effective practices. This might include observation, modeling, feedback, on-site feedback, reflection and collaborative planning, and monitoring. The VAEL study has enabled a focused analysis of the lived experiences of ECEC educators as they implement new pedagogical practices within their settings, and the support mechanisms that are effective in advancing the quality of their interactions with young children.

The early findings suggest that, in settings offering everyday ECEC programs:

- Investment directed towards a multi-component professional learning program (training, coaching, educational leadership) supports the educators' implementation and alignment of evidence-based teaching strategies within ECEC daily programs, and is effective in improving children's outcomes.
- Professional development investment that ensures an integrated, whole-of-centre approach to professional learning over a sustained period is an effective means of ECEC quality improvement.
- ECEC policy is likely to have greater effect in practice, and leverage child outcomes better, if clear role definitions and position descriptions of the Educational Leader and educators are explicit. Educational leaders who have time allocated to carry out their 'learning leader' role can effectively engage in the development of educators' pedagogical knowledge, add value to the ECEC service, increase team engagement and subsequently improve child outcomes.
- ECEC policy should require 'service management' (the owner or director) to allocate dedicated time to the Educational Leader to support the continuous improvement of the educators' pedagogical practices. Centre management leaders who report annually to their stakeholders on the amount of pedagogical support time offered to individual educators in the service ensure greater transparency, and contribute to increased staff morale and teamwork.
- Investments that include dedicated components of professional learning directed towards building capacity *within* services, and *across local professional networks* ensure ongoing educator capability, and deliver continuous quality improvement.

- 11 For journal papers and chapters on **leadership, professional learning and coaching** refer to:

Barber, H., Cohrssen, C. & Church, A. (2014) Meeting the Australian National Quality Standards: a case study of the professional learning needs of early childhood educators, *Australasian Journal of Early Childhood*, 39(4), 21-27.

D'Aprano, A. Silburn, S., Oberklaid, F., & Tayler, C. (2015). Culturally appropriate training for remote Australian Aboriginal Health Workers: Evaluation of an early child development training intervention. *Journal of Developmental and Behavioural Pediatrics*, 0, 1–9.

Church, A., Page, J., Wright, S. & Tayler, C. (2016). "Researching for Learning," In Page, J., Tayler, C. (eds.) *Learning and Teaching in the Early Years*. Port Melbourne: Cambridge University Press.

Page, J., Pilsworth, N. (2016). Reflections on the National Reform Agenda for Early Childhood Education and Care and educational leadership: what has been achieved and where to now? *Professional Educator*, 12-15.

Page, J. & Tayler, C. (2016). "Leading for Learning," In Page, J., Tayler, C. (eds.) *Learning and Teaching in the Early Years*. Port Melbourne: Cambridge University Press

Page, J., Tayler, C. (2015). The Victorian Advancing Early Learning (VAEL) Study. *Belonging Early Years Journal*, 4, 2, 37-38.

Pilsworth, N., Page, J., Tayler, C. (2016). Building and Sustaining a Culture of Learning. *Preschool Matters*, Term 1, 14-16.

Tayler, C. (2016). Reforming Australian early childhood education and care provision (2009-2015). *Australasian Journal of Early Childhood*. 41(2), 27-31.

Tayler, C., Page, J., Pilsworth, N. (2015). Building Relationships with Children. *Early Learning Review*, 1-3.



Julie Barton, from the Melbourne Graduate School of Education, with young learners in Wakathuni

Ongoing and future work

There are significant further opportunities to leverage the E4Kids data and to maximise the investments made over the past six years. Most of this work will be achievable over a further three years, and findings will provide new and better insight in child development in the context of ECEC programs. A core E4Kids team is pursuing further opportunities to fund such crucial work and may seek the support of the current partners. Already, both philanthropic and other competitive grant funds have been deployed to leverage further the findings of the E4Kids core study.

Data linkage

There is an important opportunity to ensure a pathway to ongoing NAPLAN data linkage at grades five, seven and nine. This linkage would test longer-term effects of ECEC participation. In 2016, child participants in the E4Kids study begin to complete Grade five NAPLAN. As the E4Kids children already have been linked to Grade three NAPLAN data, further linkage can be readily arranged and progressed.

Social and emotional development

Some descriptive analyses have been undertaken using the E4Kids dataset, but more needs to be done to fully address the question of how Emotional Support and Room Organisation influence social and emotional outcomes, and how child, family and community factors influence children's social and emotional development. There is the opportunity to analyse a range of study data on children's social and emotional development, and the emotional and organisational aspects of interaction quality to assess the impact on social development and emotional wellbeing, and any effects on cognitive development and school achievement. For example, this aligns with the argument for positive education approaches. So far, the full potential of the assessed data is not realised. The topic would also suit post-doctoral or doctoral candidates.

Health and physical development

Recent Australian research demonstrates that children with an unhealthy BMI are less developmentally ready for school. Children who are obese are more likely than their peers to be developmentally vulnerable even when accounting for other contextual features, like socioeconomic status. By the time children start school, differences in their physical development are associated with their readiness for school and this has implications for their lifelong development.

A significant number of E4Kids children are outside what is considered normal physical development by the time they enter ECEC programs at approximately age three, with approximately four percent considered either thin or

obese. These figures are the subject of ongoing analysis and the preparation of a journal paper on this topic by a core Melbourne team, including additional outcomes (NAPLAN).

In effect, little is known about how the early physical development outcomes of children relate to other areas of development – cognitive, social, emotional, and later school achievement. Recent Australian research suggests school-aged children who are obese suffer worse outcomes at school – can this be predicted even earlier and is there a relation to birth-weight? The E4Kids study has substantial data to interrogate, and under interrogation. This work would suit a doctoral candidate in the multidisciplinary space of health/epidemiology and early childhood education.

ECEC program quality and longer-term outcomes

There is a substantial opportunity to extend the work in the E4Kids study to examine the role that ECEC quality plays on the development of early social and emotional skills and how they, in turn, influence later, school age outcomes, including academic achievement – something already measured by the study. In addition, the E4Kids data set allows family characteristics and the quality of the home learning environment, among other variables, to be included in these analyses. Furthermore, linkage of ECEC workforce data and E4Kids data can further interrogate the influence of educator qualifications and experience on children's learning and development outcomes.

Although the E4Kids study is formally completing, and funding has been fully expended, there are opportunities open, in the first instance to the Partner Organisations to further leverage investments and the findings to date. Partner Organisations are welcome to liaise further and/or propose questions that are of priority.

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Appendix: Published papers on E4Kids and the nested and related studies, conference presentations, posters public lectures and symposia

Published journal papers

1. Barber, H., Cohrssen, C. & Church, A. (2014) Meeting the Australian National Quality Standards: a case study of the professional learning needs of early childhood educators, *Australasian Journal of Early Childhood*, 39(4), 21-27.
2. Brookes, I. & Tayler, C. (2016). Effects of an evidence based intervention on the language development of young Aboriginal children, *Australasian Journal of Early Childhood*, 41 (4), 4-15.
3. Cloney, D., Cleveland, G., Hattie, J. & Tayler, C. (2015). Variations in the availability and quality of early childhood education and care by socioeconomic status. *Early Education and Development*. DOI: <http://10.1080/10409289.2015.1076674>
4. Cloney, D., Cleveland, G., Tayler, C., Hattie, J. & Adams, R. (2016). The selection of ECEC programs by Australian families: a story of quality, availability, usage and family demographics, *Australasian Journal of Early Childhood*, 41 (4), 16-27.
5. Cloney, D., Nguyen, C., Adams, R., Tayler, C., Cleveland, G & Thorpe, K. (In press). *Psychometric properties of the Classroom Assessment Scoring System (Pre-K) implications for measuring interaction quality in diverse early childhood settings*. *Journal of Applied Measurement*. (Accepted 16/6/2016)
6. Cohrssen C. & Page, J. (2016) Articulating a rights based argument for mathematics teaching and learning in early childhood education. *Australasian Journal of Early Childhood*, 41 (3), 104-108.
7. Cohrssen, C, Church, A., & Tayler, C. (2016). Play based mathematics activities as a resource for changing educator practice and behaviour, *Sage Open*, April-June, pp1-14. <http://10.1177/2158244016649010>
8. Cohrssen, C, Church, A., Tayler, C., & Ishimine, K. (2013). Playing with maths. *Australasian Journal of Early Childhood*. 38(1) 95-99.
9. Cohrssen, C. & Tayler, C. (2016) Early childhood mathematics: A pilot study in pre-service teacher education. *Journal of Early Childhood Teacher Education*. 73(1), 25-40. DOI: <http://10.1080/10901027.015.1131208>
10. Cohrssen, C., Church, A. & Tayler, C. (2014.) Pausing for learning: Responsive engagement in mathematics activities in early childhood settings. *Australasian Journal of Early Childhood*. 39(4) 95-102.
11. Cohrssen, C., Church, A., & Tayler, C. (2014). Purposeful pauses: Teacher talk in early childhood mathematics activities. *International Journal of Early Years Education*. DOI: <http://10.1080/09669760.2014.00476>
12. Cohrssen, C., De Quadros-Wander, B., Page, J. & Klarin, S. (2016, in press) Between the big trees: A project-based approach to investigating shape and spatial thinking in a kindergarten program. *Australasian Journal of Early Childhood*, 41(3). (accepted 5 September 2016)
13. Cohrssen, C., Niklas, F. & Tayler, C. (2016). 'Is that what we do?' Using a conversation analytic approach to highlight the contribution of dialogic reading strategies to educator-child interactions during storybook reading in two early childhood settings. *Journal of Early Childhood Literacy*, 16(3), 361-382. DOI: <http://10.1177/1468798415592008>
14. Cohrssen, C., Niklas, F., Logan, D., & Tayler, C. (2016) The self-reported academic self-concept of four-year old children: global and fixed, or nuanced and changing in the year before school? *Australasian Journal of Early Childhood*. 41(3), 4-10.
15. Cohrssen, C., Tayler, C. & Cloney, D. (2015). Playing with maths: implications for early childhood mathematics teaching from an implementation study in Melbourne, Australia, *Education 3-13*, 43:6, 641 652, DOI: <http://10.1080/03004279.2013.848916>
16. Cohrssen, C., Niklas, F. & Tayler, C. (2016). Parents supporting learning: A non-intensive intervention supporting literacy and numeracy in the home learning environment. *International Journal of Early Years Education*. DOI: <http://10.1177/1468798415592008>
17. D'Aprano, A. Silburn, S., Oberklaid, F., & Tayler, C. (2015). *Culturally appropriate training for remote Australian Aboriginal Health Workers: Evaluation of an early child development training intervention*. *Journal of Developmental and Behavioural Pediatrics*, 0, 1-9:
18. D'Aprano et. al., (2016). Challenges in developmental monitoring in remote Aboriginal health services: findings and recommendations for improving practice? *Rural and Remote Health*, 16 (3), 3852-3862.
19. Davis, E., Eivers, A. & Thorpe, K. (2012). Is quality more important if you're quirky? A review of the literature on differential susceptibility to childcare environments. *Australasian Journal of Early Childhood*, 37(4), 99-106.
20. Deans, J., & Cohrssen, C. (2015). Young children dancing mathematical thinking. *Australasian Journal of Early Childhood*, 40(3), 61-67.
21. Gilley, T., Tayler, C., Niklas, F. & Cloney, D. S. (2015). Too late and not enough for some children: Early childhood education and care (ECEC) program usage patterns in the years before school in Australia. *International Journal of Child Care and Education Policy*, 9 (9). DOI: <http://10.1186/s40723-015-0012-0>

22. Hildenbrand, C., Niklas, F., Cahrssen, C., & Tayler, C. (2015) Children's mathematical and verbal competence in different early education and care programs in Australia, *Journal of Early Childhood Research*, 1-14 DOI: <http://org/10.1177/1476718X15582096>
23. Ishimine, K. & Tayler, C. (2013) Assessing quality in early childhood education and care, *European Journal of Education: Research Development and Policy*, DOI: <http://10.1111/ejed.12043>
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- Cloney, D. (2016). *What can large-scale, quantitative research tell us about the quality improvement agenda in the early childhood education and care sector?* Victorian Early Childhood Research Consortium. Wednesday 26 July 2016.
- Cloney, D. (2016). *What impact are ECEC programs having on children's development today?* 2016 Gowrie Victoria Annual Conference: demonstrating the flexibility to learn and grow. 12 August 2016.
- Cloney, D. (2016). *What impact are Victorian ECEC programs having on children's development today?* Victorian Department of Education and Training Quality Assessment and Regulation Division Forum. Wednesday 10 August 2016.
- Cloney, D., Cleveland, G., Hattie, J., Tayler, C., & Adams, R. (2016). *The selection of ECEC programs by Australian families: a story of quality, availability, usage and family demographics*. Paper presented at the Australasian Journal of Early Childhood Research Symposium: Whose knowledge is it anyway? Pushing the evidence base in early childhood research, Charles Darwin University, NT, 5 October 2016
- Cohrssen, C., Niklas, F. & Tayler, C. (2016). *Home learning environment and children's concept formation in the year prior to starting school*. Poster presented at the 24. Conference of the ISSBD (International Society for the Study of Behavioural Development) in Vilnius, 10.-14. July 2016.
- Gilley, T., Guyonne Kalb, G., Ryan, C. & Zubrick, S. (2016). *Addressing inequalities in early childhood education: Gaming the system or changing the game?* Panel discussion, 20 October 2016, Melbourne: Brotherhood of St Laurence.
- Simpson, S., D'Aprano, A., Tayler, C., & Highfield, R. (2016). *Validation of the culturally adapted ASQ-TRAK. A developmental screening tool for remote Australian Aboriginal children*. Paper presented to Caring for Country Kids Conference, 17-19 April, Alice Springs,

Conference presentations and posters, public lectures and symposia

2016

- Brookes, I. & Tayler, C. (2016): *The effects of an evidence based intervention on the Australian English language development of a vulnerable group of young Aboriginal children*. Paper presented at the Australasian Journal of Early Childhood Research Symposium: Whose knowledge is it anyway? Pushing the evidence base in early childhood research, Charles Darwin University, NT, 5 October 2016
- Cloney, D. (2016). *ECEC program quality in Australia – what do we know about equity?* Best Start – State- wide Forum. Tuesday 21 June 2016.
- Cloney, D. (2016). *Results from the E4Kids study: implications for the quality improvement agenda?* Australian Children's Education and Care Quality Authority National Forum. 15 September 2016.
- Taylor, C. & Cloney, D. (2016). *E4Kids study: Access, quality equity and child achievement*. Presentation to Moreland City Local Government, Coburg City Hall, 5 May 2016 .
- Taylor, C. & Cloney, D. (2016). *The E4Kids study: Direction of findings and report planning*, Presentation to Victorian DET Policy Leaders, 35 Spring Street, East Melbourne, 4 April.
- Taylor, C. (2016). *What does intentional teaching look like in ECEC settings?* Presetnation to the Linking Learning Symposium, Bastow Leadership Institute, 19 May 2016.
- Taylor, C., & Cloney, D. (2016). *CLASS Validation in Australia and the Influence of Instructional Support on Children's Cognitive Development*. Paper presented at the Comparative and International Education Society March 6-10, 2016, Vancouver, BC Canada.

Weston, K., Tayler, C., Cloney, D., Adams, R., & Gilley, T. (2016). *The E4Kids study: how to design a study that captures the unique Australian ECEC services context and the contribution it makes to children's learning and development*. Paper presented at the Australasian Journal of Early Childhood Research Symposium: Whose knowledge is it anyway? Pushing the evidence base in early childhood research, Charles Darwin University, NT, 5 October 2016.

2015

Cloney, D., Cleveland, G., Hattie, J., & Tayler, C. (2015, 20 April). The Availability and Quality of Early Childhood Education and Care (ECEC) Programs in Low Socioeconomic Status (SES) Areas. Paper presented at the American Educational Research Association (AERA) 2015 Annual Meeting: Toward Justice: Culture, Language, and Heritage in Education Research and Praxis., Chicago, Illinois.

Cloney, D., Nguyen, C., Adams, R., Tayler, C., & Cleveland, G. (2015, 17 April). *The Psychometric Properties of the Classroom Assessment Scoring System (CLASS)*. Paper presented at the American Educational Research Association (AERA) Annual Meeting: Toward Justice: Culture, Language, and Heritage in Education Research and Praxis, Chicago, Illinois.

Cloney, D., Nguyen, C., Adams, R., Tayler, C., Cleveland, G., & Thorpe, K. (2015, 14 January). *Measuring Early Childhood Education and Care Classroom Quality: Psychometric Properties of Classrooms Assessment Scoring System*. Paper presented at the Sixth International Conference on Probabilistic Models for Measurement in Education, Psychology, Social Science and Health., Cape Town.

Cohrssen, C., Niklas, F., & Tayler, C. (2015). *Parents leading learning: A non-intensive intervention study to support the home learning environment*. Presentation held at the biennial meeting of the Society for Research in Child Development in Philadelphia, USA, 19.-21. März 2015.

Gilley, T. (2015). *Too late and not enough: some ECEC usage patterns in the years before school in Australia*. Presentation to the Victorian Department of Education and Training, Treasury Place, Melbourne. 19 August, 2015.

Gilley, T. (2015). *Vulnerability among young children*, Presentation to the Victorian Department of Education and Training, Treasury Place, Melbourne. 19 August, 2015.

Nguyen, C., Niklas, F., Cloney, D., Tayler, C. & Adams, R. (2015). *Differential item functioning in measuring Australian home learning environment*. Presentation held at the 6. International Conference on Probabilistic Models for Measurement in Education, Psychology, Social Science and Health in Kapstadt, Südafrika, 12.-14. January 2015.

Niklas, F. (2015). *Early child development in the context of home and ECEC programs in Australia and a comparison to Germany*, Presentation to Victorian Department of Education and Training staff, 2 Treasury Place Melbourne. 29 July 2015.

Niklas, F., Cohrssen, C., & Tayler, C. (2015). *Bilingual children's language learning in Australian kindergarten programs and other forms of formal childcare*. Presentation held at the biennial meeting of the Society for Research in Child Development in Philadelphia, USA, 19.-21. März 2015.

Niklas, F., Cohrssen, C., & Tayler, C. (2015). *Parents leading learning: Supporting the home learning environment*. Presentation held at the Enhancing Language and Literacy Conference of the City of Darebin, Melbourne, Australia, 16. April 2015.

Niklas, F., Cohrssen, C., Tayler, C. & Schneider, W. (2015). *Vorlesen: Je früher, desto besser*. Poster presented at the 15. Fachgruppentagung Pädagogische Psychologie, Kassel, 14.-16. September 2015.

Niklas, F., Nguyen, C., Cloney, D., Tayler, C., & Adams, R. (2015). *Measurement properties of a self report survey on the home learning environment and its associations with key developmental outcomes*, 13th Australian Institute of Family Studies Conference, Melbourne, Families in a rapidly changing world. Melbourne. July 2014:

Pattinson, C., Smith, S., Staton, S., and Thorpe, K. (2015) *Sleep and weight status of Australian children: What are the sleep parameters at play*. Society for Research in Child Development, Philadelphia, April 2015

Staton, S., Hurst, C., Pattinson, C., Smith, S., and Thorpe, K. (2015). *Group Napping Patterns in Relation to Duration of Mandatory Naptimes in Childcare Settings*, "SLEEP, Conference of the American Sleep Physicians association, Seattle, June 2015

Staton, S., Pattinson, C., Smith, S., and Thorpe, K. (2015). *Mandatory Naptimes for Preschool Aged Children in Early Childhood Education Settings and Duration of Children's Nighttime Sleep*. Society for Research in Child Development, Philadelphia, April 2015

Tayler, C. (2015). *Early childhood education and parenting in a changing world*, Keynote to the Playgroup Victoria Annual Conference, Thornbury Conference Centre, 1 May 2015.

Tayler, C. (2015). *A bird in the hand: What E4Kids tells about early childhood programs and young children's trajectories from age 3-5*. Symposium presentation to Victorian Department of Education and Training staff, 2 Treasury Place Melbourne. 15 July 2015.

Tayler, C. (2015). *Building high-quality teaching and learning practices: the CLASS tool*. Presentation to Victorian Department of Education staff. University of Melbourne. 28 April 2015

Tayler, C. (2015). *Does Monitoring and teaching babies and toddlers make a difference?* PED talk, Victorian Department of Education, 2 Treasury Place. 7 December 2015

Tayler, C. (2015). *E4Kids and research on teaching and learning B-8*. Invited address to Northern Territory Department of Education Executives, 19 June 2015.

Tayler, C. (2015). *Elevating early childhood learning and development beyond the school boundary*. Invited address to the Queensland Department of Education Principals Conference, Convention Centre, South Bank, 27-28 February 2015.

Tayler, C. Page, J. Pilsworth, N & Pupillo, G. (2015). *The Active Ingredients for Building Learning Relationships with Children*, Early Learning Association of Australia Conference 'Together We Grow'. 29-30 May 2015

Tayler, C. (2015). *Improving child learning and development in the critical early years*. Grand Rounds Public Lecture at Royal Children's Hospital Melbourne. 10 June 2015.

Tayler, C. (2015). *Intentional teaching in the Early Phase: ECEC and EY deepening learning*. Invited symposium address to Northern Territory Department of Education Darwin and regional staff, 18 June 2015.

Tayler, C. (2015). *Leading in early childhood. Which track race? What conditions? What outcomes?* Gowrie Victoria Children in the Driver's Seat Conference. Melbourne Museum 22 September 2015.

Tayler, C. (2015). *Research in teaching and learning in the early years B-8*. Invited address to the Western Australia Catholic Education Research Symposium, Ruislip Street, West Leederville, 5-6 August.

Tayler, C. (2015). *Research in teaching and learning in the early years: Some evidence to provoke local debate*. Invited address. Early Years Conference: Today's Children Tomorrow's Future, Cairns, 10-11 September 2015.

Thorpe, K., Sinclair, D., Staton, S., Pattinson, C., and Smith, S. (2015). *If Given the Opportunity Would You Want Your Child to Sleep in Childcare?*, SLEEP, Conference of the American Sleep Physicians Association, Seattle, June 2015

Thorpe, K., Staton, S., Sawyer, E., Pattinson, C., and Smith, S. (2015). *Napping, Development and Health from 0-5 Years: A Systematic Review*. SLEEP, Conference of the American Sleep Physicians Association, Seattle, June 2015

2014

Cloney, D., & Adams, R. (2014). *Development Trajectories of children from low SES backgrounds and the influence of ECEC programs*. International Conference of the Australian Association for Research in Education (AARE) and the New Zealand Association for Research in Education (NZARE). December 2014

Cloney, D., Cleveland, G., Hattie, J., & Tayler, C. (2014). *Variations in the availability and quality of early childhood education and care by socioeconomic status*. International Conference of the Australian Association for Research in Education (AARE) and the New Zealand Association for Research in Education (NZARE), December 2014

Cohrssen, C., & Tayler, C. (2014). *Children learn when educators play with maths: Implications for early childhood mathematics learning from an implementation study*. Poster presented at the 23. Conference of the ISSBD (International Society for the Study of Behavioural Development) in Shanghai, July 2014.

Hildenbrand, C., Niklas, F., Cohrssen, C. & Tayler, C. (2014). *Children's mathematical and verbal competence in early education and care settings in Australia*. Poster presented at the 23. Conference of the ISSBD (International Society for the Study of Behavioural Development) in Shanghai, July 2014.

Niklas, F., Nguyen, C., Cloney, D., Tayler, C. & Adams, R. (2014). *The home learning environment and children's early development in large scale research*. Presentation held at the 13. Conference of the AIFS (Australian Institute of Family Studies) in Melbourne, July/August 2014.

Niklas, F., Tayler, C. & Schneider, W. (2014) *Home-based Literacy Activities and Children's Cognitive Outcomes; A Comparison between Australia and Germany*. Conference of the ISSBD (International Society for the Study of Behavioural Development) in Shanghai, July 2014.

Niklas, F., Tayler, C. & Schneider, W. (2014). *Early familial based literacy interactions and children's cognitive outcomes: A comparison between Australia and Germany*. Poster presented at the 23. Conference of the ISSBD (International Society for the Study of Behavioural Development) in Shanghai, July 2014.

Pollitt, R. & Cohrssen C. (2014). *Assessing four-year-old children's number knowledge in a play-based program*. Early Childhood Management Services Conference, Beyond Tomorrow: inspiring Journeys, Melbourne, Australia, August 2014

Sparling, J. Tayler, C. Page, J & Beckingham, L. *Learning Games in multiple Australian contexts* Symposium held at the Early Childhood Australia National Conference in Melbourne, September 2014

Staton, S., Smith, S., Pattinson, C., and Thorpe, K. (2014). *The relationship between history of childcare and age of cessation of napping in preschool aged children*. SLEEP, Conference of the American Sleep Medicine association USA 2014

Tayler, C & Siraj-Blatchford, I. (2014). *The quality of early childhood education and care programs and associations with child development at entry to school*. Invited Plenary for the ELAA Early Childhood Education Conference, Melbourne. 31 May, 2014:

Tayler, C. (2014). *Leadership – a driving force of program quality improvement in ECEC settings*. Invited address to Griffith University's Queensland Principals Professional Network, Woolloongabba, Brisbane, 15 September 2014

Tayler, C. (2014). *Leading learning in contemporary early education settings: signposts from research, evidence collection and the study of 'method'*, Keynote to QCAA Forum, Brisbane Convention Centre, Brisbane October, 2014.

Taylor, C. (2014). *Making a world of difference – the first 1000 days. Social, family, educational policy and practice: turning to 'method' in early education*. Symposium presentation to joint meeting of Victorian Government Education, Health and Social Services Secretaries and staff, Melbourne. October, 2014.

Taylor, C. (2014). *The quality of learning Birth – 12 Years* Invited address to Linking Learning Ministerial launch and symposium Bastow Institute of Educational Leadership, Melbourne. May.

Taylor, C. (2014). *What counts as quality in early childhood education and care programs?* Keynote to the Australian College of Educators 2014 National Conference. September 2014

Taylor, C., Niklas, F. & Cohrssen, C. (2014). *Leading the change: Increasing the quality of mathematics learning in play-based programs*. Symposium held at the Early Childhood Australia National Conference in Melbourne, September 2014.

Taylor, C. (2014). *Leading learning in contemporary educational settings: the work between a thousand flowers blooming and shared models of teaching*. The Dr Lawrie Shears Public Lecture, The Bastow Institute of Educational Leadership, Melbourne.

Taylor, C. (2014). *A bird in the hand: What E4Kids tells about young children's trajectories of development, the quality of programs and actions that may improve outcomes*, Invited plenary to Early Childhood Australia National Conference 2014; Season of Change. September 2014.

Thorpe, K., Staton, S., Marriott, A., Pattinson, C., and Smith, S. (2014). *Impact of sleep practices in childcare settings on child well-being* SLEEP Conference of the American Sleep Medicine association USA 2014

Thorpe, K., Staton, S., Smith, S., and Pattinson, C. (2014). *Are sleep policies and practices in childcare a cause for concern?* SRCDC conference: Connecting policy Practice and Research, Alexandria Old Town, Virginia, USA., 2014

2013

Inglis, J., Staton, S., Smith, S., Pattinson, C., and Thorpe, K. (2013). *Napping in preschoolers: Staff beliefs and experiences in early childhood centres*. Sleep Biol Rhythms. Vol. 11, Supplement 2.

Marriott, A., Staton, S., Thorpe, K., Pattinson, C., and Smith, S. (2013) *How do current sleep practices in Early Childhood Education and Care settings reflect current knowledge about good sleep habits and environments?* Sleep Biol Rhythms. Vol. 11, Supplement 2, p15-16.

Neil, E., Staton, S., Smith, S., Pattinson, C., and Thorpe, K. (2013) *Problem nappers: Are they a problem?* Sleep Biol Rhythms. Vol. 11, Supplement 2, p14.

Pattinson, C., Staton, S., Smith, S., Thorpe, K. (2013). *Observing Emotional Climate of Sleep Time in Early Childhood Education and Care Settings: Application of the CLASS*. The Society for Research in Child Development (SRCDC), Seattle, USA.

Sinclair, D., Staton, S., Smith, S., Pattinson, C., and Thorpe, K. (2013). *Parental preferences towards daytime sleep for preschool aged children in Early Childhood Education and Care settings*. Sleep Biol Rhythms. Vol. 11, Supplement 2, p13-14.

Staton, S., Pattinson, C., Smith, S., Thorpe, K. (2013). *The effects of child-centred versus compulsory sleep practices in childcare: a salivary cortisol study*. 16th European Conference on Developmental Psychology, Lausanne, Switzerland.

Staton, S., Smith, S., Pattinson, C., and Thorpe, K. (2013). *Group differences in salivary cortisol patterns in relation to sleep practices in childcare*. Sleep Biol Rhythms. Vol. 11, Supplement 2.

Staton, S., Smith, S., Pattinson, C., Thorpe, K. (2013). *Examining the responsiveness of current sleep practices in early childhood education and care settings to children's social, emotional and physical needs*. Infant & Early Childhood Social & Emotional Wellbeing Conference, Canberra, Australia.

Taylor C. & Weston K. (2013). *A comprehensive approach toward excellence in early childhood teaching and learning*. Symposium for OMEP International Conference, Shanghai, China. 8-11 July 2013.

Taylor, C. (2013). *Quality reforms and family day care: combining education and care to support children's learning and development*, Invited address to the Victorian family Day Care Conference, Richmond, May 2013.

Thorpe, K., Staton, S., Pattinson, C., and Smith, S. (2013). *Day-time sleep patterns of Australian Preschool aged children*. Sleep Biol Rhythms. Vol. 11, Supplement 2.

Thorpe, K., Staton, S., Pattinson, C., Smith, S. (2013). *Day-time sleep patterns of Australian Preschool aged children*. Sleep Biol Rhythms. Vol. 11, Supplement 2, p17. DOI: 10.1111/sbr.12028

2012

Cleveland, G. Taylor, C. & Cloney, D. (2012). *The Determinants of Interaction Quality in Australian Child Care: A Production-Function Approach*. Presented at joint International Conference of the Australian Association for Research in Education (AARE) and the Asia Pacific Educational Research Association (APERA) 5 December, 2012.

Cleveland, G., Colley, S., Taylor, C. & Cloney, D. (2012). *Economies of Scale and Scope and the Structure of Costs in Australian Early Childhood Services*. Presented at joint International Conference of the Australian Association for Research in Education (AARE) and the Asia Pacific Educational Research Association (APERA) 5 December, 2012.

Cloney, D., Taylor, C., Cleveland, G., Thorpe, K. (2012) *The No-Program Control: Identifying and recruiting a random sample of children who do not participate in early childhood services*. Society for Research on Child Development (SRCDC), Developmental Methodology Program, Tampa Florida. February 2012

Cohrssen, C., Tayler, C. & Cloney, D. (2012). *Playing with maths: does implementation dosage affect children's learning outcomes? Preliminary findings and recommendations for future curriculum-based implementation studies in early childhood settings*. Presented at Biennial Australian Implementation Conference 2012. 26, October 2012

Tayler, C. (2012). *E4Kids Findings about the usage patterns and the quality of ECEC programs*. Early Childhood Australia (ECA) National Conference, Perth. October 2012

Tayler, C. (2012). *Usage Pattern in Australian ECEC Programs*, Dean's Public Lecture, November, 2012

2011

Staton, S., Thorpe, K., Tayler, C., Dyson, R., & Canning-Ure, A (2011). *Children's social networks and friendship quality across different early childhood education and care setting in Australia*. Presented at 15th European Conference on Developmental Psychology, Bergen Norway, August| 23-27 2011

Tayler, C., Ishimine, K., Thorpe, K., & Cloney, D. (2011). *Teacher-Child Interactions in Early Childhood Education and Care: An Australian Study*. Presented at Society for Research in Child Development (SRDC) 2011 Biennial Meeting; Montreal, Quebec, Canada, March 31 – April 2 2011

Thorpe, K., Staton, S., Bell-Booth, R., Thompson, C., Tayler, C., Cloney, D., Dyson, R., & Canning-Ure, A (2011). *Adaptation of the Friendship Bus Story for Assessment of Social Bridging and Social Inclusion*. Presented at 15th European Conference on Developmental Psychology, Bergen Norway, August 23-27 2011

Research seminars: University of Melbourne

Bekkhush, M. *"Optimal care? 9-months fully paid maternal leave, high quality care and associations with Child behaviour at 3 years"* May 2010

Bente Jensen - August 2012 *"How can we address Early Childhood Education and Care (ECEC) more effectively"*

Birch, E. *"Indigenous Wisdom for Future Generations"* October 2011

Cleveland, G. *"Quality in Quebec Child Care Centres: What Matters and How Much?"* February 2011

Cleveland, G. *"Selection Effects in the E4Kids Longitudinal Study"* February 2010

Cleveland, G. *"The Determinants of Interaction Quality in Australian Child Care: A Production-Function Approach"* December 2012

McGrew, K. *"Reflections on 35 Years of Intelligence Testing"* September 2010

Mitchell, L. *"Lessons from NZ Policy Approaches"* November 2012

Siraj-Blatchford, I. *"Effective Pedagogy in Primary Schools in English and Maths"* October 2012

Siraj-Blatchford, I. *"Performing Against the Odds: How working class kids succeed in education"* August 2011

Research bulletins (available in E4Kids website)

E4Kids Research Bulletin Issue 1 - December 2011 (PDF)

E4Kids Research Bulletin Issue 2 - January 2012 (PDF)

E4Kids Research Bulletin Issue 3 - July 2012 (PDF)

E4Kids Research Bulletin Issue 4 - May 2013 (PDF)

E4Kids Research Bulletin Issue 5 - August 2013 (PDF)

E4Kids Research Bulletin Issue 6 - April 2015 (PDF)

Other dissemination

Filmcast - *Sleep Routines in Childcare need a Rethink, Day Care Decisions* <http://daycaredecisions.com.au/sleep-routines-in-childcare-need-a-rethink/>

SLEEP program for Authorised Officers and ECEC providers: print resources and podcast <http://deta.qld.gov.au/earlychildhood/news/sector-reports/sleep.html>
Also available through ACECQA

Thorpe, K, Pattinson, C and the Sleep in Early Childhood Research Group (2016). The importance of sleep for preschool children's learning. Implications for practices in early education settings. *Bedrock: National Journal of the Independent Education Union*, May 2016.

Dr Staton, S. and Professor Thorpe, K. for the Sleep in Early Childhood Research Group What Parents Want: Sleep, Rest and Relaxation for Pre-schoolers, *Belonging, Journal of the Australian Childcare Alliance (ACA)* June 2016

Media

2016

Pattinson, C. & Thorpe, K. *Global research hub publishes QUT study on light exposure and kids' weight*.

Brisbane News (January 2016) Health Canal (January 2016) Science Codex (January 2016) Science Media Exchange – Scimex (January 2016) EurekAlert! (January 2016)

Pattinson, C. & Thorpe, K. *Light exposure and kids' weight: Is there a link?* Science Daily (January 2016)

Pattinson, C. & Thorpe, K. *Light exposure plays a role in preschool children's weight, reveals QUT study*.

The Medical News (January 2016)

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University of Melbourne Master of Teaching (Early Childhood)
graduate Maria Paula Acevedo-Gonzalez on placement in 2011

MITCHELL REPORT NO. 01/2016

Quality Early Education for All

Fostering creative, entrepreneurial, resilient
and capable learners

APRIL 2016

Megan O'Connell
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About the Mitchell Institute

The Mitchell Institute at Victoria University is an independent think tank that works to improve the connection between evidence and policy reform. The Mitchell Institute promotes the principle that high-quality education, from the early years through to early adulthood, is fundamental to individual wellbeing and to a prosperous and successful society. We believe in an education system that is oriented towards the future, creates pathways for individual success, and meets the needs of a globalised economy. The Mitchell Institute was established in 2013 by Victoria University, Melbourne with foundational investment from the Harold Mitchell Foundation.

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■ Executive Summary: Quality Early Education for All

There is a mismatch between investment and opportunity in early childhood policy in Australia. The early years are a critical window for building the foundations that enable all children to become creative, entrepreneurial, resilient and capable learners. Yet current policy settings are not meeting the needs of the children who stand to benefit most. This report aims to inform priorities for action for the next five years.

Early education is one of the most significant investments in education and productivity that governments make. It has positive impacts on all children and is a key strategy for overcoming the impact of early disadvantage on educational outcomes and life chances.

However, in Australia, there remains an unacceptable divide in both opportunity and outcome between the poorest and wealthiest communities, between cities and very remote towns, and between children from different cultural backgrounds.

A third of Australian children do not attend preschool for the number of hours needed to make a difference and children in poorer communities have fewer high-quality services available to them.

More than one-in-five children start school with vulnerabilities that can make it hard for them to take up the opportunities that schooling provides.

This has long-term consequences for the future productivity and prosperity of the nation.

We need to act urgently.

Australia does not have a coherent or equitable policy framework and service delivery platform for children and their families in the early years. The system is complex, fragmented, and unequal access to effective services further entrenches health, social and economic inequalities.

The early childhood education and care (ECEC) sector is a key element of the early years platform and shares this complexity. Responsibility for funding and delivery of early education is spread across all levels of government and there is a lack of robust data to measure impact and target investment decisions.

Advances in boosting participation in early education have been made, and the National Quality Framework (NQF) provides the foundations for high-quality and more equal ECEC but the pace of change is too slow. Australia does not yet provide all Australian children with high-quality early education.

Current policy settings are still not extending educational opportunity equally to all children. This means we are missing out on chances to maximise the potential of all children to thrive, participate in and contribute to our society.

The growing gap between the most advantaged and least advantaged children, in both learning and wellbeing, creates significant challenges for an education system already struggling to reduce the gap in achievement. Unequal access to early education and difficult transition into primary school also contributes to increased risks around early disengagement from school, the incidence of mental health issues, substance misuse and involvement in juvenile justice.

High-quality, developmentally-appropriate early education in the two years prior to school must be a core component of national investment to secure the health, wellbeing and education of our children and to secure positive futures for them and for the country.

This report aims to inform priorities for action for the next five years to ensure that all Australian children can benefit from a quality early education.

High-quality, developmentally appropriate early education in the two years prior to school must be a core component of the platforms our nation invests in to secure the health, wellbeing and education of our children, to secure positive futures for them and for the country

Early education in Australia

The signing of the National Partnership Agreement in 2009 (and commencement of the NQF in 2012) ushered in a new national approach to the regulation and delivery of high-quality ECEC in Australia. The NQF provides the foundation and framework for lifting levels of quality across the system. Its core elements – the Early Years Learning Framework (EYLF) and the National Quality Standard (NQS) – reflect research evidence and a broad professional consensus about the conditions that create positive relationships and a high-quality learning environment for children. The EYLF and NQS highlight the fact that children learn through play and in the context of secure and positive relationships and recognise that the early years are a crucial period for early cognitive and social and emotional development.

In the past five years, the proportion of children accessing early education has increased and progress has been made towards achieving higher and more consistent quality across services. This is a strong foundation that can and must be built on.

Although measurable progress has been made, access and quality are still skewed by socio-economic status, meaning that we are missing opportunities to extend access to quality early education to the children who stand to benefit most.

A substantial proportion of services have been independently assessed as working towards the minimum quality standards outlined in the NQF. The NQF Assessment and Ratings results provide independent confirmation that quality remains highly variable across the country, although there are indications that the assessment process is resulting in services improving their quality. A quarter of services have still not been assessed.

Of most concern is that nearly one-in-four services experience difficulty in meeting the NQF's 'education program and practice' standard which focuses on embedding children's individual learning, exploration and identity in everyday practice.

There is a clear need for a focused strategy to ensure all services meet the NQS. In particular, it is necessary to accelerate assessment processes to drive an increase in quality and to embed quality improvement across the system.

How Australia's children are tracking

Despite the rapid expansion in provision, access and funding for early education and care in the past decade, there are cohorts of children who are either not accessing a preschool education, or who are not accessing the hours of quality early education needed to make difference to their development.

Each year, 15 per cent of the children from the lowest socio-economic quintile and around 60,000 children in total enter school developmentally vulnerable. Quality early educational opportunities are a vital strategy for reducing these numbers.

While overall levels of developmental vulnerability have not shifted significantly, these levels have widened between the poorest and wealthiest communities, and metropolitan cities compared to very remote towns. Cohorts of children and an unacceptable number of communities fare extremely poorly on the Australian Early Development Census (AEDC).

Early education must be delivered in a way that, as far as possible, reduces barriers to access for the children who stand to benefit most. Priorities include shifting family and community perceptions about the importance of early education and delivery models that prioritise assertive outreach, engagement with families, cultural appropriateness and additional support for families where needed.

Early education must also be delivered with a level of quality and an intensity that is proportionate to need, which will require additional investment in the communities the AEDC indicates need more support.

Priorities and recommendations

This report makes five priority recommendations that the Mitchell Institute believes should be key national objectives for early childhood policy over the next five years.

These overarching recommendations address issues of access, equity, quality and data. They reflect the evidence about which investments can have the greatest impact and a pragmatic approach to building on existing achievements.

The Mitchell Institute will explore these issues in more detail in 2016.

Mitchell Institute Priority Recommendations

1. Establish affordable access to preschool as a legislated entitlement, make a permanent commitment to funding Universal Access for 4 year olds, and commence work on extending Universal Access to 3 year olds
2. Scale up evidence-based, high-intensity programs for the most vulnerable children, prioritising the communities in each state that are in the bottom decile for developmental vulnerability in the AEDC
3. Ensure the NQF is achieving its objectives and is appropriately resourced to do so, and that all services are meeting the NQS, at a minimum, by mid-2017
4. Deliver a national early childhood data strategy that establishes the information infrastructure needed to drive policy and practice improvement into the future
5. Commence a national campaign to strengthen family and community knowledge and beliefs about children's early learning

■ Missed Opportunities: The benefit of early education for all

It is well-established that the early years are a crucial window for fostering positive health and wellbeing and for establishing the foundations that enable all children to become creative, entrepreneurial, resilient and capable learners. Yet current policy settings are not meeting the needs of the children who could benefit most.

Successive reports have identified the need for a coherent policy and service delivery framework that integrates effective health, learning, wellbeing and parenting support for children, and their families, from birth to school age (and beyond) delivered with an intensity proportionate to need (Marmot, 2010; Moore, 2008; Moore et al, 2014; Fox et al, 2015).

Despite various attempts to move from rhetoric to practice, and the existence of many pockets of excellent practice, the service system as a whole remains characterised by fragmentation, inaccessibility, the delivery of poorly-evidenced interventions, a lack of clarity about what outcomes are being achieved, and uncertainty about where to target investment to optimise outcomes (DHS, 2011; Cassells et al, 2014; valentine and Hilferty, 2011).

One of the most significant opportunities to improve practice and outcomes in early childhood is by expanding access to quality early education and better equipping the early education and care (ECEC) sector to support children's learning, development and wellbeing.¹

Children are learning from the moment they are born and relationships provide the context in which they are supported to explore, learn and develop positively (National Scientific Council on the Developing Child, 2004). This report focuses on the role of early education in the two years prior to entering school, but recognises the importance of children's learning in their earliest years and the crucial role families play as children's first teachers.

Early education is especially important for the cohort of children

The service system as a whole remains characterised by fragmentation, inaccessibility, the delivery of poorly-evidenced interventions, a lack of clarity about what outcomes are being achieved, and uncertainty about where to target investment to optimise outcomes

¹ A quality early learning experience ideally follows high-quality child and family healthcare, including sustained nurse home visiting from the antenatal period to age 2 for families who stand to benefit from a more intensive service (Moore et al, 2012), augmented by access to parenting skill development, support to provide a rich home learning environment and early intervention for emerging language and social and emotional wellbeing issues (Fox et al, 2015).

likely to arrive at school developmentally vulnerable.

Australia has made significant advances in the past five years, but issues around ensuring equitable access to high-quality early education remain a challenge.

The Mitchell Institute is focused on building an education system that is oriented towards the future, creates pathways for individual success, and meets the needs of a globalised economy. This requires creative, entrepreneurial, resilient and capable learners. The Mitchell Institute's landmark 2015 report, 'Educational Opportunity in Australia 2015: Who Succeeds and Who Misses Out', found that many of the children who enter school developmentally vulnerable fail to catch up, with around 10 per cent remaining behind throughout the middle years and in their attempts to transition into further education or work (Lamb et al, 2015). Children experiencing multiple and intersecting forms of adversity are the least likely to catch up. They are also the least likely to have access to high-quality early education.

In order to achieve more equitable outcomes for children, this report identifies three key issues:

- Ensuring access to early education for all children, including systemic implementation of evidence-based strategies for attracting and retaining the families who currently experience significant barriers to access.
- Ensuring all children receive high-quality early education with the 'dose and intensity' necessary to make a difference.
- Investment that is proportionate to impact, including the investments needed to achieve equitable outcomes for disadvantaged children and the ability to measure that impact.

Challenges and opportunities

Early childhood education is a genuinely challenging policy space, currently caught between shifting community attitudes, a compelling but complex evidence-base and difficult fiscal circumstances.

Australia appears to be caught between the perception that early education is primarily a private concern and family responsibility – because the purpose of 'child care' is primarily to help parents get back to paid work – and the growing recognition of the significant public benefits that flow from investing in the early years. The recent Productivity Commission 'Childcare and Early Childhood Learning Inquiry' report suggests that because many of the benefits of early education "accrue primarily to the child attending ECEC and to their family" it is not reasonable to expect the governments to fully fund their participation (PC, 2015, p. 13). More recently the Government's proposed childcare legislation, *Jobs for Families Child Care Package* (2015) ties children's access to childcare subsidies to their parents' workforce participation status.

However, it might be argued that the benefits of healthcare and *school* education also accrue primarily to the individual, although there is widespread recognition of the public benefits of universal access to health and education and a strong community belief – reinforced by and reflected in legislation – that children are entitled to health and school education in their own right.

There is clear recognition that public investment in health and education benefits us all. There is also unequivocal evidence that early childhood education delivers some of the strongest returns on investment of all social programs (Heckman, 2009; WISPP). Melhuish (2011) asserts that "the benefit arriving from 18 months of pre-school is similar to that gained from 6 years of primary school".

"Children who start school in good shape are likely to learn well, they're likely to develop the expertise and skills that will make them productive members of the workforce."

PROFESSOR OBERKLAID

It is time that quality early education is considered a core entitlement for all Australian children.²

The evidence for what constitutes quality early education is strong: existing information can provide a reliable compass for action if backed by ongoing measurement, evaluation and mechanisms to support continual quality improvement. But there are no perfect answers and ‘silver bullet’ solutions. We need to use this evidence and develop and evaluate Australian-specific solutions to answer the crucial questions around ‘what works’, for whom and in what circumstances.

High-quality ECEC is a significant lever for improving children’s outcomes – a critical part of the package of inputs that sets children up to succeed at school and in life – but it is important that it is not seen as *the* solution for transformational change.

High-quality universal platforms offer the best opportunity to shift outcomes at the population-level and should be the priority for investment

Bold policy decisions are needed for Australia to address the huge downstream personal and social costs of missing the opportunity to act early – when interventions are most effective. Responding to the consequences of the stark socio-economic differences evident when children arrive at school is enormously challenging for the education system. Recent Grattan Institute data on the impact of disadvantage on educational attainment highlights the difficulty the current education system has in maximising the potential of all children, including the huge gulf in learning between the most highly performing and lowest performing students (Goss and Sonnerman, 2016). This reinforces the Mitchell Institute’s findings in ‘Educational Opportunity’ that without additional support, early disadvantage can continue throughout a child’s schooling.

One of the core issues plaguing social policy and service delivery in Australia is that of funding and delivery models that are often incapable of servicing the number of people who need them. In the same way that only taking half a course of antibiotics will not address the underlying infection, a program with the capacity to work with 30 children in a community of 1000 children will never shift the outcomes measured by the Australian Early Development Census (AEDC). This is why AEDC results have not substantially altered since 2012, despite investments in a range of evidence-based programs. These programs have their place, and should be supported, but will not deliver the population-level change we need unless they reach the majority of children likely to benefit from them. Similarly, low to moderate quality early education will not be sufficient to close the gap in school readiness and subsequent achievement.

High-quality universal platforms offer the best opportunity to shift outcomes at the population-level and should be the priority for investment.

There is, therefore, a clear and compelling rationale to prioritise establishing early education as a universal entitlement for all Australian children, ensuring that education is delivered with the intensity and with the quality needed. We also need to build capacity to track the extent to which it is, in fact, benefitting children.

Australia has begun building the infrastructure needed to achieve genuine Universal Access, but a proactive approach is needed to ensure that previous landmark reforms are able to achieve their intended outcomes.

² The International Labour Organization contends that broad acceptance of the idea that early education is a public good is likely to coincide with its inclusion as part of the school system (ILO, 2012, p. 24).

Recognising achievement and looking forward

In 2008 and 2009 the Council of Australian Governments (COAG) made historic commitments to introduce a new National Quality Framework for ECEC and a new national commitment to ensure that all children can access a preschool program delivered by a qualified Early Childhood Teacher (ECT) in the year before school.³

The national law underpinning the NQF, passed in 2010, was a significant milestone. It provided, for the first time:

- a consistent national approach to ECEC regulation including staff qualifications and ratios, and an outcomes-based regulatory framework (the NQS);
- a new single national curriculum and pedagogy framework (the EYLF);
- the development of processes and information infrastructure to support nationally consistent measurement of some elements of ECEC data (the Assessment and Ratings process);
- a shared commitment to the provision of preschool education in the year before school; and
- formal recognition that quality early education is important for children's development, not just parental workforce participation.

Five years on from these breakthrough reforms, and in the wake of a major inquiry by the Productivity Commission and new federal legislation, it is timely to reflect on the extent to which the reforms have achieved their intended purpose and to articulate key areas for policy and practice development over the next five years.

Crucially, it is important to remember that the 2010 reforms simply brought Australia up to international norms (OECD, 2001). A significant gap remains between international best practice and Australia's current policy settings and Australia remains considerably below average for public investment in ECEC (OECD, 2015; Brennan and Adamson, 2014, p. 8).

The NQS is designed to set national minimum benchmarks for quality, and its Assessment and Ratings process and Quality Improvement Plan provide a framework for continuous improvement and for services to exceed the standards. However, 31 per cent of services that have received a rating were assessed as 'Working Towards' the standards. Critically, after five years 26 per cent of services have not even been assessed (ACECQA, 2016). This is not sufficient to drive continuous improvement in the sector, or to encourage excellence.

The pace of the change initiated by the NQF is too slow. With around 60,000 children arriving at school developmentally vulnerable each year, we cannot move quickly enough to raise levels of quality to at least minimum levels, so that all services deliver a quality education for all children.

Funding for the ECEC sector is complex and often opaque. In addition to family contributions (fees and fundraising), there are three main funding sources: childcare subsidies provided by the Australian Government; the Universal Access to Preschool National Partnership, and state and local government investment in providing access to preschool for (some) 3 and 4 year olds.

We can learn from overseas experience. The United Kingdom extended subsidised ECEC to all 3 and 4 years olds in 2004 and 1998 respectively, and to the 40 per cent most disadvantaged 2 year olds in 2012. However, evaluation of the United Kingdom's expansion of free ECEC to all 3 and 4 year olds has not had an impact of the size expected. It appears that the primary reasons for this are related to the quality of the services provided and the fact that although all children can benefit from early education, the biggest gains to be made are through uptake from the most disadvantaged families (Brewer et al, 2014). There are clear lessons here for Australia. Current policy settings will only yield improvements in population-level outcomes through a concomitant focus on quality and access.

³ In this report, the term 'preschool' is used to refer to an educational program delivered (across settings) in the year before fulltime schooling.

Policy objectives for the next five years

The Mitchell Institute goal is for an education system that equips *all* young people to be creative, entrepreneurial, resilient and capable learners. Early childhood education has a pivotal role in developing the building blocks for learning and wellbeing, and in making sure that children's capabilities, attributes and talents shape their futures, not their experiences of disadvantage.

This report aims to inform the ongoing conversation about policy and practice directions for early education in Australia over the next five years. The report:

- provides a synthesis of the evidence around why early childhood education is crucial for all children, and especially important for vulnerable children;
- outlines the expansion of quality early childhood education in Australia over the past decade;
- shows who is participating in early childhood education, who is missing out and why;
- provides a stocktake of data on how Australian children are faring; and
- suggests potential policy levers for driving change and provides recommendations that could be actioned by all levels of government in Australia to improve access, quality, data and outcomes.

An education system
that equips *all* young
people to be creative,
entrepreneurial,
resilient and capable
learners

The Impact of Quality Early Education

Quality early education provides a strong foundation for positive life outcomes for children. It can play a key role in narrowing the gap between advantaged and disadvantaged children that begins long before a child's first year of school.

Early education provides children with opportunities to develop critical skills during the years prior to school (Cloney et al, 2015), and is particularly important for children who have not had the opportunity of exposure to a rich home learning environment. Numerous studies have shown the impact of quality early education on children's social, emotional and learning outcomes (Sylva, 2010; Moore and McDonald, 2013; Warren and Haisken-DeNew, 2013; Burchinal et al, 2009). There is a growing evidence-base illustrating the impact of early years interventions on downstream outcomes, such as educational attainment, economic and social participation, involvement in the criminal justice system and family wellbeing (Manning, Homel and Smith, 2009; Schweirnhard et al, 2005; Campbell et al, 2012).

Universal provision of quality early childhood education, delivered with greater intensity for the children who need it most, is a key strategy for changing the trajectories of children and reducing the unsustainable costs of late intervention (Heckman, 2008; Access Economics, 2009; Allen, 2011; Fox et al, 2015). Intervening early is more effective and cost-efficient.

All children benefit from access to high-quality early education, especially in the year before school, but children from disadvantaged backgrounds benefit more (Heckman, 2008; Harrison et al 2012). Available evidence suggests that 15 hours per week is adequate and appropriate for most children.

The children most at risk of poorer outcomes – those experiencing abuse or neglect or who had experienced trauma, and children from families experiencing mental health issues, family violence or drug and alcohol abuse – can benefit significantly from daily access to high-quality early education and care from a young age, especially when this is combined with access to family support and therapeutic services as required (Sylva et al, 2010; Sylva, 2004; Melhuish et al 2006; Burchinal et al, 2009; AIHW, 2015). For children experiencing significant disadvantage, access to at least 30 hours of quality early education from age 3 is optimal.

The impact of quality early education has been highlighted across numerous studies.

- AEDC research snapshots show that children who attend preschool are less likely to be developmentally vulnerable. For example, in 2009 children from advantaged communities who attended a preschool had less than a one-in-seven chance of being developmentally vulnerable, compared to a nearly one-in-four chance for children who did not attend preschool. Similarly,

Universal provision of quality early childhood education, delivered with greater intensity for the children who need it, is a key strategy for changing the trajectories of children

children from disadvantaged backgrounds had a less than 30 per cent chance of being developmentally vulnerable if they attended preschool, compared to a 40 per cent chance if they did not (Australian Government, 2014).

- The advantage of early education is maintained throughout schooling with the Longitudinal Study of Australian Children (LSAC) confirming that children who attend preschool score higher on Year 3 NAPLAN tests, even after controlling for their personal circumstances (Warren and Haisken-DeNew, 2013).
- LSAC data shows a correlation between children who participated in preschool and reduced probability of being rated by their teachers as doing poorly in school, having low maths or literacy levels, and being rated by their carer as having poor social and emotional development (Biddle & Seth-Purdie 2013). However, they also found that these impacts would disappear for children with multiple risk factors and concluded that standard ECEC (in 2008, prior to the implementation of the NQS) was of insufficiently high quality to mitigate the impacts of disadvantage.
- The OECD finds that a lack of pre-primary education increases a young person's likelihood of performing poorly in maths, and that a child with no pre-primary education is 1.9 times more likely to perform poorly in education than a student who has attended more than a year of pre-primary education, after accounting for other student characteristics (OECD, 2016, p.80).
- In 2012, Australian children with a year of pre-primary education scored 27 points more in the Program for International Student Assessment (PISA) than children who did not attend preschool. This represents an additional six months of learning (OECD, 2015).
- Two years of high-quality ECEC for 15 hours per week gives the same protective effect as having a tertiary-educated mother (Sylva et al, 2010).
- The threshold of 15 hours of high-quality early education per week is well-established in research (Sylva et al, 2004; Loeb et al, 2010), and it appears that highly disadvantaged children can benefit from full-day preschool (Loeb et al, 2010; Chang and Singh, 2008; Chang, 2012; Boardman 2005; Ontario Ministry of Education, 2013).

Why quality matters

"If ECEC is to deliver the benefits that are claimed for it, it must be provided in a way that meets rigorous standards of evidence" (Brennan and Adamson, 2014, p. 5).

ECEC must be high quality to have a positive effect on children's short and long term outcomes. There is broad consensus on what constitutes quality in early education. Quality learning environments are made up of:

Process elements shaping the dynamics of daily occurrences in childcare settings, such as:

- children's interactions and engagement with caregivers;
- children's interactions with other children;
- learning opportunities activities such as language stimulation; and
- health and safety measures.

Structural factors that facilitate these interactions and learning activities, such as:

- child:adult ratios;
- the size of each group of children; and

"Higher levels of social competence and lower behavioural problems in pre-kindergarten classrooms are linked to more emotionally supportive teacher-child interactions in centres that achieve higher levels of quality"

HARRISON ET AL 2012

- the formal education and training of caregivers (Vandell & Wolfe, 2000; Ishimine et al, 2009).

Structural elements are more easily measured and have tended to form the basis of quality measures. However, on their own, they do not work well as a proxy for quality: they enable the enriched educator-child interactions and attention to learning and development that drive improvement in children's outcomes but are not outcomes in themselves. For this reason, the NQF is intended to influence both structural and process elements of quality. For instance:

Teachers with greater knowledge of early childhood development have been shown to be more attuned to children's communication and emotional cues, lower carer-child ratios permit more responsive interactions and one-on-one interaction, centres with better qualified staff are more likely to score well on quality rating scales, high quality centres are more likely to result in improved outcomes for children (ARACY, 2015, p. 8).

Also crucial to quality is the developmental appropriateness of the learning environment (Sylva, 2010), particularly the use of play-based and inquiry-focused learning activities, with pedagogical practices that support:

- play-based activities and routines which allow children to take the lead in their own learning;
- support for language and communication (through use of narrative, shared reading, informal conversations, song and rhymes); and
- opportunities to move and be physically active (Mathers et al., 2014 in ARACY 2015).

An overly structured, academic focus in preschool can prevent children from developing the social and emotional skills they need. Studies show that children can experience stress in environments with a predominant focus on academic training (Gray, 2015; Lipsey et al, 2015; Carlsson-Paige et al, 2015; Darling-Hammon and Snyder, 1992; Marcon, 2002). Although more academic approaches result in early achievement gains, especially in literacy, they can be followed by detrimental outcomes longer term, particularly in terms of social and emotional wellbeing (Farran and Lipsey, 2015).

Quality early education is play-based, requires positive educator-child relationships and places children's social and emotional development at the forefront.

There are significant differences in outcomes depending on the level of quality care provided. High-quality child care benefits cognitive development, improves concentration, and fosters better intellectual development, enhanced vocabularies and greater sociability. In contrast, poor quality care is associated with deficits in language and cognitive function for very young children, and has been associated with poorer social and emotional development (Productivity Commission, 2014; Sammons et al, 2012a, 2012b; Sylva, 2010; Belsky et al, 2007).

- Children who attend preschool with a preschool teacher who has an early childhood education degree or diploma perform better in Year 3 NAPLAN testing for reading, numeracy and spelling than children who did not attend preschool, even when controlling for personal circumstances (Warren & Haisken De-New, 2013).
- Children who attended preschool with a certificate qualified teacher, or a degree-qualified teacher in a field other than early childhood, did not fare better than children who did not attend preschool (Warren and Haisken De-New, 2013).
- Data from the Effective Preschool, Primary and Secondary Education (EPPSE 3-16) Project study shows that there is a difference in outcomes at age 16 between very poor and very high-quality preschools, including

"Children benefit from higher-quality care overall in both their language and social skills, but larger benefits tend to accrue when quality is in the good to high range."

BURCHINAL ET AL 2009

after adjusting for circumstances. Preschool quality is particularly relevant for children whose mothers were early school leavers, and for children who have not been exposed to a rich home learning environment (Taggart et al, 2015).

- Burchinal et al (2010) found substantially higher impacts on children's outcomes in classrooms that were rated high-quality. For instance, children in classrooms rated highly for 'instructional support' scored over three times higher on expressive language.

Research suggests that children experiencing higher levels of disadvantage benefit most from higher quality early education, and require a greater level of intensity. Pianta notes: "preschool in the United States narrows the achievement gap by perhaps only 5 per cent rather than the 30 per cent to 50 per cent that research suggests might be possible on a large scale if we had high-quality programs" (Pianta et al, 2009, p. 65).

"Programs in low SES areas that include vulnerable children should be model programs of the highest quality" (Cloney, et al, 2015), but are currently the least likely to be meeting the NQS, particularly in the crucial educative component.⁴

The foundations for future life and learning

Quality early childhood education is also vital for building the social and emotional skills that are key to succeeding at school and employability in the long term. In the recent Skills Outlook 2015: 'Youth, Skills and Employability', the OECD cited a lack of social and emotional skills as a key barrier to employment, including for low-skill jobs.

The Centre for the Developing Child at Harvard University points to the importance of the early years for developing these skills, as well as children's executive functioning, the cognitive and life skills that require working memory, mental flexibility and self-control. Executive functioning, they suggest, underpins school achievement, positive behaviours, good health and successful transition to work. Development of executive functioning starts early:

"The rudimentary signs of these capacities (e.g., focusing, attention) emerge during the first year of life. By age 3, most children are already using executive function skills in simple ways (e.g., remembering and following simple rules). Ages 3-5 show a remarkable burst of improvement in the proficiency of these skills (e.g., increased impulse control and cognitive flexibility)" (Centre on the Developing Child, 2016, p. 8).

Given that children develop these skills through "their relationships, the activities they have opportunities to engage in, and the places in which they live, learn, and play" high-quality early education and care has a crucial role to play in supporting the development of crucial capabilities for life and learning (CDC, 2016; CDC, 2011).

Return on investment

"It is no longer viable to take ever increasing amounts of taxation from the public to deal with the ever increasing impact of failing to intervene early" (Allen and Smith, 2008, p. 113).

Governments at all levels have competing priorities, and need to make complex and often challenging fiscal decisions about where to invest in order to maximise impact.

The strongest, and most frequently cited, return on investment data comes from a handful of intensive programs from the US, all implemented in the 1970s and 1980s in very specific circumstances (Table 1).

⁴ Biddle and Seth-Purdie note that quality standards prior to the introduction of the NQS "were not adequate to mitigate developmental vulnerability and that [long day care], at the time, may have been harmful" (2013, p. i).

Table 1: Benefit-cost ratios cited for early education and care programs (return per dollar invested)

Program	Benefit to cost ratio
Perry Preschool Program	17 : 1 for participants at 40 year follow up
Abecedarian Program	Between 3-4 : 1 at 21 year follow up
Chicago Child-Parent Centres	10 : 1 at 28 year follow up

Source: Fox et al, 2015, p. 45

It is unlikely that Australian interventions will achieve the same impact, given the vast difference in context and base-level social protection and health systems, but PWC modelling works with the lower ratios and applies a 75 per cent discount and still finds significant positive impacts. Cost-benefit evaluations of system-wide preschool and early education programs, conducted in 2013 by the Washington Institute for Public Policy (WISPP), continued to find strong positive returns on investment (WISPP, n.d.; Kay and Pennucci, 2014; Bania, Kay, Aos and Pennucci, 2014) (Table 2).

In the EPPSE 3-16 study it was found that individuals who attend preschool earn, on average, £27,000 more over their working lives than those who do not attend preschool, with the largest difference for children with low-educated mothers attending quality preschool (Taggart et al, 2015, p. 14).

Table 2: WISPP modelling of cost-benefit of preschool and early education

Program name	Total benefits	Taxpayer benefits	Non-taxpayer benefits	Costs	Benefits minus costs	Benefit to cost ratio	Chance benefits will exceed costs
State and district early childhood education programs	\$37,036	\$11,955	\$25,081	(\$7,130)	\$29,906	\$5.19	93 %
Head Start	\$27,175	\$8,864	\$18,311	(\$8,783)	\$18,392	\$3.09	82 %

Source: WISPP, 2015

PricewaterhouseCoopers Australia (PWC) has modelled a range of impacts associated with the impact of increased access to quality ECEC:

- In 2014, they suggested that children accessing ECEC services that were Meeting or Exceeding the NQS would yield benefits of up to \$10.3 billion by 2050, while engaging children from the lowest income brackets who currently receive no ECEC would resulting in an additional \$13.3 billion by 2050.
- In 2016, they modelled the impact of the Australian Government's proposed legislation and found a net fiscal saving to the Australian Government of \$4.3 billion by 2050, an extra 29,000 workers either joining the workforce or increasing their hours of employment, and an increase of \$7.6 billion in real GDP by 2050.

In conclusion

Early education has substantial and sustained impacts on children's learning, development and wellbeing. It is a key strategy for mitigating the socio-economic gradient that so strongly influences children's progress at school and their trajectories over their lives.

The NQF provides a good foundation to set minimum standards for quality early education – although implementation of its assessments remains slow and quality is variable, indicating that further work is required to maximise the impact of this important reform.

High-quality early education must become a core component of contemporary systems for achieving positive learning and development for Australian children, alongside and of equivalent value to child and family health and school education.

The benefits of the current investment in the ECEC sector will be muted if higher levels of quality are not achieved, particularly for the most disadvantaged children.

“The advantages gained from effective early interventions are best sustained when they are followed by continued high quality learning experiences ... [and] due to dynamic complementarity, or synergy, early investments must be followed by later investments if maximum value is to be realised”

HECKMAN 2008

■ Early Childhood Education in Australia: Looking back to look forward

The early education and care reforms that Australia has pursued over the past five years have had significant impacts, with substantial increases in the proportion of children accessing early education and progress towards achieving a consistent base-level of quality for all children. The foundations have been built – but there is more to be done.

This section provides an overview of key recent developments in ECEC policy and delivery in Australia and identifies opportunities and critical junctures for further development.

Looking back

An historical division of responsibilities for ECEC policy and delivery exists in Australia (Elliot, 2006), which has resulted in different conceptualisations of the policy problem and of policy goals, and contributed to a highly fragmented ECEC sector. The sector has different policy instruments, different guiding philosophies and highly variable quality of services.

The focus of this report is on solutions to assist all children to succeed in education, and as such does not delve into the complexities of governance, accountability and funding responsibilities. However, Appendix One highlights the difficulty of navigating the ECEC sector including the impact of the fragmentation of the sector on levels of fees and funding. Further work is needed to address these complexities.

Historically, state and territory governments have had primary responsibility for schooling and a number of jurisdictions extended downwards to provide or subsidise optional preschool services, often approaching preschool from a more formal educational perspective.

In contrast, the Australian Government has had responsibility for national workforce and economic issues, and began subsidising childcare services as a productivity measure to increase the participation of parents – especially mothers of young children – in the labour market.

This division persists in the perception that there is, or should be, a separation between ‘education’ and ‘care’ in early years policy (PC, 2015), but lags behind the explosion of research on early brain development and early learning of the past 20 years (Shonkoff and Phillips, 2000; McCain, Mustard and Shanker, 2007; OECD, 2007; NSCDC, 2004a, 2004b, 2010, 2006, 2011, 2012; Winter, 2010). This research conclusively establishes the importance of the first five years of a child’s life for their later outcomes, and makes any division between ‘care’ and ‘education’ redundant.

In the past decade, ECEC in Australia has expanded in terms of demand, supply, expenditure and the breadth and depth of services provided.

- About 43 per cent of Australian children aged 0-5 years old now participate in ECEC in Government-approved services, up from 36 per cent in 2006;
- In March 2015, there were 16,966 Australian Government Child Care Benefit-approved childcare services in Australia and 273 state and territory government-only funded children care services (PC, 2016).

This growth has largely been driven by the expansion of female workforce participation, but the expansion of preschool also reflects a growing recognition of the importance of early education as well as explicit cross-government policy goals.

Size of the investment

Australia's public and private investment in ECEC has grown significantly, driven primarily by increases in the number of children in care and an increase in hours (PC, 2015, p. 116).

- Combined public funding is projected to increase to \$11 billion a year in 2018-19, if proposed legislation is passed, but \$8.5 billion under current arrangements.
- The Australian Government's expenditure in the ECEC sector has increased by over 250 per cent in ten years, to \$7.2 billion in 2014/15.⁵
- State and territory government spending has increased approximately 150 per cent since 2009-2010 to \$1.2 billion in 2012/13.⁶
- Average fees for childcare and preschool services have increased by around 50 per cent between 2007 and 2013.

Combined public and private expenditure per child in preschool in Australia is \$13,421, among the highest in the OECD, compared to an average of \$10,432 (OECD, 2015, p. 2), converted to AUD. However, Australian public investment in ECEC as a proportion of GDP remains well below OECD averages, especially in terms of programs that deliver a strong educational component. The Melbourne Graduate School of Education notes that:

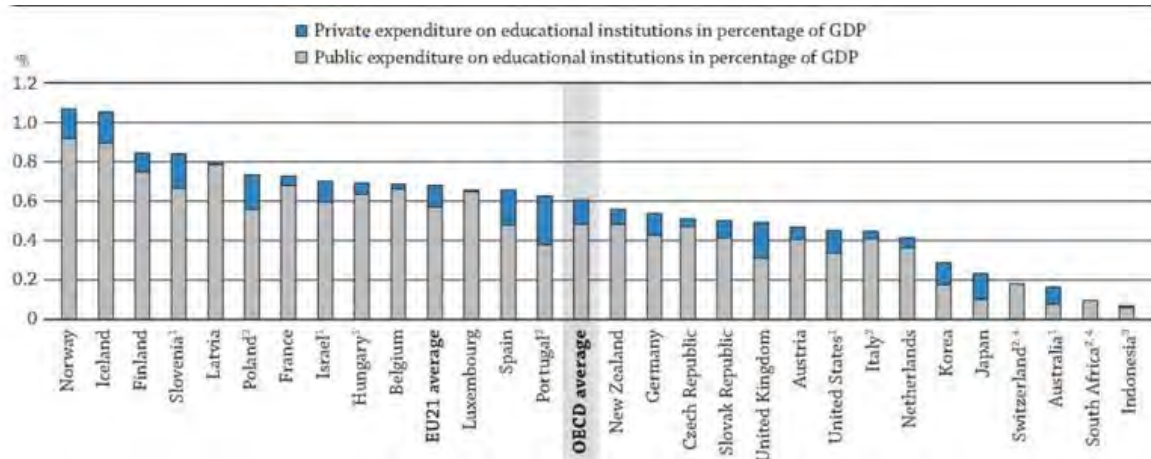
"In international terms Australia is not yet providing sufficient threshold investment in quality early learning provision: Australian children do not yet have sufficient access to ECEC programs of internationally comparable quality and duration" (MGSE, 2015, p. 3).

There is a substantial discontinuity between investment in early education and primary and secondary education (Figure 1). While governments spent an average of AUD\$6,100 in 2012-13 on ECEC for every child in formal care (Productivity Commission, 2015, p. 128), in 2014 the school resourcing standard was a fixed amount of AUD\$9,271 per primary school student and AUD \$12,193 per secondary student (Australian Government, 2013a). Heckman (2008, 2010) suggests that public investment in children should follow the opposite pattern: frontloading investment from the antenatal period.

⁵ Eighty seven per cent of Australian Government funding is in payments to families to offset fees, with 7 per cent supporting the National Partnership Agreements and 6 per cent on quality assurance.

⁶ State and territory funding goes to a range of regulatory functions, direct provision, capital investment, planning and capacity building, with significant differences across jurisdictions.

Figure 1: Public and private expenditure on pre-primary education as a percentage of GDP in 2012/13



Source: OECD, 2015, p. 328.

The gap between the total cost of early education and government support is met by families, and the high private costs of early education remain a barrier to access for many families (Brennan, 2012; Brennan and Adamson, 2014).

There is a strong association between family income and access to early education. Brennan and Adamson show that:

- In families with a combined weekly income of \$2,000 or more, 52 per cent of 0-14 year old children regularly participate in child care, compared to 25 per cent in families earning \$800 or less.
- Children whose parents' weekly income exceeds \$2,000 are more likely than those earning less than \$800 to use both formal care (18 per cent and 11 per cent respectively) and informal care (24 per cent and 13 per cent).
- Families earning \$800-999 per week are the least likely to use either formal or informal child care (2014, p. 21).

This pattern of access continues, with more recent Australian Bureau of Statistics (ABS) data showing a sharp discrepancy between access to ECEC across income brackets (Table 3).

“For children in low-income families, access to early childhood education will only become a reality if services are offered at no, or minimal, cost”

DEBORAH BRENNAN, 2012

Table 3: Type of care usually attended by children aged 0-12, by weekly income of parents

	Weekly income of couple parents						Weekly income of single parents			
	<\$1000	\$1000- \$1399	\$1400- \$1999	\$2000- \$2499	>\$2500	Total	<\$600	\$600- \$999	>\$1000	Total
Usually attended care	31.2	39.2	46.9	55.9	54.6	46.2	49.7	58.0	76.3	57.1
Usually attended formal care only	10.8	16.1	15.3	19.3	19.6	16.0	11.3	12.1	16.8	12.8
Usually attended Informal care only	17.2	19.5	23.9	25.9	22.7	22.1	29.1	35.0	43.8	33.5
Usually attended formal and informal care	3.1	3.2	7.9	11.2	12.3	8.1	8.4	9.2	18.7	10.7
Did not usually attend care	68.5	60.5	53.4	44.1	45.3	53.8	50.9	43.2	21.4	42.9

Source: ABS 2015: Early Childhood Education and Care, June 2014 (Tables 6 and 7)

The cost of accessing early education remains a significant barrier to families and the complex funding environment in the ECEC sector adds to the difficulties families face in making decisions about the cost and benefit of enrolling their children in early education.

There is currently a two-tier model of preschool funding. Standalone preschools are funded through the National Partnership Agreement to provide low or no cost preschool for 15 hours per week. Parents are levied low or minimal fees. Preschool delivered in long daycare (childcare) services is funded through fees paid by parents. These fees are offset by means-tested, activity-tested subsidies. Fees are often levied for full days even if children only attend part of the day, so parents may need to fund two or more whole days for their child to receive 15 hours of preschool.

The scenario below is for a median preschool and childcare service in New South Wales and illustrates the impact of different funding approaches on 'out of pocket' costs.

Standalone Government preschool (NSW)

Child A attends a local government preschool 3 days a week from 9am to 2pm

The service receives

\$1850 National Partnership Agreement in funding

Fees are \$2.50 per hour for the 15 hours of attendance

Parents are

\$37.50 per week out of pocket

Preschool in childcare service (NSW)

Child B attends a childcare service preschool program 2 days a week from 9am to 4:30pm

The service receives

\$300 National Partnership Agreement funding

Fees are \$90.60 per full day of care. Parents receive 50% rebate on fees.

Parents are

\$90.60 per week out of pocket

The National Quality Framework

In 2008 and 2009 the Council of Australian Governments made historic commitments to introduce a new national approach to the delivering high-quality and accessible ECEC.

The National Quality Framework was introduced from 2010 (and came into effect in 2012) to drive continuous improvement, consistency, transparency and accountability in early childhood services and to improve developmental outcomes for all children. It comprises:

- **The National Quality Standards (NQS)**, which establishes national benchmark for early childhood education and care and establishes minimum standards of acceptable quality, with the intention of driving improvement over time.
- **Belonging, Being and Becoming: The Early Years Learning Framework for Australia (EYLF)**, which provides a nationally consistent early years curriculum and pedagogical approach, with a “specific emphasis on play-based learning and recognises the importance of communication and language (including early literacy and numeracy) and social and emotional development” (EYLF, 2009, p. 5).
- **Independent Assessment and Ratings process** and embedded Quality Improvement Plans in every service
- **Publicly available information** about services quality ratings is available to parents.

The NQF was a significant achievement, providing a major and long-overdue overhaul of Australia’s ECEC sector and bringing Australia closer to the research-informed baseline standards and frameworks that characterise other systems internationally. The key elements of the NQF and NQS are:

- better (higher and more related) educator qualifications;
- lower educator-to-child ratios;
- streamlined regulatory arrangements, with uniform national standards;
- a National Register of educators and services to enable families to assess the quality of approved education and child care services across the country; and
- the National Quality Standard Ratings, which provide a transparent, evidence-informed and accessible way to communicate quality.

Under the 2009 National Partnership Agreement on the National Quality Agenda for Early Childhood Education and Care (December 2009), the Commonwealth, states and territories have different but complementary roles in funding, regulating, providing and planning early education and care, supported by the Australian Children’s Education and Care Quality Authority (ACECQA), the national, independent, statutory authority for the ECEC sector.⁷

States and territories share responsibility with ACECQA for

1. Educational program and practice
2. Children’s health and safety
3. Physical environment
4. Staffing arrangements
5. Relationships with children
6. Collaborative partnerships with families and communities
7. Leadership and service management.

QUALITY DOMAINS OF THE NQS

⁷ ACECQA’s fundamental role is overseeing the implementation and administration of the NQF, especially with regard to monitoring and promoting consistency. ACECQA’s secondary roles include educating and informing the sector and the community on the importance of quality ECEC and provision of current, authoritative research to ensure the NQF policy and service delivery is in line with best practice (ACECQA, 2015).

administering the National Quality Framework. Each state or territory is responsible for monitoring and assessing the quality of services within their jurisdiction and reporting this information to ACECQA. These state and territory regulatory agencies are generally located within departments of education, who also grant service and provider approvals, record and investigate incidents and complaints, and ensure ECEC services meet legislative requirements.

Additionally, states and territories fund and manage preschool programs, including those delivered within childcare service settings, or directly provide preschool programs and other programs themselves. Some states and territories offer funded access to an additional year of preschool for very vulnerable children and targeted cohorts such as Aboriginal and Torres Strait Islander children.

Implementation progress and outcomes

Given the early stage of the NQF's implementation, its impact on children's development and academic performance over the course of their schooling and later health, economic and social outcomes, is not yet known (AIHW, 2015). The NQF has largely achieved its primary goals of lower ratios and better-qualified staff with the final tranche of ratio changes delivered in 2016. Requirements for early childhood teachers (ECTs) in childcare centres have largely been implemented, with at least one bachelor-qualified teacher, especially in the 'preschool room' of their service, although many educators and early childhood teachers are still 'working towards' their qualification.

The significant change and upskill of the workforce necessary for full implementation of the NQS has required a phased implementation approach. The final implementation is scheduled for 2020 with the introduction of a second ECT from 1 January 2020.

Implementation of the standards has, however, been uneven and is not yet complete:

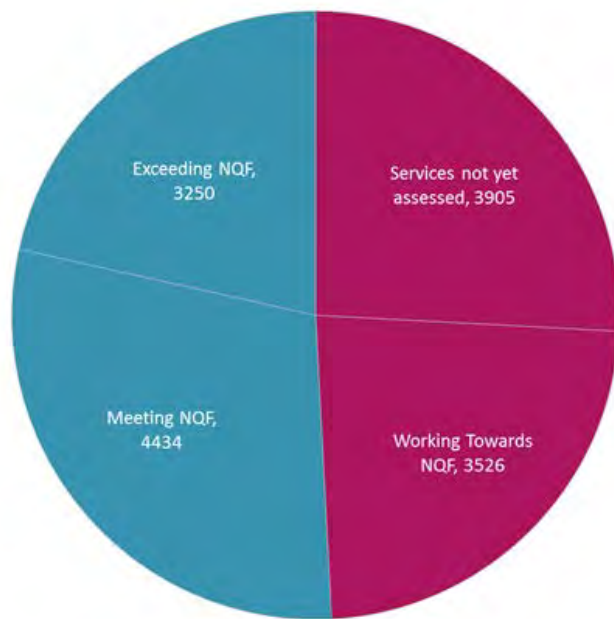
- Only 74 per cent of Australia's 15,166 ECEC services have been visited and rated by ACECQA, with 3905 services yet to receive a rating (Figure 2).
- Fourteen per cent (367) of preschools across Australia received a Working Towards rating when they were assessed against the National Quality Standards, an improvement on the previous three years.
- Of all services that have received a rating, 68 per cent were rated overall as meeting or exceeding the National Quality Standard (ACECQA, 2016b).
- Services that rated as Working Towards the NQS or requiring Significant Improvement are disproportionately located in areas of concentrated disadvantage (Cloney et al, 2015; ACECQA 2016b; Lamb et al, 2015).
- Only 44 out of 11,261 services have received an Excellent rating.⁸
- There was only a 3 per cent increase in services meeting or exceeding the NQS between 2014 and 2015.
- While 85 per cent of preschools met or exceeded the NQS, only 65 per cent of long daycare services, and only 54 per cent of family day care services did.
- ACECQA report that 440 services have been rated more than once, with just under half of these moving from 'working towards' to 'meeting' the NQS and the remainder moving from 'meeting' to 'exceeding' the NQS (ACECQA, 2016b).

There were also differences between states, with a majority of services in Western Australia, Tasmania, the Australian Capital Territory and the Northern Territory rated as 'working towards' the NQS. These results are not unexpected given that, prior to the introduction of the national system, some service types had not previously been regulated against a regime of quality standards. Recent research confirms that there are fewer services

⁸ This may reflect the fact that 'excellent' ratings have an additional application and assessment process and require additional fees.

available in lower socio-economic areas and lower levels of quality (Cloney et al, 2015; ACECQA 2016; Lamb et al, 2015).

Figure 2: Breakdown of service assessment ratings as at 31 December 2015



Source: ACECQA 2016b

Achieving high-quality learning environments

Worryingly, the quality area least likely to have been met nationally was 'Education program and practice'. In the E4Kids study, Cloney et al (2015) found generally high and consistent levels of emotional support across socio-economic quintiles, but generally low and much more inequitable levels of instructional support (Figure 3).

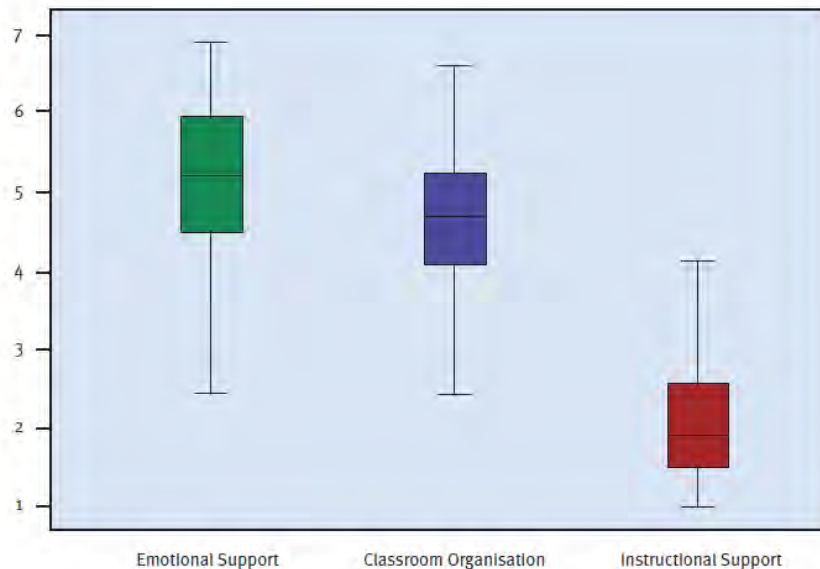
E4Kids confirmed that only 7 per cent of children in the lowest socio-economic quintile attended programs delivering the highest levels of instructional support, compared to 30 per cent of children from the highest socio-economic quintile (MGSE, 2015, p. 6).

Overall, in Australia, 31 per cent of services that have been assessed are not meeting the minimal national standard and are still working towards the NQF, while 26 per cent of services have not been assessed.

The elements that services were least likely to meet are:

- Each child's current knowledge, ideas, culture and interests provide the foundation for the program;
- Each child's learning and development is assessed as part of an ongoing cycle of planning, documenting and evaluating children's learning;
- Critical reflection on the children's learning and development, both as individuals and in groups, is regularly used to implement the program.

Figure 3: Classroom Assessment Scoring System (CLASS) assessment of ECEC classrooms on 3 summary domains



Source: E4Kids, 2012.

More than 20 per cent of services were also not meeting elements related to: the impact of curriculum decision-making on children’s identity; connection with community; wellbeing and confidence as learners; documentation of each child’s learning and providing this to families; promoting the agency of each child; and educators responding to children’s ideas and play, using intentional teaching to scaffold and extend learning (ACECQA, 2016b).

ACECQA report that many services found it difficult to provide appropriately creative and responsive learning environments that built on children’s knowledge, interests, cultures and capabilities in accordance with the ELYF (2016). Services also experienced difficulties planning, documenting and evaluating their educational programs, and sharing relevant information about their educational program and each child’s participation in the program with the child’s parents.

The quality of the learning and relational environment is the key driver of the positive impacts of early education. There is a significant opportunity to add value to the existing investment in ECEC by boosting the quality of the instructional support provided to children. The assessment process is not yet responsive enough to work effectively as a continuous quality improvement framework.

The slow progress on assessing services under the NQS (let alone reassessing) is a lost opportunity to accelerate the quality of early education in Australia.

Quality in instructional support involves “intentional teaching approaches in a play-based learning environment. It is about how teachers use discussions and activities to promote thinking skills, encourage children’s language and extend learning through responses to children’s ideas”.

E4KIDS

A skilled and supported workforce

There are persistent workforce challenges, especially around attracting and retaining highly qualified staff in a context of inequitable pay and conditions, which impact Australia's ability to accelerate the provision of high-quality early education for all children (PC, 2011). Continuing to strengthen children's exposure to enriched learning environments, in which intentional teaching is embedded in everyday interactions and play-based activities, requires a workforce with a strong grounding in child development and skills in pedagogical practice.

Early childhood teachers can play an important role in developing a learning-rich program for all children, and in building the skills and knowledge of other educators. Attraction and retention of early childhood teachers is often limited by:

- The difference in remuneration, professional support and occupational status between early years settings (including long daycare) and primary schools.
- The availability of professional learning, community of practice and career development opportunities, especially around the role of early childhood teachers in shaping the educational program of centres.
- Community understanding of the nature and impact of learning in the early years and recognition of the professional skill and role of early childhood teachers.
- Difficulties in hiring highly qualified staff in some regional and remote areas or in some disadvantaged communities.

Given the importance of quality in early education, there is a clear role for government in facilitating workforce development.

The shift towards professional registration of early childhood teachers by state-based regulatory bodies is a positive one, reflecting Productivity Commission recommendations (2011, p. 268). However, broader strategies will be needed to build widespread recognition of the importance of learning in the early years, and it is clear that market-based mechanisms alone are not adequate for addressing discrepancies in pay and conditions and creating incentives to attract early childhood teachers to hard-to-staff locations.

Similarly, the lack of professional wages and the difficulty of accessing professional learning are consistently identified as issues for educators with certificate and diploma-level qualifications. The Productivity Commission identified the limitations of the market in driving improved remuneration and the challenge of sharing costs for the increase in qualifications under the NQS between government, services and families.

Government-funded initiatives to meet the increased demand for training driven by the NQS (such as reductions in Vocational Education and Training (VET) fees and the creation of additional university places) appear to have had some success, but limitations on the number of places available and partial subsidies not covering the full cost of training limit the potential impact of these strategies.⁹ In order to ramp up quality standards across the system and for all children, consideration should be given to strategies that have proven effective, such as:

- Investing in evidence-based professional learning approaches such as observational approaches, coaching and mentoring, including for centre managers (Jensen et al, 2016; Pianta et al, 2008; Pianta et al, 2014; Powell et al, 2012; Downer, Kraft-Sayle and Pianta, 2009; Pleschová and McAlpine, 2015; Walter and Briggs, 2012).¹⁰
- The types of resources, tools and data systems that support continuous quality improvement approaches in other sectors (Shortell et al, 1995; Reed and Card, 2015; Schierhout et al, 2013).

⁹ Work by the Mitchell Institute has demonstrated that VET fee-relief has a more substantial impact on decisions to accessing training or upskill than HECS discounts because VET fees are paid up-front. Consideration needs to be given to extending income-contingent loans across the entire tertiary sector (Noonan and Pilcher, 2015).

¹⁰ A robust evaluation of the Inclusion and Professional Support Program and scale-up of effective elements is also warranted, especially as the format and funding for the program changes in mid-2016.

- Incentivising partnerships and ongoing collaboration between innovative providers of early education and researchers.
- Scaling up incentives and pathways to increase the qualifications of workers and support for them to work in difficult-to-fill positions – including scholarships, reduced HECS, qualification funds, professional registration of early childhood teachers and other strategies outlined in the National Early Childhood Workforce Strategy implementation plans deemed effective (Productivity Commission, 2011).
- Cluster management approaches that facilitate professional learning, communities of practice and the dissemination and scale up of effective practice.

The current policy environment

Three years after the establishment of the NQF, the Productivity Commission was asked to review ECEC evidence, policy and funding – with a focus on:

- the contribution ECEC makes to increased workforce participation and child development;
- current and future need for ECEC in Australia;
- potential models for implementation and/or scale-up in Australia;
- options for enhancing how Australian families receive support for ECEC; and
- benefits and impacts of the NQS and options for change (within the existing funding envelope).

The Productivity Commission's report acknowledged the funding pressures that restrict access to ECEC, especially for low-income families, as well as recognising the benefit of high-quality preschool. However, the Commission's draft report raised a number of issues of concern:

- An overarching focus on parental workforce participation rather than a prioritisation of child development and wellbeing.
- Suggestions that the structural quality standards in the NQS could be reduced, including lower ratios and less frequent assessment, in order to reduce costs.
- Proposing a division between 'education' (for 3-5yr olds) and 'care' (for 0-3yr olds), including reducing the qualifications needed for working with 0-3yr olds (ECA, 2015; ARACY, 2015; Goodstart, 2015; Degotardi and Cheeseman, 2015, SNAICC, 2015).

The final report stepped back from the initial suggestions around lowering NQS thresholds and the education/care division, but beyond addressing affordability (and payment complexity) issues, the Commission's report appeared to question many of the advances made through the 2012 reforms and did not outline a strong vision for progressing ECEC policy in Australia.

The groundswell of support for the NQF from the sector resulted in an early announcement from the Australian Government that it would be retained. However, subsequent proposed legislation in relation to childcare subsidies (the Jobs for Families Child Care Package) contains several problematic elements:

- Tying children's access to subsidised childcare to their parents' workforce participation status, meaning that many children likely to benefit most from early education are likely to have reduced hours or no access to subsidies if accessing long daycare.
- In particular, children from low-income families have had their hours subsidy reduced, and families in insecure or seasonal work may also experience changes in their access to subsidy. Australian National University (ANU) modelling indicates that 149,000 families are likely to be affected by the activity test, most of whom have both parents working less than eight hours per fortnight (Phillips, 2016, p. 7).

- Complexities around sustained, streamlined and adequate access to ECEC for children deemed ‘at risk’, especially the determination that these children will need to be involved with their state or territory child protection system to qualify for assistance, the narrow definition of vulnerability and the reduction of the entitlement for vulnerable children from 24 hours of subsidised care per week to 12 hours per week.
- Changes in block funding grants that are likely to reduce access for Aboriginal and Torres Strait Islander families (SNAICC, 2015).

The Jobs for Families package aims to inject an additional \$3.2 billion into the sector, targeted at lower and middle-income families, but largely fails to:

- set a clear agenda and vision for the future of early education and children’s learning and development for Australia;
- resolve the muddy landscape around funding, fees and access; and
- target investment where it will have the biggest impact – children from disadvantaged backgrounds.

Given the potential impact of early education, a strong and evidence-informed vision for the future is essential for keeping Australia on the front foot.

In conclusion

Establishing a national early years curriculum and a consistent national approach to articulating and monitoring quality were considerable achievements for Australia. They provide a strong foundation that can be built on.

Although significant progress has been made, Australia does not yet provide universal access to high-quality early education for all children. Access and quality are still skewed by a family’s socio-economic status, meaning that the children who need the most assistance are the least likely to receive it.

A substantial proportion of services are yet to meet the base-level quality standards established by the NQF, resulting in highly variable levels of quality across the country. Of most concern is the difficulty many services experience in meeting the crucial standards around the delivery of an educative program.

There is a clear need for a focused strategy to ensure all services meet the NQS and to accelerate assessment processes to proactively drive an increase in quality across the system.

This analysis of the current state of policy and delivery provides the rationale for the recommendations made in this report around:

- Ensuring access to early education for all children, including systemic implementation of evidence-based strategies for attracting and retaining the families who currently experience significant barriers to access.
- Ensuring all children receive high-quality early education with the ‘dose and intensity’ necessary to make a difference, and
- Investment that is proportionate to impact, including the investments necessary to achieve equitable outcomes for disadvantaged children and the ability to measure that impact.

■ How Australia's children are tracking

Authors of the Mitchell Institute's landmark report, 'Educational Opportunities', concluded that, "Australia's education system is not working well for the most disadvantaged young people" (Lamb et al, 2015). There is a cohort of children who arrive at school developmentally vulnerable and never catch up to their peers.

Lamb et al contend that the disparity in outcomes for these children is compounded by differences in access to educational services: they attend fewer hours of early education, have lower attendance at school, are more likely to leave school early and are less likely to go to university or vocational education and training.

The education system clearly struggles to reduce the impact of early disadvantage on educational outcomes and appears to be maintaining rather than reducing inequality. Early education can play an important role in reducing the socio-economic gradient evident when children arrive at school. This section reviews recent data on participation in early education and children's outcomes.

Participation in ECEC services (0-5 year olds)

Overall more children are entering early childhood education. However, recent Productivity Commission data (2016) shows that some cohorts of children are clearly under-represented (Figure 1.3):

- Forty-three per cent of children aged under 5 attend ECEC services, up from 34 per cent in 2006.
- Aboriginal and Torres Strait Islander children make up 5.5 per cent of the of all 0-5 year olds, but only 2.2 per cent of ECEC participants.
- Children with a disability make up 4 per cent of 0-5 year olds, but only 2.9 per cent of ECEC participants.
- Children from regional areas make up 26.3 per cent of the population, but only 23.7 per cent of ECEC participants (declining from 25.2 per cent in 2013).
- Participation of children from culturally and linguistically diverse (CALD) backgrounds increased between 2010 and 2013 from 13.7 per cent to 17.3 per cent.
- While they make up 20 per cent of the population, only 11.1 per cent of children from CALD backgrounds are participating in preschool.
- Disadvantaged children make up 19.5 per cent of the community, but only 17.6 per cent of children attending preschool in the year before full-time schooling.

Participation in preschool (4-5 year olds)

The National Partnership Agreement (NPA) on Universal Access to Early Childhood Education aims to ensure that "all children have access to a quality early childhood education program in the year before they go to full time school" (COAG, 2013). Quality is measured by the inclusion of the service in the NQS, regardless of the

assessment the service receives, and the program must be delivered by a four-year qualified teacher in a range of settings, including long daycare, government or community preschools or family day care.

The initial NPA set a target of 95 per cent enrolment by 2015, although it is important to note that these targets reflect enrolment and not attendance (COAG, 2013).¹¹ Attendance rates are lower than enrolment – by up to 6 per cent – and the proportion of children meeting the objective of 15 hours of attendance per week is lower still, especially for Aboriginal and Torres Strait Islander children (Figure 4).

Figure 4: Representation of 4-5 year old cohorts in preschool

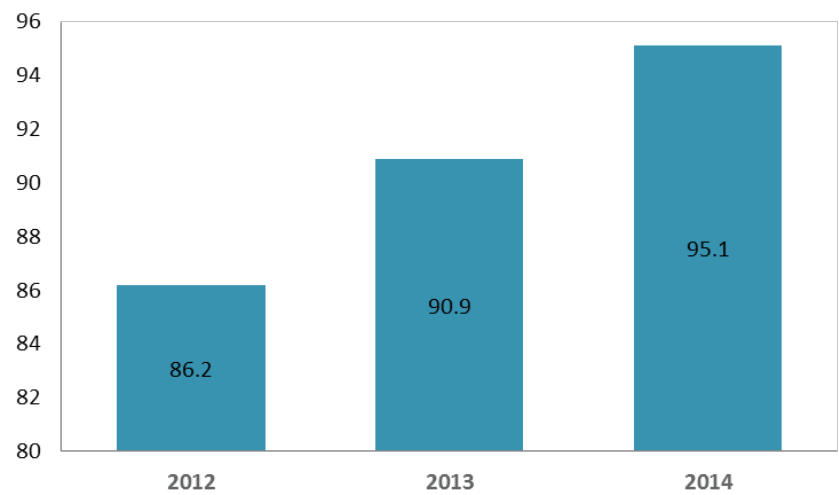


Source: Productivity Commission, 2016

Preschool participation among Australian 4 year olds has increased significantly over the past decade, and is now on par with OECD rates (Figure 5). In 2014, the most recent year for which comparable data is available, 95.1 per cent of Australian 4 year old children attended preschool in the year before full-time school, up from only 51 per cent in 2005.

¹¹ Current data systems do not allow an accurate assessment of how many hours children attend preschool. Measures for attendance vary across the country, with attendance information for some providers derived from the hours a service operates. Given the pivotal importance of early learning, greater transparency is crucial (see Appendix One for more detail). Shifting national targets from measuring enrolment to prioritising attendance for at least 15 hours per week (or equivalent) would also be an important advance.

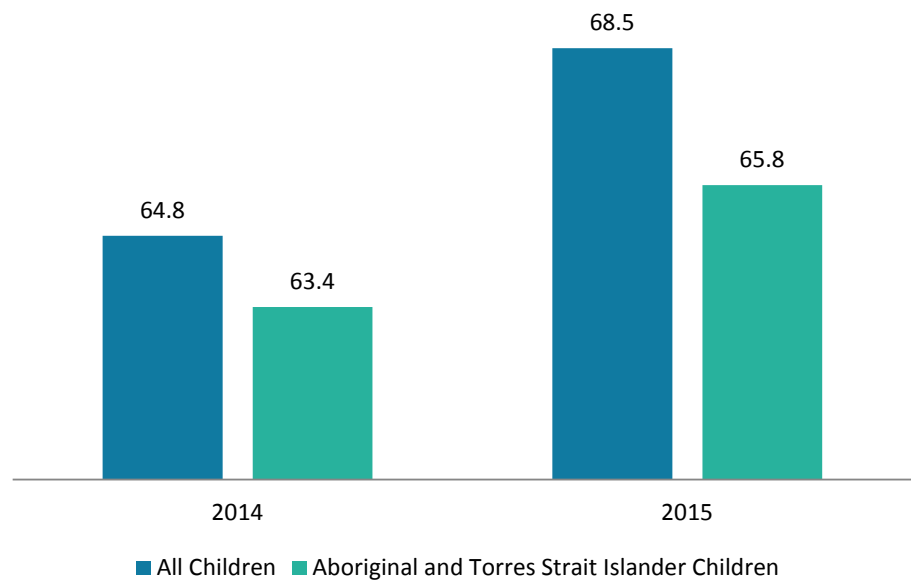
Figure 5: Percentage of children involved in preschool



Source: Productivity Commission, 2016

Whilst more than 57,000 children enrolled in preschool in the most disadvantaged areas, under 36,000 attended 15 hours or more of preschool (ABS Preschool Education 2015)¹² (Figure6).

Figure 6: Proportion of 4-5 year olds attending at least 15 hours of preschool per week



Source: ABS 2014 and 2015, Preschool Education, Australia.

¹² Figures on attendance may be inflated for children attending preschool at long daycare (see Appendix One).

On the whole, the NPA has been successful in increasing access and boosting participation in early education. However, Australia does not yet have universal access to quality early childhood education for all children in the year before school.

- While most children (86 per cent) are enrolled in preschool for 15 hours a week, a significant minority do not attend for this time, with participation skewed to higher socio-economic areas. More than a quarter of children – 80,000 out of nearly 300,000 – attend less than 15 hours per week (ABS, 2015).
- Children that are under-represented in preschool participation include: Aboriginal and Torres Strait Islander children, CALD children, children with a disability and children from low-income families (PC, 2015; CCCH, 2009).

Participation of Aboriginal and Torres Strait Islander children is below national averages, but their attendance rate in the year before school has increased to nearly 70 per cent. This is a welcome rise from 60 per cent in 2012, although the rate in 2014 was the same as in 2013 (Steering Committee for the Review of Government Service Provision, Table 3A.36).

This indicates the success of targeted funding and intergovernmental collaboration on their participation as part of the National Partnership Agreements. Interestingly, Aboriginal and Torres Strait Islander children are more likely to attend preschool in the year before school if they live in a remote area (nearly three in four children) compared to those living in a major city (65 per cent) (Steering Committee for the Review of Government Service Provision, Table 3A.35).

Australia is close to international norms on the attendance of 4 year olds in a preschool program, but significantly below OECD averages for the proportion of 3 year olds participating in early education. Three year olds, especially those from disadvantaged backgrounds, benefit significantly from earlier participation in early education. Earlier participation in early education also provides greater opportunities for early intervention in health, learning and wellbeing issues that can impact on children’s ability to succeed at school.

Australian Early Development Census

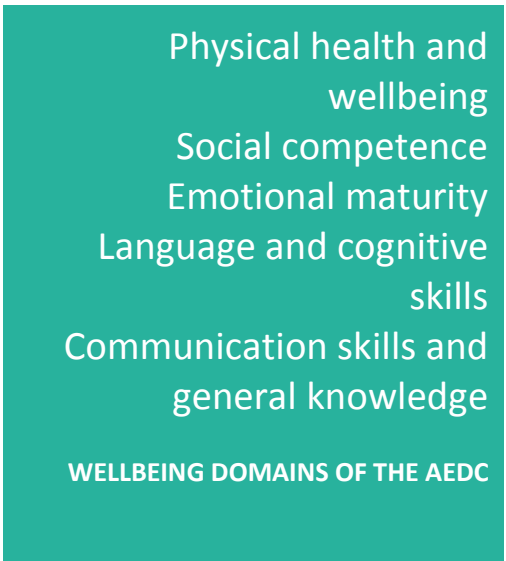
The Australian Early Development Census (AEDC) is a nationwide triennial, population-based census of children that measures how children are developing as they enter their first year of school, and indicates where further efforts are required. The AEDC is made up of five domains that have been shown to predict later wellbeing and academic success.

The AEDC reports whether children are on track, at risk or developmentally vulnerable, based on benchmarks developed in 2009:

- **Developmentally vulnerable:** scores ranked in the lowest 10 per cent;
- **Developmentally at risk:** scores ranked between 10 per cent and 25 per cent; and
- **Developmentally on track:** scores that ranked in the highest 75 per cent.

Overall progress on the AEDC has remained consistent since 2012 (Figure 7). Most children are tracking well but a significant minority are developmentally vulnerable.

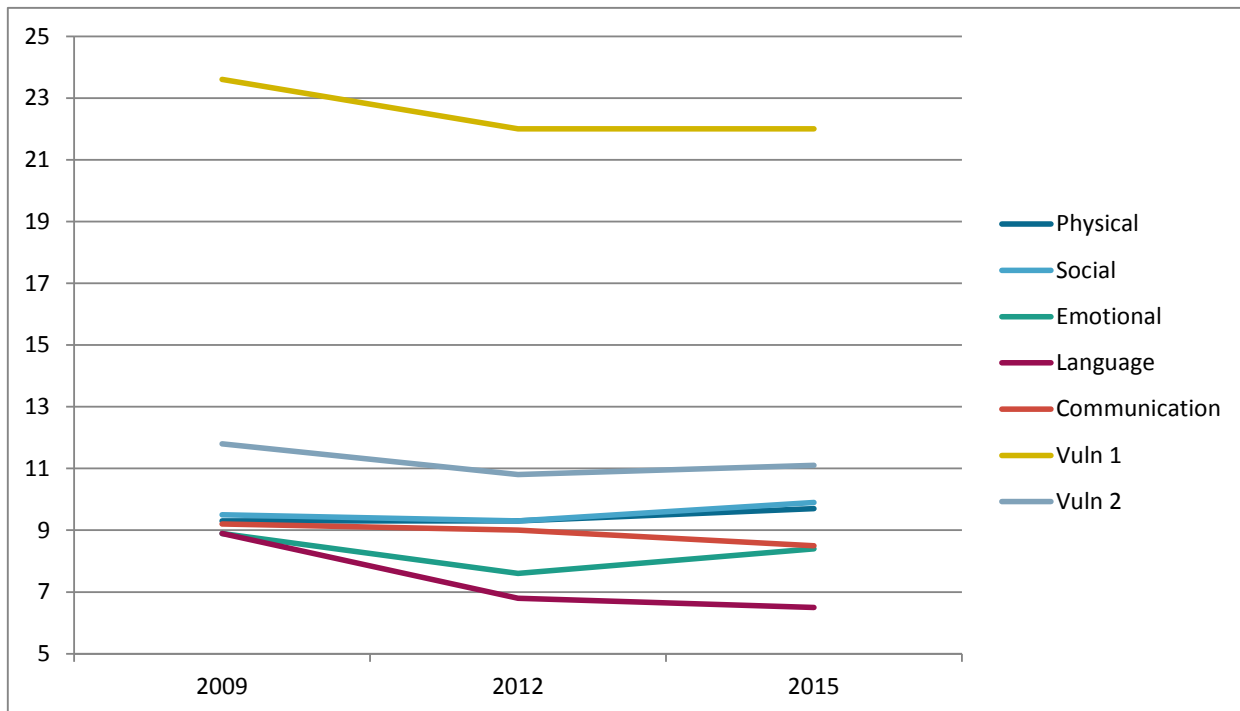
- In 2015 nearly four-in-five children (78.0 per cent) are not developmentally vulnerable in any domain. This



was the same as in 2012 and an improvement on 2009 (76.4 per cent).

- Twenty two per cent of children are developmentally vulnerable on one or more domain.
- 11.1 per cent are developmentally vulnerable on two or more domains.

Figure 7: Trends in rates of developmental vulnerability 2009-2015



Source: Australian Government, 2016

Although nearly 80 per cent of children are not developmentally vulnerable, there are highly variable patterns across the country (Table 4) and clear patterns of locational disadvantage (Vinson et al, 2015):

- Eighty per cent of children living in major cities are developing well, compared to just over half of children in very remote areas.
- Children living in the least socio-economically disadvantaged Australian communities are most likely to be on track on each of the AEDC domains.
- Under 16 per cent of children living in the least socio-economically disadvantaged Australian communities are developmentally vulnerable on one or more of the AEDC domain/s, compared with nearly 33 per cent of children in the most disadvantaged communities.
- Children from a language background other than English are more likely to be developmentally vulnerable, although their level of vulnerability reduces significantly if they are proficient in English.

Table 4: Developmental vulnerability by jurisdiction

	Physical	Social	Emotional	Language	Communi- cation	Vuln 1	Vuln 2
Australia	9.7	9.9	8.4	6.5	8.5	22	11.1
NSW	8.5	9.2	6.8	4.8	8.1	20.2	9.6
VIC	7.9	8.7	8	6.3	7.6	19.9	9.9
QLD	12.4	12.4	10.1	8	10.5	26.1	14
SA	10.8	10.8	9.7	6.8	8.2	23.5	12.2
WA	9.9	8.4	8.5	6.6	8	21.3	10.5
TAS	10	8.6	8.9	7.5	6.4	21	10.7
NT	15.9	18.5	15.5	21.5	16.2	37.2	23.1
ACT	10.9	9.4	8.2	5.9	7.7	22.5	10

Source: Australian Government, 2016

2015 data show most Aboriginal and Torres Strait Islander children are developing well and not considered developmentally vulnerable on each of the five AEDC developmental domains. But Aboriginal and Torres Strait Islander disadvantage remains a persistent concern with levels of Aboriginal and Torres Strait Islander childhood vulnerability around double that of non-Aboriginal and Torres Strait Islander children.

The influence of early education

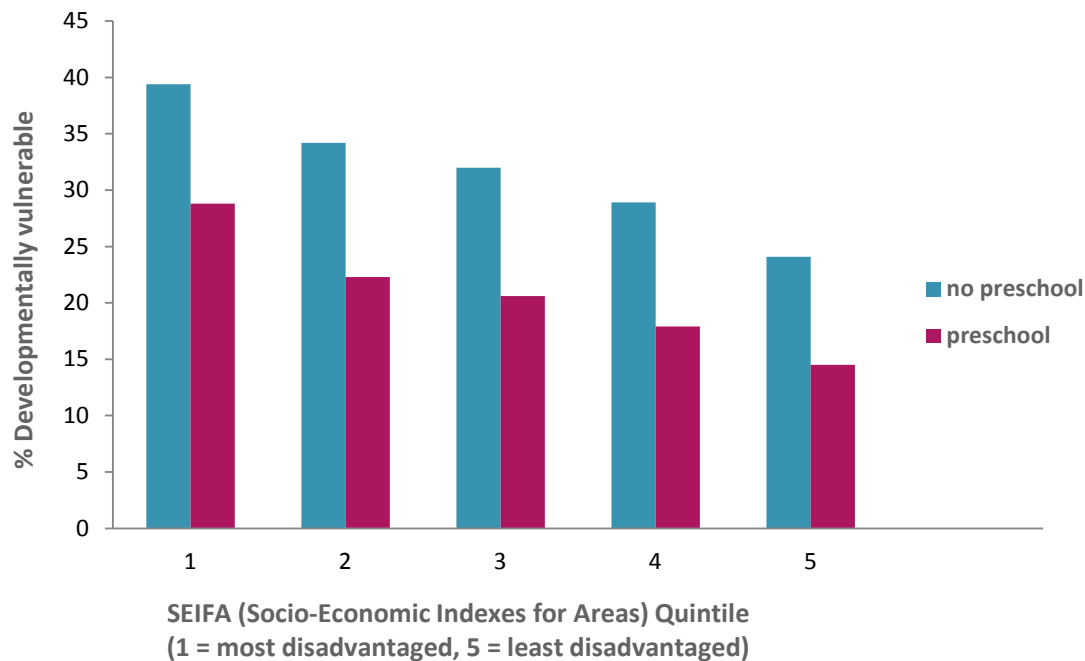
Children who attended preschool are less likely to be developmentally vulnerable across all five developmental domains assessed by the AEDC (Figure 8):¹³

- Preschool had a positive effect on children from both advantaged and disadvantaged communities, but there were still higher rates of vulnerability among children living in disadvantaged communities who attended preschool than children from advantaged communities who did not attend preschool.
- The highest rate of vulnerability was among children from disadvantaged communities who did not attend preschool.

Research highlights the importance of preschool attendance for promoting strong developmental outcomes and successful school transitions for all children. Accordingly, lower rates of preschool attendance by disadvantaged children may be contributing to early developmental vulnerabilities and inequities. Conversely, children from low socio economic areas who attend preschool and are not at risk on the AEDC transition continue to perform well at school, albeit not as well as children from higher socio-economic backgrounds who attend preschool.

¹³ However, this data should be interpreted with some caution as it reflects limitations in available data. Preschool, childcare and playgroup attendance data for the AEDC is collected through teacher report rather than systematic data collection and data linkage. For instance, around 70 per cent of teachers report not knowing about a child's playgroup attendance, although preschool data is more robust, given it plays a stronger role in school transition processes and teachers are more likely to be aware of children's participation.

Figure 8: Developmental vulnerability by preschool participation status



Source: CCCH and TICHR, 2009

Measuring change over time

A number of changes have been observed in the seven years the AEDC has been in operation.

Improvements in language, communication and knowledge:

- The percentage of children developmentally vulnerable in the language and cognitive skills (school-based) domain has fallen from 8.9 per cent to 6.5 per cent from 2009 to 2015.
- The percentage of children developmentally vulnerable on the communication skills and general knowledge domain fell from 9.2 per cent to 8.5 per cent from 2009 to 2015.

Decreases in social and emotional wellbeing and physical health:

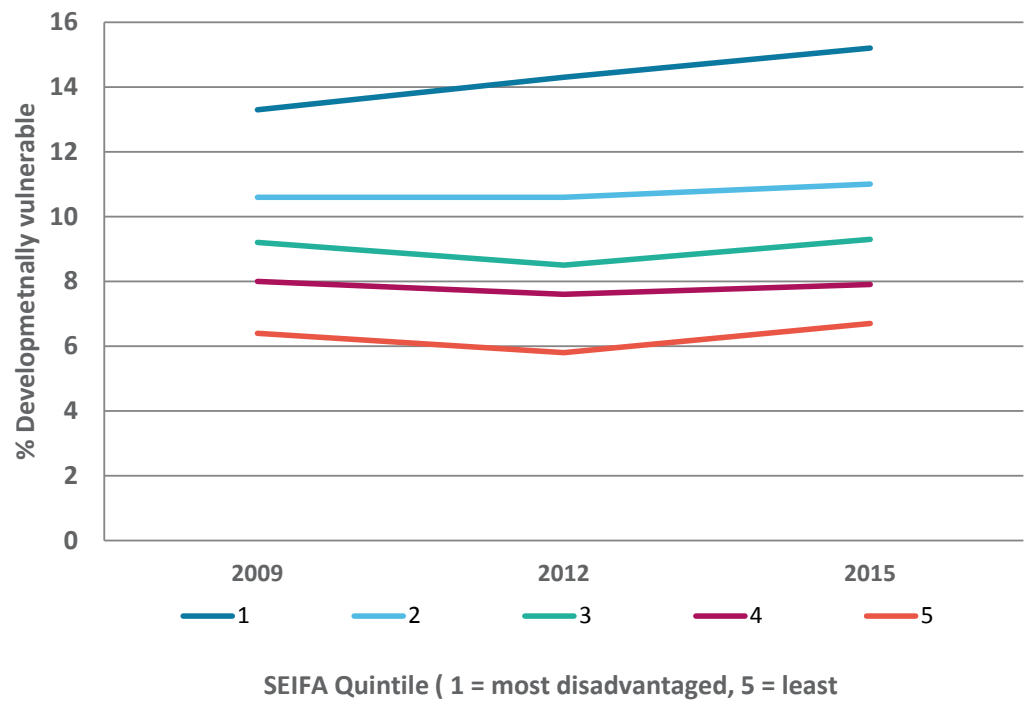
- Vulnerability in the physical health and wellbeing domain increased from 9.3 to 9.7 per cent from 2012–2015.
- Vulnerability on the social competence domain increased from 9.3 per cent in 2012 to 9.9 per cent on 2015.
- Vulnerability in emotional maturity increased from 7.6 per cent in 2012 to 8.4 per cent in 2015.

The improvement in the language and cognitive skills and communication skills and general knowledge domains is welcomed, the commensurate decrease in other domains is cause for concern.

There is a widening divide between the most and the least disadvantaged communities (Figure 9).

- Over 15 per cent of children in the most disadvantaged quintile are developmentally vulnerable, an increase from 13 per cent in 2009.
- Levels of developmental vulnerability in the least disadvantaged communities are just over 6 per cent.

Figure 9: AEDC % Developmentally vulnerable by SEIFA quintile

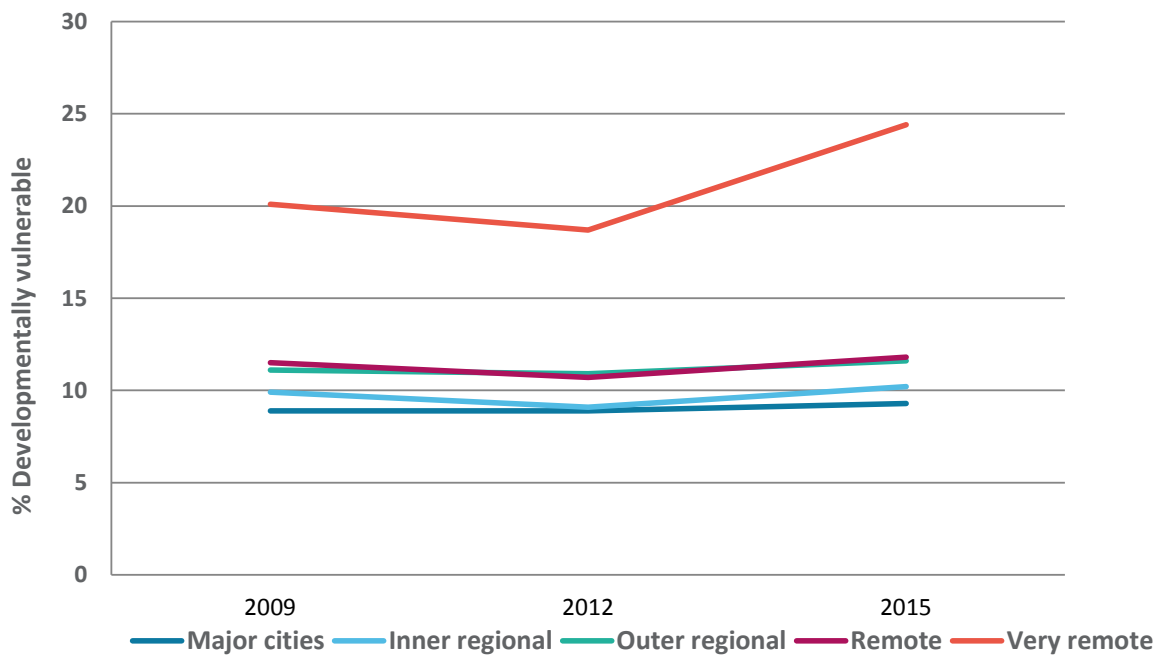


Source: AEDC, 2009, 2013, 2015

Similarly, levels of developmental vulnerability have increased for very remote communities far more than in major cities (Figure 10). Between 2009 and 2015 developmental vulnerability increased from 8.6 per cent in 2009 to 8.9 per cent in major cities, but increased from 21.8 to 23.4 per cent in very remote communities.

If the gap between the most advantaged and least advantaged continues to grow, the personal and social costs will be significant.

Figure 10: AEDC % Developmentally vulnerable by social competence domain



Source: CCCH and TICHR, 2009; Australian Government 2013, 2015

Downstream impacts

A number of studies have found substantial evidence relating to the sustained impacts of early education and intervention on later adolescent outcomes. For example, Manning, Homel and Smith (2009) undertook a meta-analysis of early years programs targeting vulnerable children aged 0-5 years, including preschool programs. Significant effects were found in a number of key outcome areas, including educational success, cognitive development, reduced involvement in criminal justice and improved social and emotional development. Overall, there was a 61 per cent difference between intervention and control groups.

Participation in high-quality early education boosts children's readiness to learn, their social and emotional development, and can support positive transitions into primary schooling. It is a key strategy for supporting children's opportunities for early educational success, and therefore for initiating and sustaining their engagement in learning, positive relationships with peers, and sense of belonging at school. These are key factors for retaining young people in education (Burns et al, 2008).

Other protective factors for supporting young people's engagement in education include high levels of wellbeing, high literacy and numeracy skills and early school achievement (Burns et al, 2008). Parental engagement in education is a protective factor for children and young people in all age groups (Fox and Olsen, 2015). Early education helps to set the foundation for the development of these vital capabilities and later engagement and success in schooling.

In addition to school-based and structural factors, student disengagement is associated with disrupted education, poverty, lack of positive relationships with peers and adults, alcohol and drug use, having a disability or mental health issues and offending behaviours (Burns et al, 2008, Deloitte Access Economics, 2012). This is highlighted in

a recent evaluation of an education justice initiative in Victoria, which found that nearly 40 per cent of youth justice clients aged 12-16 years were not involved in any education. Those who were involved attended infrequently (Te Riele and Rosauer, 2015). Quality early education helps build the social and emotional skills that act as key protective factors for preventing early disengagement (Fox et al, 2015).

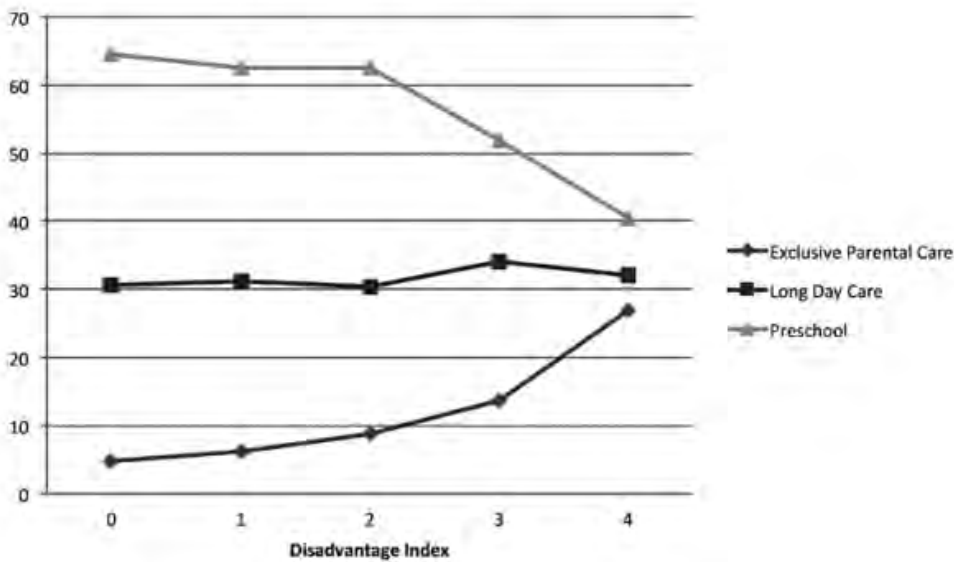
The Business Council of Australia estimates that GDP would increase by \$1.8 billion over 20 years if school completion rates increased from 80 per cent to 90 per cent, with a rate of return on investment of 8-10 per cent. Currently, around 21 per cent of young people leave school early (Deloitte Access Economics, 2012). While this may yield short-term savings to governments the economic and social benefits of school completion are far greater (Te Riele, 2013). School completion is an important indicator as it predicts the longer-term employment and life prospects for young people.

Supporting increased participation

Families who are less likely to be participating in ECEC services are most often represented among disadvantage groups.¹⁴ Wong et al (2014) found that children with multiple indicators of disadvantage were more likely to be in exclusive parental care, with rates of preschool attendance declining as levels of disadvantage increased (Figure 11).

Figure 11: Use of early education services by level of disadvantage

Figure 1. Percentage utilisation of ECEC by Disadvantage Index



Source: Wong et al, 2014

Disadvantaged families often experience concurrent barriers to participating in and accessing early education (Carbone et al, 2004; CCCH, 2009; Baxter and Hand, 2013; Grace and Bowes, 2010). Families consistently highlight a number of structural and contextual factors that impact the decision to participate in early education services:

¹⁴ This includes families from low socio-economic backgrounds, single-parent families, young parent families, Aboriginal and Torres Strait Islander families, some CALD communities, families living in remote communities, families experiencing issues with housing, domestic violence or who have had contact with Child Protection, and families with a child or parent who has a disability or mental health issues (Carbone et al, 2004; Centre for Community Child Health, 2009; Baxter and Hand, 2013).

- parents' preferences and beliefs about the value of early education and about child development;
- access and availability, including cost, operating hours, location (remoteness and living in disadvantaged communities) and lack of private and public transport;
- services not meeting need;
- poor coordination between services;
- limited access to specialist supports for children with additional needs;
- lack of publicity about services;
- complex paper work and enrolment processes; and
- lack of trust in services and fear of judgemental attitudes/behaviours (Cabone et al, 2004; CCCH, 2009; Baxter and Hand, 2013).

Beliefs about the importance of early education appear to be a core driver of parental decisions about enrolling children in ECEC. As part of LSAC, parents of 4-5 year old children who were expected to start full-time school the following year but were not enrolled in ECEC were asked why they did not use services. The most common responses were that parents were available and preschool was therefore not needed (20 per cent) or that the child did not need it (19 per cent) (AIFS, 2013). These findings are echoed in another study of 101 disadvantaged families, where 20 per cent of respondents reported that they chose not to participate in ECEC, despite initiatives to extend hours or provide transport, due to a belief: in the role of mothers as full-time carers of children; that ECEC does not provide valuable education and/or that education begins when children start school (Grace and Bowes, 2010).

National and international research has identified a number of best-practice approaches for engaging and retaining vulnerable families in ECEC:

- strength- based approaches;
- solution-focused approaches;
- family-centred practice;
- culturally responsive and culturally safe delivery;
- relationship-based practice; and
- accessible and family-friendly environments (CCCH, 2009).

There are a number of examples of excellent practice in Australia, and increasingly, these initiatives are supported by high-quality evaluations. This growing evidence-base must be used to drive scale-up across the system – changes in outcomes at a population-level will only be achieved through systemic changes of quality provision, not simply by pockets of excellence.

Examples of promising practice are provided in Boxes 1-5.

Box 1: The Home Interaction Program for Parents and Youngsters (HIPPY)

- Home-based early education and parenting program aiming to build parents' capacity and skills to create a positive home learning environment to prepare for their child's schooling.
- Currently operates in 100 Australian communities with a high proportion of families experiencing disadvantage and supports approximately 4,000 children annually.
- The program is voluntary, free and aligns with the AEDC domains and the Australian Early Years Learning Framework. It is funded by the Australian Government.
- Over two years parents are supported to undertake educational activities with their child for around 10-15 minutes every day, including playing and reading together. They also participate in parent meetings and social gatherings.
- A tertiary qualified coordinator works with around 50 families in each location and a team of home tutors each work with 10-15 families. The tutors are paid, receive training and support and participate in the program with their own child.
- Sites are encouraged to set up or join an existing local advisory group with representation from key partners in their community, such as schools and government agencies.
- An evaluation in 2011 found that the program has positive impacts across a number of child and family domains, is meeting a significant need and is cost-effective when compared with other programs in Australia and overseas – for every dollar spent the return on investment is up to \$2.53.
- The program is a promising approach for engaging Aboriginal and Torres Strait Islander families (Liddell et al, 2011).

Box 2: Western Australia – Child and Parent Centres (CPCs)

- There are 21 CPCs in WA, operated by non-government organisations and established in parts of the state with a high proportion of children who are developmentally vulnerable.
- WA Government has invested \$52.5 million over 2013 to 2017.
- Hub model – located on or near public schools and provides support to families with young children up to 8 years of age (mainly targeting 0-4). Services available to all in the community and surrounding areas.
- CPCs design and implement sustainable strategies/interventions to improve developmental outcomes for children in their relevant locality, working closely with their local community to target effort where it is needed.
- The overall aim is to reduce levels of child vulnerability, across all domains of the AEDC, and improve children's transition into school.
- A coordinator is employed to work with the local community, parents and schools.
- The latest AEDC results for WA showed that 21 per cent of children were developmentally vulnerable in 2015 compared to 25 per cent in 2009 – WA results were also better than the national average (22 per cent) for the first time (Australian Government, 2015; Government of Western Australia, 2016).

Box 3: National Community Hubs program

- Community Hubs (42 altogether, based in QLD, NSW and VIC) work with women and preschool-aged children from migrant/refugee backgrounds, located in areas with a high

proportion of disadvantaged families.

- Key components of the model: school-based approach (where services, schools and the community work together); amplifying reach and impact through service networking; and resourcing to support program delivery (Press et al, 2015).
- Services open to all families in the relevant area and may include supported playgroups, parenting and family support programs, English classes, as well as linking families to other services like child and family health.
- Funded by the Australian Government, in partnership with Community Hubs Australia and the Scanlon Foundation.
- Place-based, community-engagement approach, engaging families in a safe and accessible environment in their own neighbourhood – usually a primary school or community space.
- Builds on tested model in Victoria (Hume Early Years Community Hubs program), where child development/readiness for school scores increased for children aged 4-5 years.
- Future vision to expand to 100 locations nationally. Currently piloting an Outcomes Evaluation Framework in sample hubs in Melbourne and Sydney (Community Hubs, 2016).

Box 4: The Let's Count Program

- Early mathematics program for children aged 3-5 years – primarily aims to support children from disadvantaged backgrounds to develop appropriate maths knowledge and skills in the lead up to school.
- Based on the premise that when educators and families have positive dispositions towards maths, the children in their care are also more likely to have positive experiences.
- Approach underpinned by strong partnerships between early childhood educators and families and use of play, discussion and investigation.
- Addresses research showing the importance of numeracy for future success, and that disadvantaged children are more likely to have difficulty with numbers, shapes and time concepts.
- Piloted in five disadvantaged locations in 2011. Four-year partnership to expand program valued at \$1.6 million.
- Over 2011-15 the program reached 8,500 children, 4,500 parents and more than 300 educators across more than 17 Australian communities.
- Three year evaluation showed the program increases children's maths skills – for example, while only 17 per cent of children could rote count to 20 before the program, 55 per cent of participating children successfully completed this task by the end of the program, compared with 37 per cent who did not participate; 61 per cent of participating children could successfully divide four teddies between four mats, compared with 31 per cent (The Smith Family, 2015).

Box 5: Supporting the transition into schooling

- Following the 2009 AEDC results, Mahogany Rise Primary School set an ambitious goal to improve outcomes for children commencing schooling, particularly in the areas of language and communication.
- The school is located in a Victorian community with a high proportion of families from low socio-economic backgrounds. The community has high levels of child vulnerability across all domains in comparison with state and national averages.
- Using the AEDC as an early education tool, the school worked with local learning centres to

identify priority areas, plan for and implement interventions, and track progress.

- An Oral Language Program was subsequently introduced in the school and learning centres, allowing children's language development to be tracked well before they transition into schooling.
- A Child and Family Centre, co-located with the primary school, offers preschool and integrated parenting and family services. In addition, the school offers alternative educational options for students with additional social and emotional needs.
- A local Early Years Network was also established to address the high rates of child vulnerability in the area. Members work together to develop coordinated responses and include local schools, preschools, childcare providers and government agencies.
- As part of the network's efforts, speech therapists from local schools started visiting local preschools, and teachers from Mahogany Rise visited local preschools for four hours each week to help build preschoolers' phonic awareness skills.
- Since 2009 substantial improvements in AEDC results have been achieved. Levels of child vulnerability have improved overall, with around 41 per cent of children vulnerable on one or more domains in 2015 compared with 70 per cent in 2009. Furthermore, vulnerability in the communication domain has significantly decreased, with around 15 per cent of children vulnerable in 2015 compared with 46 per cent in 2009 (AEDC, 2016).

Working with the community

A key feature of the delivery models that appear to be more effective at engaging and retaining children and families experiencing barriers to access, is the capacity of centres to be linked in with their communities – both with other services and organisations including schools, and with the members of the community itself.

With the right support and resourcing early education services are well-placed to:

- identify early any learning or health issues a child might be experiencing;
- provide information to families on parenting strategies and ways to support children's learning at home;
- build supportive relationships with families that might be disengaged from other services; and
- help link families to other services when they need additional support.

Given that children and families from across the socio-economic spectrum can experience vulnerability, this is a role that all early education services can and should play. However, investing in building relationships with families and participating place-based/integrated service delivery initiatives is especially important for early education services in disadvantaged communities.

A number of governments in Australia and internationally are investing in integrated service hubs for children and families, most of which include early education alongside a range of other services, as well as place-based approaches to funding, governance and commissioning. The Australian evidence-base about the conditions that support the effectiveness of these initiatives is growing (Taylor et al, 2015; Department of Education and Employment, 2013).

The impact of early education will be strengthened when connections between health, parenting support, early intervention, ECEC and schools are systematised, sustained and seamless.

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Transition to School

A collaborative relationship between early years settings and schools is one of the most important for promoting children's learning and wellbeing. A positive start to school sets children up to be engaged and confident learners: schools have a role to play in reaching out to families early.

Research on effective transitions highlights the importance of continuity between settings, including continuity of pedagogical approach, and the impact of coordination and relationship-building between early education providers, schools and families (Dockett and Perry, 2015; Eastman et al, 2012).

Although state and territory governments have implemented a number of initiatives to improve transition practice in Australia, it is clear that these have not necessarily been systematised and sustained so that all children benefit from a coordinated and evidence-informed approach to transition (CESE, 2015). Regulatory and industrial barriers to collaboration and coordinated approaches remain.

Given that around 60,000 children arrive at school each year experiencing developmental vulnerability – many of whom never catch up to their peers – there is a compelling rationale for more comprehensive and individualised approach to transition, so that schools can be ready for the children and communities they serve.

Research on transition initiatives in Australia highlights the importance of a whole-of-system approach to building and maintaining the relationships that facilitate effective transition. This includes:

- enabling policy frameworks that create an authorising environment, defining transition as a core responsibility for schools and early education settings, and support action;
- adequate support and resourcing for relationships and collaboration on the ground;¹⁵
- tools and resources, such as transition statements, coupled with training and support to use them well;¹⁶ and
- engaging with families and delivering programs that build the capacity of families to support their children's learning.¹⁷

“More than any other element of transition, relationships between and among children, families and educators are the basis for continuity between home, prior-to-school, school and school age care settings”

DOCKETT AND PERRY, 2007

¹⁵ Evaluation of Victoria's Linking Schools and Early Years project highlighted the impact of a local facilitator responsible for forging relationships and maintaining momentum on the ground, as well as concerns about sustainability without this support (Eastman et al, 2012; Newton and valentine, 2013).

¹⁶ New South Wales's evaluation of transition statements found teachers reported being better informed about the strengths, interests and learning styles of their students and better able to respond to the learning needs of their class (CESE, 2015). However, uptake of the transition statements was low, especially in regions where it was not actively promoted and supported, where 76 per cent of respondents had heard of the statements but only 26 per cent had used them (CESE, 2015).

¹⁷ Tasmania's Launching into Learning program provides resources to schools to work with families to support children's early learning prior to their entry into school. The program resulted in significantly improved outcomes for participating children at entry into school, with the greatest impact experienced by children from disadvantaged backgrounds and improvements that are sustained in Year 3 NAPLAN results (Educational Performance Services, 2014).

A more systematised approach to connecting early education settings and primary schools is needed, so that supported and effective transitions are the norm for all children.

In conclusion

Despite the rapid expansion in provision, access and funding for ECEC in the past decade, and a raft of good local practice, there are cohorts of children who are either not accessing a preschool education, or who are not accessing the hours needed to make difference to them.

There are cohorts of children and numerous communities that continue to exhibit poorer outcomes on the AEDC: levels of developmental vulnerability have remained relatively consistent for them since 2009.

Early education must be delivered in a way that, as far as possible, reduces barriers to access for the children who stand to benefit most. Shifting community perceptions about the importance of early education and delivery models that prioritise assertive outreach, engagement with families and cultural appropriateness is a priority.

Early education must also be delivered with a level of quality and an intensity that is proportionate to need, which will require additional investment in the communities that the AEDC shows need the greatest help.

Priorities for the next five years

Accelerating quality and access

Over the past decade, Australia has begun building the foundations of a strong and effective platform for early education, but there is more to be done. To reap the benefits of public investment in early education, the priorities are boosting access, ramping up quality, investment that reflects impact and better measurement of that impact.

This section provides a snapshot of key considerations and potential policy directions for accelerating access, quality and impact. The next section outlines the Mitchell Institute's immediate priority recommendations.

These strategies or approaches are happening already, the point is that they tend to be patchy and inconsistent rather than systematised and sustained.

Our pockets of good practice and instances of effective policy settings need to be scaled up across the system, supported by the information infrastructure that allows their effectiveness to be monitored.

Additional work is needed to map out the detail of each of these priority areas and key considerations, including funding options, governance and accountability mechanisms, implementation planning and data and evaluation needs.

The intention of this report is to inform priorities for action in the short and medium term.

Throughout 2016, the Mitchell Institute will be releasing additional papers on its priority recommendations and catalysing conversation about the priorities and strategies explored here.

Australia needs to accelerate

- Access to early learning for all children, including systemic implementation of evidence-based strategies for attracting and retaining the families who currently experience significant barriers to access
- The ability of all children receive high quality early learning with the 'dose and intensity' necessary to make a difference
- Investment that is proportionate to impact, including the investments necessary to achieve equitable outcomes for disadvantaged children

Early education is a core component of the platforms our nation invests in to secure the health, wellbeing and education of our children, to secure positive futures for them and for the country. We must ensure that all children can benefit from a quality early education.

Ensuring equitable access to early education for all children

Countries achieving the best early learning outcomes “... have established a right to ECEC. The guarantee of a place puts the onus on governments to ensure that services are available and accessible to all children” (Brennan and Adamson, 2014, p. 36)

Although their participation in early education has expanded significantly over the last decade, there are cohorts of children missing out and clear indications that many children are not accessing the optimum number of hours. The children who are least likely to experience early education are often those who could benefit most.¹⁸

Priorities for ensuring equitable access to early education for all children

- Reframing the perception that early education is less important than school education
- Embedding and resourcing family engagement, with a focus on:
 - developing relationships with families to attract and retain children in early education
 - building the capacity of families to be active partners in their children’s learning, and
 - active outreach for families not currently accessing early education
- Prioritising access to early education services in future planning and development

¹⁸ These include: children from low socio-economic backgrounds; Aboriginal and Torres Strait Islander children; children living outside major cities and towns; children from families experiencing issues with housing, domestic violence, mental health issues or who have had contact with child protection; and some culturally and linguistically diverse communities (Carbone, Fraser, Ramburuth and Nelms, 2004; CCCH, 2009; Baxter and Hand, 2013).

Perceptions of the benefit of early education for children is a key driver of family decision-making around enrolling children in preschool, and may explain low rates of attendance for 3 year old children. Similarly, lack of recognition about the importance of early learning – and the professional skill involved in fostering young children’s learning, social and emotional wellbeing and identity – contributes to the lower status of early childhood educators and, by extension, to workforce attraction and retention issues in the sector.

There are substantial differences between the way education experts and Australian families understand child development and early learning. In particular, while experts see early education as a critical site of development and learning, families often see ‘child care’ primarily as a place where children are looked after safely while they work or study (Kendall-Taylor and Lindland, 2013). There are also relatively low levels of community knowledge about child development and the important role families play in supporting their children’s learning and development in the years before school (ARACY, 2011).

Social marketing has been a core component of many effective Australian initiatives to promote changes in health and safety (ARACY, 2011; Kendall-Taylor and Lindland, 2013). In conjunction with other strategies (like regulatory changes, information provision, changes in service delivery), social marketing and strategic communication can have a significant impact on individual beliefs and community norms – leading to changes at a population-level.

Strategies for reframing early education include:

- Establishing access to preschool as a formal, legislated entitlement for all children in the year before school. This will require a firm and ongoing commitment to the National Partnership Agreement on Universal Access to remove uncertainty about funding sustainability.
- Extending Universal Access to 3 year olds and prioritising free access for disadvantaged 3 year olds.
- Encouraging continuity and alignment between early education and primary schooling, with a focus on enabling positive transitions, with a strong commitment to the early education sector’s developmentally-appropriate pedagogical approach (play-based, inquiry-focused, child-focused).
- Clear and consistent messaging from all levels of government about the importance of early education.
- Use of evidence-informed social marketing strategies to shift community beliefs about the importance of early childhood development and learning in the early years, with social marketing understood as “an approach used to develop activities aimed at changing or maintaining people’s behaviour for the benefit of individuals and society as a whole” (Hopwood and Merritt, 2011, p. 4).
- A focus on family engagement in learning from birth, including ongoing support and scale-up of evidence-based programs that strengthen family knowledge and skills around providing a strong home-learning environment.

Strategies for engaging families include:

- Building the capacity of services to engage and retain families in ECEC, including resourcing family engagement strategies, investing in localised strategies that target the cohort of families not utilising ECEC, and strengthening the cultural appropriateness of services.
- Increasing linkages (on-the-ground and in policy frameworks and governance arrangements) between child and family health, ECEC and primary schooling systems to encourage continuity, and supporting children and families to move through these systems.
- Reducing the red tape (regulatory, industrial and other systemic barriers) that inhibit more coordinated and collaborative approaches, especially around greater continuity between early education settings and primary schools.

- Utilising localised approaches that build capacity across regions and enable whole-of-community collaboration (like cluster management), and fostering the capacity of the ECEC sector to participate in place-based service delivery approaches.
- Prioritising accessibility to early education and strategies to facilitate co-location in planning processes, including systematising the co-location of key services such as child and family health, early education and care, schools and community services.¹⁹

Ensuring all children receive high-quality early education

“Policy and provision should strive to exceed standards and continuously improve the quality and coherence of children’s early experiences. Beyond these minimum standards defining and assuring quality should be participatory and democratic, involving different groups including children, parents, families and professionals who work with children” (OECD, 2001, p. 131).

Nearly half of all ECEC services are not yet meeting the NQS. Its Assessment and Rating process is not happening quickly enough to facilitate and drive continuous quality improvement. Ensuring that all services are, at a minimum, Meeting the NQS must be a priority.

This requires an ongoing commitment by government to supporting workforce development. A long-term strategy for addressing the issues around pay and conditions and access to professional learning is needed. This should look at strategies that have been effective in other sectors, like coaching and professional supervision, and consider linking professional development with place-based, collaboration strategies.

The quality standards established in the NQS meet the needs of most children, but some children require additional access and a broader package of supports to maximise their potential. Investing in higher-intensity programs in the communities with the greatest need provides the most promising opportunity to lower the socio-economic gradient evident upon entry into school.

Large-scale implementation of high-quality and high-intensity early education for all children who stand to benefit – not just in selected centres or in a handful of locations – reflects benefits of a proportionate universalism approach. It also indicates the fundamental limitation of many current social policy interventions in Australia: they are often only accessible to a tiny fraction of the children who need them, and therefore cannot shift outcomes at a population level.

The current evidence-base provides strong guidance about the features of high-quality intensive early education services, but it does not provide a silver bullet answer. Evaluated programs such as the Abecedarian approach,²⁰ promising models such as the Early Years Education Program²¹ (currently mid-way through a randomised controlled trial), and the broader literature on high-quality ECEC and attracting and retaining families in support services, establish a number of critical elements.

¹⁹ Early Childhood Australia note that “currently there is no national planning mechanism or agreement in place across the three levels of government (federal, state and local) to address this. The provision of ECEC is entirely dependent on market forces. ECEC is such an important service that families need and expect to be able to access that we believe there should be a national approach to planning and influencing service provision” (ECA, 2015, p. 44).

²⁰ Abecedarian is a research-based approach to early learning, with the Australian adaptation emphasising strategies around learning games, conversational reading and enhanced caregiving, with an overarching focus on language learning and emotional development (Sparling, 2015). US studies have found significant impacts on early development and long-term outcomes (Campbell et al, 2012)

²¹ The Early Years Education Program is a universal yet intensive model of early education and care, in which children receive at least 25 hours a week for 50 weeks of the year. The program involves “high staff-to-child ratios; qualified staff; attachment-focused and trauma-informed care; a child-centred curriculum based on the EYLF; integration with family support services; support from infant mental health professionals; and partnerships between educators and parents” (Fordham, 2015; Jordan et al, 2014).

These models tend to commence prior to age 3 and are characterised by greater attendance hours, high child-staff ratios, a strong learning focus with individualised curriculum approaches, connections with other services, and strong partnerships with families (Harrison, Metcalfe, Goldfeld and Moore, 2012).

As with all initiatives to scale-up evidence-based approaches, it is crucial to pay close attention to:

- implementing the elements of models that are the core of their impact and effectiveness, while tailoring them to local contexts and community priorities;
- building and sustaining workforce and system capacity;
- coaching, mentoring and the provision of quality and sustained professional development;
- working with Aboriginal and Torres Strait Islander communities to ensure cultural appropriateness;²² and
- ensuring mechanisms are in place to track whether the approaches are effective in lifting practice standards of educators and improving outcomes for children.

Priorities for accelerating provision of high-quality early education

- Ensuring all services currently not meeting the NQS are required and supported to meet the standard as a matter of urgency
- Ongoing commitment to the NQF to enable it to meet its potential as a quality improvement mechanism as well as a regulatory framework
- Resolving workforce issues that impact the ability of the sector to provide high-quality education and care
- Investing in higher-intensity and higher-quality programs for children who will benefit most from them

Strategies for strengthening quality include:

- Investing in capacity-building and faster assessment and reassessment to ensure all services are Meeting the NQS by mid-2017 at the latest.
- Increasing the pace of the Assessment and Rating process so that the NQF is better able to support continuous quality improvement.

²² Harrison et al (2012) indicate that “designing and implementing early learning programs for Indigenous children requires a process that goes beyond simply taking into account what has worked elsewhere. The process of implementation will need to consider all of the aspects that make Indigenous children, families and communities unique” (p. 10). SNAICC’s work on the implementation of the EYLF provides an extensive analysis of strategies that have been effective in engaging Aboriginal and Torres Strait Islander families in ECEC services (Mason-White, 2012).

- Scaling up evidence-based, high-intensity programs for the children most likely to benefit.
- Addressing workforce issues that impact the ability of the sector to ensure quality care, such as discrepancies in status and remuneration, through a long-term strategy to provide professional wages and access to professional learning.
- Reinforcing and continuing to embed the pedagogical approaches underpinning the EYLF so that all children receive developmentally-appropriate educational experiences.

Investment that is proportionate to impact

“Creating a stable research framework would help inform effective policy-making and raise the overall quality of ECEC. As in other areas of social and educational policy, the field is changing rapidly and there is a need for up-to-date research and evaluation information to strengthen the connections between research, policy, and practice” (OECD, 2001, p134).

Australia ranks well below the OECD average level of public investment in ECEC and has one of the largest shares of private funding. Given the potential of high-quality early education to impact learning and wellbeing outcomes, it warrants an investment that is proportionate to its impact. This requires both an increased investment, a clear and coherent strategy about where that investment can have the greatest impact, and the ability to measure and track the size and scale of the impact.

Priorities for investment and impact

- Building the data and evidence infrastructure needed to drive policy reform and maximise investment decisions, including:
 - Strengthening nationally consistent data
 - Leveraging the opportunities of data linkage to answer the more fine-grained questions about what works, for whom, and in what circumstances
 - A national research agenda to support identification and system-wide scale-up of evidence-based practice
 - Establishing an independent national body to collect, link, analyse and disseminate data and information on early childhood
- Lifting public investment in early education, with investment targeted to ensuring access to the highest quality ECEC for vulnerable families

Strategies for investment and impact include:

- A national early childhood data strategy that establishes the infrastructure needed to drive policy and practice improvement into the future.
- Establishing a jointly-funded and independent national organisation to collect, link, analyse and disseminate data, either as a standalone body or as a new responsibility of an existing organisation. This organisation would have the capacity to drive a national data linkage agenda and responsibility for disseminating data and analysis in ways that can be used on the ground, including to support local planning and commissioning.
- Improving access to quality linked data for planning, commissioning, research and evaluation purposes.
- Setting a long-term investment agenda for ECEC that progressively increases funding in the areas where ECEC can have the biggest impact.

Conclusion: Priority Recommendations

This report highlights a broad range of challenges and opportunities facing the provision of early education in Australia. The Mitchell Institute's five overarching recommendations reflect the evidence about which investments can have the greatest impact and a pragmatic approach to building on existing achievements.

Investment decisions are always difficult for governments, even more so in a tight and uncertain fiscal environment. Initiating and sustaining systemic change is complex and challenging work. There is no easy answer to transforming the provision of early education in Australia. These five recommendations address issues of access, equity, quality and data and should be considered key national objectives for the next five years.

More work is needed on what implementation could look like, including funding options, governance and accountability mechanisms, data and evaluation needs, as well as knowledge gaps and strategies needed to test, confirm, scale and systematise new approaches.

Priority recommendations

1. Establish affordable access to preschool as a legislated entitlement, make a permanent commitment to funding Universal Access for 4 year olds, and commence work on extending Universal Access to 3 year olds
2. Invest in scaling up evidence-based, high-intensity programs for the most vulnerable children, targeting the communities scoring in the bottom 10% in the AEDC in each state and territory
3. Ensure the NQF is achieving its objectives and is appropriately resourced to do so, and that all services are Meeting the NQS, at a minimum, by mid-2017
4. Deliver a national early childhood data strategy that establishes the information infrastructure needed to drive policy and practice improvement into the future
5. Commence a national campaign to strengthen family and community knowledge and beliefs about children's early learning

Recommendation 1: Universal Access

Establish affordable access to preschool as a legislated entitlement, make a permanent commitment to funding Universal Access for 4 year olds, and commence work on extending Universal Access to 3 year olds

Establishing preschool education as a legislated entitlement, equivalent in status and importance to primary and secondary schooling, both brings Australia into line with OECD peer nations (Brennan and Adamson, 2014) and consolidates and extends the significant achievements of the National Partnership on Universal Access to Early Childhood Education. Establishing preschool access as a legislated entitlement has the two-fold impact of:

- Shifting the discourse around early education to emphasise that preschool holds equivalent importance to primary and secondary school and is an entitlement that each 4 year old child holds in their own right (regardless of workforce participation status of their parents); and
- Establishing a requirement for governments to provide ongoing and sustainable funding for preschool.

Framing preschool education as an entitlement held by all Australian children and a firm commitment to ongoing and sustainable funding would address two of the key issues currently inhibiting access and quality.

This does not necessarily require significant new funding, as funding for universal access to preschool is already provided under the National Partnership Agreement on Universal Access (currently only agreed until 2017). A more permanent commitment is needed.

Commencing work on planning the extension of Universal Access to 3 year olds would bring Australia into line with international norms. A pathway that follows the successful approach of the current National Partnership Agreement would be appropriate – beginning with a range of jurisdiction-specific strategies to increase the total number of places available, measures to address workforce issues, setting nationally consistent minimum hours requirements, and developing funding approaches that prioritise free access for disadvantaged 3 year olds. Additionally, it will be necessary to develop resources and support for a developmentally-appropriate play-based learning program for 3 year olds and consider optimum models for delivery.

Recommendation 2: The highest quality for the children with the greatest need

Invest in scaling up evidence-based, high-intensity programs for the children most at risk of developmental vulnerability, targeting the communities scoring in the bottom 10% in the AEDC in each state and territory

The NQS is an extremely valuable and appropriate approach to establishing a common standard of quality, sufficient to meet the needs of most children, as the basis of a system-wide regulatory framework. However, it was not designed to provide the level of intensity and quality that research shows most developmentally vulnerable children need to reach their potential:

“In the typical programs and in the absence of no specific additional supports or interventions, our analyses support the finding that children with low baseline scores tend to remain below the level of ability expected for their age two years later” (Tayler, Cloney and Niklas, 2015, p. 58).

Current policy settings are not adequate for reducing the socio-economic gradient evident in AEDC data, or for reaping the potential benefits of public investments in ECEC for children experiencing developmental vulnerability.

The Mitchell Institute recommends the roll-out of an appropriate suite of evidence-based, high-intensity pedagogical and engagement practices, with the aim of lifting the quality of the learning environment and educative program across *all* existing early education settings in priority communities. Communities currently scoring in the lowest 10 per cent in the AEDC in each state and territory should be the initial priority.

The suite of practices may include widespread implementation of the evidence-based Abecedarian approach and/or wrap-around models that research indicates should involve greater attendance hours, high child-staff ratios, a strong learning focus with individualised learning plans, connections with other services – including health, family support, cultural workers, early intervention, mental health and other specialist services – and active outreach strategies combined with strategies to build strong partnerships with families.

This approach would dramatically accelerate the availability of high-quality early education for the children who need it most. This strategy must be universal, aiming to reach all 3-4 year old children within the target community, rather than continuing to meet only a fraction of the children who would benefit.

Recommendation 3: Quality early education for all children

Ensure the NQF is achieving its objectives and is appropriately resourced to do so, and that all services are Meeting the NQS, at a minimum, by mid-2017

All children must have access to quality early education opportunities and the NQF is a key strategy for achieving this.

Given that the NQS represents a minimum standard, it is essential that all services currently rated not meeting the NQS be required and supported to be on a rapid path to meeting the standard. This will require assessment of the 3905 services not yet assessed, more rapid re-assessment for the 3526 services now rated as Working Towards the standard and more frequent assessments across the board.

For the next scheduled review of the NQF, it is important to consider the extent to which the it is meeting its objectives, particularly:

- whether it is functioning adequately to support a continuous quality improvement approach;
- determining whether it is adequately resourced and sufficiently responsive;
- strategies to increase the proportion of services exceeding the standards and receiving an excellent rating; and
- the models of professional learning, local collaboration and cluster management that are most effective in lifting standards and supporting the provision of quality learning environments.

Recommendation 4: A national data strategy and coordinating agency

Deliver a national early childhood data strategy and coordinating agency that establishes the information infrastructure needed to drive policy and practice improvement into the future

The recent announcement of a Productivity Commission inquiry into the Education Evidence Base is a welcome opportunity to build the data and information infrastructure needed to make informed investment decisions into the future.

Investment in high-quality, systematic, outcomes-focused data collection will yield dividends for many years to come and should form the basis of a national early childhood data strategy. As the Grattan Institute note, targeting funding to where it is most needed relies on fine-grained data and linked datasets that track progress over time (Goss and Sonnerman, 2016).

There are four key issues for consideration in the development of a data strategy:

- **Administrative data:** considering how the quality and reach – and therefore impact – of existing administrative data can be strengthened. For example, generating more frequent and accurate enrolment

and attendance data; unit-level data tracking and linking hours of attendance, pattern of attendance and type of program or environment; and systematic collection of learning and wellbeing outcomes data to enable more comprehensive evaluation of the impact of practice and policy differences.

- **Data linkage:** pursuing opportunities for linking early childhood data to child and family health service data, the AEDC, NAPLAN and other government administrative data, including data held by the Australian Government Department of Human Services, such as families receiving Family Tax Benefit. This will enable much more rigorous and long-term tracking of the impact of investments in early education, especially the more useful and granular data that enables an assessment of ‘what works, for whom, and in what circumstances’.
- **Research:** a long-term research strategy would provide both direction and funding for crucial, policy-relevant research (Harrison et al, 2012; AIHW, 2015). Priorities include longitudinal data to track impact, rigorous (experimental) evaluation of high-intensity programs targeted at vulnerable children, implementation studies that track system-wide delivery and impact; and the ability to track population-level changes.
- **Data literacy and information dissemination:** concurrent investment in making research findings and data available, accessible and meaningful, to both policy-makers and early childhood practitioners, is crucial.

A national independent coordinating agency should be established to collect, link, analyse and disseminate data, with the capacity to drive a national data linkage agenda. This body could be established either as a standalone body or as a new responsibility of an existing organisation.

Recommendation 5: Recognising the importance of early education

Commence a national campaign to strengthen family and community knowledge and beliefs about children’s early learning

Building family and community knowledge about children’s learning in the early years – through a evidence-informed national social marketing campaign – will encourage greater family engagement in children’s learning and enhanced recognition of the importance of early education.

A campaign that makes the insights of the science of early childhood development accessible and available to families will promote positive home learning environments, while also contributing to boosting early education enrolment and attendance rates and the status of early childhood educators.

The campaign should highlight the importance of early education for amplifying children’s learning and development. It should be a long-term campaign, informed by strategic communication strategies and existing evidence on the elements of effective practice, including:

- using multiple media channels;
- delivery in partnership with the early childhood sector;
- building on existing programs, apps and resources (such as the NSW Health’s Love Talk Play Sing Read app, TheSmith Family’s Let’s Count program or the Parenting Research Centre’s smalltalk); and
- communication targeted at key cohorts, including translation into different languages.

Appendix One

The structure of the Early Childhood Education and Care sector

The early childhood sector is difficult to navigate, in part due to shared responsibilities across local, state and Commonwealth governments, and the private sector. These complexities, driven by different data collections and funding and fee regimes between levels of government and other entities, make it difficult to gain a comprehensive understanding of the ECEC sector.

All levels of government are involved in funding and governance of ECEC services. The key roles of each are:

- Local government funds some infrastructure, plans delivery and may deliver or coordinate service, including family daycare, occasional childcare and preschool.
- State and territory governments distribute funding to preschools under the National Partnership Agreement for Universal Access, often provide additional funding for disadvantaged cohorts, manage the regulators that conduct the Assessment and Rating process (usually a subsection of state education departments), provide support to approved providers of ECEC services and families using these services and deliver some services directly. For example, the Australian Capital Territory and South Australia directly provide preschool programs that are free of charge to families, whereas in Victoria, Queensland and New South Wales preschool programs are provided by external approved providers (including long daycare centres, Committees of Management composed of parent volunteers, or cluster managers).
- The Australian Government funds childcare subsidies and rebates (paid directly to families or to approved providers, such as childcare centres, who then charge families the gap between the fee and each family's rebate and childcare benefit subsidies), funds the National Partnership Agreements, and supports the implementation of the NQF, particularly through support for the national and independent agency the Australian Children's Education and Care Quality Authority.

Funding complexities

Funding for preschool is provided by state and territory government, supplemented by Commonwealth funding via the short-term National Partnership Agreements on Universal Access to Preschool, and to a lesser degree, payment of the child care benefit as a rebate on fees paid by families.

Each state and territory government has its own funding formulas. For example in New South Wales base funding for preschool programs begins at \$1850 per annum per child with loadings for support, based on a child's relative need and on service location. However, if the preschool program is delivered within in a childcare service setting a base fee of only \$300 is provided (NSW Department of Education and Training 2015). In contrast, preschool in Victoria (where it is known as kindergarten) is funded on the basis of per capita grants. The standard rate is \$3247 per annum with higher rates for rural areas, and much lower rates (\$546 - \$1716) for preschools provided by non-government schools. A fee subsidy of \$1317 per child per annum for preschool (in the year before school) is paid to long daycare services providing preschool programs to children from vulnerable families (to compensate for

services' obligation to waive fees for these children)²³. The Victorian government also provides Kindergarten Inclusion Support Packages (KIS) which provides additional funding to preschools to build their capacity to meet the needs of enrolled children with a disability, complex medical needs or other high support needs and to support inclusive practice. This additional funding for higher needs and to compensate for fee waivers (see footnote 22) does not necessarily fully cover all costs. Preschools set their own fees and enrolment priorities, although all must waive fees for certain children from marginalised backgrounds, and are also encouraged to prioritise the enrolment applications (where demand exceeds supply) of children from these and other marginalised groups (Department of Education and Training, Victoria 2015).

Nearly half of all Australian children attend preschool through a long daycare service. The amount of funding that states and territory governments provide for preschool in long daycare services varies by jurisdiction, and is less than the provision for standalone preschools.

Childcare, including long daycare, funding is provided to parents by the Commonwealth as a rebate on fees paid – rather than a fixed funding cost for service provision as in preschool or schools. Thus at present parents who send their children to a more costly service, mostly located in inner suburbs and growth areas of major cities, receive more government funding (while also incurring greater out-of-pocket) expenses. The Australian Government's proposed *Jobs for Families* legislation addresses this inequity somewhat by funding on a benchmark cost of delivery.

This proposed legislation and accompanying proposed funding package places more stringent activity tests for families to receive childcare subsidies, and could see the cost of preschool through long daycare settings increase for non-working parents. Families would be reliant on sufficient places being available in stand-alone preschools to access lower cost preschool.

Fees

Fees for preschool vary across the country, from free to several dollars per hour of attendance (amounting to several thousand dollars per year). At a national level most state government delivered preschool programs are free, although this is not the case in New South Wales, Victoria or Queensland (ABS, 2015).

The calculation of fees for preschool is likely to underestimate the true cost to families. In some states, such as New South Wales and Queensland, preschool attendance is mainly through long daycare. The National Early Childhood and Care collection includes estimates that parents of children in long daycare only pay for 15 hours of preschool.

Each long daycare service can choose how they provide preschool – it may be for a whole day or only certain hours (such as 9:00 till 2:00 three or four days a week). Services also set their own fees. Families are usually levied fees for the entire day (around 12 hours), regardless of how many hours their child attends. In these circumstances children need to attend several days of long daycare, and families pay for 24 hours of care or more, to receive 15 hours of preschool. Costs of childcare vary tremendously, from under \$80 per day in some family daycare services (which do not provide preschool programs) to nearly \$200 per day for centre-based services in high-demand locales. In some long daycare centres, a lower fee is charged if children only attend for the “preschool program” hours instead of the full day.

The Commonwealth Government rebates reimburse parents a portion of the cost of childcare relative to their income.

²³ Fee waivers – and Victorian government supplementary funding to approved providers to compensate – apply to children that identify as Aboriginal or Torres Strait Islander; children holding (or whose parent or guardian holds) a Commonwealth Health Care Card, concessions card, Veterans' Affairs Gold Card, Refugee Visa, a variety of other humanitarian, protection and emergency rescue visas, children with mothers' at risk and triplets. Each preschool or childcare centre sets their own fee policies and make additional fee reductions, waivers or payment plans.

Governance and Legislative Arrangements

Early childhood education and care is covered by separate governance and legislative arrangements to school education. This has implications for planning and delivery of seamless education across the early years from birth to eight. For example, services face multiple planning regulations when co-locating on school sites. Different teacher registration requirements and different pay scales apply between early childhood education and schools, meaning that teachers are generally not employed across sectors. These issues create added complexity in providing 'joined-up' service delivery.

Implications for data collection and policy

The complexity in the fees, funding and delivery arrangements also affects capacity to fully understand the sector. Given the variation in delivery arrangements in long daycare, we do not know accurately how many hours children attend preschool. Measures for attendance vary across the country, with attendance information derived for some providers, particularly long daycare services, based on the hours a service operates.

Opaque funding arrangements mean that policy makers and researchers alike cannot ascertain comprehensive, accurate information on the early childhood sector. Given the pivotal importance of early learning, greater transparency is needed.

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W(H)ither the Early Childhood Teacher: tensions for early childhood professional identity between the policy landscape and the politics of teacher regulation

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ABSTRACT Over the last decade teachers, teachers' work and teacher education across all domains of education have been subject to increasing surveillance and regulation. Recent developments in the Australian regulatory context are signalling the emergence of a strengthening bifurcation between prior-to-school and schooling contexts that is forcing a narrowing construction of 'teaching' as work that is only undertaken in schooling contexts. This trend seems likely to have serious implications for the professional identity, status and professional preparation of early childhood teachers and the potential to reposition early childhood contexts as marginalised and non-pedagogical spaces. This article traces some recent developments in teacher regulation and locates an analysis of possible implications for the field of early childhood against a backdrop of emerging trends in the early childhood policy landscape. The emerging tensions invite questions about the potential gains and losses should the current trends become entrenched. The article concludes with a consideration of naming and framing as elements of possible action.

Introduction

Whilst international definitions of 'early childhood' generally locate the field as being concerned with the care and education of children between birth and eight years, across a range of contexts (Sawyer, 2000; Organisation for Economic Cooperation and Development [OECD], 2001), who and what constitutes an 'early childhood professional' has frequently been contested ground in Australia and internationally. The historical antecedents of the field have meant that policy and practice has been informed by diverse knowledge bases that include those in the health, education and welfare arenas. Such eclecticism has undoubtedly contributed to ambiguity in professional identity for the early childhood professional, although other factors such as training structures and industrial conditions also contribute to making aspects of professional identity problematic. In the Australian context, the term teaching has been widely employed to describe the work undertaken by university-qualified professionals working with pedagogical intent in a wide range of early childhood contexts. These include early years classrooms, child and family services in the community, and in contexts known as childcare settings. However, with the increasing regulation of teachers and teacher preparation, there is evidence of a trend towards a strengthening bifurcation between prior-to-school and schooling contexts that is forcing a narrowing construction of 'teaching' as work that is only undertaken in schooling contexts. Such a trend invites a number of questions. If this trend has the potential to redesignate prior-to-school settings as a 'non-pedagogical' space, what is at stake? Is there a risk of reinscribing traditional and outdated roles for those who work with young children? How might these limit or enhance the visions and

imagination of what early childhood as a social and political institution might contribute and achieve for young children as citizens, for advancing democratic principles and for the community more broadly (Dahlberg et al, 1999)? If 'teaching' is designated only as pedagogical action in school contexts, how might this affect emerging policy discourses concerning the potential role of schools as community hubs and the seamless provision of services for children and families? Will it also limit the opportunity for early childhood curriculum approaches to exert an upward influence on schools (Choi, 2002)?

This article begins to take up the challenge offered by provocative questions such as those suggested above by exploring possible implications of some recent developments in the accreditation of teachers and teacher education. The article begins with a thumbnail sketch of the Australian context and proceeds to describe some recent developments in teacher regulation nationally and in some Australian states. It then moves on to provide a reading of some possible implications of perceived emerging trends, particularly in relation to how the technologies of teacher registration and teacher education accreditation may be contributing to a narrowing of the policy/political and pedagogical space for the early childhood teacher. The analysis is undertaken in the context of current and emerging policy trends, nationally and internationally. By raising these issues, the intention is to provoke dialogue about potential gains and losses inherent in the current situation and inform thinking about possible future action.

The Australian Context

In Australia, those university-qualified professionals who work with a dual focus on the care and education dimensions of young children's development and learning in both school and non-school contexts are typically referred to as early childhood teachers. They may work in a variety of contexts that include classrooms in schools, pre-school (both within schools and independently operated by community organisations) and childcare centres (variously operated by independent and community organisations as well as by private for-profit enterprises and corporate chains). However, requirements vary across states and territories in relation to the qualifications of people working in early childhood programs. School-based programs almost always require teacher qualifications, as do most pre-school programs, whilst only in some states are teacher qualifications required in childcare settings. In recent years, a strengthening pedagogical discourse and identity has framed early childhood professionals' work in both prior-to-school and school settings, particularly as curriculum frameworks have emerged to support, define and in some cases regulate early childhood teacher's work in non-school settings (Woodrow & Brennan, 2000; Grieshaber, 2000a). Along side these, professional resources such as the Code of Ethics (Early Childhood Australia [ECA], 2006) and professional standards (Maloney & Barblett, 2000) continue to privilege and promote professional values associated with engagement and partnership with families, care and nurturance, children's citizenship and holistic concerns for children's well-being, contributing to a distinctiveness in early childhood discourse when compared to schooling.

Early childhood teacher education, like teacher education for primary and secondary schools, is undertaken by universities. Typically these degree courses incorporate curriculum content and professional experience appropriate to working pedagogically with children aged 0-8, or 3-8 years across a range of settings that include school, pre-school and childcare (Watson, 2006). Recent research identified some commonality to degree programs across the nation, with distinctive and/or specialist content core areas most commonly relating to understanding children, knowledge of communities, families and children, health, leadership and management in addition to curriculum studies and pedagogical knowledge across the age range (Watson, 2006).

Regulating Teaching and Teacher Education – pushing early childhood teaching to the margins?

In Australia, as in many OECD countries, education has experienced successive waves of reform, strongly influenced by neo-liberal discourses. One of the great ironies to emerge from neo-liberalism in practice is the deceptiveness of the defining rhetoric around 'smaller' government, deregulation and flexibility. In fact, across many areas, the reverse appears to occur. Over the last

decade the early childhood curriculum has become increasingly prescribed and centralised, and in many cases linked overtly to the school curriculum and through this to vocational outcomes, teachers' work in the schooling sector has become increasingly (ac)countable, and development of standards and compliance regimes have proliferated to encroach significantly on teacher identity and autonomy (Sachs, 1999, 2003; Woodrow & Brennan, 2000; Grieshaber, 2000a). Early childhood teachers have experienced these trends primarily through codification of the curriculum (Woodrow & Brennan, 2000; Greishaber, 2000a) and through the mechanism of accreditation (Grieshaber, 2000b).

Recently, the regulatory gaze on teachers, teachers' work and teacher preparation has intensified significantly in Australia as mechanisms through which compliance, registration and regulation can be ascertained and managed have been established or reviewed. This has given rise to new regulatory bodies at both state level (New South Wales Institute of Teachers) and national level (Teaching Australia) and the refocusing and strengthening of others (e.g. Queensland College of Teachers), ostensibly in the service of supporting teaching and 'rais(ing) the status, quality and professionalism of teachers' (Teaching Australia, 2007).

However, the institutional gaze has primarily been on the schooling sector and the work of teachers of children at and beyond compulsory school commencement age. For example, both the national body, Teaching Australia, and the newly established New South Wales Institute of Teachers (NSWIT) have no mandate and had little interest in either supporting or regulating early childhood teachers outside of schooling, despite vigorous encouragement from the early childhood sector to do so. In the state of Queensland, the Queensland College of Teachers (formerly the Board of Teacher Registration) has been making moves to deny full registration to early childhood teachers they have previously registered if these teachers are working in non-school contexts and have no recent experience in school settings. Interestingly, the home page of the Queensland College of Teachers claims, 'the College was established by the *Education (Queensland College of Teachers) Act 2005*, as an independent professional body representing *all* members of the Queensland teaching profession' (June 2007; emphasis added). However, by referring only to school settings in its statement on professional standards and its proposed action in denying registration to early childhood teachers working outside schools, the College is clearly not recognising early childhood teachers working in childcare, pre-school and kindergartens in settings which are not attached to schools.

Thus, early childhood teachers are increasingly finding themselves excluded from the institutional arenas and discourses that 'register' 'accredit' and recognise teachers and courses for 'teachers'.

Whilst these developments leave early childhood teachers working in early childhood contexts other than formal schooling less subject to regulation and control than their peers in school settings, such 'freedom' might come at a cost. This might include less public visibility and diminishing public acknowledgement of the pedagogical work undertaken by early childhood teachers in non-school contexts, and decreasing recognition, both within the peer community of teachers, and more broadly in public space, of the contribution an early childhood focused pedagogy might make to teaching in the early years of school (Hard & O'Gorman, 2007). There are also issues of access to resources developed (e.g. professional development programs) by the regulatory organisations, and inclusion in public education programs promoting the status of teachers. Such moves cast adrift from the mainstream those early childhood professionals working as teachers outside of school settings, and may contribute to alienating or denying the place of educational discourses in many early childhood contexts.

Regulating Teacher Education

In Australia, university teacher education has now become the new focus for surveillance and control in the education landscape, again at both a national and state level, with some potentially serious implications for early childhood teacher education.

Although teacher education is no stranger to review, few of the 99 reports, reviews or inquiries into teacher education in Australia since 1979 (Hartsuyker, 2007) have paid any particular attention to the cross-sectoral complexities associated with early childhood teacher education. One

review focused on the status of teaching, *A Class Act* (Crowley, 1998), acknowledged the low status of early childhood teaching, which according to submissions received, could at least in part be attributed to the feminised nature of the sector and the lack of community valuing of young children. Given the current trends on which this article reports, one might wonder if little has changed in a decade for the status of early childhood.

Accrediting of teacher education courses is a new development for Australia, as universities have traditionally self-accredited their courses, although there has been varying degrees of oversight of teacher education and involvement in course development by state education departments through the mechanism of employment guidelines, 'approvals' and course advisory structures. Whilst processes for national approval are yet to be confirmed, there is no evidence that the national body that has carriage of the accreditation initiative has any interest in settings outside of school. In a recent consultation paper on a proposed national accreditation system for teacher preparation programs, Teaching Australia raised the issue of whether a national system should take account of 'specialised areas of teaching or stages of schooling (such as early childhood, primary, middle years, secondary)' (Teaching Australia, 2006), but its interest is confined only to the schooling sector.

The case of the NSW Institute of Teachers becomes interesting both in relation to early childhood concerns specifically, and its role in course accreditation. Whilst the NSWIT's strongest function is the accreditation of teachers, and not the accreditation of courses, it has released draft content guidelines for subject content to assist universities to design 'graduate and undergraduate initial teacher education programs to meet the demands of relevant discipline knowledge and associated approaches to teaching NSW syllabuses' (NSWIT, 2006) in order that graduates will meet the Professional Standards developed by the NSWIT. These guidelines make no reference to early childhood specifically. The depth and breadth of requirements in relation to school contexts suggest little room in courses for other content that might support the knowledge building and dispositions required for early childhood teachers working across the 0-8 age range.

The developments described here suggest an emerging pattern across the nation of early childhood teachers and related teacher education courses being marginalised or excluded from mainstream consideration in the strengthening policy discourses around teacher accreditation.

In recent months, however, there has been a slight movement by some state authorities to reconsider the case of early childhood. For example, the NSWIT has decided to host a forum to explore 'issues related to prevailing philosophies, current research, legislation issues, structure of programs of initial teacher education ... with a view to facilitating the process of approval of Early Childhood Programs' (Lee, 2007). This development indicates a shift from the original position of non-engagement with early childhood concerns and suggests that there may be some room for movement within the recently released framework of mandatory content areas and specific standards which are primarily focused on narrowly defined discipline content and school-focused curriculum and pedagogical knowledge (NSWIT, 2006).

As they currently stand, compliance with these draft guidelines potentially excludes an early childhood focus across the 0-8 age range and makes it extremely difficult for universities to meet dual accreditation requirements with the NSW Department of Community Services for teachers in prior-to-school settings and NSWIT for school settings. Recent communication with the Queensland College of Teachers suggests that this organisation may also now consider issues of 'equivalence' to school teaching experience for the purposes of early childhood teacher registration, but the mechanism for undertaking this is so far unclear (personal communication, 2007).

Possible Implications for the Early Childhood Field

Whilst small windows of opportunity are opening for early childhood to enter the mainstream debate in the state institutions for teacher accreditation and course recognition, some general trends are clear in the (dis)location of early childhood teachers. These trends of exclusion reflect a narrowing definition of 'teacher' as one who works only with classes of children in school settings, with a potential impact of pushing early childhood teaching to the margins of legitimacy as teachers, and creating ambiguity around definitions of early childhood outside of school contexts as a pedagogical space. Historically, when early childhood professionals have been positioned outside

of teacher discourses, wage parity with school teachers has been difficult to achieve (Queensland Industrial Relations Commission, 2000; Burton & Lyons, 2000). There is evidence of the consequences of reduced status, conditions and attractiveness of working in prior-to-school contexts in NSW in the extreme shortage of early childhood qualified teachers for the prior-to-school sector (Warrilow et al, 2002).

In turn, shortages of qualified staff contribute to leaving the field vulnerable to pressures to lower the requirements for university-qualified early childhood teachers in non-school settings such as childcare and pre-schools. For example, there are strong vested interests, particularly, although not exclusively, in the private and corporate sector in keeping labour costs low and hence minimising the educational dimension of prior-to-school services. Excluding teachers employed in these settings from processes of teacher accreditation, and early childhood courses from review by teacher education accreditation authorities, might well play into the hands of these interests. One effect is to place pressure on university programs to divide their course offerings into separate degrees for professional preparation for school and non-school settings. Whilst the desirability of this is open to debate, data collected in research with students at one NSW university demonstrates a strong student preference for integrated degrees catering for career opportunities across the early childhood sector (Ashton & Elliott, 2006). The discipline content knowledge requirements and the tight focus on this and curriculum, syllabus and school pedagogical issues in the draft content requirements for NSW teacher education courses also pressures early childhood programs to abandon or reduce studies in areas such as the sociology of childhood, communities, families, leadership and collaborative partnerships. Arguably, such trends potentially rob the schooling sector of graduates with strong social and community knowledge and the potential to positively influence pedagogical approaches in schooling at a time when there are international trends to expand the role of school in the community, particularly in relation to outreach programs for young children and families (Petrie, 2005).

Anecdotal evidence suggests that there is widespread concern that the distinctive focus of early childhood teacher education programs is at risk in these conditions. A reading of the literature, and overviews of courses and course pathways, suggests that approaches to curriculum that are child-responsive, involve active learning investigations, shared goals, intentional teaching, holistic concerns for the child and their learning and a perspective on continuity of learning, in addition to a strong child, family and community focus are distinguishing features of such programs (National Association for the Education of Young Children [NAEYC], 2003; Watson, 2006; Hard & O’Gorman, 2007).

These Australian trends contrast with some recent international developments in teacher education. For example, recent reforms in Sweden have resulted in all teaching degree qualifications being integrated into one degree with opportunity for specialisation within a uniform framework (Moss, 2004). In the Swedish experience, the emphasis on play, children’s natural learning strategies and their holistic development typical of an early childhood focus has been maintained and a surprising consequence has been an ‘upward integration’ in which early childhood philosophy and pedagogy is being seen to influence school practices (Choi, 2002). Here the focus has shifted from teacher’s teaching to children’s learning, an outcome consistent with a policy vision of ‘lifelong learning’ for the Swedish community (Choi, 2002) and a useful example of early childhood knowledge discourses being influential in school contexts.

These findings resonate, at least partially, with some Australian studies of early childhood teachers in primary schools in which ‘fundamental differences in the ways that primary teachers and preschool (early childhood) teachers conceptualise teaching and learning’ were discerned (Sawyer, 2000). Despite the ‘different languages, landscape and cultures’ reported by early childhood teachers, the studies found that the discourses associated with early childhood education were resilient for teachers in negotiating their experiences in schools and did not suggest that early childhood professional preparation was inadequate for teaching in school settings (Britt & Sumsion, 2003). In Britt & Sumsion’s study, the researchers conceptualised the space inhabited by early childhood teachers in school settings as a kind of ‘borderlands’ where transformation of both countries (early childhood and primary discourses) might both overlap and intersect and be transformed in realising new possibilities for early years education (Britt & Sumsion, 2003). This complements a theme taken up recently by Hard & O’Gorman (2007), who posits the recent major

early childhood reform in the state of Queensland involving a new early years curriculum and preparatory year as a possible site of leadership and influence for early childhood teachers.

Emerging Trends in the Policy Landscape

Internationally and in Australia trends are emerging to promote and consolidate the importance of the early childhood years, and in some contexts interface early years provision with schooling. These emergent trends have been influenced by and reflect the important work undertaken within the OECD and the Starting Strong project (OECD, 2001, 2006) and the weight of evidence from brain research and more recently the work of economists (e.g. Cleveland & Krashinsky, 2003).

Examples of recent program initiatives include government funding of supported playgroups staffed by early childhood professionals as a strategy to facilitate children's transition to school, and numerous early literacy programs located in libraries and community agencies. In the states of Queensland and Western Australia, traditional sessional pre-school for children in the year before compulsory schooling has been relocated in the school context and, in the case of Queensland, accompanied by the development of an innovative play-based early years curriculum, and there is increasing policy interest in developing schools as sites for community capacity building and support, particularly in relation to young children and their families.

Such initiatives, together with increasing evidence of the efficacy of high-quality childcare in effecting positive and sustained educational and learning outcomes for children considered to be 'at risk', and strengthening arguments for universal provision of a pre-school year, foreshadow a place for specialised early years educators with strong pedagogical knowledge and skills, together with highly effective communication and collaboration skills and a community orientation. Reviewing the Queensland early years curriculum initiative, Hard & O'Gorman (2007) argue that this change in early years provision provides an opportunity for leadership from the field of early childhood to influence the early years curriculum in school contexts. Yet despite these trends, professional pedagogical work in the years before the formal commencement of school continues to be undervalued and under-rewarded.

When the trends to exclude early childhood teachers from mainstream teacher institutions are read against emerging policy directions, a critical tension emerges as contradictory forces become evident. On the one hand, there is an emerging emphasis on quality programs in early childhood, integrated service provision (Department of Education and Children's Services [DECS], 2005; OECD, 2006; Council of Australian Governments, 2006), an extended role for schools (Petrie, 2005), schools as community hubs (Blue Mountains Stronger Families Planning Group Strategic Plan, 2007) and program initiatives designed to facilitate children's transition to school in the year before school. A place for specialist early childhood teachers with knowledge of children, families and communities as well as curriculum and pedagogy across the school/non-school divide is strongly implicated in such policy and practice directions. However, a counter-flow associated with the increasing regulation of teachers' work and teacher accreditation and the activities associated with teacher registration are working to exclude these teachers from official recognition when their employment is outside of schools. Additionally, trends evident in the prescription of content within initial teacher education to relegate the usefulness of distinctive early childhood teacher professional knowledge only to the prior-to-school sector seem both ill founded and contradictory to emerging national and international policy interests and directions in emphasising continuity of children's learning experience, especially as it impacts on children's transition to school and school success (Sawyer, 2000; Dockett & Perry 2001; Petriwskyj et al, 2005).

These trends and counter-flows are suggestive of significant challenges for the field in negotiating, articulating and promoting early childhood professional identities that are relevant within and across the various domains of a rapidly changing policy landscape.

Early Childhood Professional Identity

In the fragmented policy landscape that characterises early childhood in Australia, professionals working with young children and families in the prior-to-school sector have consistently struggled to gain wider recognition of the educational dimension of their work. Unlike some other contexts,

such as some Scandinavian countries where the notion of the social pedagogue (Oberhuemer, 2005) seems to have successfully realised the interdependence of care and education in work with young children, a persistent care/education dichotomy pervades much of the early childhood discourse in Australia. The impact of this distinction was most evident in a salary pay claim before the Queensland Industrial Relations Tribunal where a 1996 decision not to award university-trained professionals working in long day care salary parity with teachers in other settings (school and kindergarten) was based on a perception that practitioners in these settings were 'only' providing 'developmental' programs, supposedly requiring of less skill (Burton & Lyons, 2000, p. 73). It would seem that adopting a developmental lens reinforced the work as low-status, 'caring' work. The impact of these poorer working conditions is also reflected in the ongoing shortage of early childhood teachers in the prior-to-school sector. Research with commencing early childhood university students indicates that their preferred career trajectories in the early years of school (Ashton & Elliott, 2006) are strongly influenced by pay and conditions. Despite significant changes in both the Australian policy context and the conceptual and theoretical framings of early childhood professional practice, and some evident trends of shifts away from the dominance of developmentalism, the artificial divides remains and continues to reinforce early childhood work in the prior-to-school sector as peripheral and low status, non-educational and 'un-teacherly'.

Whilst a combination of structural/institutional issues and shifts in policy trends make understanding early childhood professional work only as pedagogical work problematic, it could be argued that the nomenclature of 'teacher' has played an important role in emphasising the professional status of early childhood work, supporting improvement in wages and conditions and defining early childhood settings as education contexts in the Australian context. However, internationally there is considerable diversity in how the work of early childhood professionals is represented through language.

Drawing on Alexander (2000), Oberhuemer (2005) encourages the use of the term 'early childhood pedagogue' rather than teacher as potentially useful in communicating both the act and the discourse associated with professional behaviours in early childhood and one which gestures towards the cultural, historical and socio-political embeddedness of such conceptualisations. Moss (2004) too, encourages the take-up of the conceptual framings associated with the European term pedagogue as an inclusive construct for pedagogical work across ages ranges; work that 'is both relational and holistic'. As he explains, 'the pedagogue sets out to address the whole child, the child with body, mind, emotions, creativity, history and social identity' (Moss & Petrie, 2002). The use of such terminology might contribute to releasing care work from its maternal bonds, which have undoubtedly constrained the public discourses around early childhood. The impact of caring discourses in early childhood, how these position the profession in feminine discourses of domesticity and nurturance, and their implications for strong professional identity have been well rehearsed (Petrie, 1992; Moyles, 2001; Grieshaber, 2001; Woodrow, 2003).

Moving Forward – naming and framing

This article has attempted to expose some critical tensions in relation to the positioning of early childhood in the politics of teacher regulation and read these against emergent policy trends in the provision of early childhood services. Such exposition involves the author in adopting a position of critique. However, as Singh et al (2006) recently reminded education policy analysts, critique is of limited use in progressing agendas: 'reproducing bad sense in the name of critique serves to replicate these issues, interests and definitions and thereby increase their share of the prevailing governing outlook ... this is a danger, but surely untangling the dominant discourse and searching for hidden and alternate meanings is a good place to start'. Working as part of the project 'Robust Hope', involving a research collective concerned to investigate ways to imagine, engage with and enact utopian possibilities in the face of the structural pressures of neo-liberalism, Singh identifies five interdependent strategies that have emerged in the Robust Hope project as potentially useful (Singh et al, 2006). These strategies are 'framing', 'engaging', 'assessing', 'communicating' and 'reflecting self-critically'. All strategies are fundamentally connected to the idea of undertaking real-world research that goes beyond critique and identifying problems to working in ways that can inform policy action.

The first strategy, framing, is potentially an important one to deploy for the early childhood field, particularly in any project of repositioning, which emerges as a significant challenge for addressing some of the issues identified in this article. Describing frameworks as 'mental structures that shape the way we see the world', Lakoff (2006, p. xv) argues that frames are fundamentally important to how meaning is made and what is seen as common sense. To reframe is to change the way we and the public make meaning of policy, actions and events and thus to change what counts as common sense. Since language is the way we know and respond to frames, new language is required for new frames. Researchers have found that the 'prudent choice of frames, and the ability to effectively contest frames lies at the heart of successful policy advocacy' (Bales, 2005, p. 2).

The historical framings of early childhood education have shown remarkable resilience over a sustained period and through periods of significant social change. Given the changing circumstances, shifting the frames might be an important strategy to repositioning policy discourses about this provision in a project of reclaiming and emphasising early childhood education as an important pedagogical space.

Extensive research undertaken by the Frameworks Institute in the USA provides a number of insights into dominant frames in relation to early childhood provision and how these impact on the capacity for incursions on the status quo. In particular, understandings of children's development as a 'black box' and images of the child as a 'blank slate', 'clay to be moulded' or a 'plant to be nurtured' predominate in the frames people use to make sense of early childhood and early childhood provision (Bales, 2005). Additionally, children's existence is mostly understood in terms of the (nuclear) family domain. The influence of the physical environment, the child as active agent, and the children in interaction with the community and building relationships outside the home as well as social and emotional growth are poorly understood and minimised. To inform policy advocacy for stronger educational provision in the early years, the research indicates the efficacy of a change in language: 'the public, child development experts and community stakeholders actually share similar beliefs about what children need to grow and develop. The language is the problem, not the core recommendations' (Bales, 2005, p. 18). At its most simplistic level, research suggests that terms such as day care and childcare need to disappear from our language and be replaced by consistent reference to terms such as early learning and early childhood education (Lakoff & Grady, 1998), as childcare evokes the metaphor of 'child storage' (Lakoff & Grady, 1998, p. 10) and the early learning frame is a more stable foundation from which to argue that the provider is a teacher who requires training. Although this has been recognised for some time, the research suggests that framing communication in terms which promote values of community exchange, futures, stewardship and prosperity for the society might help provide a mechanism for this to be heard at policy and community levels (Frameworks Institute, 2005). These values are consistent with the important theoretical and policy work undertaken in repositioning early childhood in Europe by activists such as Dahlberg & Moss (2005). These findings might also usefully inform the conceptualisation, data analysis and framing of findings of an important nine-country international study exploring early childhood professionalism across social contexts which is currently under way under the auspices of the European Early Childhood Research Association. Given the power of the dominant discourses, projects of framing and reframing are significant and challenging undertakings to mobilise, but, under the weight of evidence, necessary to moving dialogue forward on these important issues pertaining to the early childhood education project. Such mobilisation also requires highly effective strategies of communication and an understanding of real-world contexts and actions, informed by research.

Conclusions

Judyth Sachs (2003) suggests that the concept and practice of professionalism is a 'site of struggle' and that to 'seek a fixed position is futile: professionalism has always been a changing concept' (p. 6). Early childhood professional identity is very much a 'work-in-progress' – vulnerable, ambiguous, and buffeted by competing policy discourses. This article has drawn on recent developments in Australia relating to teacher accreditation to suggest that there is a strengthening policy trend that is marginalising early childhood teachers by relegating early childhood teaching outside the mainstream. In addition to the risks this might pose in relation to issues of professional

identity and status, issues emerge in relation to other policy discourses that would suggest a strengthening place for early childhood pedagogy and greater fluidity in pedagogical discourse across the school/non-school divide. There is a case that the current politics of teacher and teacher education regulation reduce the public space for such activist energy and new forms of teacher education. One possible resource for (re)claiming that space is through a consideration of the nomenclature and frames that surround early childhood professional work.

There is a clear need for a research agenda exploring issues of professional roles and identity in order to provide evidence for interrupting trends that diminish participation, and recognition of opportunities for leadership in exciting new developments in the international early childhood landscape. There seems to be a strong case for engagement with the politics of teacher education regulation and resistance to the teacher policy discourses to enable recognition of the contribution early childhood teachers might bring to young children's learning across the age range.

For early childhood teachers, the current political context offers many challenges and opportunities for struggle. However, paraphrasing Sachs (1999), it is better to find the right questions than answers to the wrong questions.

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INTERPRETING THE EVIDENCE ON LIFE CYCLE SKILL FORMATION

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Abstract

This paper presents economic models of child development that capture the essence of recent findings from the empirical literature on skill formation. The goal of this essay is to provide a theoretical framework for interpreting the evidence from a vast empirical literature, for guiding the next generation of empirical studies, and for formulating policy. Central to our analysis is the concept that childhood has more than one stage. We formalize the concepts of self-productivity and complementarity of human capital investments and use them to explain the evidence on skill formation. Together, they explain why skill begets skill through a multiplier process. Skill formation is a life cycle process. It starts in the womb and goes on throughout life. Families play a role in this process that is far more important than the role of schools. There are multiple skills and multiple abilities that are important for adult success. Abilities are both inherited and created, and the traditional debate about nature versus nurture is scientifically obsolete. Human capital investment exhibits both self-productivity and complementarity. Skill attainment at one stage of the life cycle raises skill attainment at later stages of the life cycle (self-productivity). Early investment facilitates the productivity of later investment (complementarity). Early investments are not productive if they are not followed up by later investments (another aspect of complementarity). This complementarity explains why there is no equity-efficiency trade-off for early investment. The returns to investing early in the life cycle are high. Remediation of inadequate early investments is difficult and very costly as a consequence of both self-productivity and complementarity.

Keywords

skill formation, education, government policy, educational finance

JEL classification: J31, I21, I22, I28

1. Introduction

The most valuable of all capital is that invested in human beings; and of that capital the most precious part is the result of the care and influence of the mother.

Marshall (1890, paragraph VI.IV.11)

The study of human skill formation is no longer handicapped by the taboo that once made it impermissible to discuss differences among people. It is well documented that individuals are very diverse in a variety of abilities, that these abilities account for a substantial amount of the interpersonal variation in socioeconomic outcomes, and that this diversity is already apparent at an early age. The family plays a powerful role in shaping these abilities, contributing both genetic endowments and pre- and post-natal environments, which interact to determine the abilities, behavior and talents of children. Some families do this task poorly, with detrimental consequences for their children. From a variety of intervention studies, we know that it is possible to partially compensate for exposure to adverse environments if high-quality interventions are made sufficiently early in children's lives. The remediation efforts that appear to be most effective are those that supplement family resources for young children from disadvantaged environments. Since the family is the fundamental source of inequality in American society, programs that target children from disadvantaged families can have substantial economic and social returns.

This chapter presents formal models of skill formation that distill the essence of recent empirical findings from the literature on child development. The goal is to provide a theoretical framework for interpreting the evidence from a large empirical literature, for guiding the next generation of empirical studies, and for formulating policy.

Recent empirical research has substantially improved our understanding of how skills and abilities are formed over the life cycle. The early human capital literature [Becker (1964)] viewed human capital as a rival explanation for human ability in explaining earnings. It emphasized that acquired human capital could explain many features of earnings distributions and earnings dynamics that models of innate and invariant cognitive ability could not. This point of view still underlies many recent economic models of family influence [e.g., Aiyagari, Greenwood and Sechadri (2002), Becker and Tomes (1979, 1986)]. Related work [Ben-Porath (1967), Griliches (1977)] emphasized that invariant innate ability was an input into the production of human capital, although its effect on human capital accumulation was ambiguous. More innate ability could lead to less schooling if all schooling does is to teach what an able person could learn without formal instruction. On the other hand, more innate ability might make learning easier and promote schooling. The signaling literature [Spence (1973), Stiglitz (1975)] focused on the latter interpretation in developing models of education where higher levels of schooling signal higher innate ability. In its extreme form, this literature suggested that there was no learning content in schooling.

The entire literature assumed that ability is an innate, scalar, age-invariant measure of cognitive skill. This early point of view still prevails in most quarters of economics.

Except for work by Marxist economists [see, e.g., Bowles and Gintis (1976), Edwards (1976)], noncognitive traits like motivation, persistence, time preference, and self control were neglected in empirical research and treated as “soft skills,” peripheral to educational and labor market outcomes.

In contrast to the wisdom of Marshall (1890), as encapsulated in the quotation that begins this chapter, the recent economic literature on family influence on child outcomes focuses on family income constraints and heritability as the principal sources of parental influence on child development. Becker and Tomes (1979, 1986) initiated a large literature that emphasized the importance of credit constraints and family income on the schooling and earnings of children. Important developments of this work by Benabou (2000, 2002), Aiyagari, Greenwood and Seshadri (2002), Caucutt and Kumar (2003), Hanushek, Leung and Yilmaz (2004), and Seshadri and Yuki (2004), emphasize the role of credit constraints and altruism in forming the skills of children. In this work, ability is treated as determined by genetic factors. The life cycle of the child at home is collapsed into a single period so that there is no distinction between early and late investments in children. Becker and Tomes (1986) show that there is no trade-off between equity and efficiency in making government transfers directed toward credit-constrained families because the return to human capital investment in children from such families is high due to the presence of credit constraints. We show that their insight holds true for early period investments in a multi-period model of child investment, but not for investments in later periods. We also generalize their discussion of credit constraints to a multiperiod setting following work by Caucutt and Lochner (2004), Cunha (2004), and Cunha and Heckman (2004, 2006).

Recent research, summarized in Heckman (2000) and Carneiro and Heckman (2003), presents a richer picture of schooling, life cycle skill formation and earnings determination. It recognizes the importance of both cognitive and noncognitive abilities in explaining schooling and socioeconomic success. These abilities are produced by the family and by personal actions. The role of the mother is especially important, as anticipated in the quote by Marshall that begins this chapter. Both genes and environments are involved in producing these abilities. Environments affect genetic expression mechanisms [see, e.g., Turkheimer et al. (2003)]. This interaction has important theoretical and empirical implications for skill policies. It suggests an important role for environment-enriching policies in fostering human skills.

In the light of a substantial body of recent research, the traditional sharp distinction between acquired skills and genetically determined cognitive ability maintained in the human capital literature is no longer tenable. Abilities are multiple in nature. They are both cognitive and noncognitive. Measured cognitive ability is susceptible to environmental influences, including *in utero* experiences. So is measured noncognitive ability. There are genetic components to both.¹ We have come to understand that achievement tests used to monitor performance in school and to determine acceptance

¹ See Robinson, Grozinger and Whitfield (2005) for a summary of recent research on primates and other animals. See Knudson et al. (2006).

into the military are not the same as IQ tests. Achievement test scores are determined by IQ, noncognitive inputs and by environmental factors. Even IQ can be affected by environmental interventions at least up to age 10 or so.² It is hard to change IQ after this age. In the popular literature, achievement tests and IQ tests are often confused.³ Achievement test scores are affected by IQ, schooling inputs, and noncognitive skills, and are malleable over a much greater range of ages than is IQ. Noncognitive abilities such as motivation, self-discipline, and time preference – associated with the development of the prefrontal cortex – are also affected by environmental influences. They are more malleable at later ages than IQ. Achievement test outcomes can be influenced until very late ages and are affected by both cognitive and noncognitive skills. Noncognitive abilities and cognitive abilities affect schooling attainment and performance, and a wide array of behaviors [Heckman, Stixrud and Urzua (2006)]. Abilities have an acquired character although they differ in their malleability at different ages.

We characterize the human skill formation process in the following fashion. Skills and abilities are used interchangeably throughout this chapter because both are affected by environments, investment and genes. Agents possess a vector of abilities at each age. These abilities – or skills – are multiple in nature and range from pure cognitive abilities (e.g., IQ) to noncognitive abilities (patience, self control, temperament, time preference). Achievement test scores are affected by cognitive, noncognitive and environmental inputs. These abilities are used with different weights in different tasks in the labor market and in social life more generally.

The human skill or ability formation process is governed by a multistage technology. Each stage corresponds to a period in the life cycle of a child. Inputs or investments at each stage produce outputs at that stage. Unlike the Ben-Porath (1967) model, in our models qualitatively different inputs can be used at different stages and the technologies may be different at different stages.⁴ The outputs at each stage are the levels of each skill achieved at that stage. Some stages of the technology may be more productive in producing some skills than other stages, and some inputs may be more productive at some stages than at other stages. Those stages that are more productive in producing certain skills are called “sensitive periods” for those skills. If one stage alone is effective in producing a skill (or ability) it is called a “critical period” for that skill.

An important feature of this technology is that the skills produced at one stage augment the skills attained at later stages. This is termed *self-productivity*. It embodies the

² Until age 4 or 5, measures of IQ do not predict adult IQ very well. Using parental IQ actually yields a better prediction of the child’s score at age 15 than any test given before age 5. After age 10, however, IQ becomes stable within the constraints of psychometric measurement error. See Jensen (1980) for a discussion.

³ See, e.g., Herrnstein and Murray (1994).

⁴ Heckman, Lochner, and Taber (1998) generalize and estimate the Ben-Porath model by allowing the technology producing schooling human capital to be different from the technology producing post-school investment. Su (2004) and Cardak and Givon (2004) develop multistage models of secondary and postsecondary schooling choices focusing on determinants of progression through school. However, their emphasis is on later stages of the life cycle, not the early years.

idea that skills acquired in one period persist into future periods. It also embodies the idea that skills are self-reinforcing. For example, self-control and emotional security may reinforce intellectual curiosity and promote more vigorous learning of cognitive skills. A second key feature of skill formation is *complementarity*. Skills produced at one stage raise the productivity of investment at subsequent stages. In a multistage technology, complementarity also implies that levels of skill investments at different ages bolster each other. They are synergistic. Complementarity also implies that early investment has to be followed up by later investment in order for the early investment to be productive. Together, complementarity and self-productivity produce multiplier effects which explain how skills beget skills and abilities beget abilities.

Complementarity, self-productivity of human capital and multiplier effects imply an equity-efficiency trade-off for late child investments but not for early investments. These features of the technology of skill formation have consequences for the design and evaluation of public policies toward families. In particular, the returns to late childhood investment and remediation for young adolescents from disadvantaged backgrounds are low, while the returns to early investment in children from disadvantaged environments are high.

Our analysis demonstrates the quantitative insignificance of credit constraints in the college-going years in explaining child college enrollment. Controlling for cognitive ability, under meritocratic policies currently in place in American society, family income during the child's college-going years plays only a minor role in determining child college participation, although much public policy is predicated on precisely the opposite point of view. Abilities (and skills) are formed over time, and the early periods in a child's life cycle are crucial for development. Augmenting family income only in the time period when a child goes to college will not make up for suboptimal investment in the 18 years before. *Permanent* family income plays an important role in explaining educational choices, insofar as it is a proxy for the high level of investment in abilities and skills that wealthier families provide, but it is not synonymous with family income in the adolescent years, nor with tuition and fees.

Carneiro and Heckman (2002, 2003) present evidence for the United States that only a small fraction (at most 8%) of the families of American adolescents are credit constrained in making their college decisions. The quantitatively important constraints facing disadvantaged children are the ones determining their early environments – parental background, and the like. The empirically important market failure in the life cycle of child skill formation is the inability of children to buy their parents or the lifetime resources that parents provide, and not the inability of families to secure loans for a child's education when the child is an adolescent. Our analysis has major implications for the way policies should be designed in order to help low income and disadvantaged populations. Evidence from disadvantaged populations demonstrates that enriched early interventions can raise measured ability and other skills.

Ours is an unusual survey. The standard approach to survey writing in empirical economics is to compile lists of facts and “treatment effects” from various empirical studies. Instead, in this chapter, we develop a comprehensive model of the skill forma-

tion process that is grounded in the best available empirical evidence. We distill general theoretical principles that can guide skill formation policy. We present economic models that focus on basic principles. Any study of skill formation policy grounded in economic and scientific fundamentals improves on a purely empirical approach to policy evaluation that relies on evaluations of the programs and policies in place or those previously experienced. Although economic policy analysis should be grounded in data, it is important to recognize that those policies that can be evaluated empirically are only a small subset of the policies that might be tried.⁵ If we base speculation about economic policies on economic fundamentals, rather than solely on estimated “treatment effects” that are only weakly related to those fundamentals, we are in a better position to think beyond what has been tried to propose more innovative answers to skill formation questions. We investigate the study of skill formation policy by placing it in the context of economic models of life cycle learning and skill accumulation rather than focusing exclusively on which policies have “worked” in the past. The current literature on childhood skill formation abounds in facts and figures, but lacks a clear interpretive framework that is faithful to the evidence. If a picture (graph) is worth a thousand words, then a model is worth a thousand pictures (graphs). Our models summarize the existing evidence succinctly and point the way to future developments.

Any model that is faithful to the evidence summarized in this paper must recognize that (a) parental influences are key factors governing child development; (b) early child investments must be distinguished from late child investments and that an equity-efficiency trade-off exists for late investments, but not for early investments; (c) abilities are created, not solely inherited, and are multiple in variety; and (d) the traditional ability-skills dichotomy is obsolete. These insights change the way we interpret evidence and design policy. Point (a) is emphasized in many papers. Point (b) is ignored by models that consider only one period of childhood investment. Points (c) and (d) have received scant attention in the formal literature on child investment.

The central concept in this paper is the production function for skills. Since both skills and abilities can be acquired, we do not distinguish between these two concepts. Both skills and abilities are affected by genes, environments and personal actions.⁶ We use a skill production technology to interpret the evidence on the life cycle evolution of skills and abilities, developing the technology and its implications more formally in Section 3.

Here, we provide an intuitive summary of the main theoretical ideas that organize the evidence presented in this paper. Assume, for the sake of simplicity, that there are two stages in the life cycle of the child prior to attaining adulthood. Adulthood is a third and

⁵ See Heckman and Vytlačil (2005, 2007a, 2007b) for comprehensive discussions of econometric policy evaluation.

⁶ One possible distinction between abilities and skills is that the latter are acquired by personal actions while the former are acquired by external influences. This distinction is not sharp since personal actions may affect the operation of the environment on the individuals, and personal actions (self help programs) may alter abilities.

final stage. Denote investment in a child during period t as I_t , and the skill produced from that investment as S_t for $t = 1, 2$. Both I_t and S_t may be vectors (e.g., cognitive and noncognitive skills), and they may be of different dimensions. The S_t are different levels of the same skills or abilities at different stages. Thus S_t could contain a variety of abilities and skills, ranging from pure IQ to noncognitive skills like motivation. It could also include cognitive skills as measured in achievement tests that are affected by IQ, motivation and self-control. I_t is a vector of investments at stage t . These may be stage-specific investments (e.g., phonics lessons) or general investments that are not stage-specific. Some stages may be uniquely suited to the formation of some skills. These are the critical or sensitive periods.

Let S_0 be the vector of initial skills of the child, say at birth. These skill levels may be influenced by *in utero* experiences and genetics.⁷ We define the technology of skill formation at stage t in a recursive fashion:

$$S_t = f_t(I_t, S_{t-1}), \quad (1)$$

where $f_t(\cdot)$ is increasing in (I_t, S_{t-1}) and is concave in I_t . For simplicity, we assume differentiability, except in special cases. Each stage of the life cycle may have a different production technology using different inputs.⁸

Different adult tasks $j = 1, \dots, J$ require skills that can be combined in different ways to produce task-specific output at period t in adult life, $T_{j,t}$. The tasks correspond to the outputs in the J different occupations (e.g., lawyer, ditch digger, full time mother, athlete):

$$T_{j,t} = T_{j,t}(S_t) \quad \text{for } j = 1, 2, \dots, J. \quad (2)$$

In some tasks, components of S_t can substitute for each other. In other tasks, those same components may be strongly complementary. For example, to be a good mother requires many skills. To be a good ditch digger requires fewer skills.

Appendix A presents a more general discussion of our specification of the technology of skill formation and compares it to the conventional Ben-Porath (1967) model which is a very special case of our framework. Throughout much of this paper, we focus on technology (1), and for simplicity we assume that there is one task in the economy. However, task function (2) reminds us that remediation for early disadvantage may take two forms: (a) through later investments or (b) through subsidy and technical change in the tasks that disadvantaged children can perform in adulthood.⁹

Given the technology of skill formation (1), the concept of universal *self-productivity* is captured by the assumption that $\frac{\partial S_2}{\partial S_1} = \frac{\partial f_2}{\partial S_1} > 0$.¹⁰ More generally, some components

⁷ As emphasized in the studies in Keating and Hertzman (1999) these endowments are influenced by parental genes and environment.

⁸ This technology and its properties are developed more formally in Appendix A.

⁹ For example, remediation through technological change might involve automatic change machines for cashiers who are innumerate.

¹⁰ A better terminology would be “recursive productivity,” where the output from one stage is the input in the next stage because S_1 and S_2 can be vectors.

of S_1 may be productive for S_2 while others may not or may even have a negative effect. This formulation is sufficiently general to allow cross effects of knowledge of one skill (or ability) on another skill (or ability).¹¹ The concept of universal *direct complementarity* of investments in stage 2 technology is that

$$\frac{\partial^2 f_2(I_2, S_1)}{\partial I_2 \partial S'_1} > 0.$$

For the vector case, this says that higher levels of the stocks of all skills increase the productivity of period 2 investment. More generally, $\frac{\partial^2 f_2(I_2, S_1)}{\partial I_2 \partial S'_1} \geq 0$, since some inputs may not be complementary with stocks of past skills or abilities. Even more generally, some skills may have a negative effect on the productivity of some investments.¹²

In addition to the notions of direct complementarity and self-productivity in skill production, there is the notion of complementarity or substitution of period t skills in each task, as determined by the task function (2). The story of the tortoise and the hare tells us that it is sometimes possible to compensate with effort for what one lacks in pure athletic skill. In the general case with J different task functions corresponding to different adult jobs or occupations, tasks will have different degrees of substitution among the skills, and some components of skills are irrelevant for certain tasks, so it is possible in some tasks to compensate for skill deficits while for other tasks it may not be. A failure to acquire one skill can be offset by choosing to do tasks that do not require it or else by compensating for investments in other skills.

The structure of complementarity or substitutability in investments over time as governed by equation (1) is crucial in determining whether or not there is an equity-efficiency trade-off for late investments.¹³ To see this, consider two children, A and B , with $S_0^A = S_0^B$ but who differ, for whatever reason, in their level of period 1 investment, I_1 . We assume that there is only one investment good. Suppose that A comes from

¹¹ In capital theory, the “Crusonia vine” of Knight (1944) is a pure version of a self productive process. His vine grows at a fixed rate of g per year, independently of any inputs once the seed is sown. In our notation, for a scalar S_t this would be $S_t = (1 + g)S_{t-1}$, so that $S_t = (1 + g)^t S_0$ and $\partial f_t / \partial I_t \equiv 0$ for $t > 0$. Our notation is more general because we allow for multiple inputs that may interact synergistically.

¹² In capital theory, Hayek’s (1941) stages of production of capital entail investments at each stage that are stage-specific. His theory encompasses both self-productivity and direct complementarity.

¹³ Complementarity has multiple definitions in economics and these definitions are not equivalent [Samuelson (1974)]. The two polar cases, perfect substitutes and perfect complements, have been a part of the economist’s toolkit at least since Fisher (1982). A production function for output, $g(x, y)$, defined in terms of inputs (x, y) is said to exhibit *perfect substitution* among the inputs if the output $g(x, y)$ is

$$g(x, y) = g(ax + (1 - a)y), \quad 0 < a < 1.$$

Thus x and y substitute perfectly in the sense that one unit of y produces exactly the same output as $(1 - a)/a$ units of x for all levels of x and y . If x is an early input and y is a late input, technically one can always remediate for a low x input by a compensation in terms of y . If $a = 1$, this is *not* possible. The closer a is to 1, the greater the required remediation in y . As we note in this chapter, it may not be economically feasible or efficient to remediate.

a deprived environment whereas B does not so $\bar{I}_1^A < \bar{I}_1^B$.¹⁴ Given period 1 investments, what is the appropriate investment allocation for period 2? If there is one skill, and the goal is to maximize the sum of adult skills in society, the problem is

$$\max (S_2^A + S_2^B) \quad \text{given } I_1^A = \bar{I}_1^A, I_1^B = \bar{I}_1^B. \quad ^{15}$$

This is the “social planner’s” problem.

Perfect complementarity characterizes $g(x, y)$ if

$$g(x, y) = g(\min(x, y)).$$

This is an “O ring” technology where output is limited by the weakest link (the lowest level of input). Thus if x is an early input, a low level of x cannot be remediated by any investment in y . Another implication of this technology is that if x is big, a low level of y undoes the early investment.

A second definition of complementarity and substitution, sometimes called direct substitution or complementarity, for a twice differentiable $g(x, y)$ is that (x, y) are direct complements if

$$\partial^2 g(x, y) / \partial x \partial y > 0,$$

while (x, y) are direct substitutes if

$$\partial^2 g(x, y) / \partial x \partial y < 0.$$

Inputs (x, y) are independent if

$$\partial^2 g(x, y) / \partial x \partial y = 0.$$

What is confusing is that the two definitions do not always agree. Suppose that $g(x, y) = ax + (1 - a)y$. Then (x, y) are perfect substitutes under the first definition, but they are independent inputs under the second definition. Note further that if (x, y) are perfect complements under the first definition, g is not everywhere differentiable. However, if g is strictly concave and differentiable, (x, y) are perfect substitutes under either definition. To make matters worse if $g(x, y)$ is homogeneous of degree one and $\partial^2 g(x, y) / \partial x^2 < 0$, then it is a consequence of Euler’s Theorem that

$$\partial^2 g(x, y) / \partial x \partial y > 0,$$

so that inputs are direct complements.

The CES technology for two inputs,

$$g(x, y) = [ax^\sigma + (1 - a)y^\sigma]^{1/\sigma},$$

nests the two polar cases subsumed in the first definition ($\sigma = 1$ perfect substitutes; $\sigma = -\infty$ for perfect complements). The parameter σ is a measure of substitution or complementarity. However for $0 < a < 1$ and $-\infty < \sigma < 1$,

$$\partial^2 g(x, y) / \partial x \partial y > 0,$$

so that (x, y) are direct complements for all values of the substitution/complementarity parameter σ . In the general case with more than 2 inputs, direct complementarity is not imposed as a consequence of assumptions about substitution or complementarity in the CES case. In the example, we use the two polar cases because they are intuitive.

¹⁴ Plausibly $S_0^A < S_0^B$, but we abstract from this.

¹⁵ This criterion is the same as maximizing human capital if adult skill is the same as adult human capital.

Assume that the resources available for investment are M .¹⁶ We assume that the social planner is free to impose taxes and lump sum transfers. For large enough M (i.e., assuming that investment is feasible), this problem yields the interior solution

$$\frac{\partial f_2(I_2^A, S_1(\bar{I}_1^A))}{\partial I_2^A} = \frac{\partial f_2(I_2^B, S_1(\bar{I}_1^B))}{\partial I_2^B}.$$

The marginal return to second period investment should be equated across persons.¹⁷

Consider the role of complementarity and substitutability by first studying the polar case in which inputs are perfect substitutes in the intuitive [Fisher (1982)] sense of the term. If I_2 and S_1 are perfect substitutes, the second period technology can be written as $S_2 = f_2(\gamma S_1 + (1 - \gamma)I_2)$ for $0 \leq \gamma \leq 1$. The parameter γ determines the relative productivity of investment in the different periods. For interior solutions, the problem of maximizing social output yields the first order condition:

$$f_2'(\gamma \bar{S}_1^A + (1 - \gamma)I_2^A) = f_2'(\gamma \bar{S}_1^B + (1 - \gamma)I_2^B),$$

which implies that adult skill levels are equated. Specifically, second period investments are fully equalizing:

$$I_2^A = I_2^B + \frac{\gamma}{1 - \gamma}(\bar{S}_1^B - \bar{S}_1^A),$$

so there is full compensation for adverse early environments.

If S_1 and I_2 are strong complements in the intuitive sense of that term, we obtain a very different result. Consider the polar opposite case of perfect complementarity (i.e., the so-called “Leontief case”) with

$$S_2 = f_2(\min\{S_1, I_2\}).$$

It takes a unit of S_1 and a unit of I_2 together to produce S_2 . In the Leontief case, efficiency dictates that lower first period investments in A relative to B be followed by lower second period investments in A relative to B ($\bar{I}_1^A < \bar{I}_1^B$ implies $I_2^A < I_2^B$). Efficiency in this case dictates a policy that perpetuates the initial inequality of inputs due to disadvantaged environments. Attempts to remediate early deficits are not possible due to the structure of the technology of skill formation. There is an efficiency-equity trade-off for period 2 investments, but not for period 1 investments. With this production technology, the skill level attained in period 2 is restricted by the skill level attained earlier. Period 1 is a bottleneck period. Efficient period 2 investment can be no larger than period 1 investment. This example is a bit artificial because we have postulated only a single skill. More generally, there may be some skills (abilities) that are essential for making investment in the second period productive.

¹⁶ This may include social and private resources.

¹⁷ Low M may imply zero investment for one or both persons unless Inada conditions (which guarantee infinite marginal product at zero levels of input) are imposed on the production function.

Complementarity has a dual face. Investments in the young are essential and cannot easily be substituted for by later investments. At the same time, later investments are needed to make the early investments pay off. On efficiency grounds, the Leontief example shows that early disadvantages will be perpetuated and compensatory investments at later ages may be inefficient if complementarity is sufficiently strong.

On the other hand, a technology with perfect substitutes and equal productivity of investments at all ages implies that the timing of investment is irrelevant for producing a given level of human capital. Indeed, with discounting and common unit investment costs across periods, common productivity in both periods (i.e., $\gamma = 1/2$), and $S_1 = I_1$, later investments are preferred to early investments because it is cheaper to defer costs. Second period compensation for adverse environments will be efficient. Delaying all investments to the second period is optimal. However, if γ is close to 1 it may be very costly to remediate deficient first period investments. When $\gamma = 1$, it is impossible.

We develop some implications of complementarity and age-specific productivity in this paper for the general vector case in [Appendix A](#). We organize the evidence we present in this chapter around the concepts of self-productivity and complementarity. We introduce the notion of a skill multiplier in [Section 3.1](#). The available empirical evidence on human skill formation is consistent with both self-productivity and complementarity. These features of the technology of human skill formation explain why early interventions targeted towards disadvantaged young children are more effective than interventions given to older disadvantaged children, and why later investments yield higher returns for the more able.

The plan of this chapter is as follows. [Section 2](#) presents the evidence. [Section 3](#) presents simple formal models that summarize the evidence by using economic theory, applying the concepts of complementarity, self-productivity, and the derived investment multiplier. [Section 4](#) concludes the paper.

2. A summary of the empirical evidence on life cycle skill formation

2.1. Human capital accumulation

Skill formation is a dynamic process. The skills and abilities acquired in one stage of the life cycle affect the productivity of learning in the next stage. Human capital, as we define it in this chapter, consists of different types of skills and abilities. It is now well established that cognitive ability is an important determinant of schooling and labor market outcomes [see [Heckman \(1995\)](#)]. At the same time, noncognitive abilities, although harder to measure, play an important role as well [see the evidence in [Heckman, Stixrud and Urzua \(2006\)](#)]. As emphasized in recent studies of child development [e.g., [Shonkoff and Phillips \(2000\)](#)], different abilities are formed and shaped at different stages of the life cycle. Empirical evidence from human and animal species tells us that when the opportunities for formation of these abilities are missed, remediation can

be costly, and full remediation prohibitively costly [Cameron (2004), Knudsen (2004), Knudsen et al. (2006)]. These findings highlight the need for economists to take a comprehensive view of skill formation over the life cycle.

The dynamic feature of human capital accumulation has implications for how investments in human skills should be distributed over the life cycle. Figure 1A summarizes the major finding of an entire literature. It plots the rate of return to human capital at different stages of the life cycle for a person of given abilities. The horizontal axis represents age, which is a surrogate for the agent's stage in the life cycle of skill formation. The vertical axis represents the rate of return to investment assuming the same amount of investment is made at each age. This is an out-of-equilibrium productivity curve. *Ceteris paribus*, the rate of return to a dollar of investment made while a person is young is higher than the rate of return to the same dollar invested at a later age. Optimal investment profiles equate the marginal rate of return to investment with the opportunity cost of funds in all periods and for all persons, assuming that these investments are feasible. For an externally specified constant opportunity cost of funds r (represented by the horizontal line with intercept r in Figure 1A), an optimal investment strategy is to invest relatively less when a person is old and more at younger ages (see Figure 1B). For persons with higher "innate" ability (higher S_0 in the production technology of Section 1), both curves shift to the right.

Cognitive ability is only one aspect of S_0 . It is necessary for success in life, but for many aspects of performance in social life, it is not sufficient. Noncognitive abilities also matter for success both in the labor market and in schooling. Even when early childhood

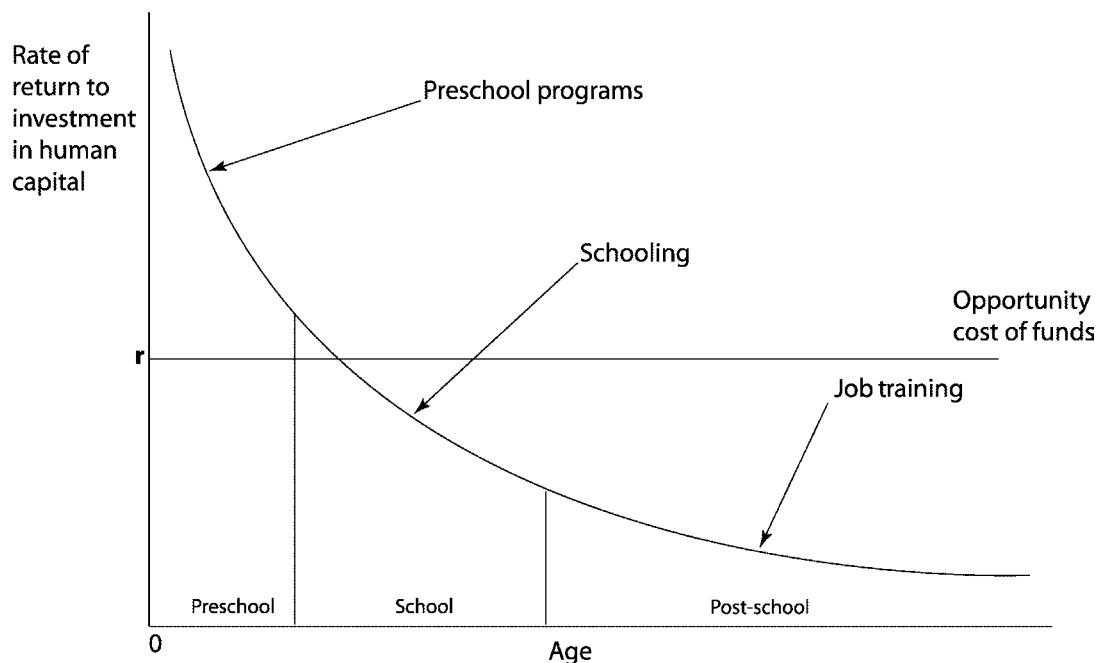


Figure 1A. Rates of return to human capital investment initially setting investment to be equal across all ages.

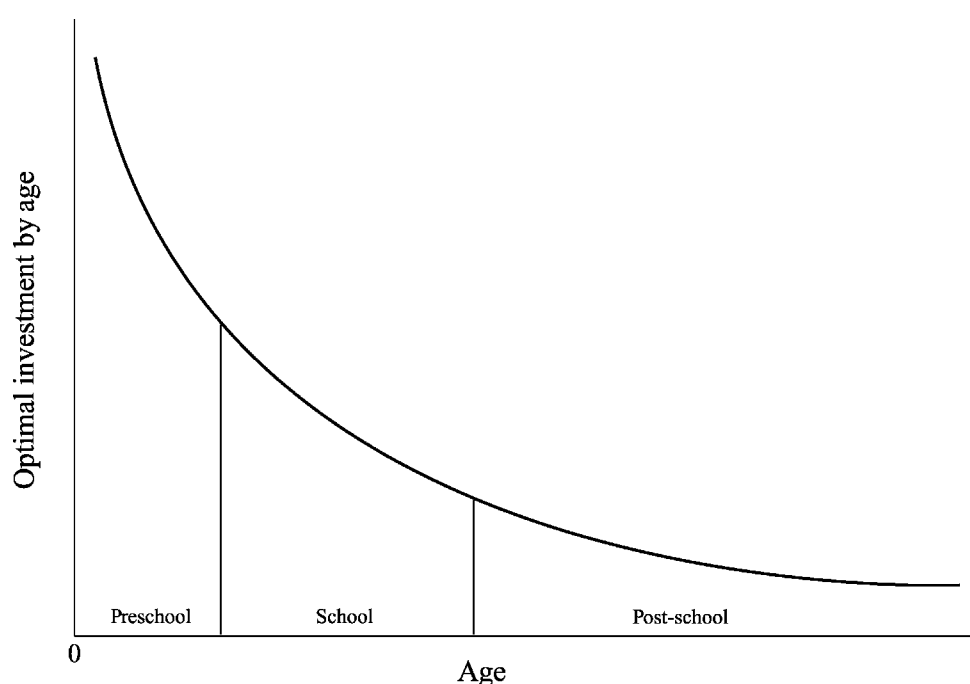


Figure 1B. Optimal investment levels.

interventions do not boost IQ, they improve noncognitive skills, with substantial effects on schooling, labor market outcomes, and behavioral outcomes such as teenage pregnancy and participation in criminal activities. They raise achievement test scores, which can be influenced by schooling (and other inputs), even when they do not boost IQ. In light of this evidence, the neglect of noncognitive ability in evaluating human capital interventions, and in formalizing the skill formation process, is unwarranted. We summarize the evidence on the importance of noncognitive skills in Section 2.3. For now, it will suffice to say that both types of skills or abilities are affected by families and schools, but they differ in their malleability over the life cycle. Differences in levels of cognitive and noncognitive skills by family income and family background emerge early and persist. If anything, schooling widens these early differences, but the main gaps in these skills that are found in adulthood emerge before schooling begins.

2.2. Early test score differentials

Important differences in the ability of children across family types appear at early ages and persist. Figure 2A plots average percentile ranks¹⁸ on the Peabody Individual

¹⁸ In constructing the graph in Figure 2A, we computed each individual's position in the distribution of test scores at each age. Then we divided individuals into different quartiles of permanent family income and computed the average percentile rank at each age. Because the scale of test scores is arbitrary, an analysis of test scores can only determine how the factors being studied shift people in the overall distribution of ability.

Achievement Test in Math (PIAT Math) by age for different quartiles of family income. This test is a measure of age-appropriate math knowledge. There are large gaps by the time children enter school. The gaps in ranks across income quartiles remain relatively stable as children develop. Such gaps also appear in other test scores, although for some test scores they widen slightly.¹⁹ Just as income gradients in schooling participation rates are evident, racial differences in early test scores also emerge. Figure 2B presents evidence on the emergence of racial gaps in ranks on the PIAT Math Test.

Ability affects schooling participation and affects wages as we document below. It is shaped early in life. The available evidence indicates that IQ is relatively more malleable early in the life cycle than in later years [see Shonkoff and Phillips (2000), and Carneiro and Heckman (2003)]. Having access to more and higher-quality resources that contribute to improving cognitive ability early in life affects skill acquisition later in life. IQ is not the same as what is measured by achievement tests. Achievement tests are affected by schooling and other environmental influences into adolescence even if IQ is not [see Hansen, Heckman and Mullen (2004), Heckman, Stixrud and Urzua (2006)].

Figures 3A and 3B present the gaps in PIAT Math from the previous two figures after controlling for some main features of the child's family background. The gaps across racial and income groups are significantly reduced when we control for maternal education and cognitive ability,²⁰ and for family structure. Measured long-term family factors

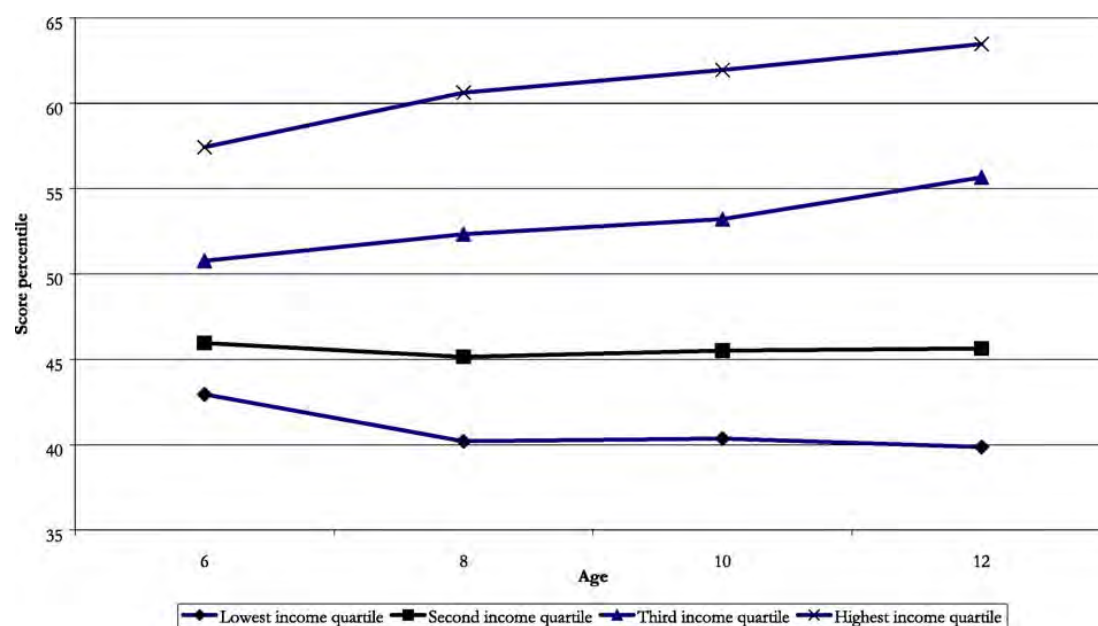


Figure 2A. Children of NLSY79. Average percentile rank on PIAT Math score, by income quartile.*

* Income quartiles are computed from average family income between the ages of 6 and 10.

¹⁹ For evidence on other tests, see Carneiro, Heckman and Masterov (2005).

²⁰ Cognitive ability is measured using the Armed Forces Qualifications Test, corrected for the effect of schooling using the methodology of Hansen, Heckman and Mullen (2004).

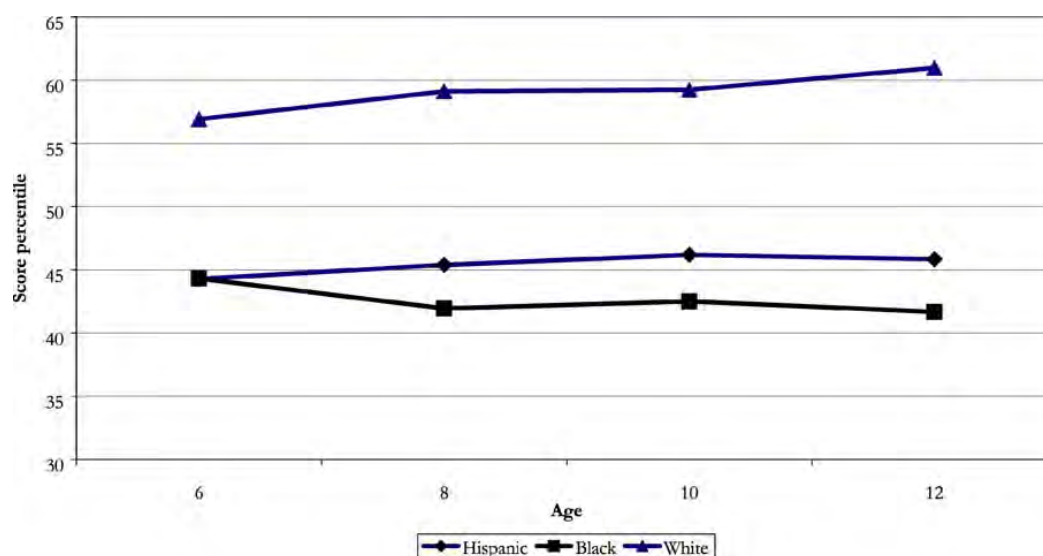


Figure 2B. Average percentile rank on PIAT Math score, by race.

play a powerful role in a correlational sense. The gaps at age 12 do not disappear entirely, however, when we compare the highest and lowest income quartiles or whites with blacks. The evidence from early intervention programs with randomized assignment that we discuss in Section 2.6 shows that these correlational results have a causal basis. When disadvantaged children are given enriched early environments, the gaps in academic achievement test scores between advantaged and disadvantaged children can be partially remedied.

The emergence of early test score gradients is not limited to cognitive measures. At early ages, differences in children's behavior across income and racial groups are also evident, as Figures 4A and 4B illustrate. These figures present differences in ranks on an index of Anti-Social Behavior across different income and racial groups. The Anti-Social Behavior index is based on exhibiting age-specific behaviors like cheating and telling lies, bullying and cruelty to others, not feeling sorry for misbehaving, breaking things deliberately, disobedience at school, and trouble getting along with teachers. High values of the index correspond to a higher prevalence of behavioral problems. As we discuss further in Section 2.3, understanding the gaps in these behavioral skills across different income and racial groups and how to eliminate them is important for understanding the determinants of economic success. Figures 5A and 5B present Anti-Social Behavior index adjusted for mother's ability, mother's score on the Armed Forces Qualification Test (AFQT), and broken home.²¹ Adjusting for early family background

²¹ We first regress the Anti-Social score on mother's education, mother's AFQT, and broken home at the same age at which the score is measured. We then rank individuals on the residuals of this regression and construct percentiles. We then include family income in the regression as well as the other variables mentioned above before taking the residuals and constructing the ranks.

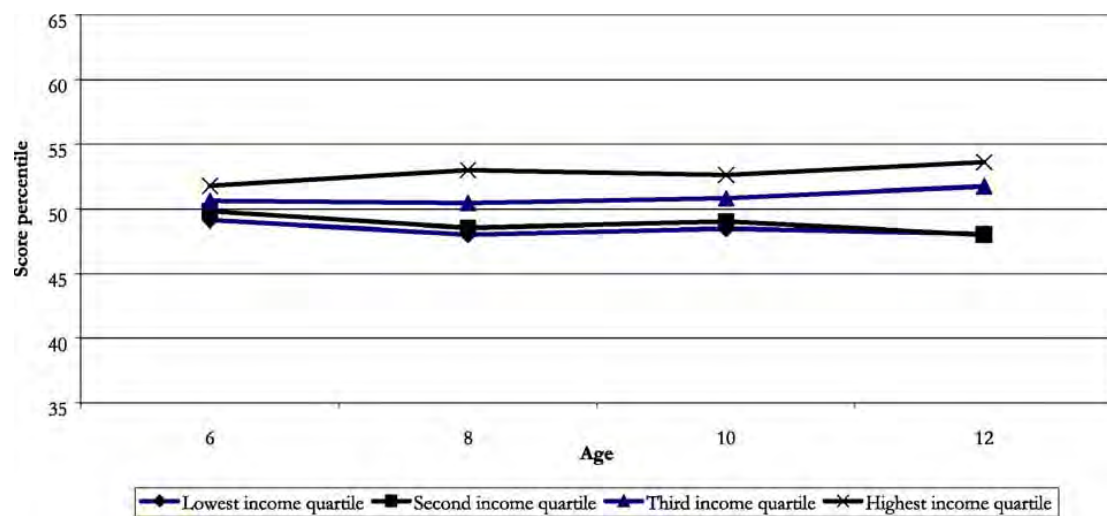


Figure 3A. Children of NLSY79. Adjusted average PIAT Math score percentiles by income quartile.*

* Adjusted by maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age.

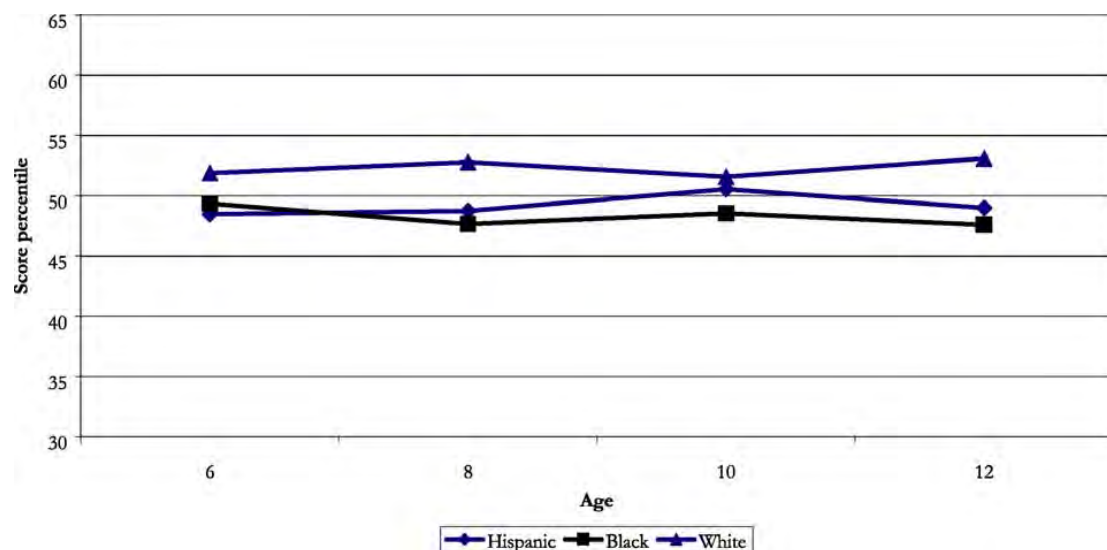


Figure 3B. Adjusted average PIAT Math score percentile by race.*

* Adjusted by maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age.

factors substantially reduces gaps in ranks in noncognitive skills across income and racial groups. Comparing adjusted cognitive and noncognitive test scores reveals the importance of long-term factors in reducing the gaps in behavioral scores across these groups. Although noncognitive ability gaps across income and racial groups cannot be fully eliminated by a regression adjustment, controlling for mother's ability and education, family income, and family structure significantly reduces the gaps in noncognitive

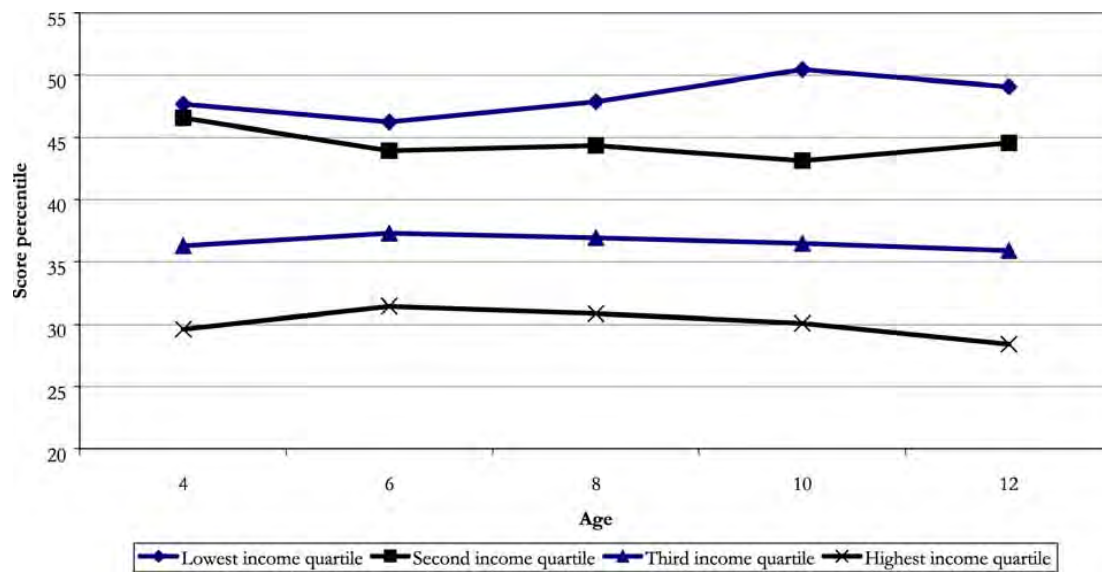


Figure 4A. Children of NLSY79. Average percentile rank on anti-social behavior score, by income quartile.

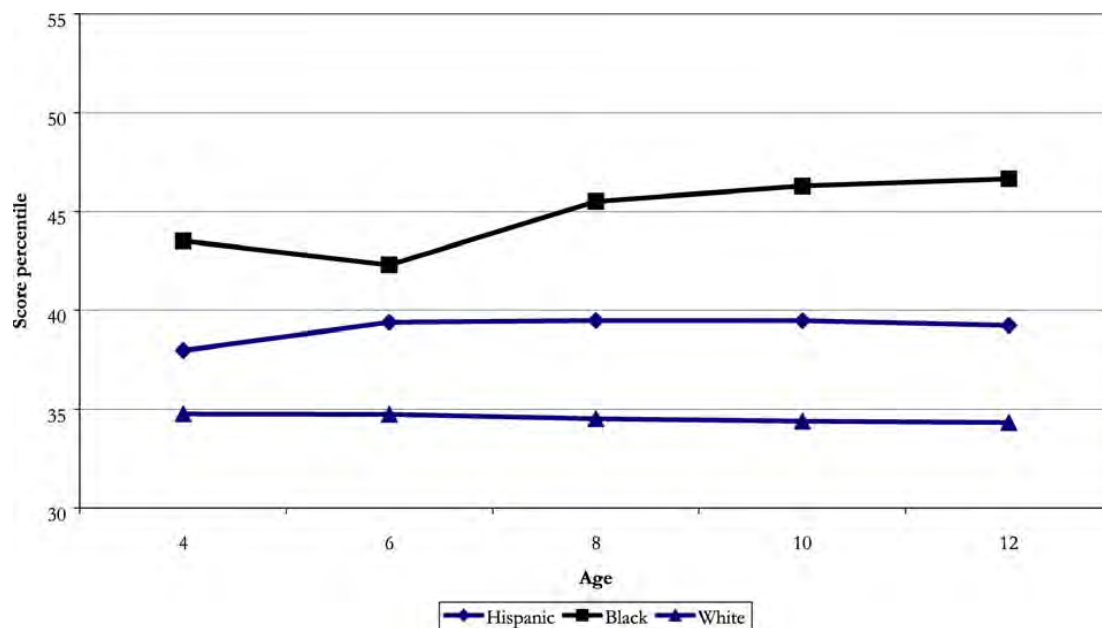


Figure 4B. Average percentile rank on anti-social behavior score, by race.

abilities across these groups at both early and later ages. The experimental evidence discussed in Section 2.6 confirms that these findings on noncognitive skills have a causal basis. Indeed, the evidence across a variety of studies suggests that early childhood interventions affect motivation and other noncognitive skills.

This evidence suggests that strong families (those with enriched parental environments) promote cognitive, social, and behavioral skills. Weak families do not. This

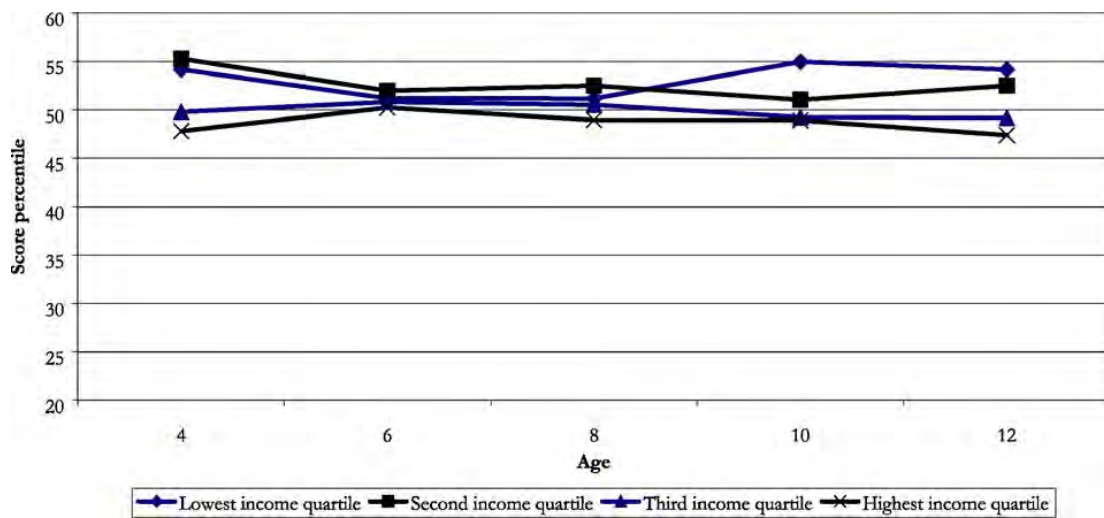


Figure 5A. Children of NLSY79. Adjusted average anti-social behavior score percentile by income quartile.*
 * Adjusted by maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age.

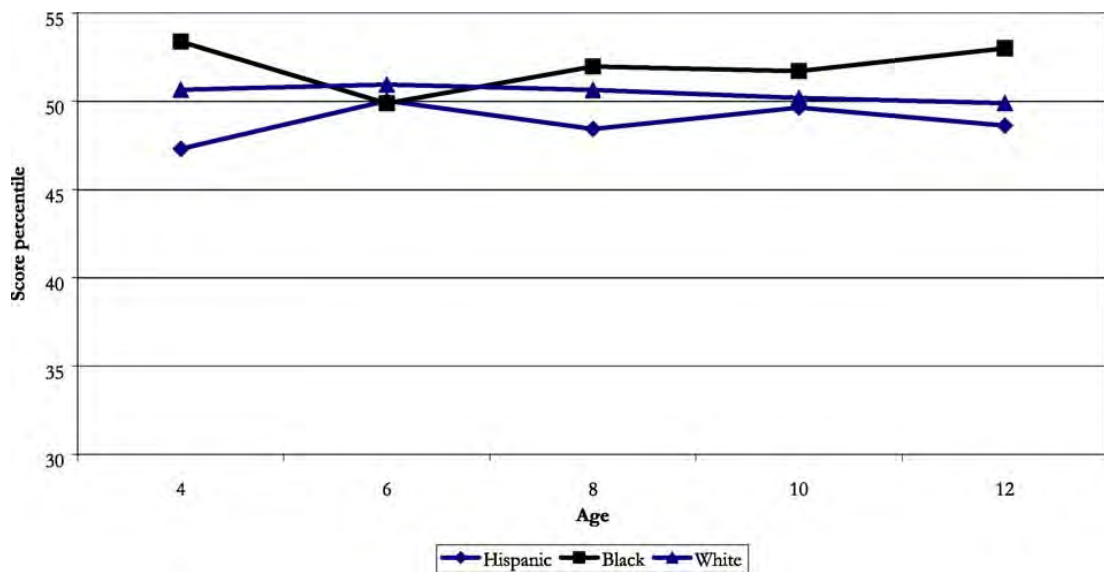


Figure 5B. Adjusted average anti-social behavior score percentile by race.*
 * Adjusted by maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age.

evidence is consistent with a large body of evidence in sociology and economics [see, e.g., [Duncan and Brooks-Gunn \(1997b\)](#)]. The relevant policy issue is to determine what interventions in dysfunctional families, if any, are successful. The evidence presented in Section 2.6 addresses this question.

2.3. The evidence on the importance of noncognitive skills

Much of the neglect of noncognitive skills in analyses of earnings, schooling, and other life outcomes is due to the lack of any reliable means of measuring them. Many different personality traits are lumped into the category of noncognitive skills. Psychologists have developed batteries of tests to measure these skills [Sternberg (1985)]. Companies use these tests to screen workers, but they are not yet widely used to ascertain college readiness or to evaluate the effectiveness of schools or reforms of schools. The literature on cognitive tests ascertains that one dominant factor (g) summarizes cognitive tests and their effects on outcomes. No single factor has emerged as dominant in the literature on noncognitive skills and it is unlikely that one will ever be found, given the diversity of traits subsumed under the category of noncognitive skills. Heckman, Stixrud and Urzua (2006), test and reject the g theory of noncognitive skills.

Studies by Bowles and Gintis (1976), Edwards (1976), and Klein, Spady and Weiss (1991) demonstrate that job stability and dependability are the traits most valued by employers as ascertained by supervisor ratings and questions of employers, although they present no direct evidence of the effects of these traits on wages and educational attainment. Perseverance, dependability and consistency are the most important predictors of grades in school [Bowles and Gintis (1976)].

Self-reported measures of persistence, self-esteem, optimism, future orientedness, and the like are now collected in major data sets, and some recent papers discuss estimates of the effects of these measures on earnings and schooling outcomes [see Bowles and Gintis (1976), Duncan, Claessens and Engel (2004)]. These studies shed new light on the importance of noncognitive skills for success in social life. Yet these studies are not without controversy. For example, *ex post* assessments of self-esteem may be as much the consequence as the cause of the measures being investigated.

Heckman and Rubinstein (2001) avoid the problems inherent in these *ex post* assessments by using evidence from the GED testing program in the United States to demonstrate the quantitative importance of noncognitive skills in determining earnings and educational attainment. The GED program is a second-chance program that administers a battery of cognitive tests to self-selected high school dropouts to determine whether or not their level of academic attainment is equivalent to that of high school graduates.

The GED examination is successful in psychometrically equating GED test takers with ordinary high school graduates who do not go on to college. Recipients are as smart as ordinary high school graduates who do not go on to college, where cognitive ability is measured by an average of cognitive components of the AFQT or by the first principal component (g) derived from the components. According to these same measures, GED recipients are smarter than other high school dropouts who do not obtain a GED [see Heckman and Rubinstein (2001)]. In the raw data, GED recipients earn more than ordinary high school dropouts, have higher hourly wages, and finish more years of high school before they drop out. This is entirely consistent with the literature that emphasizes the importance of cognitive skills in determining labor market outcomes.

When measured ability is controlled for, however, GED recipients earn the same as or less than other dropouts. Heckman and Rubinstein (2001) note that noncognitive skills play an important role in this gap. GEDs have higher cognitive skills than dropouts but exhibit the same problems of self control and self discipline exhibited by dropouts, and on some behaviors are worse than other dropouts.

Heckman, Stixrud and Urzua (2006) and Urzua (2006) present evidence that both cognitive and noncognitive skills affect schooling and the returns to schooling.²² They analyze the changes in the probabilities of various outcomes that arise from changing cognitive or noncognitive abilities. Figures 6A and 6B, taken from their 2006 study, shows that both higher levels of cognitive and noncognitive skills are associated with lower rates of attrition from high school. For many outcome measures, increasing noncognitive ability over the same decile range as cognitive ability has a greater effect on outcomes than increasing cognitive ability over the same decile range. These effects are not always uniform across genders.²³

Increasing noncognitive ability to the highest level reduces the probability of being a high school dropout to virtually zero for females with average cognitive ability (see Figure 6B).²⁴ This effect is especially pronounced at the bottom of the distribution (going up from the bottom fifth). The effect is less strong for males. Both cognitive and noncognitive skills are strong predictors of who graduates from a four year college but the effects of noncognitive skills are stronger for females (see Figures 6C and 6D). Increases in both types of ability have the same effect on reducing the likelihood of spending time in jail by age 30 for males (see Figure 6E).²⁵ Figures 6F and 6G show strong effects of both cognitive and noncognitive skills on smoking. Here there is a larger effect for males of increasing noncognitive ability. Figure 6H shows the strong effect of both cognitive and noncognitive skills on non-marital

²² Cognitive and noncognitive abilities are estimated using a two-factor model and the NLSY79 data. The cognitive skill is identified by using a subset of five Armed Forces Vocational Aptitude Battery (ASVAB) tests (word knowledge, paragraph comprehension, numerical operations, coding speed and mathematics knowledge). The noncognitive factor is identified using the Rosenberg Self-Esteem and Rotter Locus of Control scales. The Rosenberg scale contains ten statements of self-approval and disapproval with which respondents are asked to strongly agree, agree, disagree or strongly disagree. A high score indicates a high self-approval rating. The Rotter scale is based on four questions about the extent to which respondents believe themselves to have control over the various domains of their lives. A higher score indicates more control over one's life. All tests were administered in 1979–1981, when the respondents were 14–24 years old. The estimation of the model is carried out using an MCMC routine. Heckman, Stixrud and Urzua use only the young sample to analyze the data (the scores are measured at least 3–4 years before the outcomes). They also show results from other data sets where the separation between the age of the test and the outcome is more substantial, and they find very similar results. They apply the method developed in Hansen, Heckman and Mullen (2004) to account for spurious feedback between outcomes and test scores.

²³ Heckman, Stixrud and Urzua (2006) show how this nonuniformity in the effects of cognitive and noncognitive skills on outcomes across genders can explain the differential effectiveness of early intervention programs across genders.

²⁴ Heckman, Stixrud and Urzua (2006) show the same patterns apply to college attendance.

²⁵ Incarceration is not an important phenomenon for females.

pregnancy. For this outcome both cognitive and noncognitive ability are important.²⁶ Higher levels of noncognitive skills promote success on achievement tests even when they do not affect IQ. This effect operates because noncognitive skills affect schooling and schooling raises measured achievement [Hansen, Heckman and Mullen (2004), Heckman, Larenas and Urzua (2004)]. Responses to changes in cognitive and noncognitive skills are not always uniform across genders.

Current systems of evaluating educational reforms are based predominantly on changes in scores on cognitive tests. These tests capture only one of the many skills required for a successful life [see Heckman (1999)]. A more comprehensive evaluation of educational systems would account for their effects on producing the noncognitive traits that are also valued in the market. There is substantial evidence that mentoring and motivational programs oriented toward disadvantaged teenagers are effective. We review this evidence in Section 2.6.

Much of the effectiveness of early childhood interventions comes from boosting noncognitive skills and from fostering motivation.²⁷ While IQ is fairly well set after the first decade of life, motivation and self-discipline are more malleable at later ages [Heckman (2000)]. More motivated children are more likely to stay in school and have higher achievement tests. Our analysis suggests that social policy should be more active in attempting to alter noncognitive traits, including values, especially for children from disadvantaged environments who receive poor discipline and little encouragement at home. This more active social policy approach would include mentoring programs and stricter enforcement of discipline in the schools. Although such programs are controversial, they are likely to be effective and to produce substantial saving to society from reduced pathological behavior (see Section 2.6).

We now turn to some evidence from animal and human populations that bolsters our case that early factors matter and socioemotional skills, shaped at an early age, also matter.

2.4. Critical periods, sensitive periods, and socioemotional bases of skill formation and remediation

Early experience exerts a profound influence on socioemotional outcomes directly, but it also interacts with genetic endowments, with consequences that are at least as important for development.²⁸ Experimental studies using animals have produced several suggestive findings that enhance our understanding of the evidence on human behavior.

²⁶ Heckman, Stixrud and Urzua (2006) show the same pattern for other reproductive outcomes, such as marital childbearing.

²⁷ See Karoly et al. (1998), Currie and Blau (2006), and Heckman (2000) for comprehensive reviews of the literature.

²⁸ A twins study by Turkheimer et al. (2003) found that in poor families, 60% of the variance in IQ is accounted for by the shared environments, and the contribution of genes is close to zero, whereas in wealthy families a nearly opposite result is found.

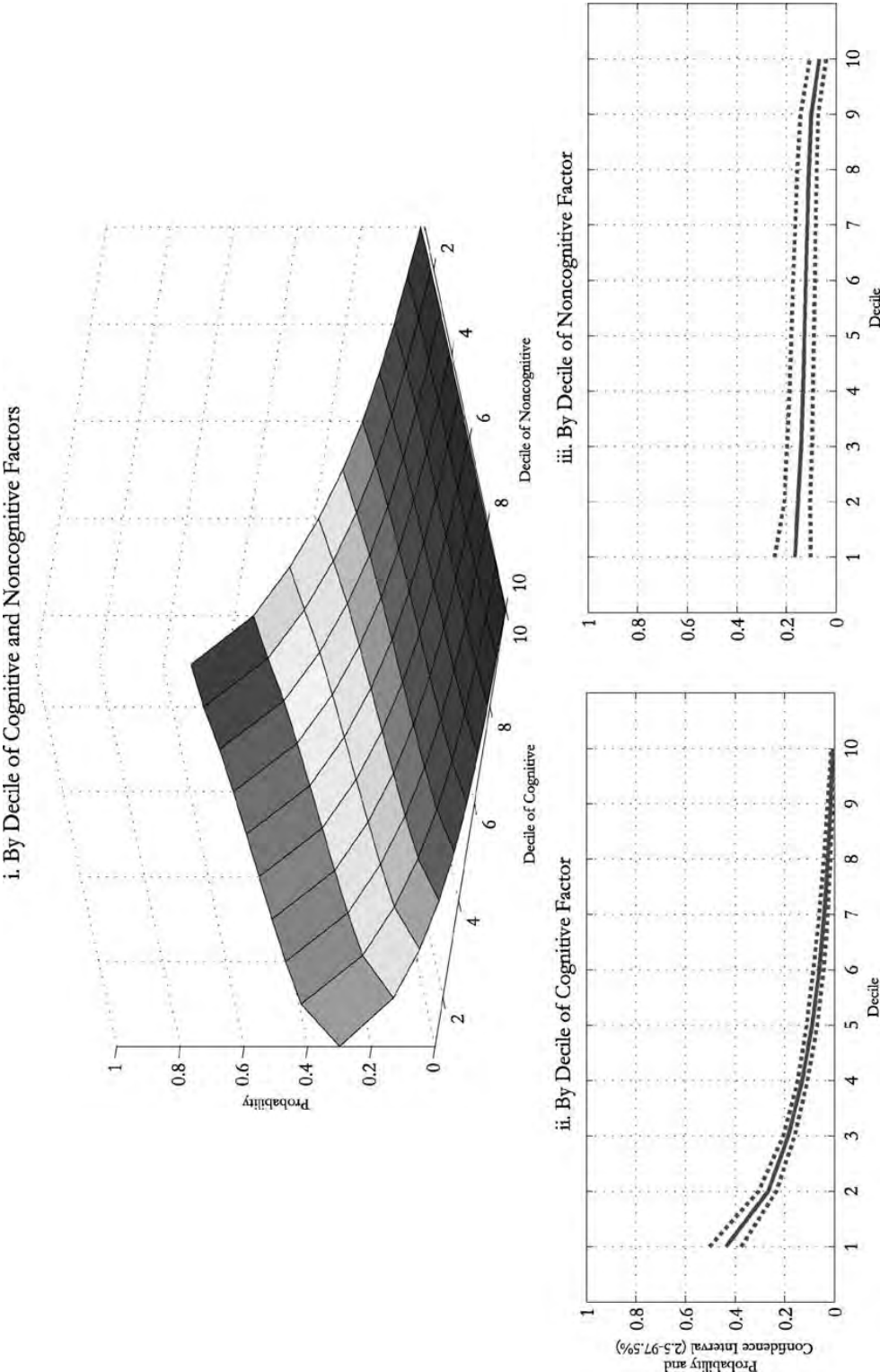


Figure 6A. Probability of being a high school dropout by age 30 – males.
Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

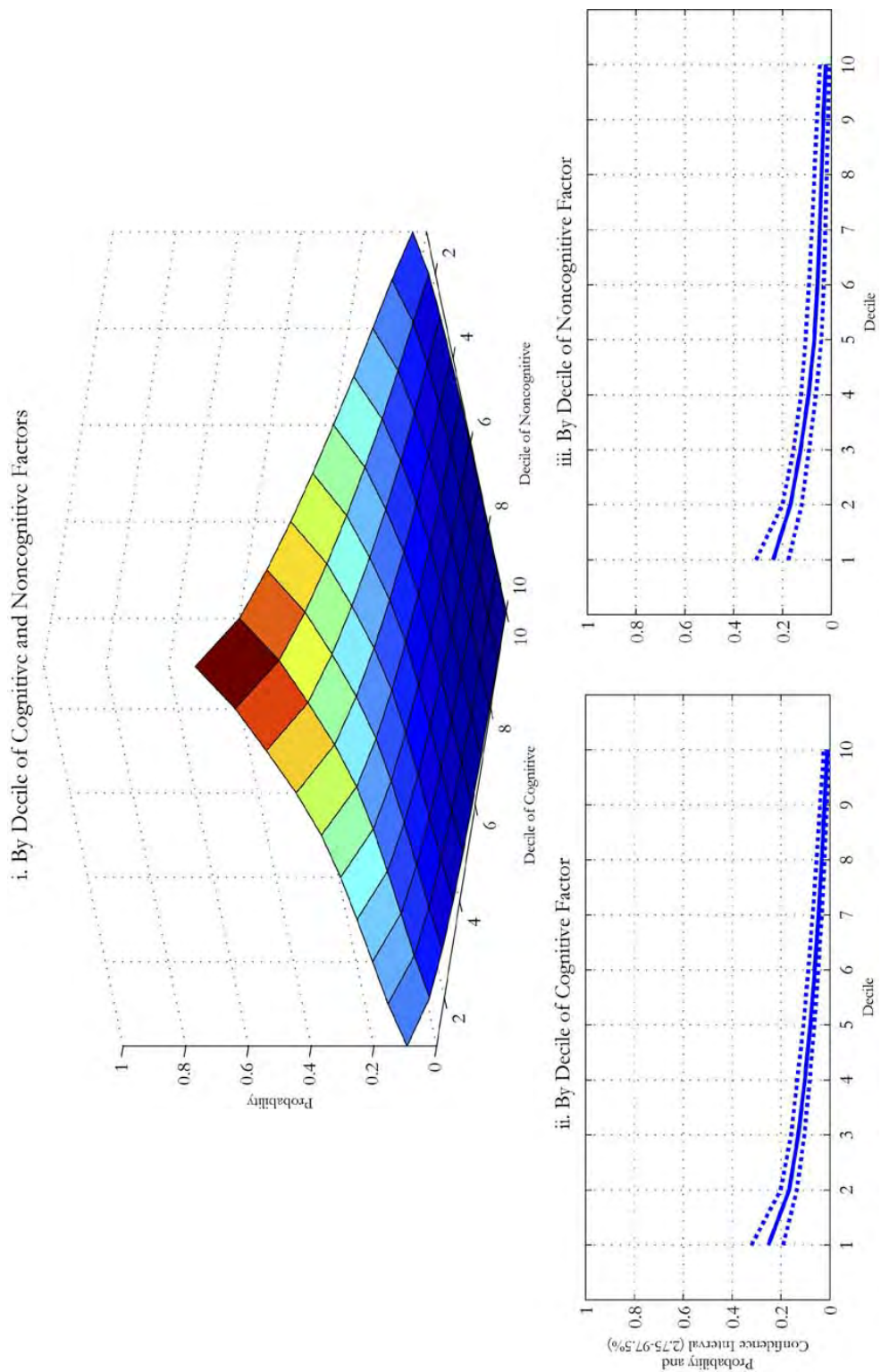


Figure 6B. Probability of being a high school dropout by age 30 – females.
Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

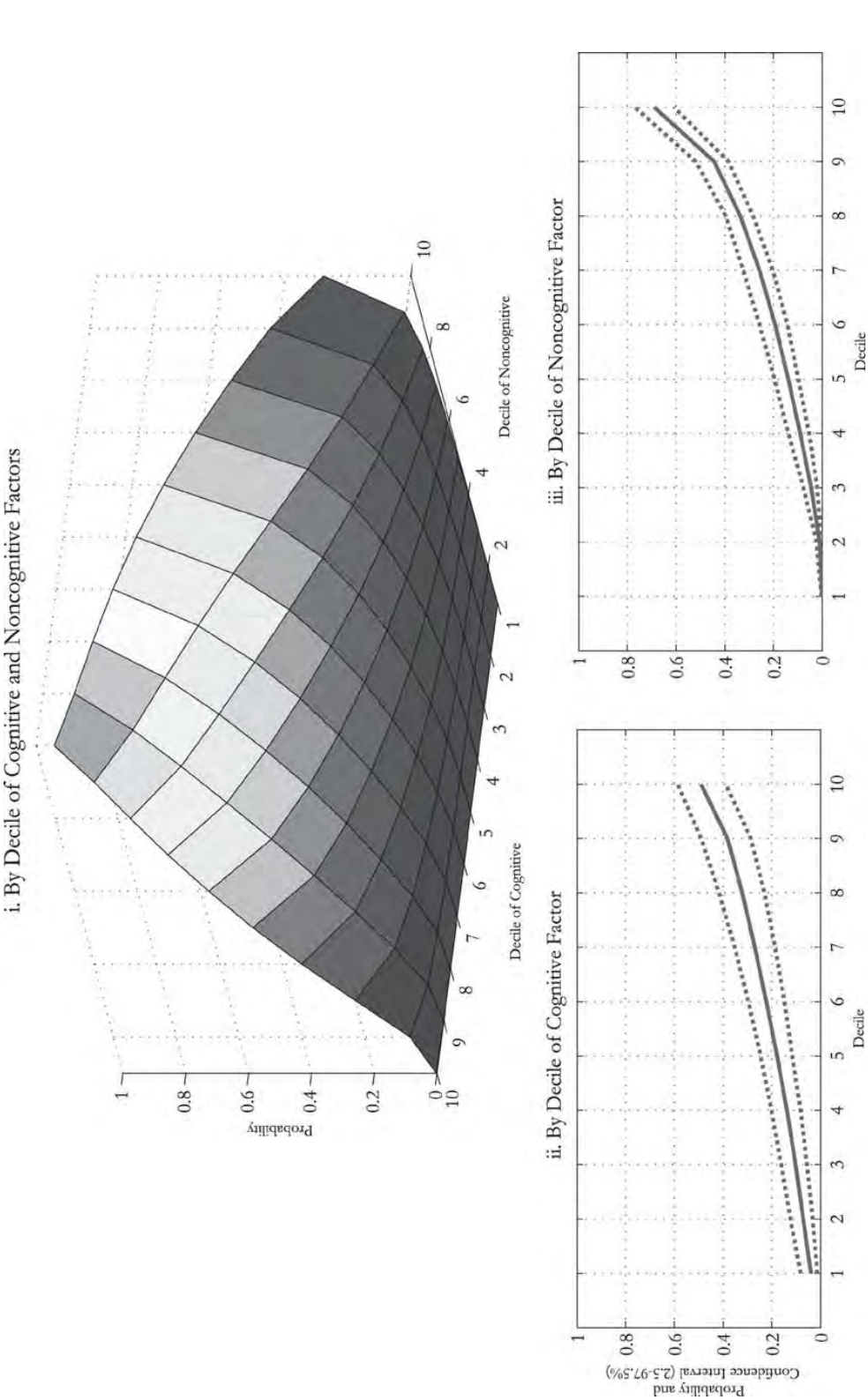


Figure 6C. Probability of being a 4-yr college graduate by age 30 – males.

Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

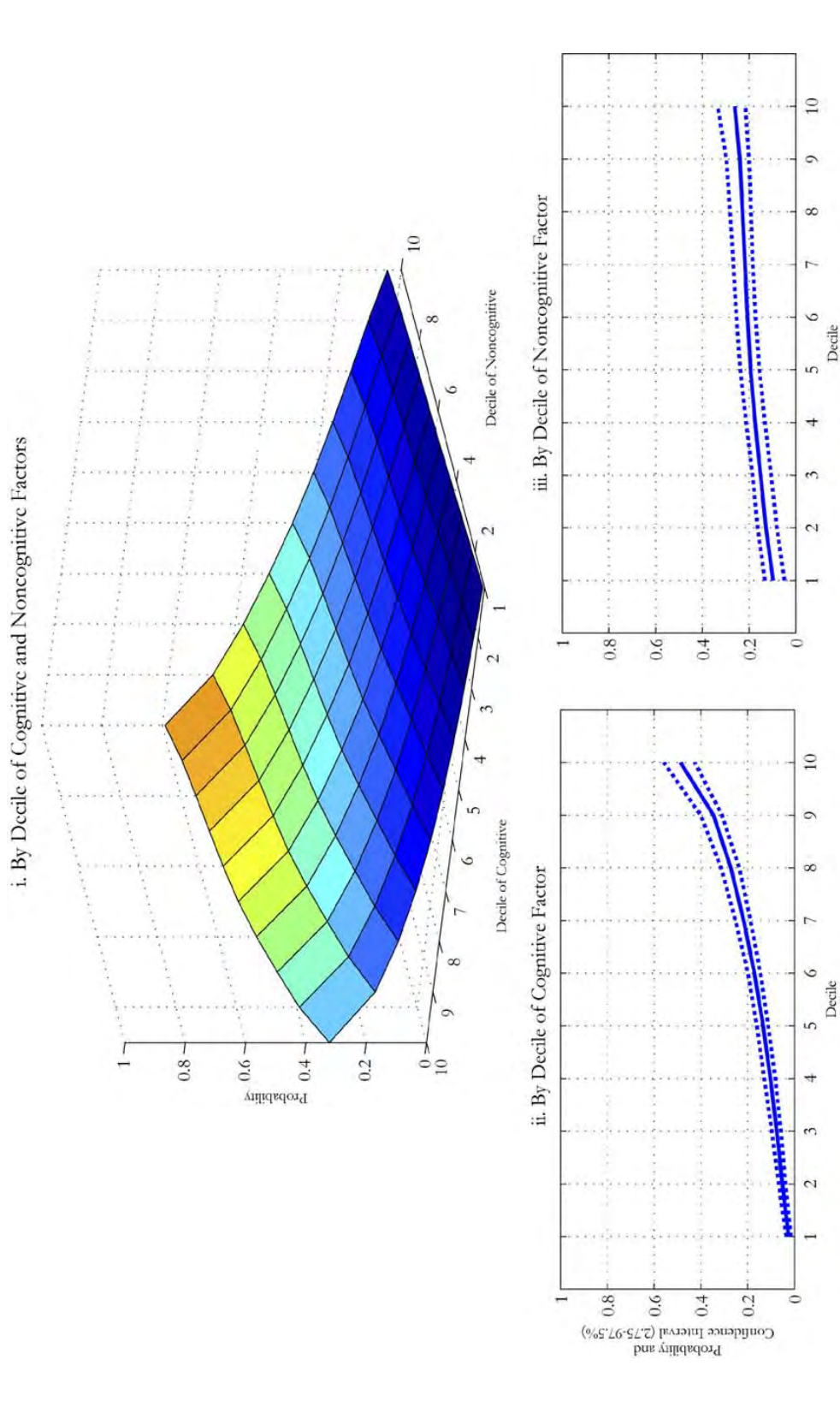


Figure 6D. Probability of being a 4-yr college graduate by age 30 – females.

Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

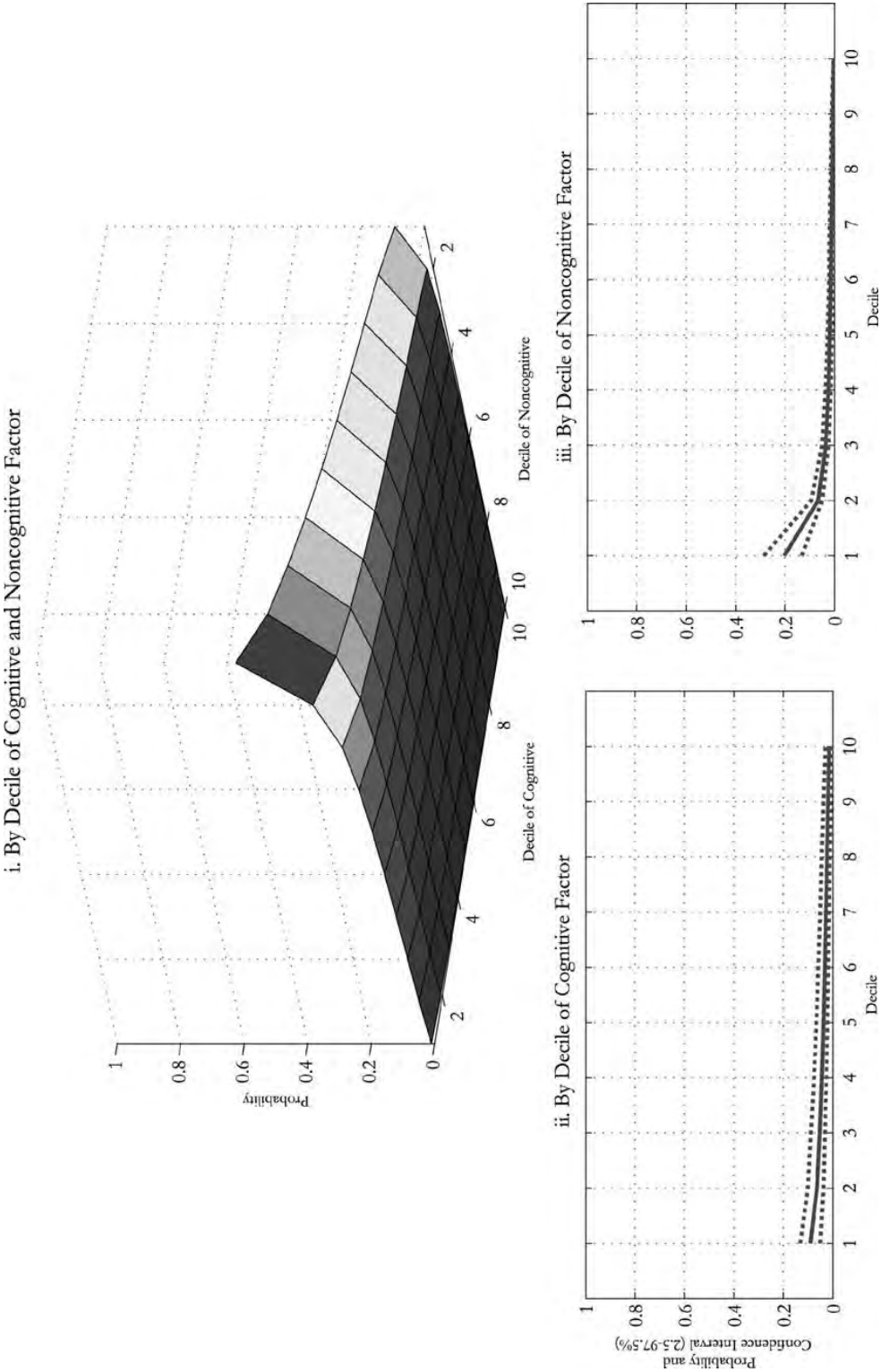


Figure 6E. Probability of incarceration by age 30 – males.

Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

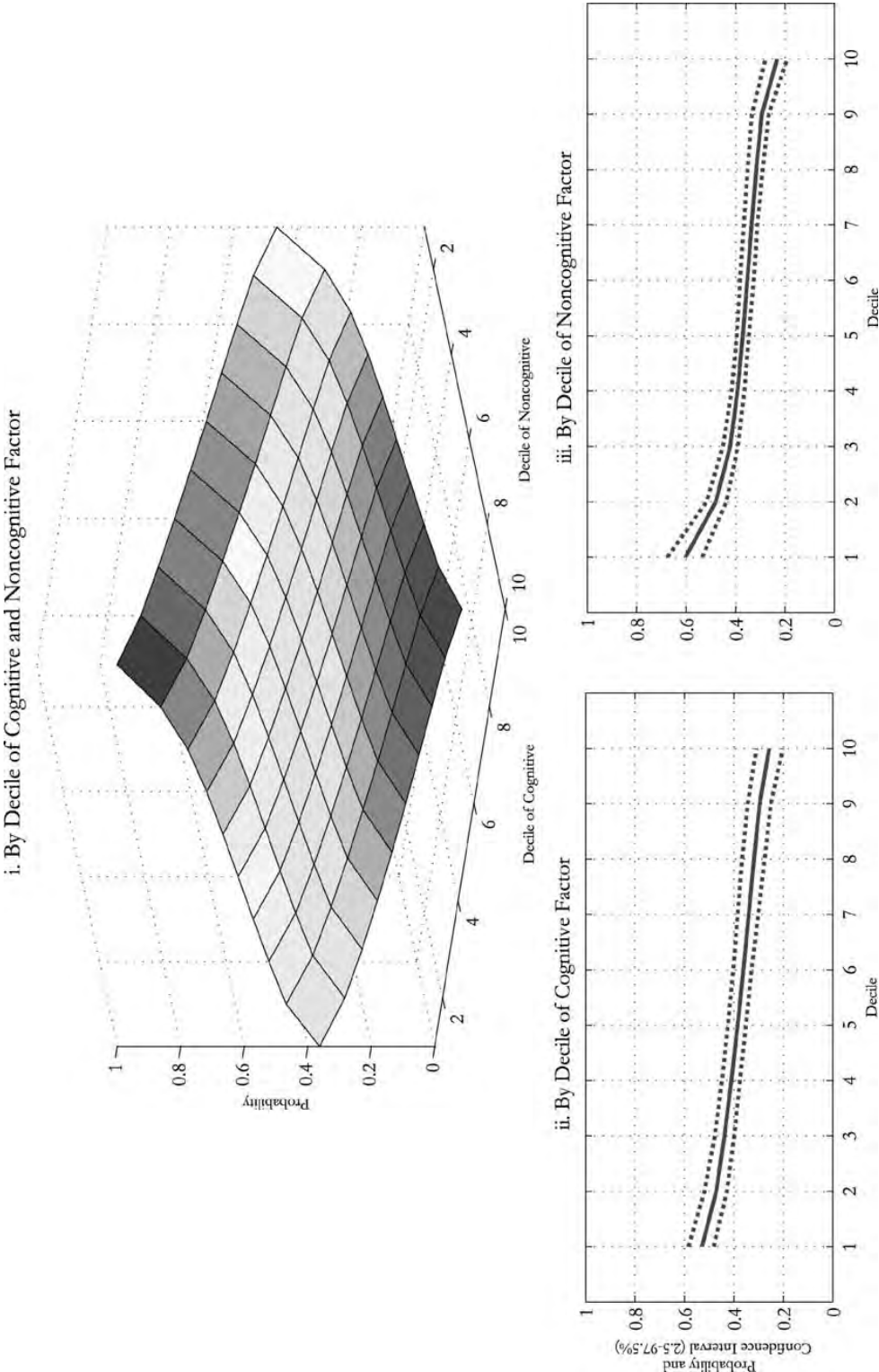


Figure 6F. Probability of daily smoking by age 18 – males.
Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

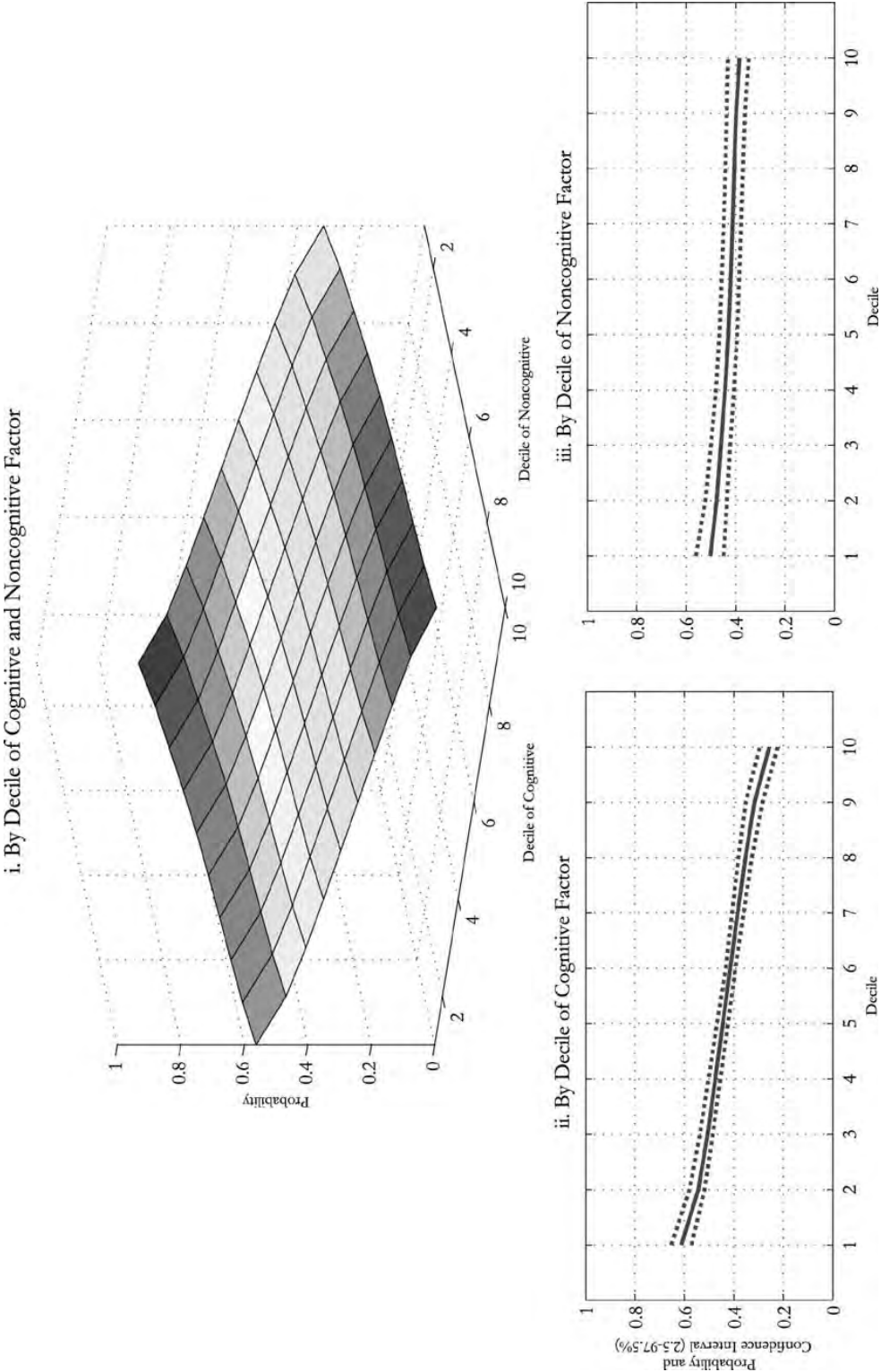


Figure 6G. Probability of daily smoking by age 18 – females.

Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: Heckman, Stixrud and Urzua (2006).

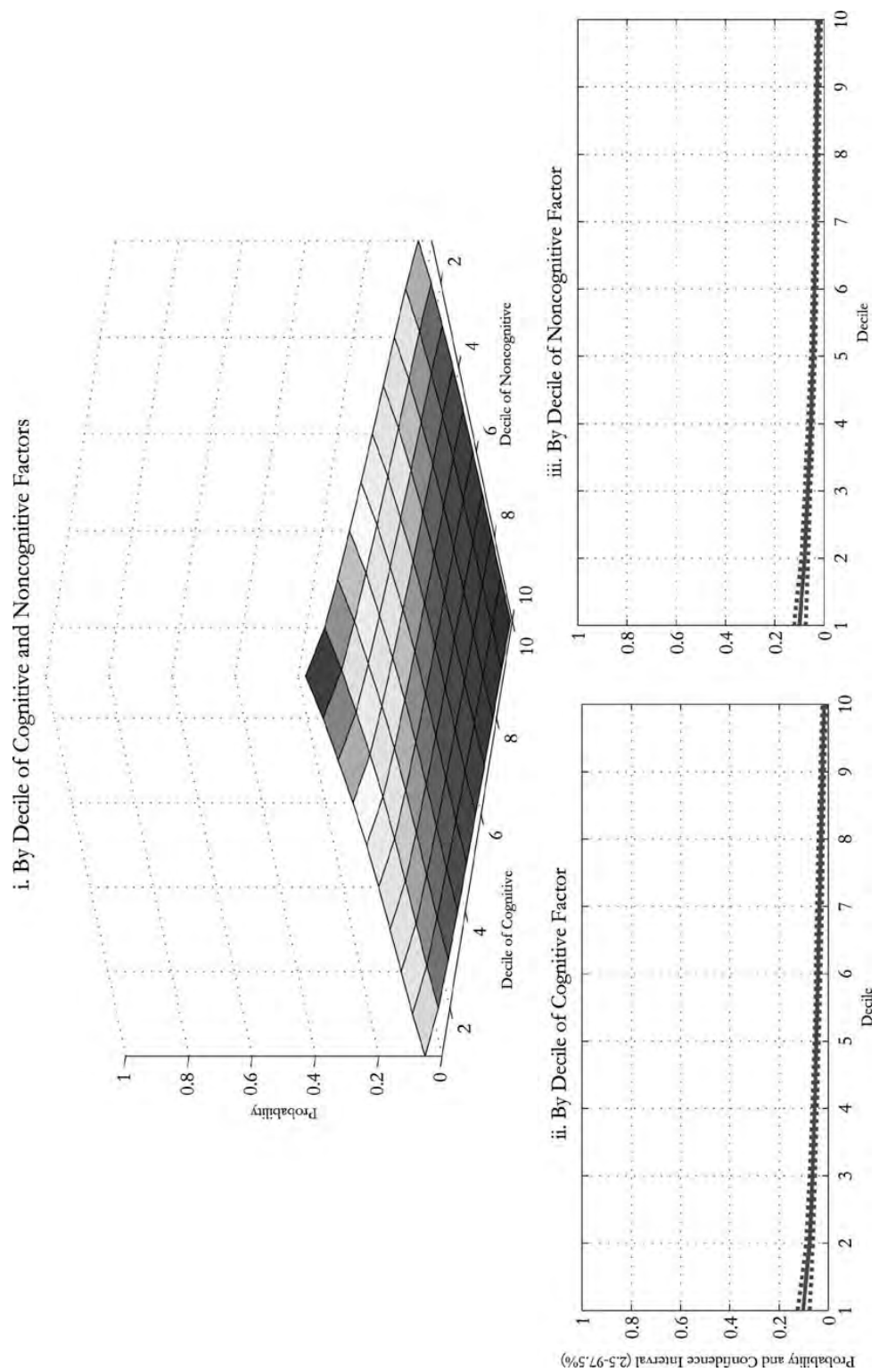


Figure 6H. Probability of being single with child at age 18 – females.
Notes: The data are simulated from the estimates of the model and our NLSY79 sample. We use the standard convention that higher deciles are associated with higher values of the variable. The confidence intervals are computed using bootstrapping (200 draws). Source: [Heckman, Stixrud and Urzua \(2006\)](#).

Suomi (1999) provides a summary of his research on the malleability of temperament. He and his colleagues selectively bred rhesus monkeys to be highly fearful. They then reassigned some of these infants to nurturing mothers, while pairing some infants of normal mothers with fearful adoptive mothers. Their results suggest that normal infants take on their foster mother's fearful characteristics. Infants born to fearful mothers assigned to nurturing mothers become even more socially precocious than their normal counterparts. They engage in autonomous exploration of their environment earlier and more frequently, and they do not display disproportionate responses to minor alarming stimuli. When they are moved into larger social groups, they are able to recruit allies and attain higher positions in the monkey hierarchy. Regardless of their genetic background, young females acquired the nurturing style of their adoptive mother with their own offspring rather than the style predicted by their genetic profile or own biological mother's behavior. These results suggest that positive early experiences can dramatically modify genetic tendencies, as expressed in behavior. Knudson et al. (2006) review the evidence from animal and human studies.

Knudsen (2004) shows that early experience can modify the biochemistry and architecture of neural circuits. When such experiences operate within a *limited* time frame in the life cycle, that period is termed "sensitive." During a sensitive period, certain patterns of connectivity among neurons become stable as a result of environmental influence. This stability is environmentally adaptive.²⁹ These pathways can be altered after the sensitive period, but their plasticity is limited by the structure created during the sensitive period, i.e., it is less efficient to invest in later periods. When experience in a given period is crucial for normal development, that period is called "critical." We formally define sensitive and critical periods in Section 3. Intuitively, if late investment is a good substitute for early investment, the early years are not critical. If it is not a good substitute, then the early period is critical.

Critical periods have been extensively documented in the development of binocular vision in the cortex of mammals, auditory space processing in the midbrain of barn owls, filial imprinting in the forebrain of ducks and chickens, and song learning in the forebrain of songbirds [see Knudsen (2004)]. For our purposes, the most relevant example is language acquisition and the fact that children tend to perform better in acquiring language skills than do adults, despite being more limited in most cognitive domains. Age of exposure to a language is negatively related to ultimate proficiency achieved in that language [see Newport (2002), for a summary of the evidence]. The decline in proficiency begins as early as 4 and 6, and continues until a plateau is reached in adulthood. This pattern is evident for many aspects of language proficiency, such as control over sounds as well as grammatical structure, and has been shown for both first

²⁹ Knudsen (2004) argues that experience provides information about the individual and his environment that cannot be predicted accurately and, therefore, cannot be encoded genetically. This may explain why the early experience of deprivation may result in maladaptive development and corresponding behavior. In some sense, the adaptation may only be adaptive locally, rather than globally.

and second languages.³⁰ However, not all aspects of language acquisition are equally sensitive. Newport (2002) cites evidence that the acquisition of vocabulary and semantic processing can be accomplished relatively easily even in adulthood, while the more formal dimensions of language (such as syntax, phonology, and morphology) are less easily acquired. These differences are apparent even on a neurological level. In short, both critical and sensitive periods are features of language learning.

Other types of social behavior are characterized by sensitive and critical periods. Independent research by Cameron (2004) suggests that development of normal social behavior in infant rhesus monkeys can be disrupted by removing the mother from the social group. When mothers and infants are separated when the infants are one week old, their subsequent adult behavior is profoundly antisocial, anxious, and aggressive. When the disruption takes place at a later age, the effects are qualitatively different and their severity declines with age at separation. The impact on the youngest monkeys can be offset by pairing them with an experienced mother, but the degree of catch-up decreases with the age at which the “foster” placement takes place. Remediation is possible, though its timing is crucial.

The monkeys who are emotionally secure explore more and learn more. This evidence shows how noncognitive skills feed into the formation of cognitive skills. It helps to explain how the Perry Preschool Program, discussed in Section 2.6, which did not raise IQ but raised noncognitive skills, affected achievement test outcomes. We formalize the notion of critical and sensitive periods in Section 3 and in Appendix A to this paper. Closely related is the concept of a “bottleneck” period. If skills at one stage of the life cycle are not formed at a sufficiently high level, it is difficult to proceed to excellence at the next stage. The Leontief technology discussed in Section 3.1 crystallizes this point.

It is important to understand how families invest in their children and why many youth do not pursue a higher education despite the purportedly high returns. As we discuss next, children from disadvantaged families often reach college-going ages without adequate preparation or skills to make college attendance worthwhile. We turn to a discussion of the importance of credit constraints and other long-term family factors on adolescent schooling decisions.

2.5. Interpreting the role of family income: The evidence on credit constraints

There is a strong relationship between family income and college attendance. Figure 7 displays aggregate time series of college participation rates for eighteen- to twenty-four-year-old American males classified by their parental income measured in the child’s late adolescent years. There are substantial differences in college participation rates across family income classes in each year. The cross sectional pattern of schooling attendance by family income levels that is evident in this figure is found in many other

³⁰ The age-of-exposure effect appears even in the grammatical skills of deaf adults who learn sign language. See Pinker (1994) and Newport (2002) for more on this topic.

countries [see the essays in Blossfeld and Shavit (1993)]. In the late 1970s or early 1980s, college participation rates began to increase in response to increasing economic rates of return to schooling, but only for youth from the top family income groups. With a lag, children from other groups also responded, but the gaps in rates did not close. This differential educational response by income class threatens to perpetuate or widen income inequality across generations and among racial and ethnic groups. See Figure 8 for the time-series evidence on college attendance rates by race.

There are two different, but not necessarily mutually exclusive, interpretations of this evidence. The common and more influential one is the most obvious one. Credit constraints facing families in a child's adolescent years affect the resources required to finance a college education. A second interpretation emphasizes the long-run factors associated with higher family income. It notes that family income is strongly correlated over a child's life cycle. Families with high income in a child's adolescent years are more likely to have high income before that period. Higher levels of family resources in a child's formative years are associated with higher quality education and better environments that foster cognitive and noncognitive skills.

Both interpretations of the evidence are consistent with a form of credit constraint. The first, more common interpretation, is clearly compatible with this point of view. But the second interpretation is consistent with another type of credit constraint: the inability of a child to buy the parental environments and genes (or their substitutes) that form the

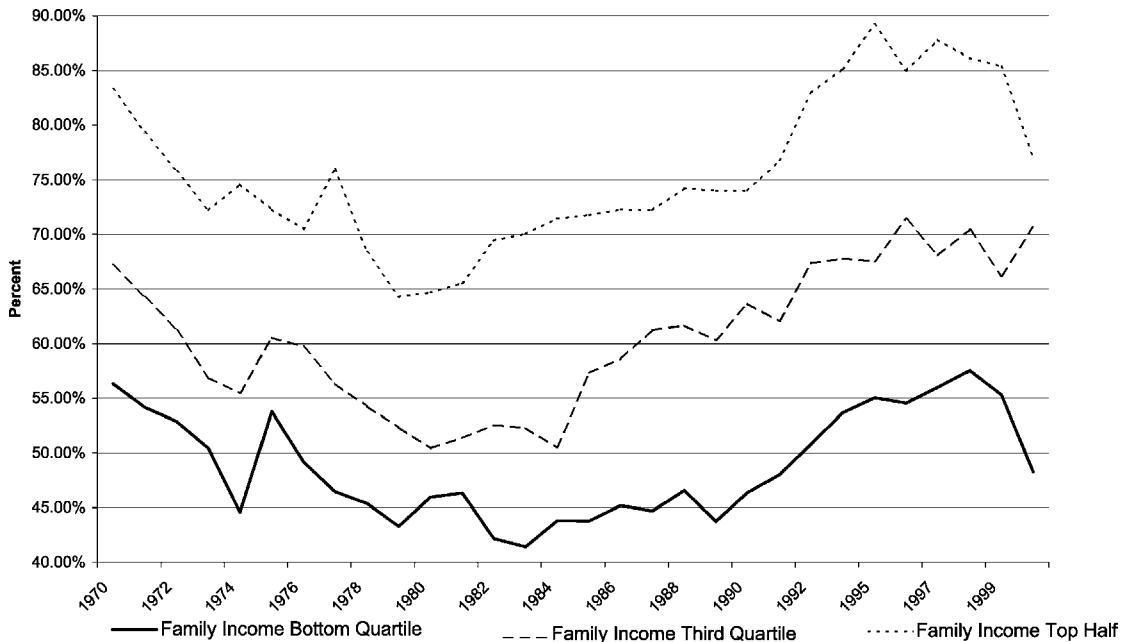


Figure 7. College participation, 18 to 24 yrs, HS graduates and GED holders. Dependent* White Males. Source: These number were computed from the CPS P-20 School Reports and the October CPS.

* Dependent is living at parental home or supported by parental family while at college.

cognitive and noncognitive abilities required for success in school. Some parents may never earn enough to provide the best developmental environments for their children.

Carneiro and Heckman (2002, 2003) argue on quantitative grounds that the inability of a child to acquire the family resources provided to children by wealthy families is the most important factor underlying Figure 7. After controlling for the ability formed by the early teenage years, they show that parental income in the adolescent years plays only a minor role in explaining college enrollment decisions. The evidence from the U.S. presented in their research suggests that at most 8 percent of American adolescents are affected by short-term liquidity constraints that inhibit their participation in post-secondary schooling. Most of the family income gap in enrollment is due to long-term factors that produce the abilities needed to benefit from participation in college.

The evidence reviewed here suggests that the first-order explanation for gaps in enrollment in college by family income is long-run family factors that are crystallized in ability. Short-run income constraints affecting families during the child's college-going years play a role in creating these gaps, albeit a quantitatively minor one. There is scope for intervention to alleviate these short-term constraints and the returns to carefully targeted interventions are potentially high. One should not expect to reduce the enrollment gaps evident in Figure 7 substantially by eliminating such constraints.



Figure 8. College participation by race. Dependent* high school graduates and GED holders. Males, ages 18–24.

Note: Three-year moving averages are shown. Source: These number were computed from the CPS P-20 School Reports and the October CPS.

* Dependent is living at parental home or supported by parental family while at college.

2.5.1. *Family income and enrollment in college*

The argument that short-term family credit constraints are the most plausible explanation for the relationship depicted in [Figure 7](#) starts by noting that human capital is different from physical capital. There is no asset market for human capital. People cannot sell rights to their future labor earnings to potential lenders to secure financing for their human capital investments in the way that indentured servants once financed the cost of travel to the New World with their labor. Even if they could, there would be substantial problems in enforcing performance of contracts on future earnings given that persons control their own labor supply and the effort and quality of their work. The lack of collateral on the part of borrowers and the inability to monitor effort by lenders are widely cited reasons for current large-scale government interventions to finance education.

If people had to rely on their own resources to finance all of their schooling costs the level of educational attainment in society would be much lower. To the extent that subsidies do not cover the full costs of college tuition, persons are forced to raise funds to pay tuition through private loans, through work while in college, or through foregone consumption [see [Keane and Wolpin \(2001\)](#)]. Such constraints may affect the choice of college quality, the content of the educational experience, the decision of when to enter college, the length of time it takes to complete schooling, and even graduation from college. Children from families with higher incomes have access to resources that are not available to children from low-income families; although children from higher-income families still depend on the good will of their parents to gain access to these resources. Limited access to credit markets means that the costs of funds are higher for the children of the poor, and this limits their enrollment in college.³¹ Proponents of this view argue the reductions in real income among parents in the bottom half of the family income distribution, coupled with a growth in real tuition costs, has prevented low income whites and minorities from taking advantage of the rising education premium.

An alternative interpretation of the same evidence is that long-run family and environmental factors play a decisive role in shaping the ability and expectations of children. Families with higher levels of resources produce higher-quality children who are better able to perform in school and take advantage of the new market for skills.

Children whose parents have higher incomes have access to better-quality primary and secondary schools. Children's tastes for education and their expectations about their life chances are shaped by those of their parents. Educated parents are better able to develop scholastic aptitude in their children by assisting and directing their studies. We

³¹ Evidence on educational responses to tuition subsidies is sometimes mistakenly interpreted as evidence on credit constraints. The purchase of education is governed by the same principles that govern the purchase of other goods: the lower the price, the more likely are people to buy the good. [Dynarski \(2000\)](#) presents recent evidence about the strength of tuition effects on college participation that is consistent with a long line of research. In addition, there is, undoubtedly, a consumption component to education. Families with higher incomes may buy more of the good for their children and may buy higher quality education as well. This will contribute to the relationship displayed in [Figure 7](#).

have reviewed the evidence that ability gaps open up early and are strongly related to family characteristics. The influences of family factors present from birth through adolescence accumulate to produce ability and college readiness. By the time individuals finish high school and their scholastic ability is largely determined, the scope of tuition policy for promoting college attendance is greatly diminished.

The interpretation that stresses the role of family and the childhood environment in producing college readiness does not necessarily rule out short-term borrowing constraints as a partial explanation for the patterns revealed in Figure 7. However, if the finances of poor but motivated families hinder them from providing high quality elementary and secondary schooling for their children, and produce a low level of college readiness, government policy aimed at reducing the short-term borrowing constraints for the college expenses of those children during their college-going years is unlikely to be effective in substantially closing the gaps evident in Figure 7. In these circumstances, policies that improve the early environments that shape ability will be more effective in the long run.

The following experiment captures the essence of the distinction we are making. Suppose two poor families participate in lotteries that are adjusted to have the same expected present value (at age zero of the child) but have different award dates. Markets are assumed to be imperfect in the sense that families cannot borrow against the future awards. Compare a family that wins the lottery in the child's adolescent years with a family that wins in the child's early formative years. The former child would lack all of the benefits of investment during the early childhood years that the child from the family that wins early would receive. The child from the late-winning family would be likely to have lower levels of cognitive and noncognitive abilities than the child from the early-winning family. To the extent that investments are complementary and self-productive, the children of the early winner will be much more likely to attend college. Although none of the data we possess are as clean as the data generated by this hypothetical experiment, taken as a whole, they point in this direction.

2.5.2. *Racial and family income gaps: Long-term family factors vs. short-term credit constraints*

A simple approach to testing the relative importance of long-run factors versus short-run credit constraints in accounting for the evidence in Figure 7 is to condition on long-run factors and examine if there is any additional role for short-run credit constraints.

Cameron and Heckman (1998, 1999, 2001) compare the estimated effects of family background and family income on college attendance, controlling for scholastic ability (as measured by the Armed Forces Qualifying Test, or AFQT). Measured scholastic ability is influenced by long-term family and environmental factors, which are in turn produced by long-term family factors. To the extent that the influence of family income on college attendance is diminished by the inclusion of scholastic ability in an analysis of college attendance, one would conclude that long-run family factors crystallized in AFQT scores are the driving force behind schooling attainment, and not short-term

credit constraints. Fitting a life cycle model of schooling to a subsample of the National Longitudinal Survey of Youth (NLSY79) data with AFQT measured before high school graduation, Cameron and Heckman examine what portion of the gap between minority youth and whites in school attendance at various levels is due to family income, to tuition costs, and to family background.³² They find that when they do not control for ability measured at an early age, about half (five points) of the eleven-point gap between black and white college attendance rates is due to family income; more than half (four points) of the seven-point difference between Hispanics and whites is due to family income. When scholastic ability is accounted for, only one half of one point of the eleven-point black-white gap is explained by family income. The gap between Hispanics and whites actually widens when family income is included in the empirical model. Adjusting for ability at the age people enter college more than accounts for minority-majority college attendance gaps. Cameron and Heckman obtain comparable results when they adjust for parental education and family structure.³³ The effects of tuition on college entry are greatly weakened when measures of ability are included. This analysis suggests that it is long-run factors that determine college attendance, not short-term borrowing constraints, that explain the evidence in Figure 7.

It is sometimes claimed that enrollment responses to tuition should be larger for constrained (low-income) persons [see Kane (1994), and the survey in Ellwood and Kane (2000)], although there is no theoretical basis for this.³⁴ Cameron and Heckman (1999) address this issue empirically. Even without adjusting for AFQT, they find no pattern in the estimated tuition response by family income level. When conditioning on ability, tuition effects become smaller for everyone (in absolute value) and the influence of family income becomes negligible. In a separate study of the HOPE Scholarship program in Georgia [Dynarski (2000)], the tuition elasticity for youth from middle- and high-income families is as high as other estimates found in the literature for lower income youth.

Based on NLSY79 data, Figures 9 and 10 illustrate the relative importance of family income and academic ability in determining a number of college-related outcomes.³⁵ Classifying white males by ability (as measured by AFQT scores) results in a clear ordering that shows that more able people are more likely to go to college than those who are less able. Within test score terciles, we further display college enrollment rates by family income measured in the child's adolescent years. Inspecting the graphs on the left (panels A, C, and E), we observe a clear ordering by family income within ability

³² See Bureau of Labor Statistics (2001) for a description of the NLSY data.

³³ Cameron and Heckman condition on an early measure of ability not contaminated by the feedback from schooling to test scores. Such feedback is documented in Hansen, Heckman and Mullen (2004).

³⁴ Mulligan (1997) shows in the context of a Becker–Tomes model that tuition elasticities for human capital accumulation are greater (in absolute value) for unconstrained people. His proof easily generalizes to more general preferences. Carneiro and Heckman (2002) use a discrete choice schooling framework to demonstrate that constrained persons may respond less than unconstrained persons.

³⁵ See Carneiro and Heckman (2002) for details.

groups – persons from families with higher income are more likely to enroll in college. However, this does not necessarily mean that short-run credit constraints are operative in the college-going years. Family income in the adolescent years is strongly correlated with family income throughout the life cycle, and long-run family resources are likely to produce many skills that are not fully captured by a single test score. When we control for early family background factors (parental education, family structure, and place of residence), the relationship between family income and school enrollment is greatly weakened for all college outcomes as the graphs in the right-hand side (panels B, D, and E) reveal. Adjusted gaps are much smaller than the unadjusted ones.

Most of the analysis in the literature focuses on college enrollment and much less on other dimensions of college attendance, such as completion, quality of school, and delay of entry into college.³⁶ When we perform a parallel analysis for completion of four-year college, we find no evidence of constraints for white males and, in fact, over-adjust the gaps in college enrollment. Figures 9(C) and (D) present the raw and adjusted gaps respectively, for completion of four-year college. Figures 9(E) and (F) show the raw and adjusted gaps for delay of entry into college. There is no evidence of short-run credit constraints in these measures. Carneiro and Heckman (2003) present evidence of short-run credit constraints among the least able poor in completing two years of college, but not for the brightest poor.

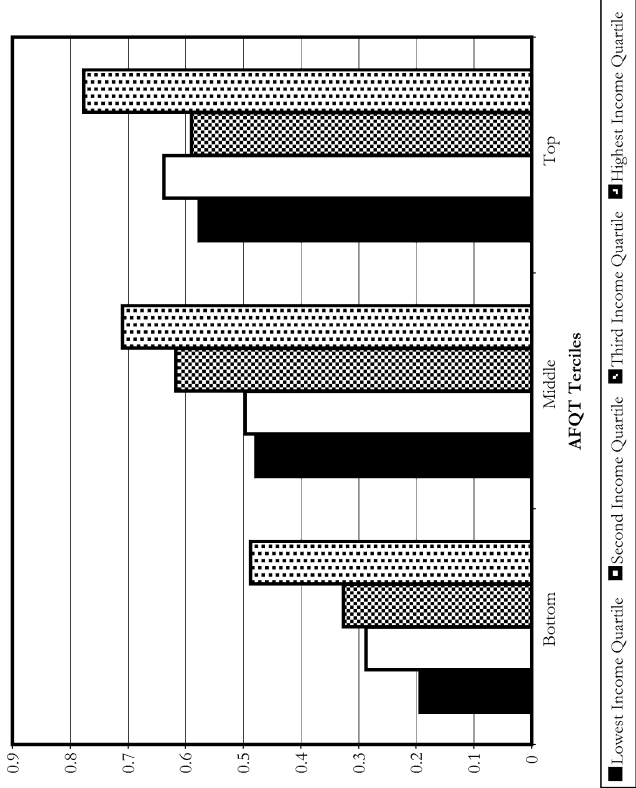
Using the difference in each outcome between the highest income category and the lower income categories as a rough measure of the fraction of persons constrained, Carneiro and Heckman (2002, 2003) find that there is weak evidence among certain subgroups for short-term credit constraints in years of entry delay and for choice of two-year versus four-year colleges, a measure of school quality. Depending on the measure of college participation selected, the estimated percentage of white males constrained ranges from 0 to 8 percent. Comparable results hold for other demographic groups.

The strongest evidence for short-term credit constraints is for Hispanic males. This is not surprising since those in the country illegally are not eligible for the same schooling aid as legal residents. The weakest evidence for credit constraints is for black males. On many measures, the effective constraint for this group is zero [see Carneiro and Heckman (2002, 2003)].

Many of the variables used to control for long-term family factors also predict family income in the adolescent years. Does the preceding analysis simply project family income in adolescent years onto other long term family factors? Carneiro and Heckman (2002) claim it does not. Independent variation in family income remains even after controlling for other family factors. When they reverse the roles of family income and family background – e.g., examining how differences in family background affect college enrollment rates after conditioning on family income levels – a strong long-run family background effect remains. As Figure 9 shows, adjusting for family income in

³⁶ Work while attending school is studied in Keane and Wolpin (2001). Delay in entry is studied in Kane (1996).

A. Percentage Enrolled in 2-Year and 4-Year Colleges



B. Adjusted Percentage Enrolled in 2-Year and 4-Year Colleges

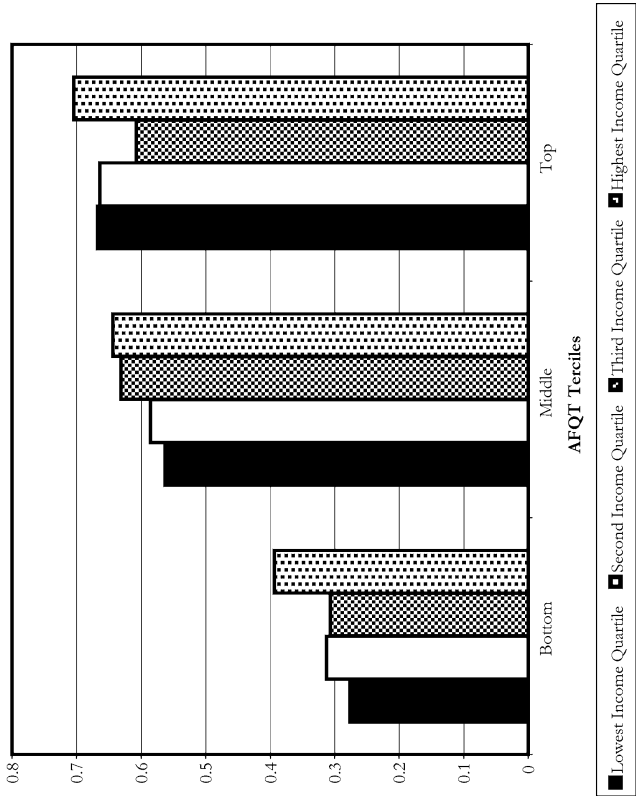


Figure 9. Enrollment, completion and no delay rates by family income quartiles and age-adjusted AFQT terciles white males, NLSY79. Note: To draw these graphs we performed the following steps. (1) Within each AFQT tercile, we regress percentage enrolled, completion rate, and percentage with no delay on family background: $y = \alpha + F\gamma + Q_1\beta_1 + Q_2\beta_2 + Q_3\beta_3$, where y is percentage enrolled, completion rate, or percentage with no delay, F is a vector of family background variables (southern origin, broken home, urban origin, mother's education and father's education), Q_1 is a dummy for being in the first quartile of the distribution of family income at 17, Q_2 is for being in the second quartile and Q_3 is for being in the third quartile. (2) Then, within each AFQT tercile, the height of the first bar is given by $\alpha + \bar{F}\gamma + \beta_1$, the second is given by $\alpha + \bar{F}\gamma + \beta_2$, the third by $\alpha + \bar{F}\gamma + \beta_3$ and the fourth by $\alpha + \bar{F}\gamma$ (where $\bar{F}$ is a vector of the mean values for the variables in F). The coefficients for the regression are given in the Appendix Table B-3 of Carneiro and Heckman (2003).

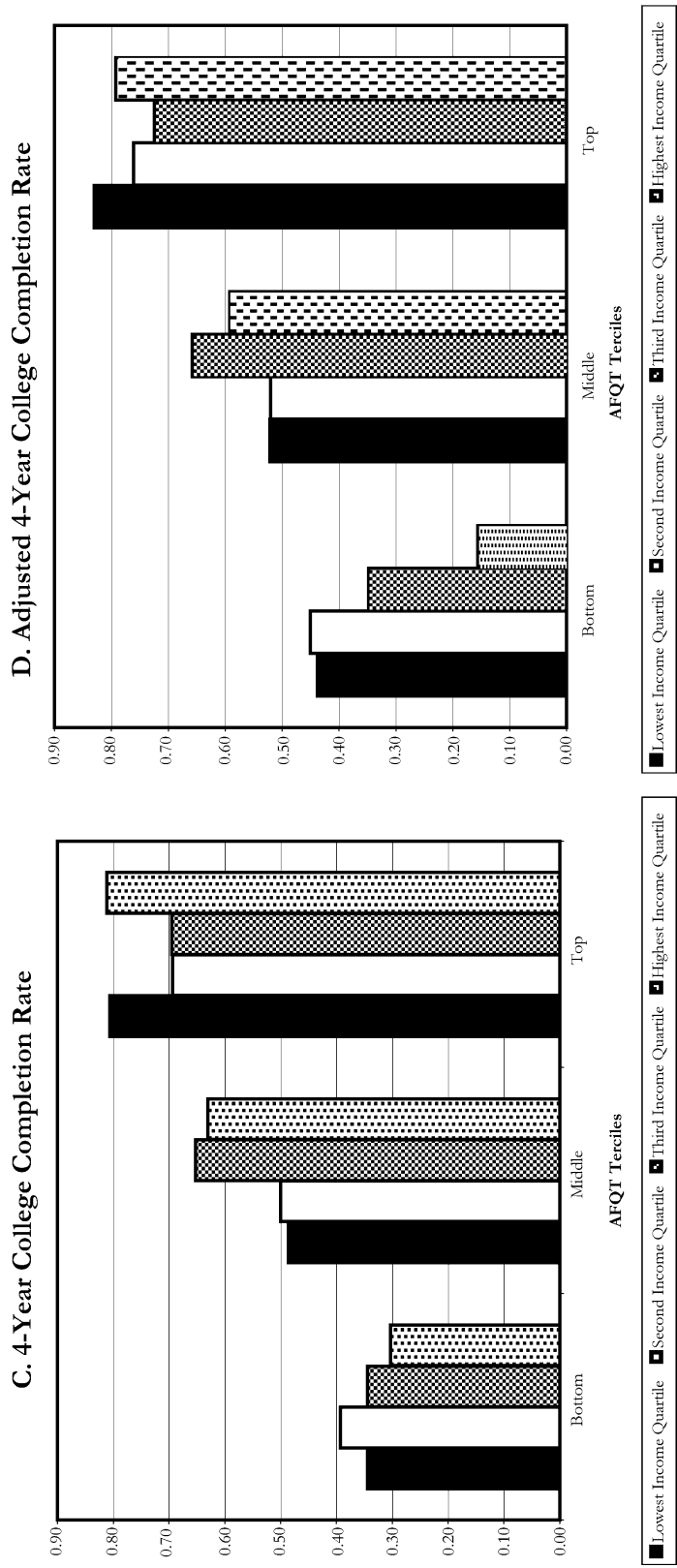


Figure 9. (Continued.)

Note: To draw these graphs we performed the following steps. (1) Within each AFQT tercile, we regress percentage enrolled, completion rate, and percentage with no delay on family background: $y = \alpha + F\gamma + Q_1\beta_1 + Q_2\beta_2 + Q_3\beta_3$, where y is percentage enrolled, completion rate, or percentage with no delay, F is a vector of family background variables (southern origin, broken home, urban origin, mother's education and father's education), Q_1 is a dummy for being in the first quartile of the distribution of family income at 17, Q_2 is for being in the second quartile and Q_3 is for being in the third quartile. (2) Then, within each AFQT tercile, the height of the first bar is given by $\alpha + \bar{F}\gamma + \beta_1$, the second is given by $\alpha + \bar{F}\gamma + \beta_2$, the third by $\alpha + \bar{F}\gamma + \beta_3$ and the fourth by $\alpha + \bar{F}\gamma$ (where $\bar{F}$ is a vector of the mean values for the variables in F). The coefficients for the regression are given in the Appendix Table B-3 of Carneiro and Heckman (2003).

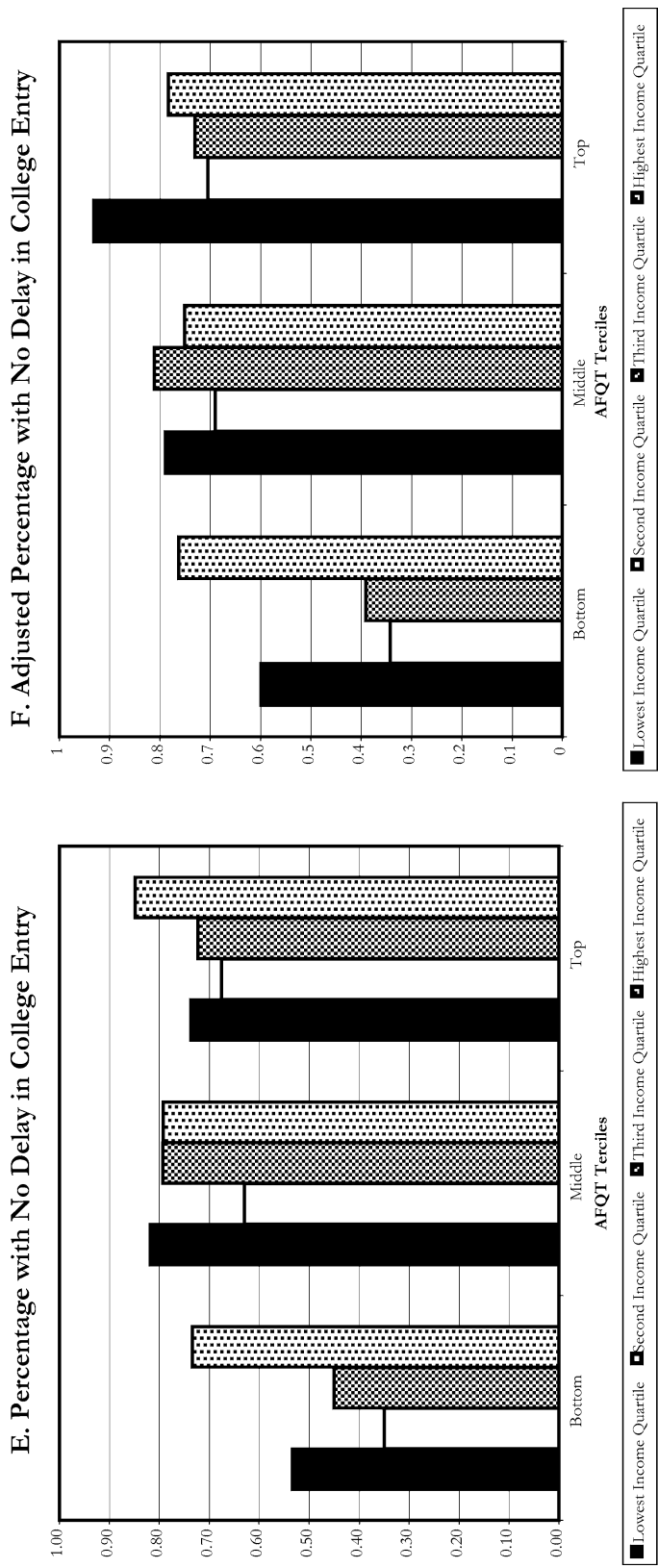


Figure 9. (Continued.)

Note: To draw these graphs we performed the following steps. (1) Within each AFQT tercile, we regress percentage enrolled, completion rate, and percentage with no delay on family background: $y = \alpha + F\gamma + Q_1\beta_1 + Q_2\beta_2 + Q_3\beta_3$, where y is percentage enrolled, completion rate, or percentage with no delay, F is a vector of family background variables (southern origin, broken home, urban origin, mother's education and father's education), Q_1 is a dummy for being in the first quartile of the distribution of family income at 17, Q_2 is for being in the second quartile and Q_3 is for being in the third quartile. (2) Then, within each AFQT tercile, the height of the first bar is given by $\alpha + \bar{F}\gamma + \beta_1$, the second is given by $\alpha + \bar{F}\gamma + \beta_2$, the third by $\alpha + \bar{F}\gamma + \beta_3$ and the fourth by $\alpha + \bar{F}\gamma$ (where $\bar{F}$ is a vector of the mean values for the variables in F). The coefficients for the regression are given in the Appendix Table B-3 of Carneiro and Heckman (2003).

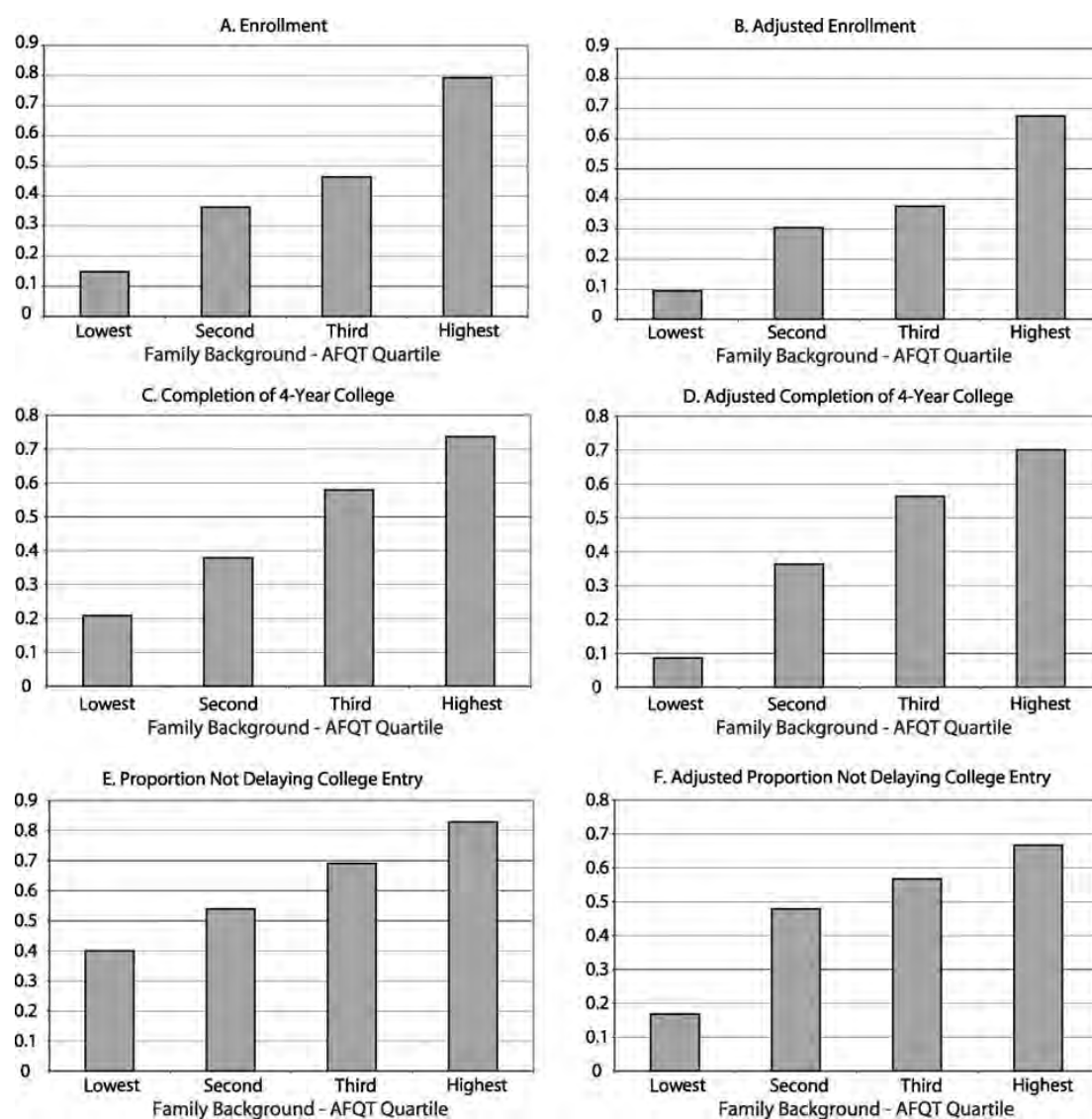


Figure 10. Enrollment, completion and delay by family background-AFQT Quartiles. NLSY79 white males. We correct for the effect of schooling at the test date on AFQT. The family background-AFQT index is based on a linear combination of south, broken home, urban, mother's education, father's education and AFQT. For the residual plots, we condition on family income at age 17. See Table B-4 in the appendix to Carneiro and Heckman (2003) for the coefficients of the linear combination of the variables forming this index.

adolescent years does not substantially affect differences in college decisions by family background.

Tables 1A and 1B report further evidence on the unimportance of short-run credit constraints on college attendance. Using data from the Children of the NLSY79 (CNLSY79) survey, they present estimates of child enrollment in college on family per capita permanent income and on family per capita income flows received at various stages of the life cycle (transitory income). Permanent income is formed as an average

Table 1A
Regression of college enrollment on various measures of family income and PIAT math at age 12

	(1) College enrollment	(2) College enrollment	(3) College enrollment	(4) College enrollment
Permanent family income at ages 0–18 (in 10K)	0.0839* (0.0121)	0.0747* (0.0184)	0.0902* (0.0185)	0.0779* (0.0284)
PIAT math at age 12	0.0077* (0.0017)	0.0076* (0.0018)	0.0076* (0.0018)	0.0075* (0.0018)
Permanent family income at ages 0–5 (in 10K)	—	0.0158 (0.0238)	—	0.0149 (0.0261)
Permanent family income at ages 16–18 (in 10K)	—	—	–0.0069 (0.0177)	–0.0023 (0.0194)
Constant	0.1447* (0.0264)	0.1404* (0.0272)	0.1410* (0.0268)	0.1380* (0.0273)
Observations	863	863	861	861
R-squared	0.1	0.1	0.11	0.11

Standard errors in parentheses. Permanent family income is discounted to age 0 using a 5% rate.

*Significant at 1%.

discounted income flow to the family over the life of the child at home (ages 0 to 18).³⁷ Two features are clear from these tables: (a) permanent income matters a lot for college enrollment and (b) given permanent income, transitory income flows matter little. This result is robust whether or not one controls for ability at age 12: compare Table 1A with Table 1B which does not control for ability at age 12. We discuss other studies on the importance of the timing of family income in Section 2.5.3.

Policies that improve the educational financing of *identified* constrained subgroups in the college-going years will increase their human capital and may well be justified on objective cost–benefit criteria. The potential economic loss from delay in entering college can be substantial. If V is the economic value of attending school, and schooling is delayed one year, then the costs of delaying schooling by one year and not earning any income, are $\frac{rV}{1+r}$, where r is the rate of return. For $r = 0.10$, which is not out of line with estimates in the literature, this delay is 9 percent of the lifetime value of schooling (roughly \$20,000 in 2004 dollars). For the identified constrained subgroups, the benefits to reducing delay and promoting earlier college completion, higher college quality and graduation are likely to be substantial even when earnings net of disutility costs of work in the year of delay are taken into account.

Stinebrickner and Stinebrickner (2004) examine the role of credit constraints in determining college attrition at a small liberal arts college in Kentucky. Since the probability

³⁷ We obtain the same empirical patterns reported in the text whether or not we use per capita income measures.

Table 1B
Regression of college enrollment on various measures of family income

	(1) College enrollment	(2) College enrollment	(3) College enrollment	(4) College enrollment
Permanent family income at ages 0–18 (in 10K)	0.0942* (0.0108)	0.0829* (0.0170)	0.1031* (0.0169)	0.0887* (0.0270)
Permanent family income at ages 0–5 (in 10K)	— —	0.0259 (0.0220)	— —	0.0233 (0.0246)
Permanent family income at ages 16–18 (in 10K)	— —	— —	–0.0108 (0.0170)	–0.0048 (0.0188)
Constant	0.1367* (0.0243)	0.1179* (0.0251)	0.1329* (0.0246)	0.1158 (0.0252)
Observations	1015	987	1013	985
R-squared	0.07	0.08	0.07	0.08

Standard errors in parentheses. Permanent family income is discounted to age 0 using a 5% rate.

*Significant at 1%.

of dropping out of college differs substantially by family income in their sample, it is natural to ask whether this may be the result of borrowing constraints. They utilize a unique set of questions asked of all survey respondents to infer the role played by borrowing constraints in determining college attrition and the relationship between family income and attrition. The survey asks whether students would like to borrow more money for school if they could and, if so, how much they would like to borrow. They find that only 20% of the sample would like to borrow more for school, and the median amount those individuals would like to borrow is only \$500. Based on these findings, they estimate that the inability to borrow plays little role in attrition decisions.

A few other studies have attempted to model borrowing constraints and schooling decisions more explicitly. [Cameron and Taber \(2004\)](#) examine the empirical importance of borrowing constraints in a model that incorporates the insight that borrowing constraints will influence both schooling choices and returns to schooling. Using a variety of methods, they find no evidence that borrowing constraints in the adolescent years play a role in explaining the years of schooling attained by recent cohorts of American youth. [Keane and Wolpin \(2001\)](#) estimate a more formally explicit sequential dynamic model and reach the same conclusion. Students are estimated to be constrained in the short-run, but alleviate the constraints they face by working while in college. Relaxing the budget constraint barely affects schooling decisions but affects work while in school. Neither study looks at delay or quality effects, which have been found to be quantitatively important.

In designing policies to alleviate short-term constraints, it is important to specifically target the interventions toward the constrained in ways that previous programs have not.

Broad-based policies generate deadweight. For example, [Dynarski \(2003\)](#) and [Cameron and Heckman \(1999\)](#) estimate that 93 percent of President Clinton's Hope Scholarship funds, which were directed toward middle-class families, were given to children who would have attended school even without the program. [Stanley \(2003\)](#) studies the impact of the GI Bill on the college-going decisions of Korean War veterans and finds that most college subsidies under the bill were used by veterans from families in the top half of the socioeconomic distribution. In an analysis of Georgia's HOPE Scholarship program, [Dynarski \(2000\)](#) finds that most of the funds went to middle- and high-income students. These studies all suggest that previous government attempts to finance college have primarily benefited the most well-off with little impact on those most likely to be constrained. This conclusion is further supported by simulations from the model of dynamic schooling choices in [Keane and Wolpin \(2001\)](#).

While targeting those identified as constrained may be good policy, it is important not to lose sight of the main factors accounting for differences in schooling attainment. Family background factors crystallized in ability are the first-order factors explaining college attendance and completion gaps. Differences in ability by family income groups appear at early ages and persist. They affect schooling decisions and wages. A major conclusion of the studies reviewed in this section is that the abilities decisive in producing differentials in college attendance are shaped early in life.

[Lochner and Monge \(2004\)](#) argue that the current structure of the student lending system in the U.S. minimizes the effect of liquidity problems on college attendance decisions, even though it may severely distort consumption patterns. This is because the student loan system directly links borrowing limits to schooling expenditures, a feature neglected in most studies of credit constraints and schooling. That is, students who spend more on college can borrow more as long as their total borrowing remains below an upper limit set by government lending programs. While Stafford loan limits for dependent students are limited to a cumulative amount of \$23,000, students from poorer families can borrow up to an additional \$40,000 from the Perkins loan program in addition to any direct transfers from the Pell Grant program. Finally, parents can borrow up to the student's determined need from the PLUS loan program.³⁸ Thus, the effective constraint on family borrowing for many college students is simply the amount needed for tuition, fees, books, and room and board at the institution of choice. In this sense, college costs can be fully covered by student loans.³⁹ While students cannot borrow

³⁸ PLUS take-up rates are low relative to the roughly 50% take-up rates of other student loans. It is difficult to know whether this reflects a reluctance of parents to take on debt when students would choose to do so themselves if they could or whether it reflects the fact that other lending and grants satisfy the needs of most students. Parents are not eligible for PLUS loans if they have a bad credit rating (they are eligible with no credit rating or a good one), but students with ineligible parents are able to borrow considerably more (at the levels set for independent students) from the Stafford loan program than other dependent students.

³⁹ While loans cannot be taken out to cover foregone earnings, room and board does not, strictly speaking, represent a cost of college. To the extent that these roughly offset each other for individuals who work a few hours a week during the school year and full-time during the summer, the full costs of college, including direct and indirect costs, can be borrowed.

above and beyond the costs of college to buy fancy cars or expensive apartments (even if their future prospects are bright and they would like to consume more while in college), the constraints embodied in the federal student loan system tend not to distort schooling decisions.⁴⁰ The analysis of [Lochner and Monge \(2004\)](#) is consistent with the analysis and evidence in [Keane and Wolpin \(2001\)](#).⁴¹

2.5.3. Borrowing constraints as determinants of family investment in children

While many recent studies have analyzed the importance of borrowing constraints among college-age students, very little attention has been given to the role played by borrowing constraints in determining family investments in younger children. Two conceptually distinct types of constraints may limit family investments in their younger children. First, parents may be unable to borrow against their children's future income even if they can borrow against their own future income. This suggests that bright children born to poor parents may not receive the efficient amount of investment because their parents may never earn enough to pay for those investments. The timing of income receipts for the parents is assumed to be irrelevant in this case. Only the discounted present value of their income matters. A second, more severe, constraint on parents may limit them from borrowing fully against their own future income. This is the constraint most commonly associated with the notion of borrowing constraints, and it implies that the timing of a parent's income matters for child investment decisions. Parents who earn a smaller share of their lifetime income when their children are young are likely to invest less in their young children. Two families with the same lifetime income may make different early investment decisions. These early investment decisions may affect later decisions about college attendance.

While it seems likely that the first form of constraint is relevant for most families, the empirical importance of the second is a matter of some controversy. The obvious test for the second borrowing constraint examines whether the timing of family income matters for child achievement and schooling outcomes. Only a few studies speak to

⁴⁰ Furthermore, the option for students to default on their student loans after leaving school may actually encourage some of the least able to attend low quality colleges that offer little net return. While this may sound farfetched, cohort default rates reached 20% in the early 1990s. Many institutions had default rates above 50%.

⁴¹ The take-up rate on Pell Grants and Perkins Loans targeted toward students from low-income families is low [[Orfield \(1992\)](#)]. Many more people are eligible for support than those who claim it. Binding borrowing constraints are not a plausible explanation for the lack of utilization of these potential resources. [Kane \(1999\)](#) suggests that nonmonetary costs of applying for financial aid may be high, especially for low-income people, because the application process is complex. He argues that decreasing these costs may be a more promising avenue for relaxing financing constraints for low-income people than expanding existing programs. He provides no evidence, however, in support of this conjecture. An alternative explanation consistent with our evidence is that many eligible persons perceive that even with a substantial tuition subsidy, the returns to college education for them are too low to pay for the foregone earnings required to attend school. Risk aversion due to the uncertainty of income flows may also reduce the returns relative to the benefits.

this issue. Duncan and Brooks-Gunn (1997b) use PSID data to estimate the effects of family income earned at different stages of a child's life (ages 0–5, 6–10 and 11–15) on final schooling outcomes. Both standard cross-sectional OLS and sibling fixed effects models reveal that early income (ages 0–5) has a significantly larger impact on years of completed schooling and high school graduation rates than does income at later ages. Levy and Duncan (2000) report similar results using the PSID and siblings fixed effects models. Carneiro and Heckman (2003) argue that these findings do not necessarily imply that timing matters, since one should discount income in all stages back to the same base year. Otherwise, the income earned when a child is young is worth more than when the child is older, simply because the latter needs to be discounted. When they control for the discounted present value of lifetime income over the child's ages 0–18, they do not find any significant additional effect of early income on college enrollment decisions using data from the Children of the NLSY79 (recall our discussion of Tables 1A and 1B). They conclude that the timing of parental income within the life cycle of the child is unimportant.

Caucutt and Lochner (2004) use the Children of NLSY79 to conduct three tests for determining whether the timing of (discounted) family income affects adolescent math and reading achievement levels. Their estimates suggest that (i) income earned at earlier ages has a slightly larger (and statistically significant) impact on adolescent test scores than does income earned at later ages, (ii) future income has less of an effect on current outcomes than does past income and (iii) the slope of a family's income profile is negatively related to test scores, even after controlling for the discounted present value of family income taken over a twenty-year period. While most of their findings are consistent with the presence of constraints on parental borrowing against their own income, none of them suggest that the timing of parental income within the life cycle of the child plays a large role in determining child outcomes. Consistent with Carneiro and Heckman (2003), their results suggest a strong effect of permanent lifetime income on child development outcomes.

Overall, the evidence on whether the timing of income matters on children's outcomes is mixed. While some of the evidence suggests that timing does matter, some does not. Even those studies that suggest a role for timing do not find large effects. Because it is necessary to observe individuals over a long time period in order to examine the role of income timing, most studies are based on a fairly small number of individuals and are forced to make strong assumptions about the dynamic process by which income may affect achievement and schooling outcomes. Additional studies of this issue are certainly warranted to explore the robustness of the findings to alternative specifications.

2.5.4. *High rate of return to schooling compared to the return on physical capital*

Least squares estimates of the rate of return to schooling, based on the Mincer earnings function, are often above 10 percent and sometimes are as high as 17 to 20 percent. Estimates based on instrumental variables are even higher. [See, for example, the evidence

surveyed by Card (1999, 2001), and the discussion of the quality of the instruments used in this literature presented in Carneiro and Heckman (2002)]. It is sometimes claimed that the returns to schooling are very high relative to the returns to physical capital, and therefore people are credit-constrained or that some other market failure is present.

The cross-sectional Mincer rate of return to schooling does not, in general, estimate the marginal internal rate of return to schooling, and the internal rate of return is not well-defined in sequential dynamic programming models.⁴² Willis (1986) and Heckman, Lochner and Todd (2006) state the conditions under which the Mincer rate of return will equal the marginal internal rate of return to schooling. The latter paper shows that these assumptions are at odds with U.S. earnings data. Even if these conditions are satisfied, implicit comparisons are usually made against a risk-free interest rate. However, this is not the relevant comparison for evaluating schooling decisions. Carneiro, Hansen and Heckman (2001, 2003), Cunha, Heckman and Navarro (2005), and Navarro (2005) estimate that agents face considerable uncertainty in their returns to schooling. The illiquidity and irreversibility of human capital investments drive the premium on human capital far above the safe interest rate [see Judd (2000)]. Consequently, comparisons of Mincer returns and returns to capital are intrinsically uninformative about the existence of credit constraints or the need for intervention in human capital markets. See Carneiro and Heckman (2002), Cunha, Heckman and Navarro (2005), and Navarro (2005) for further discussion of this point.

2.5.5. *Are rates of return to investment higher for persons from low-income families?*

If low-income families are credit-constrained, under conditions specified in Carneiro and Heckman (2002), at the margin, the returns to schooling for children from constrained families should be higher, since they are investing less than the efficient amount.⁴³ We develop this analysis formally in Section 3. Carneiro and Heckman (2002) establish that if choices are made at the margin of schooling quality, the estimated Mincer return may be lower for constrained persons, unless adjustments for schooling quality are made in the estimated returns. The empirical literature on this topic, which does not adjust for quality, finds that returns to secondary schooling and post-secondary schooling are higher for high-ability people than for low-ability people. [See, for example, Cawley et al. (2000), Meghir and Palme (1999), Tabler (2001), or the evidence presented in Section 2.5.6.] Family income and child ability are positively correlated, so one would expect higher returns to schooling for children of high-income families for this reason alone. Altonji and Dunn (1996) find in their preferred empirical specification that the returns to schooling are higher for children from more-educated

⁴² See Heckman, Lochner and Todd (2006) and Heckman, Lochner and Taber (1998) for examples in which cross-sectional rates of return are uninformative about the return to schooling that any person experiences.

⁴³ Carneiro and Heckman (2002) show that for this prediction to be valid, it is necessary to assume that all families face the same technology of schooling (relating inputs to outputs) and that there be no comparative advantage in the labor market. Cameron and Taber (2004) derive a different set of conditions.

families than for children of less-educated families. This effect operates in part through higher schooling participation rates and hence higher earnings. There is no evidence that rates of return to secondary and postsecondary schooling are higher for children from low-income families than for children from high-income families. Indeed all of the evidence points to returns in the later stages of child schooling being higher for high ability children from more advantaged environments. This is consistent with complementarity and self-productivity as discussed in Section 1. We elaborate on this point in Section 3.

Interventions at very early ages, however, have *higher* returns for the most disadvantaged. This empirical pattern holds across many studies. For example, this holds true for a nurse home visitation program in Elmira, NY [Olds (2002)], where there was no statistically significant effect of the program on child socioeconomic outcomes for the sample as a whole, but modest effects were found for the disadvantaged subsample of unmarried, young, and poor white mothers and their children. The nurse home visitation program in Memphis replicated this pattern of results, though the overall effects of treatment were much weaker.⁴⁴ The IHDP⁴⁵ study of low-birth weight babies by Brooks-Gunn et al. (1992) finds that the increase in IQ is higher among children of poorly educated mothers.⁴⁶ Non-experimental studies of preschool by Magnuson et al. (2004); Magnuson, Ruhm and Waldfogel (2004) and the Gormley et al. (2004) study of Oklahoma universal pre-K program find the effect of preschool on achievement test scores to be higher among the disadvantaged children.

By the late adolescent years, the pattern is reversed and returns are lower for low ability and disadvantaged children. An equity-efficiency trade-off becomes evident. This is clear in the higher returns to the most able in job training and in the military AFQT studies, both of which we summarize below. This reversal in the pattern of returns to investment in disadvantaged persons is a consequence of the technology of skill formation that we formalize in Section 3 of this paper. Distinguishing returns from early investment from returns to late investment reveals the value of self-productivity and complementarity as useful conceptual tools for organizing the evidence on child development.

⁴⁴ We discuss the evidence on other visitation programs in Section 2.6.1.4.

⁴⁵ The Infant Health and Development Program was a randomized study of low-birthweight infants conducted at 8 sites around the country. The treatment group received home visits by program staff, child attendance at a child development center, and parent group meetings. Both treatment and control children received medical, developmental, and social assessments, with referral for pediatric care and other services. All services were provided at no cost to the families. The intervention lasted until children were 36 months of age, adjusted for prematurity.

⁴⁶ However, any cognitive effect of IHDP are almost entirely attenuated by age 8 [see McCarton et al. (1997)].

Table 2
Average marginal effect on participation in company training (the probability of participating in training)

	Average marginal effect					
	White males		Black males		Hispanic males	
	(1)	(2)	(1)	(2)	(1)	(2)
Age-adjusted AFQT	0.0149 (0.0024)	— —	0.0182 (0.0033)	— —	0.0066 (0.0037)	— —
Family income in 1979 (in \$10,000)	−0.0021 (0.0012)	−0.0005 (0.0011)	−0.0047 (0.0024)	−0.0019 (0.0023)	0.0011 (0.0024)	0.0015 (0.0023)
Grade completed	0.0382 (0.001)	— —	0.0060 (0.0014)	— —	0.0036 (0.0014)	— —
Father's education	−0.0014 (0.0006)	0.0007 (0.0005)	0.0003 (0.0008)	0.0010 (0.0008)	0.0002 (0.0007)	0.0008 (0.0007)
	White females		Black females		Hispanic females	
	(1)	(2)	(1)	(2)	(1)	(2)
	(1)	(2)	(1)	(2)	(1)	(2)
Age-adjusted AFQT	0.0076 (0.0025)	— —	0.0169 (0.0038)	— —	0.0159 (0.0045)	— —
Family income in 1979 (in \$10,000)	−0.0007 (0.0011)	0.0001 (0.0011)	−0.0006 (0.0024)	0.0014 (0.0023)	−0.0065 (0.0031)	−0.0043 (0.0029)
Grade completed	0.0027 (0.0010)	— —	0.0014 (0.0016)	— —	0.0013 (0.0016)	— —
Father's education	0.0001 (0.0006)	0.0009 (0.0006)	0.0015 (0.0008)	0.0021 (0.0008)	−0.00001 (0.0009)	0.0007 (0.0008)

The panel data set was constructed using NLSY79 data from 1979–1994. Data on training in 1987 is combined with 1988 in the original dataset. Company training consists of formal training run by employer, and military training excluding basic training. Standard errors are reported in parentheses. Specification (1) includes a constant, age, father's education, mother's education, number of siblings, southern residence at age 14 dummy, urban residence at age 14 dummy, and year dummies. Specification (2) drops age-adjusted AFQT and grade completed. Average marginal effect is estimated using average derivatives from a probit regression.

2.5.6. The role of ability in returns to schooling and in choice of post-school investment

Ability is not only a primary determinant of schooling decisions and hence earnings, but it also affects the return per unit of schooling as well as participation in job training. Table 2 gives our evidence on the effect of ability on participation in post-school job training programs. For different demographic groups it shows the effect of measured ability (AFQT) on participation in company training programs. More able people are substantially more likely to participate in company training. Far from remediating credit constraints, as they are sometimes conjectured to do, private-sector post-school investment programs reveal that those who start with higher initial conditions make more investments throughout their lifetimes.

Table 3
Return to one year of college for individuals at different percentiles of the math test score distribution. White males from High School and Beyond

	5%	25%	50%	75%	95%
Average return in the population	0.1121 (0.0400)	0.1374 (0.0328)	0.1606 (0.0357)	0.1831 (0.0458)	0.2101 (0.0622)
Return for those who attend college	0.1640 (0.0503)	0.1893 (0.0582)	0.2125 (0.0676)	0.2350 (0.0801)	0.2621 (0.0962)
Return for those who do not attend college	0.0702 (0.0536)	0.0954 (0.0385)	0.1187 (0.0298)	0.1411 (0.0305)	0.1682 (0.0425)
Return for those at the margin	0.1203 (0.0364)	0.1456 (0.0300)	0.1689 (0.0345)	0.1913 (0.0453)	0.2184 (0.0631)

Wages are measured in 1991 by dividing annual earnings by hours worked per week multiplied by 52. The math test score is an average of two 10th grade math test scores. There are no dropouts in the sample and the schooling variable is binary (high school–college). The gross returns to college are divided by 3.5 (average difference in years of schooling between high school graduates that go to college and high school graduates that do not in a sample of white males in the NLSY79). To construct the numbers in the table we proceed in two steps. First we compute the marginal treatment effect using the method of local instrumental variables as in [Carneiro, Hansen and Heckman \(2001\)](#). The parameters in the table are different weighted averages of the marginal treatment effect. Therefore, in the second step we compute the appropriate weight for each parameter and use it to construct a weighted average of the marginal treatment effect (see also [Carneiro \(2002\)](#)). Individuals at the margin are indifferent between attending college or not.

We have already discussed the evidence that the wage returns to schooling are higher for children from the most advantaged environments. This evidence is consistent with complementarity and self-productivity. Ability also affects the economic return to schooling. [Carneiro and Heckman \(2003\)](#) study the economic returns to college for people of different ability (see [Table 3](#)). Those at the bottom 5% of the ability distribution get half of the return to college of those at the top 5% of the ability distribution. Ability also affects wages independently of its effect on schooling, as shown in [Carneiro, Heckman and Masterov \(2005\)](#). This is further evidence on complementarity and self-productivity.

A strong connection between ability and job performance has been established in a series of studies conducted for the military. The armed services rely heavily on aptitude testing to screen recruits. Aptitude is defined in terms of performance on the Armed Forces Qualification Test (AFQT), which is a subset of the Armed Forces Vocational Aptitude Battery (ASVAB). Category I corresponds to the highest ability level, while V is the lowest, representing scores below the 10th percentile.⁴⁷ [Armor and Roll \(1994\)](#)

⁴⁷ Recruits whose scores fall in category V are ineligible for enlistment. Category I corresponds to AFQT scores in the 93–99th percentiles, II to 65–92th, IIIA to 50–64th, IIIB to 31–49th, IV to 10–30, and V to 1–9th.

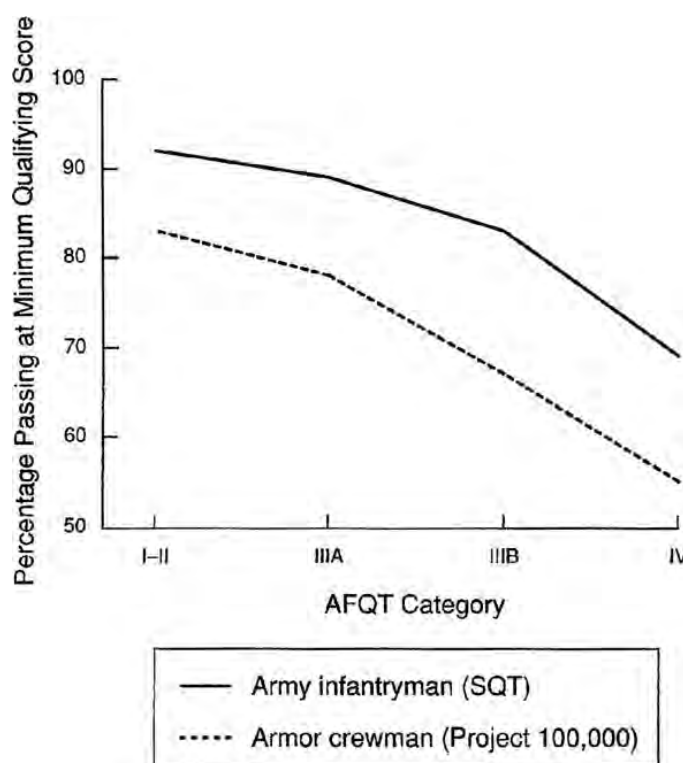


Figure 11A. Military job performance and AFQT. Source: [Armor and Roll \(1994\)](#).

establish that the test is predictive of true productivity and that initial deficits in productivity are not remedied by work experience. [Figure 11A](#) shows the relationship between the percentage passing at a minimum qualifying score on two job-performance tests and AFQT for the two largest combat specialties. The two tests are the Skill Qualification Test (SQT) for infantrymen and the Project 100,000 Test for armor crewmen.⁴⁸ The strong positive relationship between AFQT and the measures on job performance tests is unambiguous. Moreover, job experience does not appear to mediate these performance gaps substantially. Remediation through experience, which is sometimes claimed to be effective [[Bruer \(1999\)](#)], is actually ineffective in closing skill gaps. Early disadvantages are not easily remedied by compensatory investments or work experience at later ages.

[Figure 11B](#) shows the link between time on the job and the average score on the hands-on performance test developed by the Job Performance Measurement/Enlistment Standards Project (JPM) for first-term soldiers from all branches of the military. While the performance of soldiers at all ability levels improves with experience, the difference

⁴⁸ The Project 100,000 measure was a field test using real equipment of some task in which performance of each subtask was scored by an officer as correct or incorrect. The passing rate is set at 50% correct. The SQT includes a hands-on performance test, a job knowledge test, and a certification component (e.g., firing range qualifications). A score of 60% correct is considered a minimum level of job proficiency. This accounts for the gap between the two lines in the figure.

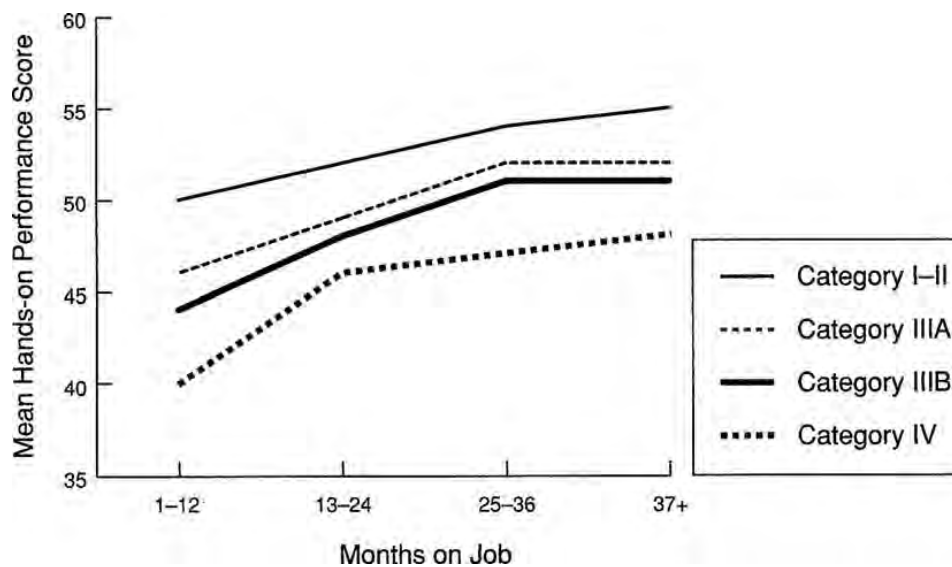


Figure 11B. Military job performance on JPM, AFQT and experience. Source: [Armor and Roll \(1994\)](#).

between categories I–II and IV remains constant at approximately one-half of a standard deviation. To put it differently, the average category IV soldier with three years of experience performs at the level of a category IIIA soldier with one year of service.

Ability formed in the early years is also important in explaining crime, teenage pregnancy and a variety of social pathologies. [Figure 12A](#) shows that women with low cognitive ability are more likely to bear children when they are young. [Figure 12B](#) shows that men of low cognitive ability are more likely to spend time in jail by the time they are 30. [Figures 12C and 12D](#) show that maternal ability is positively associated with how much cognitive and emotional stimulation children receive. Maternal ability is an important ingredient in eliminating test score gaps of children as demonstrated in [Section 2.2](#). Not only do less able women bear children at earlier ages, but they propagate themselves across generations by investing less in their children.

We next turn to an analysis of the evidence on the effectiveness of specific policies in supplementing the environments of disadvantaged children.

2.6. What is known about specific policies to foster ability and skill?

2.6.1. Early interventions

[Karoly et al. \(1998\)](#), [Currie \(2001\)](#) and [Currie and Blau \(2006\)](#) present comprehensive surveys of numerous preschool intervention programs targeted toward disadvantaged populations and their measured effects. The programs they analyze vary, both in terms of age of enrollment and age of exit. The effects are generally consistent, although in some

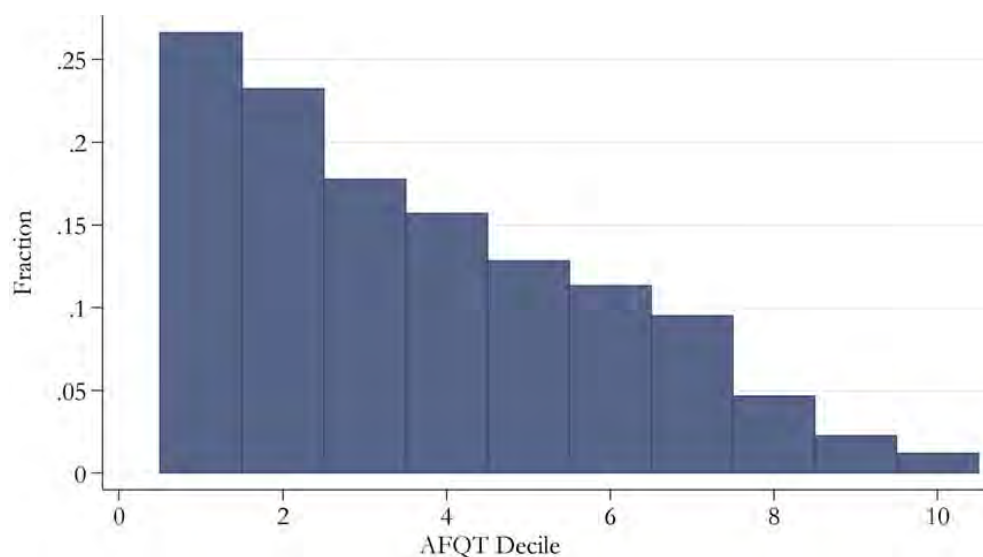


Figure 12A. Fraction of women who gave birth by 18th birthday. Data from NLSY79.

Note: Uses the AFQT calculation procedure as defined by the Department of Defense in 1989. Data used 1979–2000.

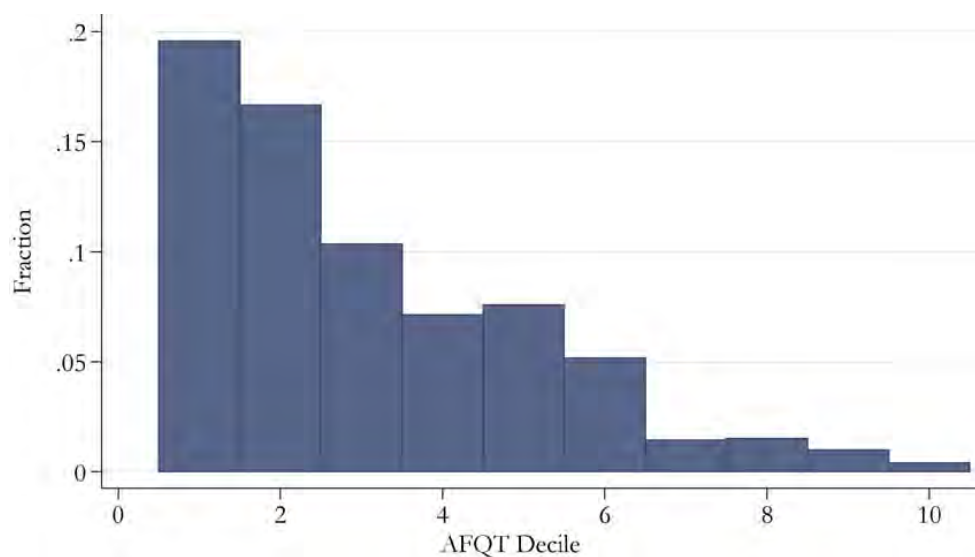


Figure 12B. Fraction of male respondents in jail at age 30 or below. Data from NLSY79.

Note: Uses the AFQT calculation procedure as defined by the Department of Defense in 1989. Data used 1979–2000.

cases they are quite small.⁴⁹ Generally, performance of children in school is improved in terms of less grade repetition, more graduation and higher test scores. Unfortunately,

⁴⁹ For example, Currie and Thomas (2000) show that test score gains of participants in the Head Start program tend to fade completely for blacks but not for whites. Their paper suggests that one reason may be that

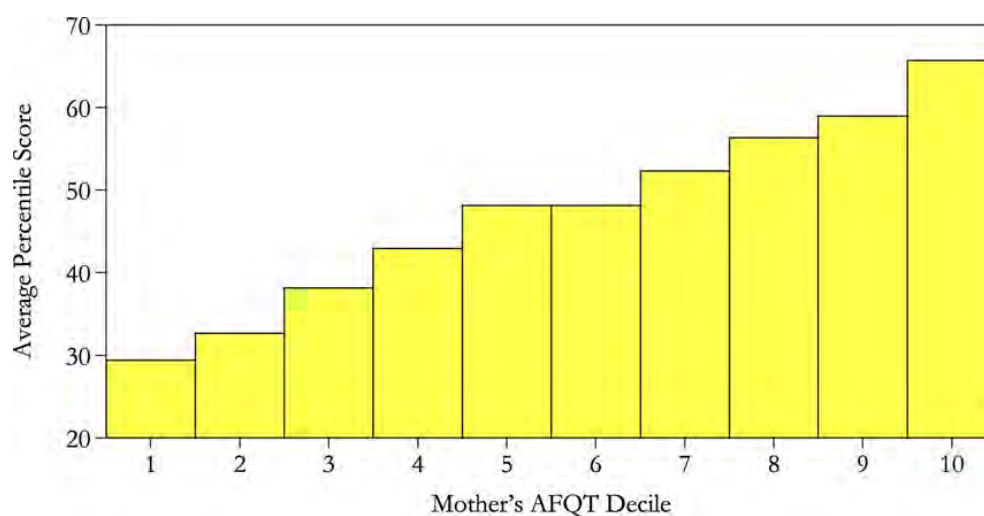


Figure 12C. Average cognitive stimulation score by mother's AFQT decile. Data from CNLSY79.
 Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

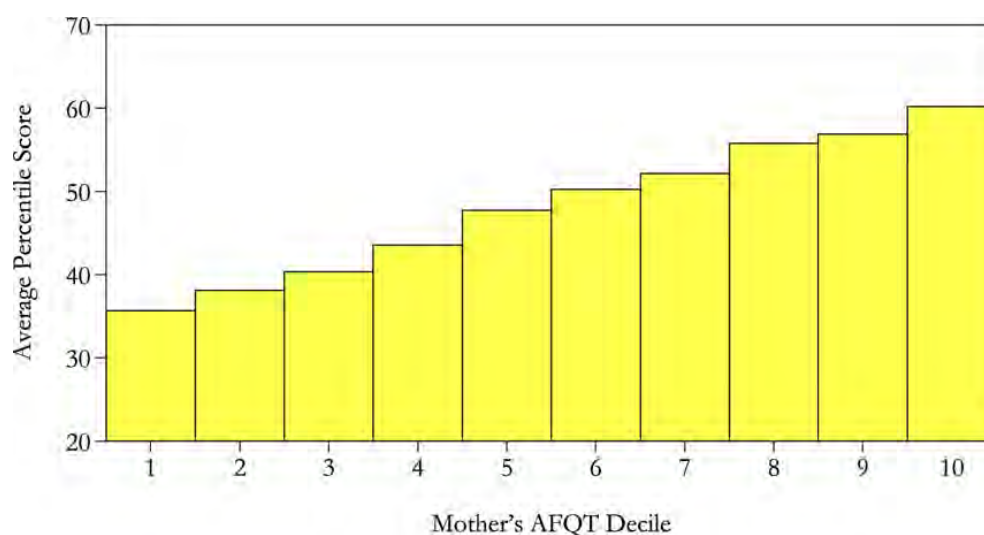


Figure 12D. Average emotional stimulation score by mother's AFQT decile. Data from CNLSY79.
 Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

blacks attend worse schools than whites, and therefore blacks are not able to maintain initial test score gains. However, Heckman, Larenas and Urzua (2004) dispute this finding. They show that schooling quality differences which are substantial across ethnic groups have only a slight effect on the levels or rates of growth in

many of the evaluations of these programs do not follow children into late adolescence or adulthood. Interventions at younger ages seem to produce larger effects.⁵⁰

Three programs have long-term follow-ups, and we focus on them here. They all targeted high-risk children from disadvantaged families. The first is the High/Scope Perry Preschool, a half-day program on a small scale in the Ypsilanti, MI public schools. Children were typically enrolled at age 4 and stayed in the program for two years. It was an experiment with a sample size of 123 and follow-up to age 40. The Abecedarian program, the second one we consider, was a full-day, year-round educational child care program in Chapel Hill, NC. Children entered around the age of 4 months and continued until age 5. Half of all children were then enrolled in a school-age program until age 8. It was evaluated by randomization and has 111 participants, and students are followed to age 21.

The final program we consider is the Chicago Child–Parent Centers (CPC), a half-day program during the school year and full-time for six weeks during the summer, conducted on a large scale in the Chicago public schools. It was evaluated by a non-experimental method (matching) and has a sample of about 1,500 children. All three programs had some sort of parental involvement component.

The programs differ by duration and child age at entry. Abecedarian started with young children in the first months of life. Perry and the CPC program start with older children, 3–5 years old. The programs differ in intensity. For some programs the comparison group received some supplementary resources relative to ordinary children, and for others they did not. Moreover, some comparison group members attended alternative preschool and kindergarten programs.

2.6.1.1. Perry preschool experiment. The Perry preschool experiment was an intensive preschool program that was administered to 65 randomly selected black children who were enrolled in the program over 5 different waves between 1962 and 1967. All the children came from Ypsilanti, MI. A control group of roughly the same size provides researchers with an appropriate benchmark to evaluate the effects of the preschool program.

The experimental group assignment was performed in the following way. Candidate families were identified from a census of the families of the students attending the Perry school at the date of operation of the program, neighborhood group referrals and door to door canvassing. Poor children who scored between 75 and 85 on the standard Stanford-Binet IQ test were randomly divided into two undesignated groups.⁵¹ The children were

test scores. Garces, Thomas and Currie (2002) find comparable results. The Mathematica evaluation of Early Head Start by Love et al. (2002) shows very modest effects as well. However, Head Start is a considerably less intensive program than many of the other programs considered in this section, which may explain why it has limited consequences for the developmental trajectories of disadvantaged children.

⁵⁰ Morris, Duncan and Clark-Kauffman (2005) find that the biggest impact of a parental wage-subsidy intervention on children's achievement is for preschool children.

⁵¹ Poverty status was determined by a formula that considered rooms per person in the child's household, parental schooling and occupational level. The IQ range was labeled as "borderline educable mentally re-

then transferred across groups to equalize the socioeconomic status, cognitive ability (as measured by the IQ test) and gender composition of the samples. Finally, a coin was tossed to determine which group received the treatment and which did not. Initially the treatment and control groups included 64 children each, but the actual treatment and control groups contained 58 and 65 children, respectively.⁵²

Children entered the Perry School in five waves, starting with wave zero (of four-year-olds) and wave one (of three-year-olds) in 1962, then waves two, three and four (of three-year-olds) entered in each subsequent year through 1965. The average age at entry was 42.3 months. With the exception of wave zero, treatment children spent two years attending the program. In the final year of the program, 11 three-year-olds who were not included in the data attended the program with the 12 4-year-olds who were. About half of the children were living with two parents. The average mother was 29 years old and completed 9.4 years of school.

The treatment consisted of a daily $2\frac{1}{2}$ hour classroom session on weekday mornings and a weekly ninety minute home visit by the teacher on weekday afternoons to involve the mother in the child's educational process. The length of each preschool year was 30 weeks, beginning in mid-October and ending in May. Ten female teachers filled the four teaching positions over the course of the study, resulting in an average child-teacher ratio of 5.7 for the duration of the program.⁵³ All teachers were certified to teach in elementary, early childhood or special education.⁵⁴ If it were administered today, the Perry preschool program would cost approximately \$9,785 per participant per year in 2004 dollars.

tarded" by the state of Michigan at the time of the experiment. Only children without an organic mental handicap were included in the study.

⁵² Some aspect of the assignment was clearly nonrandom and this has led some to call the Perry results into question. First, younger children were assigned to the same group as their older siblings. Two treatment children were transferred to the control group because their mothers were not able to participate in any classes or home visits because they were employed far from home. Four treatment children left the program before completing the second year of preschool when their families relocated, and one control child died. Thus, the final sample consisted of 123 children. The 123 children in the sample came from 100 families. In the control group, 41 families contributed 1 child each, and 12 families contributed 2 children each. In the treatment group, 39 families contributed 1 child apiece, 6 families contributed 2 children apiece, 1 family contributed 3 and another 4 children. Assigning younger siblings to the same group effectively made the family, rather than the individual, the unit of analysis. Still, it is difficult to argue that assigning siblings at random would have been a better strategy. So-called spillovers to the control siblings from home visits would have been one possible source of bias since mothers cannot be expected to treat siblings in accordance with their experimental status. Another potential source of bias is spillover from one sibling to another. In any case, differences in background characteristics between the two experimental groups are virtually nonexistent, with the exception of much higher rates of maternal employment at program entry in the treatment group.

⁵³ This number is low relative to other early education experiments. For instance, the student-teacher ratio for the Chicago Child-Parent Center and Expansion Program ranged from 8 to 12 [see [Fuerst and Fuerst \(1993\)](#)].

⁵⁴ [Schweinhart, Barnes and Weikart \(1993\)](#) argue that the certification of the teachers is an important component in the success of the Perry preschool.

2.6.1.2. Abecedarian project. The Abecedarian Project recruited 111 children born between 1972 and 1977 whose 109 families scored high on the High Risk Index.⁵⁵ It enrolled families and intervened in the lives of children beginning a few months after birth. Enrollment was based on the characteristics of the families more than on the characteristics of the children, as in the Perry program. Virtually all of the children were Black, and their parents had low levels of education, income, cognitive ability and high levels of pathological behavior. The children were screened for mental retardation. 76% of the children lived in a single parent or multigenerational household. The average mother in this group was less than 20 years old, completed 10 years of schooling and had an IQ of 85. There were 4 cohorts of about 28 students each. By the time they were 6 weeks old, the children were assigned randomly to either a preschool intervention or a control group. The mean age of entry was 4.4 months. At age 5, just as they were about to enter kindergarten, all of the children were reassigned to either a school age intervention through age 8 or to a control group. This yielded 4 groups: children who experienced no intervention at all, those who experienced an intervention when they were young, those who experienced it when they were older, and finally those who enjoyed a high-quality intervention throughout their whole childhood. The children were followed up until age 21.

The Abecedarian intervention was more intensive than the Perry one. The preschool program was a year-round, full-day intervention. The initial infant-to-teacher ratio was 3:1, though it grew to a child-to-teacher ratio of 6:1 as the kids progressed through the program. Infants in the control group received an iron-fortified formula for 15 months and diapers as needed to create an incentive for participation. Many of the control children were enrolled in preschool and/or kindergarten.

During the first 3 primary school years, a home-school teacher would meet with the parents and help them in providing supplemental educational activities at home. The teacher provided an individually-tailored curriculum for each child. This home-school teacher also served as a liaison between the ordinary teachers and the family, and she would interact with the parents and the teachers about every two weeks. She would also help the family deal with other issues that might improve their ability to care for the child, such as finding employment, navigating the bureaucracy of social services agencies, and transporting children to appointments. Data were collected regularly up to age 21.

2.6.1.3. Chicago Child-Parent Center program. The Chicago Child-Parent Center was not evaluated by the method of random assignment but by the method of matching treated children to comparable nontreated children on the basis of age, eligibility

⁵⁵ The factors used to form the index consist of weighted measures of maternal and paternal education levels, family income, absence of the father from the home, poor social or family support for the mother, indication that older siblings have academic problems, the use of welfare, unskilled employment, low parental IQ, and family members who sought counseling or support from various community agencies. Parental income and education were considered most important in calculating the index.

for intervention, and family socioeconomic status. It was started in 1967 in 11 public schools serving impoverished neighborhoods of Chicago. Using federal funds, the center provided half-day preschool program for 3- and 4-year-olds during the 9 months that they were in school. The program provided an array of services, including health and social services, and free meals. Parental participation was encouraged. Parents were helped to complete school and participated in home visits and field trips. In 1978, state funding became available, and the program was extended through third grade and included a full-day kindergarten experience. Eventually, 24 centers provided preschool and after-school activities, up to second or third grade. This is the period during which the sample analyzed by Reynolds, Ou and Topitzes (2004) was enrolled in the program. The preschool program ran 3 hours per day during the week for the 9 months that school was in session, and usually included a 6-week summer program. During the kindergarten years, more services were provided at the affiliated school. Teacher-child ratios were 17:2 for the preschool component and 25:2 for the kindergarten. Participation during the primary years was open to any child in the school. Program participants experienced reduced class sizes of 25 pupils rather than the standard of 35 or more in the Chicago public schools. Teachers' aides, extra instructional materials, and enrichment activities were also available. Some children continued to participate in CPC through age 9, for a maximum total of 6 years. 93% of the children were black and 7% were Hispanic.

2.6.1.4. The effects of early interventions. These and other studies of interventions for children from low-income families find that participants experienced increased achievement test scores, decreased grade retention, decreased time in special education, decreased crime and delinquency and increased high school graduation. The gains vary with quality and age at which the program is started, and there are important differences by the sex of the child.

Programs differ in the measures they use to evaluate the outcomes and in their intensity and quality. As a result, it is hard to compare the programs using a standard basket of benefits. The CPC program, which is less intensive, produced substantial effects on high school graduation rates, reductions in special (remedial) education, grade repetition and juvenile arrest (see Figure 13).

The Perry Preschool Program is the flagship experimental intervention study. Children are followed through age 40. The initial boost in IQ faded by the time the children were in second grade (see Figure 14A), but the program had substantial effects on educational achievement. Achievement test scores for the treatment group were consistently and statistically significantly higher through age 14. Participants had higher grades and were more likely to graduate from high school. Substantially less time was spent in special education, and higher high school graduation rates were achieved by participants (Figure 14B). Participants were more likely to be employed⁵⁶ and to earn more (Figure 14C) and they were less dependent on welfare. There was substantially less crime

⁵⁶ The difference in employment rates was only statistically significant at age 19.

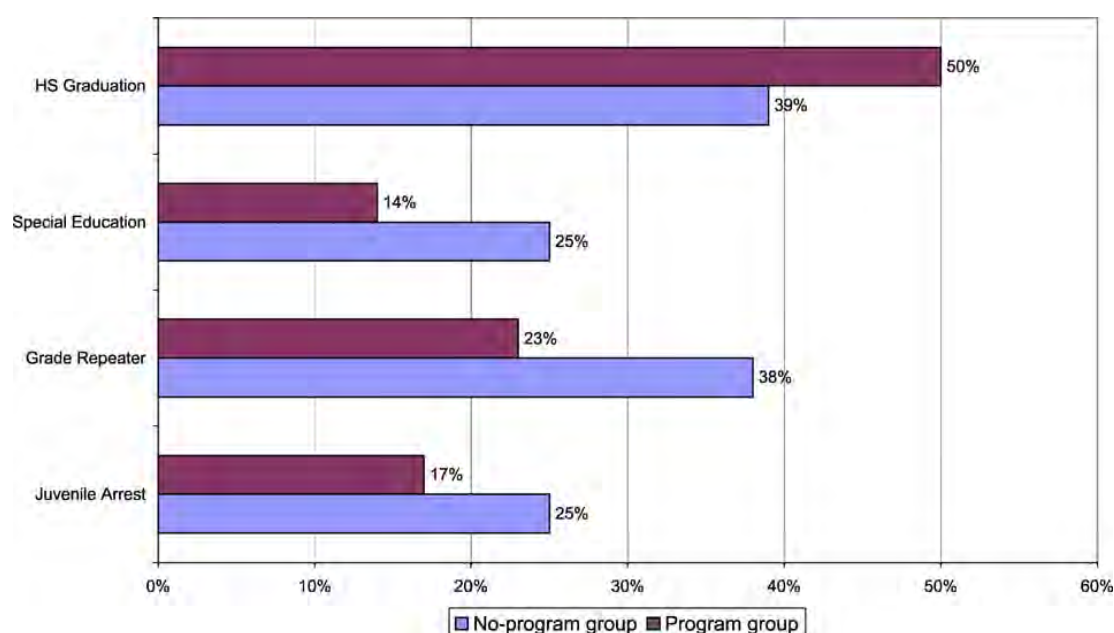


Figure 13. Academic and social benefits at school exit for CPC participants. Source: Barnett (2004).

among participants (Figure 14D) – both in terms of incidence and severity, a recurrent finding of early intervention programs. However, there was no statistically significant difference in grade retention by age 27 between the two groups, although teenage pregnancy was lower, and marriage rates were higher by age 27 for program participants. Results at age 27 are generally more favorable for girls. This reverses when outcomes at age 40 are studied [see Heckman (2005), and Heckman, Savelyev and Yavitz (2006)].

The Abecedarian program boosted IQ, but its effect is concentrated primarily among girls. Figure 15A shows the overall IQ gap between treatments and controls. It is persistent over time.⁵⁷ The Abecedarian program intervenes in the very early years, and it is known that IQ is malleable when children are very young (see, e.g., the discussion in Armor, 2003). This message is reinforced by the fact that the IQ boost was not found among children who only experienced the later intervention. Comparable effects are found for reading scores (Figure 15B) and math achievement scores (Figure 15C). The test score effects persist through age 21, which is the last age analyzed in the reports available to us.

There were substantial academic benefits as recorded in Figure 15D. Treatment group members participated less in remedial special education at age 15 and repeated fewer grades at all ages. High school graduation and four-year college participation rates were high. Participants were less likely to smoke and had better jobs (see Figure 15E).

⁵⁷ The decline in IQ over time for both groups may be a consequence of the “Flynn Effect” (see Flynn (1987)). Scores are normed against national averages, but over cohorts IQ is increasing.

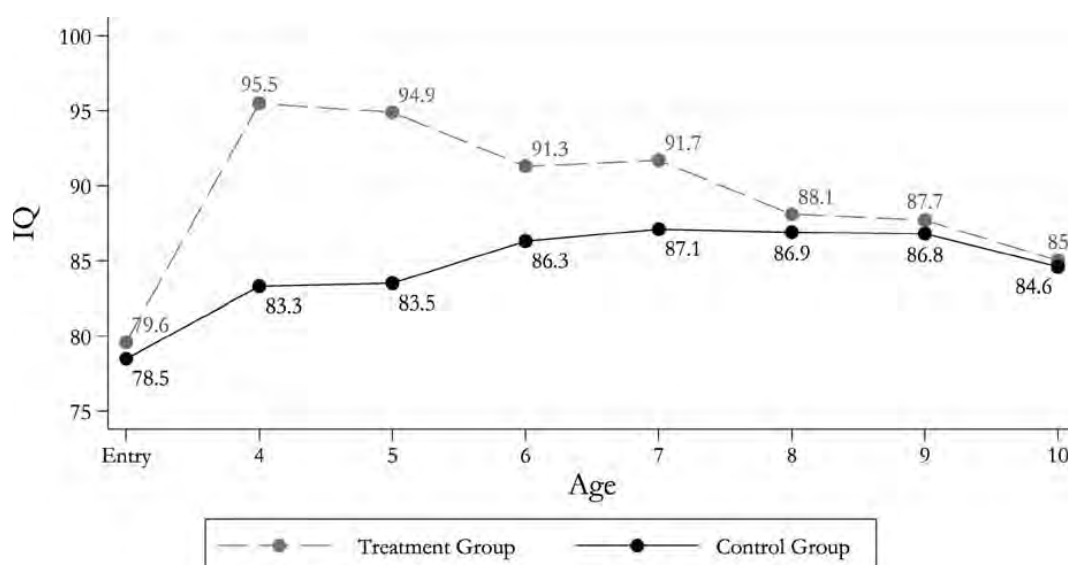


Figure 14A. Perry Preschool Program: IQ, by age and treatment group. Source: Perry Preschool Program. IQ measured on the Stanford–Binet Intelligence Scale (Terman and Merrill, 1960). Test was administered at program entry and each of the ages indicated.

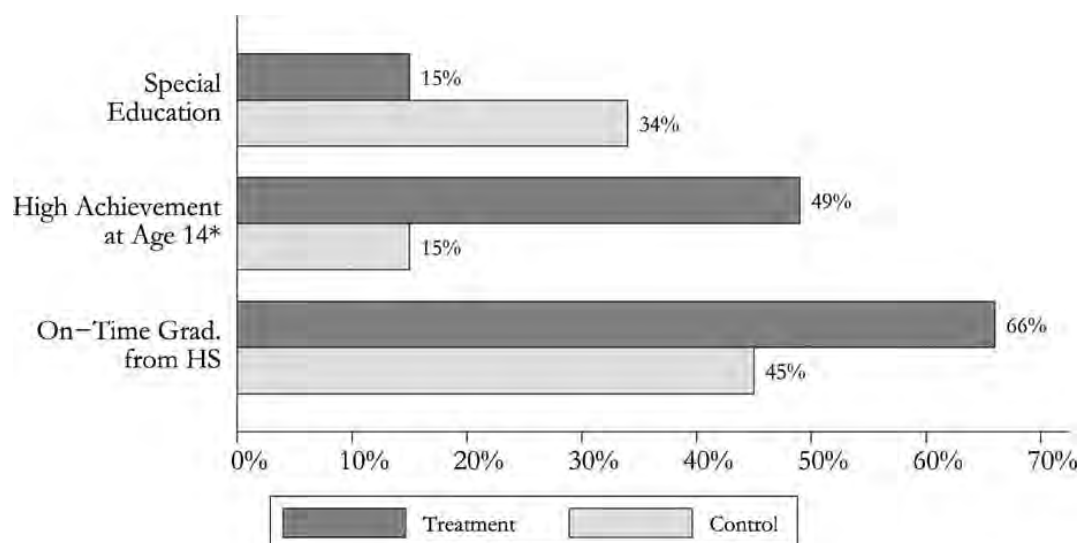


Figure 14B. Perry Preschool Program: Educational effects, by treatment group. Source: Barnett (2004).

* High achievement defined as performance at or above the lowest 10th percentile on the California Achievement Test [Tiegs and Clark (1970)].

Table 4 presents estimated costs and benefits of the Perry and Chicago programs with benefits discounted at a 3% rate. All figures are in 2004 dollars. The benefits vary among programs.⁵⁸ Perry produced some gain to parents in terms of reduced child care costs,

⁵⁸ There is a cost benefit study of the Abecedarian program [Barnett and Masse (2002)], but it is highly speculative, so that we did not include it here.

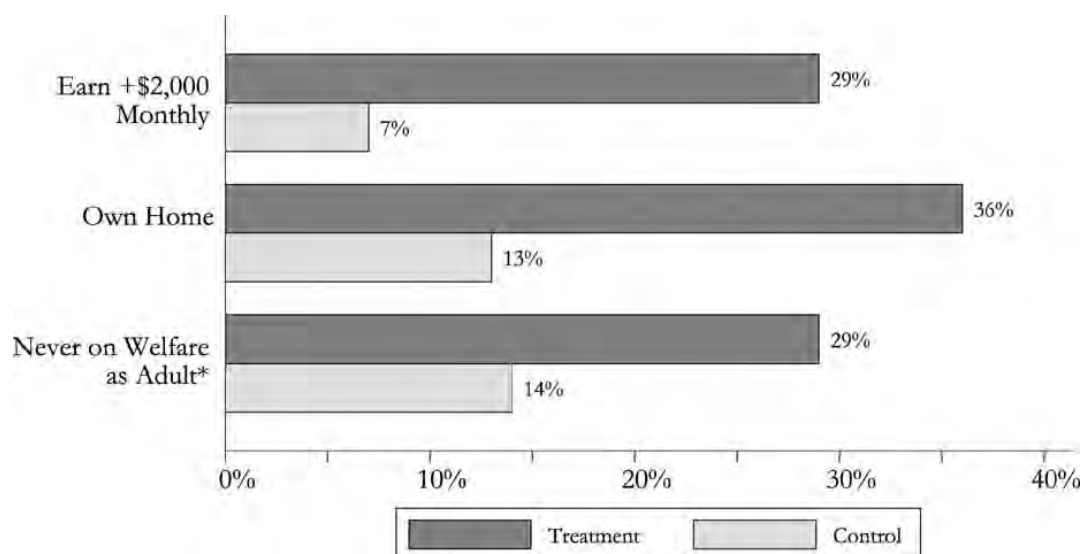


Figure 14C. Perry Preschool Program: Economic effects at age 27, by treatment group. Source: Barnett (2004).

*Updated through age 40 using recent Perry Preschool Program data, derived from self-report and all available state records.

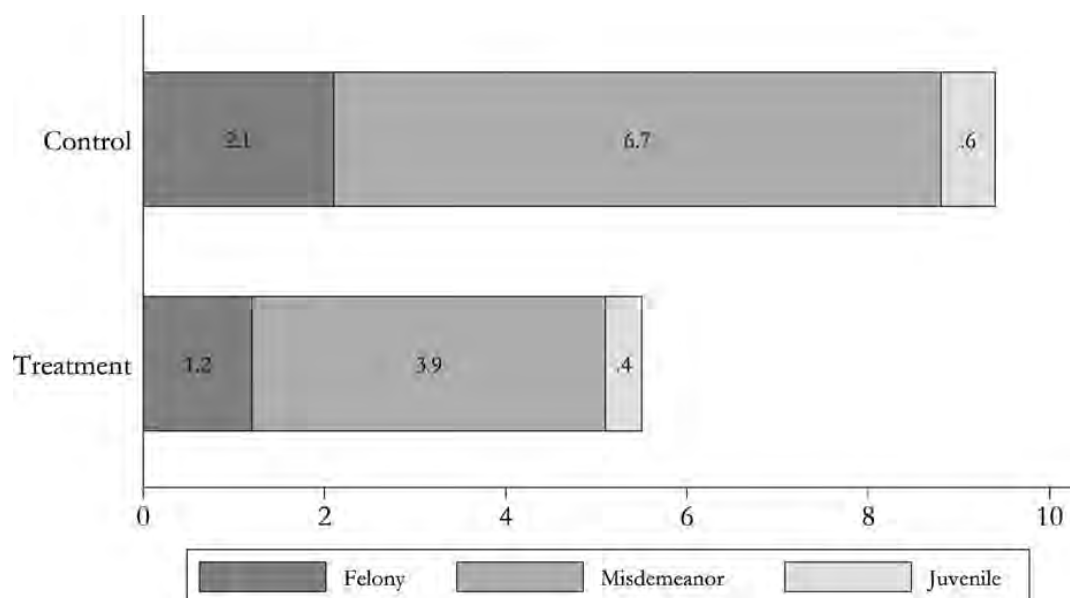


Figure 14D. Perry Preschool Program: Arrests per person before age 40, by treatment group. Source: Barnett (2004). Juvenile arrests are defined as arrests prior to age 19.

and earnings gains for participants were substantial. The K-12 benefit arises from the increment in student quality and a reduction in special education costs. This benefit is substantial across all programs. The college/adult category represents the extra tuition paid by students who go to college. Crime represents the reduction in direct costs (incar-

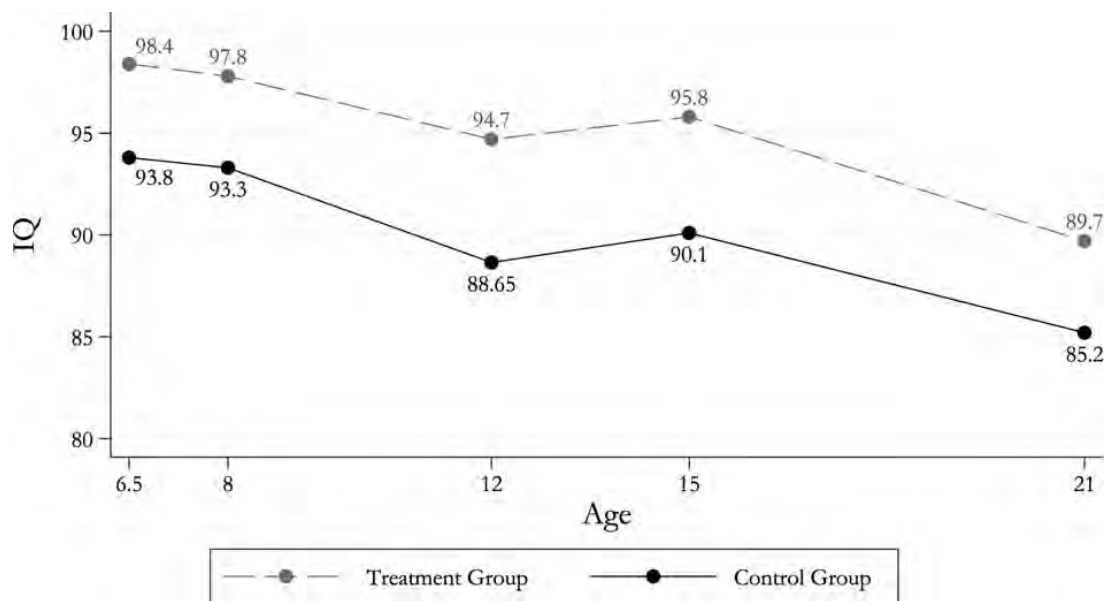


Figure 15A. Abecedarian Program: IQ, by age and treatment group. Source: Barnett (2004).

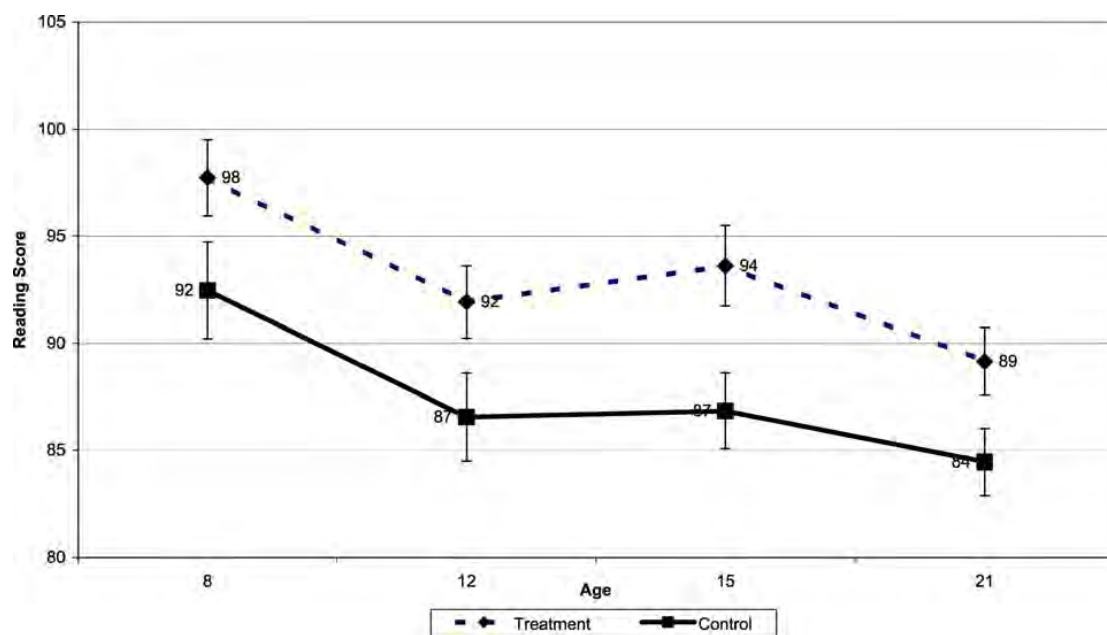


Figure 15B. Abecedarian reading achievement over time. Source: Barnett (2004).

ceration and criminal justice system) as well as damage done to victims. This excludes transfers. Welfare effects are modest. Future Generation (FG) Earnings represents the improvement in the earnings of the descendants of the program participants.

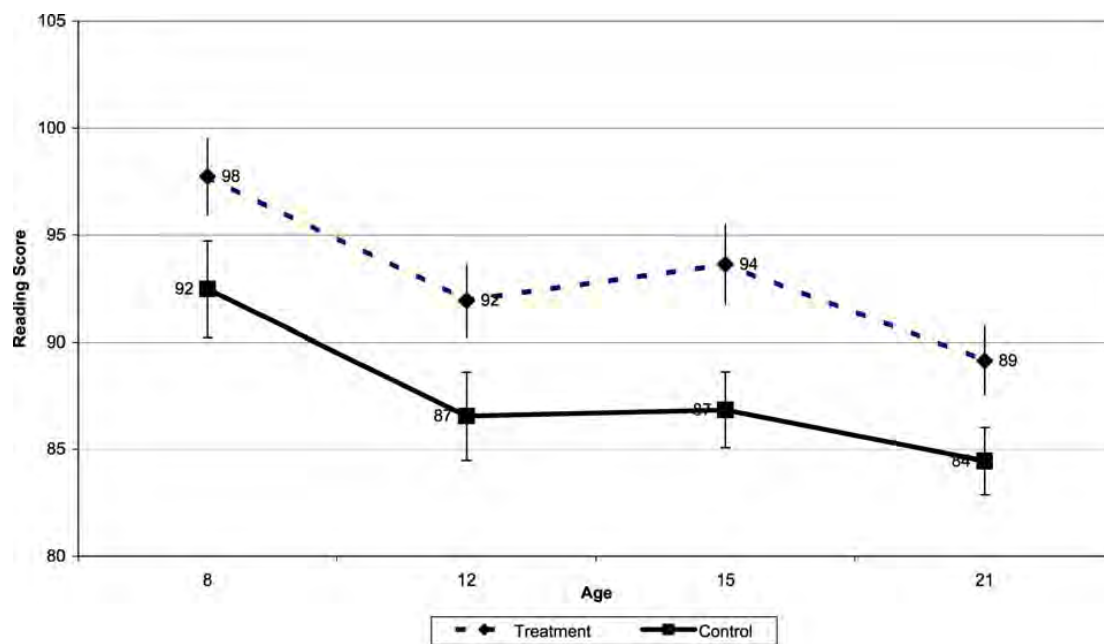


Figure 15C. Abecedarian math achievement over time. Source: Barnett (2004).

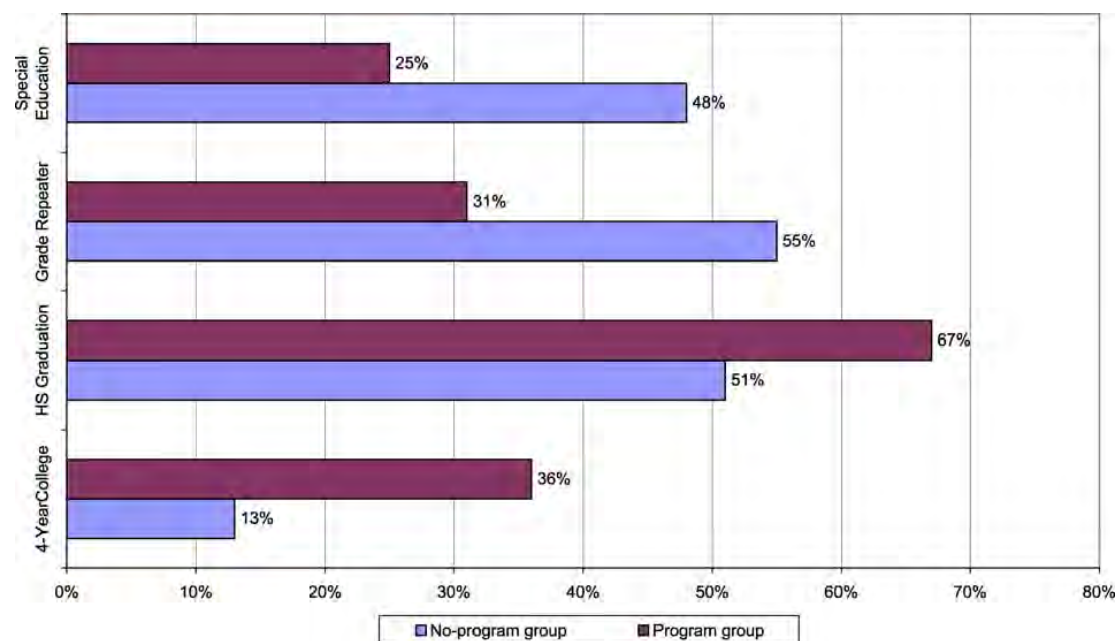


Figure 15D. Abecedarian academic outcomes. Source: Barnett (2004).

Smoking and health benefits were not measured in the Perry and Chicago data. For Abecedarian, there were substantial effects, including major differences in smoking rates. CPC documents a decline in child abuse and the costs of treating abused children.

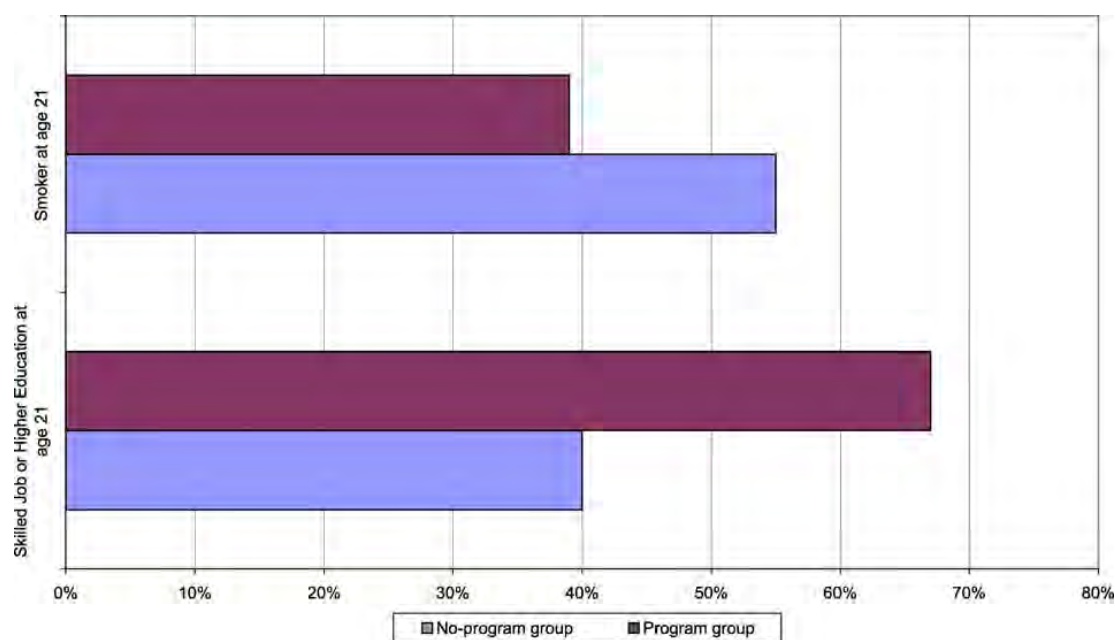


Figure 15E. Other benefits of Abecedarian. Source: Barnett (2004).

Table 4
Economic benefits and costs per treated child

	Perry	Chicago CPC
Child care	986	1,916
Earnings	40,537	32,099
K-12	9,184	5,634
College/adult	-782	-644
Crime	94,065	15,329
Welfare	355	546
FG earnings	6,181	4,894
Abuse/neglect	0	344
Total benefits	150,525	60,117
Total costs	16,514	7,738
Net present value	134,011	52,380
Benefits-to-costs ratio	9.11	7.77

All values discounted at 3% and are in \$2004. Numbers differ slightly from earlier estimates because FG Earnings for Perry and Chicago were estimated using the ratio of Future Generations Earnings Effect (FG) to Earnings Effect (about 15%) that was found in Abecedarian. Source: Barnett (2004).

The costs of Perry were substantial but per year were about the average cost of expenditure on public school students. CPC per year costs about \$6,796 for the preschool and \$3,428 for the school-age component (in 2004 dollars). The benefit cost ratios are

substantial: 9 to 1 for Perry; 8 to 1 for Chicago CPC. By projecting from the age 27 results, [Rolnick and Grunewald \(2003\)](#) estimate that the annual rate of return for Perry is 4% for participants and 12% for society at large. [Belfield, Nores, Barnett \(2004\)](#) use the data on Perry participants through age 40 to estimate that the rate of return for the participants and the general public as a whole is 18.4%. The rate varies by sex of the participants: the rate of return for males alone is 21.9%, while the rate for females is only 12.6%.⁵⁹

Some of the home visitation programs for low-income young mothers have been shown to have modest effects on maternal and offspring behavior and health.⁶⁰ [Olds \(2002\)](#) summarizes the results from two randomized trials in Elmira, NY and Memphis, TN, which served predominantly rural white and urban black populations, respectively. The treatment in both trials involved a series of pre- and postnatal home visits of poor, unmarried, and young women by specially-trained nurses.⁶¹ The visits typically lasted 75–90 minutes, and nurses spent more time with women they deemed to have higher needs. The target areas for this intervention were health related behavior during and after pregnancy, childcare skills, and personal development (family planning, education, job search assistance).

The Elmira treatment group made better use of community services and exhibited reduced prenatal-period smoking, with 75% fewer premature deliveries among smokers. At ages 3–4, children whose mothers smoked 10 or more cigarettes during pregnancy had a mean IQ of 4.5 points lower than women who smoked 0–9 cigarettes. Among the 14- to 16-year-old treatment women, the newborn children were almost 400 grams heavier relative to the children of the control women. The beneficial effects of the program were especially apparent for the most disadvantaged women (i.e., young, poor, and unmarried).⁶² After the birth of the child, the disadvantaged mothers who were visited showed better parenting skills and higher quality of the home environment. They also had 80% fewer verified cases of child abuse and neglect. Children of visited mothers had 32% fewer visits to the emergency room, and this effect persisted after the end of the program, though the differences in abuse and neglect faded.⁶³ The disadvantaged

⁵⁹ Excluding the benefits of the program for the participants, the rate for the general public alone is 16.9%. [Belfield, Nores, Barnett \(2004\)](#) do not calculate a rate of return for participants only because they do not bear any significant costs of the program. The rate for the general public on investing in males and females separately is 21.0% and 7.6%, respectively. The greater return for men comes from the effect of the intervention on crime, a predominantly male activity.

⁶⁰ [Gomby et al. \(1999\)](#) and [Brooks-Gunn, Berlin and Fuligni \(2000\)](#) show much more modest effects of home visitation programs, though these implementations are considerably less intensive.

⁶¹ Only women who were pregnant with their first child were eligible. The mean frequency of nurse visits in the prenatal and postnatal (age 0–2) stages were 9 and 23 for Elmira, and 7 and 27 for Memphis. The treatment group was divided into two subgroups, where the first received only prenatal visits. The control group was also divided. See [Olds \(2002\)](#) for more details on the intervention.

⁶² This result is found in many studies. [Brooks-Gunn et al. \(1992\)](#), [Magnuson et al. \(2004\)](#), [Magnuson, Ruhm and Waldfogel \(2004\)](#), and [Gormley et al. \(2004\)](#) find higher effects for the disadvantaged population.

⁶³ This may have been due to improved reporting of abuse by the nurses.

subsample of the treatment group had fewer subsequent pregnancies, longer periods between births, and greater employment rates. These effects were also evident by the time the child was 15. The children of the disadvantaged women reported fewer instances of running away, less criminal activity, promiscuous sexual behavior and smoking. Both parents and children reported less use of drugs and alcohol. Importantly, there were no differences in other behavioral problems. A cost–benefit analysis of the Elmira trial by Karoly et al. (1998) suggests that the program was very successful for low-income, unmarried women. Extrapolating from the results at age 15, the benefits of the program were 4 times its costs. The program paid for itself before the child’s fourth birthday, with the primary savings coming from reduced welfare and criminal justice expenditures, as well as increases in tax revenue. However, the program provided no net savings for the sample as a whole, suggesting that targeting, rather than universal provision, is appropriate.

The effects for the Memphis trial were considerably weaker, even for the disadvantaged subsample. There were no effects on birth outcomes and parenting skills. Many fewer women smoked in this sample, so any reductions were very small. The same may be the case for child abuse and neglect. Children of visited women had fewer health-care visits, especially among the disadvantaged subsample. In the first 2 years of life, more visited mothers attempted breast feeding. At age 4, there were no differences in mental development or reported behavior problems. Visited mothers reported fewer subsequent pregnancies. There were no differences in employment and some evidence of reduced AFDC and Food Stamp use. The children are still too young to perform a reliable cost–benefit analysis on their outcomes.

Much more research is needed on Perry, CPC, and a wide variety of other early childhood programs (shown in Tables 5 and 6). These samples and measurements need to be placed in a common analytical framework to better understand the differences in samples, treatments, and effects. For example, are the persistent Abecedarian effects on IQ due to the intensity or the age (4 months) at which the intervention is administered? How important are home visitation efforts? Joint analysis of the multiplicity of generally favorable treatment outcomes using methods appropriate for the small samples that are available, needs to be applied to supplement analyses of one-at-a-time outcome measure studies. A much more careful analysis of the effects of scaling up the model programs to the target population, and its effects on costs, has to be undertaken before these estimates can be considered definitive.

2.6.1.5. Extreme deprivation and remediation. Institutional rearing of children, insofar as it tends to be exceptionally poor, provides scientists with a unique natural experiment that can be used to ascertain the effects of severe environmental deprivation. Evidence on children from such environments allows us to answer questions about the developmental consequences of negative early experience and how amenable exposed children are to interventions such as foster care. It may also enable us to learn if there are critical or sensitive periods for development, which would have important implications for the relationship between the timing of an intervention and the extent

Table 5
Effects of early intervention programs

Program/study	Costs*	Program description	Test scores	Schooling	Pre-delinquency crime
Abecedarian project** [Ramey et al. (1988)]	N/A	Full-time year round classes for children from infancy through preschool	High scores at ages 1–4	34% less grade retention by 2nd grade; better reading and math proficiency	
Early training** [Gray et al. (1982)]	N/A	Part-time classes for children in summer; weekly home visits during school year	Higher scores at ages 5–10	16% less grade retention; 21% higher HS grad. rates	
Harlem study [Palmer (1983)]	N/A	Individual teacher-child sessions twice-weekly for young males	Higher scores at ages 3–5	21% less grade retention	
Houston PCDC** [Johnson (1988)]	N/A	Home visits for parents for 2 yrs; child nursery care 4 days/wk in year 2 (Mexican Americans)	Higher scores at age 3		Rated less aggressive and hostile by mothers (ages 8–11)
Milwaukee project** [Garber (1988)]	N/A	Full-time year-round classes for children through 1st grade; job training for mothers	Higher scores at ages 2–10	27% less grade retention	
Mother-child home program [Levenstein, O'Hara and Madden (1983)]	N/A	Home visits with mothers and children twice weekly	Higher scores at ages 3–4	6% less grade retention	
Perry preschool program** [Schweinhart, Barnes and Weikart (1993)]	\$13,400	Weekly home visits with parents; intensive, high quality preschool services for 1–2 years	Higher scores in all studied years (ages 5–27)	21% less grade retention or special services; 21% higher HS grad. rates	2.3 vs. 4.6 lifetime arrests by age 27 7% vs. 35% arrested 5 or more times

(Continued on next page)

Table 5
(Continued)

Program/study	Costs*	Program description	Test scores	Schooling	Pre-delinquency crime
Rome head start [Monroe and McDonald (1981)]	\$5,400	Part-time classes for children; parent involvement		12% less grade retention; 17% higher HS grad. rates	
Syracuse university family development [Lally et al. (1988)]	\$38,100	Wekly home visits for family; day care year round	Higher scores at ages 3–4		6% vs. 22% had probation files; offenses were less severe
Yale experiment	\$23,300	Family support; home visits and day care as needed for 30 months	Better language development at 30 months	better-school attendance and adjustment; fewer special adjustment; school services (age 12½)	Rated less aggressive and pre-delinquent by teachers and parents (age 12½)

All comparisons are for program participants vs. non-participants. Source: Heckman et al. (1997).

*Costs valued in 1990 dollars.

**Studies used a random assignment experimental design to determine program impacts. Data from Donohue and Siegelman (1998), Schweinhart, Barnes and Weikart (1993), and Seitz (1990) for the impacts reported here.

of its success. Some good evidence on this issue comes from the longitudinal studies of initially institutionalized Romanian infants and toddlers who were later placed into foster care abroad. In this section, we will outline the historical context for these studies, some of their results, and the implications that these data have for our model of human development.

The Ceaușescu regime in Romania, which was in power from 1966 to 1989, attempted to enlarge the country's workforce by increasing the birth rate.⁶⁴ Virtually all types of abortion were criminalized, and divorce was made much more difficult. Contraceptives were neither manufactured domestically nor imported. Progressive income taxes on childless adults over 25 were imposed. Monthly cash subsidies were awarded to families with children, and the average allowance per child rose as family size increased. Various labor laws eased working conditions for pregnant and nursing mothers by eliminating overtime and night work entirely, and by reducing physically demanding work. Over three months of paid maternity leave were available, as were additional breaks or reductions in work hours of up to two hours per day. Early retirement was available for

⁶⁴ Moskoff (1980) enumerates the regime's pronatalist policies.

Table 6
Outcomes of early intervention programs

	Program (years of operation)	Outcome	Followed up to age	Age when treatment effect last statistically significant	Control group	Change in treated group
Cognitive measures	Early Training Project (1962–1965)	IQ	16–20	6	82.8	+12.2
	Perry Preschool Project (1962–1967)	IQ	27	7	87.1	+4.0
	Houston PCDC (1970–1980)	IQ	8–11	2	90.8	+8.0
	Syracuse FDRP (1969–1970)	IQ	15	3	90.6	+19.7
	Carolina Abecedarian (1972–1985)	IQ	21	12	88.4	+5.3
	Project CARE (1978–1984)	IQ	4.5	3	92.6	+11.6
	IHDP (1985–1988)	IQ (HLBW sample)	8	8	92.1	+4.4
Educational outcomes						
	Early Training Project	Special education	16–20	18	29%	–26%
	Perry Preschool Project	Special education	27	19	28%	–12%
		High school graduation		27	45%	+21%
	Chicago CPC (1967–present)	Special education	20	18	25%	–10%
		Grade retention		15	38%	–15%
		High school graduation		20	39%	+11%
	Carolina Abecedarian	College enrollment	21	21	14%	+22%

(Continued on next page)

Table 6
(Continued)

Program (years of operation)	Outcome	Followed up to age	Age when treatment effect last statistically significant	Control group	Change in treated group
Economic outcomes	Perry Preschool Project	27	27	69%	-12% +18% +\$453 -17% -8%
	Chicago CPC (preschool vs. no preschool)	20	18	25%	
	Syracuse FDRP	15	15	22%	-16%
	Elmira PEIP (1978-1982)	15	15	0.53	-0.029
	Arrests (HR sample)				
	Probation referral				

HLBW = heavier, low birth weight sample; HR = high risk. Cognitive measures include Stanford-Binet and Weschler Intelligence Scales, California Achievement Tests, and other IQ and achievement tests measuring cognitive ability. All results significant at 0.05 level or higher. Source: [Karoly \(2001\)](#). For a discussion of the specific treatments offered under each program see [Heckman \(2000\)](#) and [Karoly \(2001\)](#).

women as a function of the number of children they raised to age 10. Increasing economic hardship coupled with Ceaușescu's goal of paying off all international debt by imposing rationing, obliged many women to work outside the home. Since childcare for the young (or any other alternative) was scarce, many children were simply abandoned.

Institutionalization of children was not stigmatized, and was even encouraged officially. When the Ceaușescu regime fell in 1989, there were roughly 170,000 children in 700 overcrowded state institutions [see [Rosapepe \(2001\)](#)]. While no rigorous statistics on the conditions in these homes are available, foreign visitors described the situation as appalling [see [Rosapepe \(2001\)](#), [Rutter \(1998\)](#)]. Children remained in their cots all day, with no toys or other types of stimulation. Caregiving and personalized affection were all but nonexistent. Many young children were fed only gruel from bottles that were propped up, and some continued to have difficulty even chewing solid food some years later. Orphanages were frequently located in remote areas of the country; some children were transferred far away from where they were born and were “lost” in the system. By the late 1980s, many institutions had no hot water, no constant heat during winter, no diapers or even detergent. Medical supplies, including antibiotics and syringe needles, were extremely scarce. Children were often tied down or locked in rooms to keep them under control and some were abused. While the prevalence and incidence of these problems are unknown, most children exhibited a range of emotional, behavioral and medical problems when they were adopted abroad.

Several studies have been conducted to evaluate the effects of interventions at various ages on these children. The largest study of this sort was completed in the UK by Michael Rutter, his colleagues and the English and Romanian Adoptees Study Team. The most recent results are summarized in [O'Connor et al. \(2000\)](#). This group studied 165 children who were adopted from Romania into UK families between 1990 and 1992 and compared them at ages 4 and 6 to 52 adopted children from within the UK who were all placed before age 6 months.⁶⁵ Selected results are shown in [Table 7](#). [Rutter \(1998\)](#) shows that at the time of adoption, the orphans showed substantial developmental retardation, malnutrition, and a range of health problems. Relative to ordinary English children, half of the Romanian orphans were below the third percentile on weight, and over a third were below the third percentile on height. The overall mean score on the Denver developmental quotient was 63, indicating mild retardation.⁶⁶ Interestingly, there were no significant differences in weight or Denver scale by age of adoption. By age 4, only 2% of the orphans were below the third percentile on weight, and only 1% was below that threshold on height. The extent of catch-up to British adoptees on the

⁶⁵ Only 87% of the Romanian children were adopted from institutions. The others came from a family setting, but there were no differences in origin by age at the time of adoption. It is true, however, that the non-institutionalized children exhibited fewer problems.

⁶⁶ The Denver Developmental Scales were used to conduct this assessment. Parents were asked to recall specific behavior (e.g., standing while holding on to something, lifting the head, making meaningful “da-da” sounds) at the time of adoption. The majority of parents used baby books that recorded these developmental milestones, which made recollection much better. See [Rutter \(1998\)](#) for more details on the analysis.

Table 7
Anthropomorphic, developmental, and cognitive outcomes of Romanian and within-UK adoptees over time

Age of adoption (months):	Within-UK adoptees	Romanian orphans		
	6	Before 6	At 6–24	At 24–42
Weight at adoption	—	–2.1	–2.3	—
	—	(1.7)	(1.7)	—
Height at adoption	—	–1.8	–2.2	—
	—	(1.6)	(2.4)	—
Denver Developmental Scale at adoption	—	76.5	48.1	—
	—	(48.1)	(25.4)	—
Weight at age 4	0.45	–0.02	0.04	—
	(0.79)	(0.92)	(0.94)	—
Height at age 4	0.25	–0.29	–0.36	—
	(0.91)	(0.89)	(1.02)	—
Denver Developmental Scale at age 4	117.7	115.7	96.7	—
	(24.3)	(23.4)	(21.3)	—
McCarthy GCI at age 4	109.4	105.9	91.7	—
	(14.8)	(17.9)	(18.0)	—
Weight at age 6	0.30	0.02	–0.25	–0.85
	(0.90)	(0.97)	(0.96)	(0.98)
Percentage with Denver Developmental Scale at age 6 below 70	2	0	5	18
	(1)	(0)	(2)	(7)
McCarthy GCI at age 6	117	114	99	90
	(17.8)	(18.3)	(19.2)	(23.8)

Standard deviations are reported below in parentheses. All anthropometric measurements are standardized using the UK age-specific distributions. The Denver Developmental Scale is based on specific behaviors (e.g., standing while holding on to something, lifting the head, making meaningful “da-da” sounds). Due to ceiling effects, the Denver scale is not meaningful at age 6, so O’Connor et al. (2000) use the percentage with impairment (defined as a score below 70) as the test criterion. The GCI is the total score on the McCarthy Scales of Children’s Abilities. It summarizes verbal, quantitative, perceptual, and memory performance. See Rutter et al. (1998) and O’Connor et al. (2000) for more details on the analysis.

Denver developmental quotient was greater for the orphans who entered foster care before they were 6 months of age.⁶⁷ At age 6, the same result was obtained.⁶⁸ The same

⁶⁷ The mean Denver scale for within-UK adoptees was 117.7 ($SD = 24.3$), 115.7 ($SD = 23.4$) for Romanians adopted before 6 months, and 96.7 ($SD = 21.3$) for those adopted when they were between 6 and 24 months of age. See Rutter (1998).

⁶⁸ O’Connor et al. (2000) add a third group of Romanian children who were adopted between the ages of 24 to 42 months. This group exhibits the worst performance on the Denver scale. Due to ceiling effects, the Denver scale is not meaningful at age 6, so O’Connor et al. (2000) use the presence of impairment (defined as a score below 70) as a test criterion. For within-UK adoptees, only 2% ($SD = 1$) qualify as impaired. The corresponding percentages for the Romanians adopted before 6, 6–24 and 24–42 months are 0 ($SD = 0$), 5 ($SD = 2$), and 18 ($SD = 7$). See O’Connor et al. (2000).

pattern appears to hold for cognitive development at ages 4 and 6, as measured using the McCarthy General Cognitive Index.⁶⁹

Romanian orphans who were adopted into UK families from an environment of severe early deprivation exhibited remarkable improvement. This recovery was characterized by a negative linear dose-response relationship with the duration (or perhaps severity) of the exposure to poor pre and postnatal environments. The children who caught up to ordinary UK adoptees were the ones who were adopted before 6 months of age. This shows the importance of early vs. late intervention that we have documented throughout this chapter. This evidence is also consistent with the notion that early environments are a sensitive, rather than a critical period of development for many child outcomes. Had the interventions occurred later in the life of the children, it is likely that they would have been less effective.

2.6.2. Intervention in the adolescent years

How effective are interventions in the adolescent years? Is it possible to remedy the consequences of neglect in the early years? These questions are relevant because cognitive abilities are fairly well determined and stable by age 10 in the sense that IQ at later ages is highly correlated with IQ at ages 8–10. Just as early intervention programs have a high payoff primarily from the social skills and motivation they impart to the child and the improved home environment they produce, so do interventions that operate during the adolescent years.

Tables 8 and 9 summarize evidence on the effects of adolescent interventions on education, earnings, and crime rates. There are few estimates of rates of return for these programs. School-based and training-based programs are compared in the tables. We briefly discuss what is known about school-based interventions during the adolescent years. A few recent studies of mentoring programs like Big Brothers/Big Sisters (BB/BS) and Philadelphia Futures Sponsor-A-Scholar (SAS) have shown that these programs have broad positive social and academic impacts on participating school-aged children and adolescents. The BB/BS program pairs unrelated adult volunteers with youth from single-parent households for the purpose of providing youth with an adult friend. This activity promotes private youth development and surrogate parenthood. No specific attempts were made to ameliorate particular deficiencies or to reach specific educational goals. A broad, supportive role is envisioned for the mentor.

In a random-assignment study, Tierney, Grossman and Resch (1995) found that eighteen months after being matched with a mentor, Little Brothers and Sisters (ages 10 to 16 at the time of the match) were less likely to have initiated drug or alcohol use, to hit someone, to skip class or a day of school, or to lie to their parents; they had higher average grades and were more likely to feel competent in their school work and report a better relationship with their parents.

⁶⁹ The GCI is the total score on the McCarthy Scales of Children's Abilities. It summarizes verbal, quantitative, perceptual, and memory performance.

Table 8
Estimated benefits of mentoring programs (Treatment group reductions compared to control group)

Program	Outcome measure	Change	Program costs per participant
Big Brother/Big Sister			\$500–1500*
	Initiating drug use	–45.8%	
	Initiation alcohol use	–27.4%	
	# of times hit someone	–31.7%	
	# of times stole something	–19.2%	
	Grade point average	3.0%	
	Skipped class	–36.7%	
	Skipped day of school	–52.2%	
	Trust in parent	2.7%	
	Lying to parent	–36.6%	
Sponsor-A-Scholar	Peer emotional support	2.3%	
			\$1485
	10th grade GPA (100 point scale)	2.9	
	11th grade GPA (100 point scale)	2.5	
	% attending college (1 year after HS)	32.8%	
Quantum opportunity program	% attending college (2 years after HS)	28.1%	
	Graduated HS or GED	+26%	
	Enrolled in 4-year college	+15%	
	Enrolled in 2-year college	+24%	
	Currently employed full time	+13%	
	Self receiving welfare	–22%	
	% ever arrested	–4%	

Sources: Benefits from Heckman (1999) and Taggart (1995), costs from Johnson (1996) and Herrera et al. (2000).

*Costs, in 1996 dollars, for school-based programs are as low as \$500 and more expensive community based mentoring programs cost as high as \$1500; HS = high school.

The primary goal of Sponsor-A-Scholar (SAS) was to help students from Philadelphia public high schools make it to college. The program provides long-term mentoring (throughout high school and for one year beyond), substantial academic support, help with college application and financial-aid procedures, and financial support for college-related expenses. Individually matched mentors served as surrogate parents, provided a successful role model, monitored student progress, and provided encouragement and support. SAS provided students with \$6,000 in financial assistance throughout college for those choosing to enroll in an accredited two- or four-year postsecondary institution. The program also provided a coordinator for groups of about thirty students to ensure a successful relationship is built between mentors and students. Using a matched sample of non-SAS students in Philadelphia high schools, Johnson (1996) estimates statisti-

Table 9
Effects of selected adolescent social programs on schooling, earnings, and crime

Program/Study	Costs*	Program Description	Schooling	Earnings*	Crime*
Job Corps [Long et al. (1981)]	\$11,000	7 mo. of educ. and vocational training for 16–21 yr. olds (mostly male)	no effect	disc. pres. value of increased earnings of \$10,000	Estimated Reduction in crime valued at approx.
STEP [Walker and Viella-Velez (1992)]	N/A	2 summers of employment, academic/ remediation and life skills for 14 and 15 year olds	short-run gains in test scores; no effect on school completion rates		
Quantum opportunities program** [Taggart (1995)]	\$10,600	counseling; educ., comm., and devp. services; financial incentives for part. (4 yrs. beginning in 9th grade)	34% higher HS grad./GED rates (2 yrs. post- program)		4% vs. 16% convicted; 0.28 vs. 0.56 avg. number of arrests (2 yrs. post-program)

Notes: All comparisons are for program participants vs. nonparticipants.

Source: Heckman et al. (1997).

*All dollar figures are in 1990 values.

**Studies used a random assignment experimental design to determine program impacts.

cally significant increases in grade point averages for tenth and eleventh grades, as well as a 22 percent (16 percent) increase in college attendance one year (two years) after graduation from high school. Because the primary goal of SAS is to increase college enrollment, Johnson did not collect other social and psychological measures.

Much like SAS, the Quantum Opportunity Program (QOP) offered disadvantaged minority students counseling and financial incentives (one dollar up front and one dollar put in a college fund) for every hour spent in activities aimed at improving social and market skills. Students who were randomly chosen to participate in the program were provided with a mentor at the beginning of ninth grade. All participants were kept in the program for four years regardless of whether they stayed in school. Over four years, the average participant logged 1,286 hours of educational activities like studying with tutors or visiting museums. Two years after program completion, about a third more participating students graduated from high school (or obtained a GED) than similar nonparticipants. Since many participants were enrolled in postsecondary schooling

at the time of the follow-up study, it is difficult to determine the program's effect on earnings. Arrest rates for program participants, however, were one-half those for non-participants. These benefits did not come without substantial expenditures, however, as the average four-year cost per participant was \$10,600. Still, a cost-benefit analysis estimated positive net social returns to QOP. [See [Taggart \(1995\)](#) for a more detailed description of the program and an evaluation of its impacts]. [Tables 8 and 9](#) present evidence from a randomized-trial evaluation of the QOP program. Again, the evidence shows that QOP and programs like it can dramatically improve social skills and the adaptation of adolescents to society. However, these programs do not produce miracles. The recent evaluation of QOP by [Maxfield, Schirm and Rodriguez-Planas \(2003\)](#) found that the program did not improve grades or achievement test scores and the effect on risky behaviors was ambiguous. It was also more effective for teens from the middle of the eligible grade distribution than for enrollees at the top or bottom of the distribution. There was considerable variability in effect by program site.

Two other studies provide additional evidence that creative programs designed to keep adolescents in school can be effective. These are discussed more extensively in [Heckman \(2000\)](#) and [Heckman and Lochner \(2000\)](#), and we briefly summarize these discussions here. Ohio's Learning, Earning, and Parenting (LEAP) program and the Teenage Parent Demonstration (TPD) provided financial incentives for teenage parents on welfare to stay in school or take GED classes (or, alternatively, imposed financial penalties for nonenrollment). LEAP showed increases in high school graduation or GED rates among randomly assigned participants who were still enrolled in school when they entered the program. TPD showed mixed results on educational attainment depending on the program site. Young women who had already dropped out of school at the time of enrollment in the program (and, to a lesser extent, those who were still attending school when they entered the program) may have substituted GED training for high school graduation as an easier way to meet program requirements, raising concerns about an unintended, potentially negative effect. Both of these programs show positive post-program effects on earnings and employment for students who were still in school when they entered the program. The estimated effects were often negative, however, for participants who had already dropped out of school before entering the program. Both studies thus show more positive impacts for individuals still enrolled in school than for dropouts. It is still unknown whether the effects of the programs are more positive for those still in school because, on average, they are of higher ability than those who have already dropped out, or because there is some advantage to intervening before adolescents leave school.

The available schooling literature demonstrates that providing disadvantaged students with financial incentives to stay in school and participate in learning activities can increase schooling and improve employment outcomes. It should be noted that although programs providing such incentives have proven to influence employment and earnings positively (and, in the case of QOP, to reduce crime), they do not perform miracles. The impacts they achieve are modest, but positive.

The Summer Training and Employment Program (STEP) provided remedial academic education and summer jobs to disadvantaged youth ages 14 and 15. Each summer, participants enrolled in 110 hours of classes and 90 hours of part-time work. Although program participants achieved modest short-term gains in reading and math skills, those gains did not last. Two to three years after program completion, program participation was found to have no effects on high school graduation rates, grades, or employment (see [Table 9](#)). The program has been criticized for not attempting to follow up on its summer program with a school year curriculum. Maryland's Tomorrow program did just that: it combined an intensive summer program with a school year follow-up, offering participants summer jobs and academic instruction, career guidance, and counseling through adult mentors, peer support, or tutoring. Although the program did not reduce final attrition rates, it did seem to delay attrition (dropout rates were lower for program participants during the ninth grade but not by the end of the twelfth grade). The program also increased the pass rate for twelfth grade students taking the Maryland Functional Tests, a series of tests of basic skills [see [Heckman and Lochner \(2000\)](#)].

There is also some non-experimental evidence that Catholic secondary schooling is associated with increased college participation among urban students, especially minorities [see [Grogger and Neal \(2000\)](#)]. This increase does not appear to be accompanied by large gains in math scores, at least for the groups whose attainment is most affected. This is consistent with our hypothesis that adolescent interventions alter noncognitive skills but have weaker effects on cognitive skills. [Altonji, Elder and Taber \(2005\)](#) find a similar pattern that attendance at Catholic schools raises high school graduation rates and, more tentatively, promotes college attendance but has no effect on test scores.

The evidence on programs aimed at increasing the skills and earnings of disadvantaged youth suggests that sustained interventions targeted at adolescents still enrolled in school can positively affect learning and subsequent employment and earnings. The studies discussed in this section also suggest that interventions for dropouts are much less successful. One plausible interpretation, consistent with other evidence reported in this chapter, is that those who choose to drop out have less motivation and lower ability, making programs less effective for them regardless of when the intervention takes place. It is important to note, however, that the interventions conducted by such programs only alleviate and do not fully reverse early damage caused by low quality family environments.

2.6.3. The effectiveness of late adolescent and young adult remediation programs

The evidence from public job training and second chance programs like the GED suggests that remediation targeted towards children from disadvantaged environments is costly and at current expenditure levels is ineffective [see [Carneiro and Heckman \(2003\)](#)]. [Heckman, LaLonde and Smith \(1999\)](#) survey evaluations of public job training programs in the United States. Returns are low (and sometimes negative) and even when they are positive they do not lift most persons treated out of poverty. Similar evidence

is reported for remediation efforts in public schools. As discussed above, the return to GED certification is very low. While the return to private sector on-the-job training is high, access to such training is difficult for the less able and the disadvantaged (recall Table 2). Adolescent remediation programs are effective for a targeted few who use them as second chance opportunities. They are not effective for the rest.

Some look to public schooling as a way to remedy early ability deficits and to alleviate disadvantage in endowments. Hansen, Heckman and Mullen (2004) and Heckman, Larenas and Urzua (2004) address this issue. They use a variety of methods to control for the endogeneity of schooling. All methods show that schooling, while it raises measured ability, does not eliminate gaps between children from different racial and economic strata, and if anything widens them. This evidence parallels the evidence on military experience and productivity discussed in Section 2.5.6. Experience raises performance but does not close gaps.

Figures 16A and 16B, taken from Heckman, Larenas and Urzua (2004), show how schooling raises achievement test scores at different levels of ability. These authors use the methodology of Hansen, Heckman and Mullen (2004) to isolate causal effects of schooling on AFQT test scores, holding pure cognitive ability constant. The level of latent ability is determined by a version of factor analysis. Graphs are given by decile of ability from the lowest to the highest. Their analysis is based on longitudinal data to

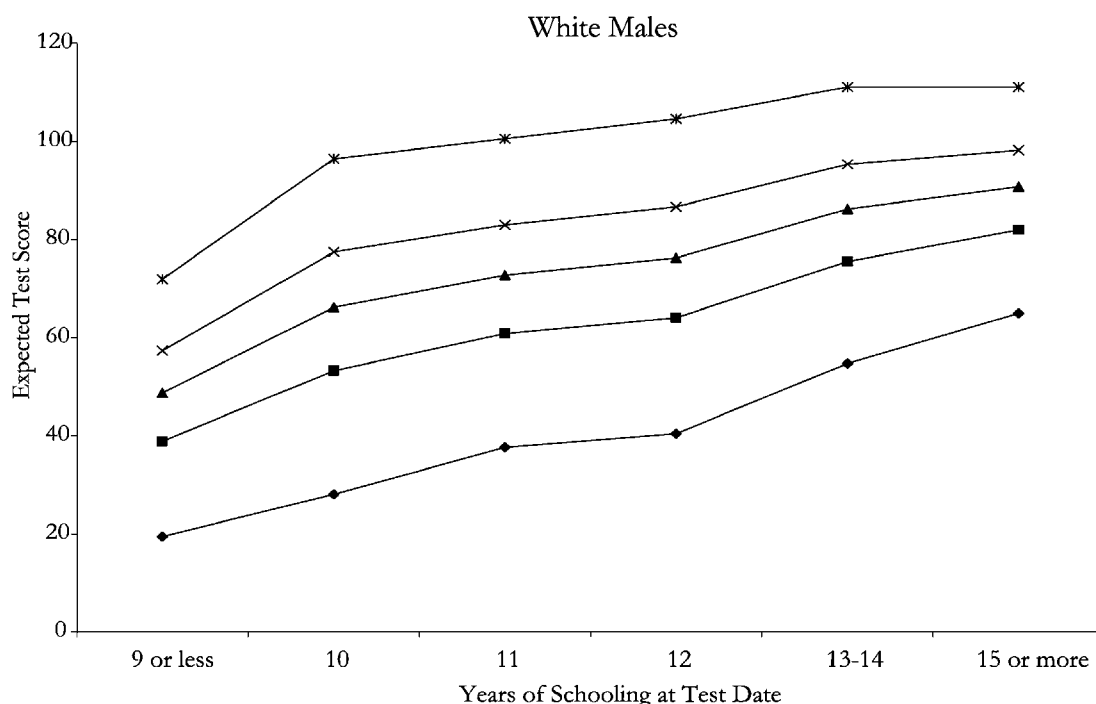


Figure 16A. Expected value of AFQT score conditional on latent ability (plots are by decile of latent ability). Notes: The structural model includes the following covariates: urban status, broken home and southern residence at age 14, number of siblings and family income in 1979, mother's and father's education, and age of the child at December 1980.

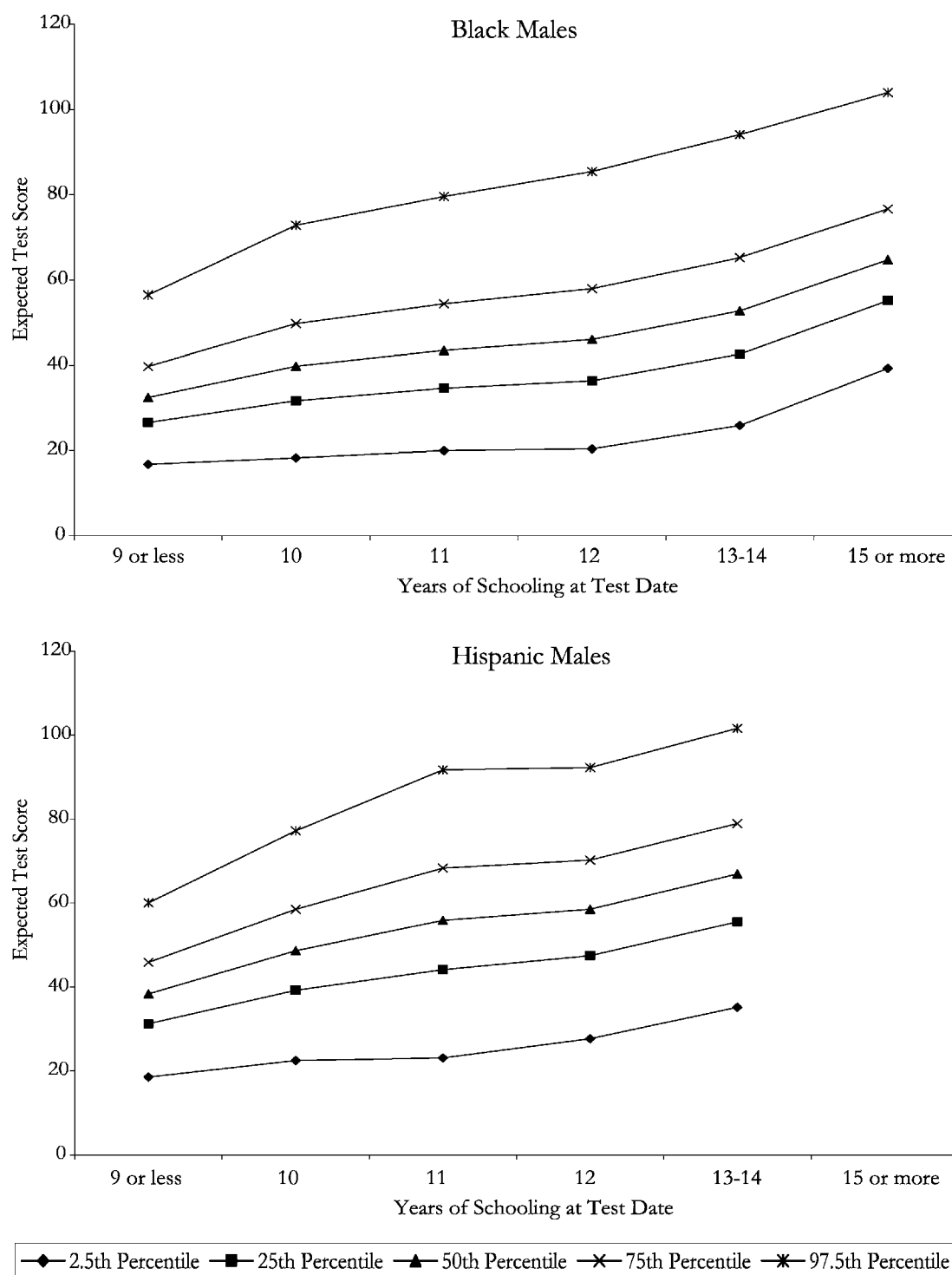


Figure 16A. (Continued.)

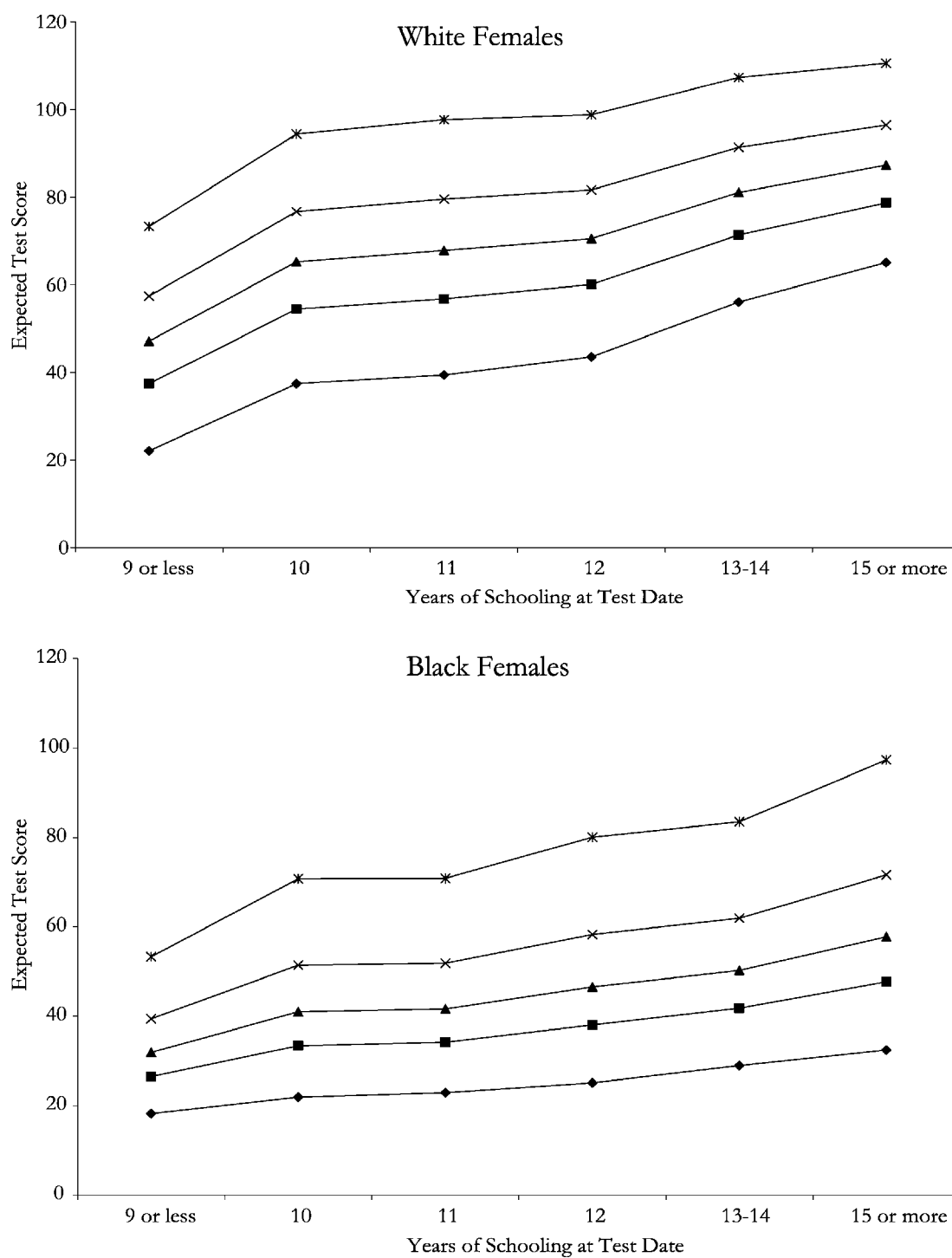


Figure 16B. Expected value of AFQT score conditional on factor.

Note: The structural model includes the following covariates: urban status, broken home and south residence at age 14, number of sibling, family income in 1979, mother's and father's education, and age of the child at December 1980.

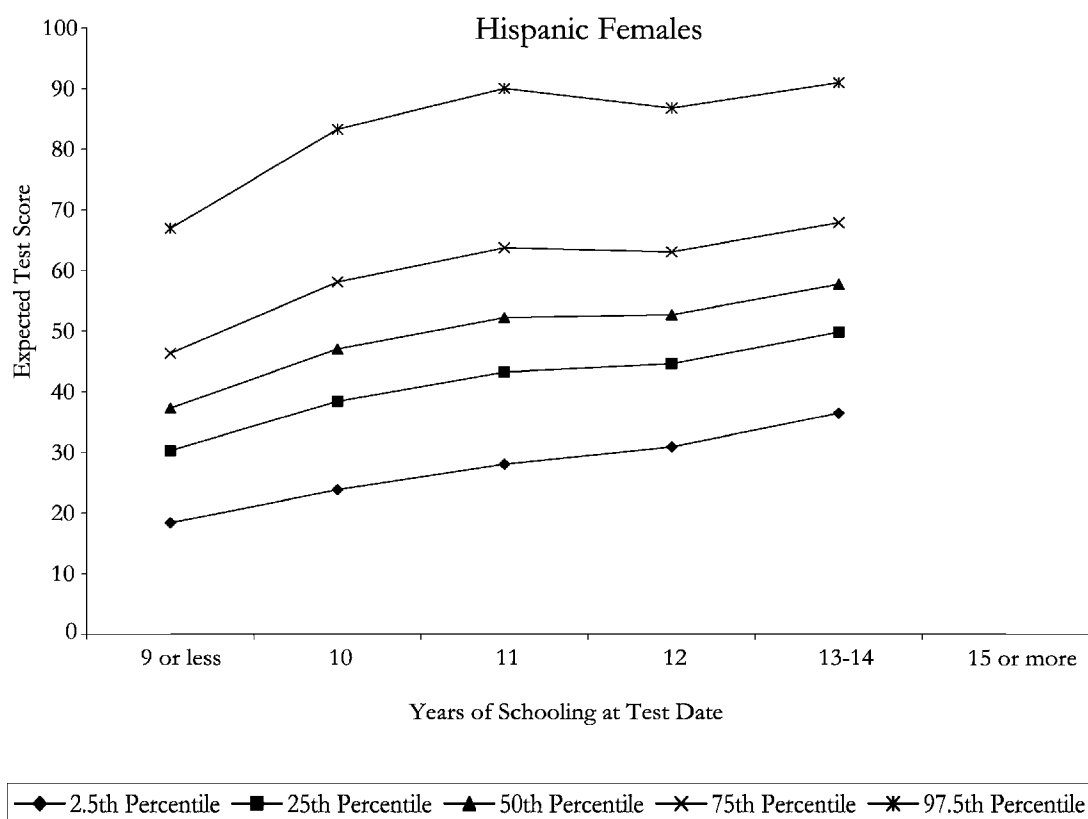


Figure 16B. (Continued.)

measure the effects of different levels of schooling attained at the date the test is taken on achievement for people who all eventually get the same schooling. For all major demographic groups, initial (ninth grade) test score gaps are maintained regardless of schooling level. Schooling raises test scores, but it does not equalize them. These results persist even after controlling for measures of schooling quality. One cannot count on schooling to eliminate early test score deficits. On the other hand, one cannot blame schools for widening initial test score gaps.

The evidence reviewed in Section 2 points to the empirical importance of self-productivity and complementarity. Skill begets skill. Later remediation of early skill deficits can be costly. This evidence supports the qualitative conclusions of [Figures 1A and 1B](#) that returns to investment are higher for the young and the disadvantaged. We next present a more formal model of the technology of skill formation that is a starting point for the theoretical unification of a scattered literature on treatment effects that presents “effects” for different programs in different environments directed towards different clientele.

3. Using the technology of skill formation to explain the evidence

3.1. A model of skill formation

We use simple economic models to organize the evidence presented in Section 2 as summarized in Figures 1A and 1B. We define the concepts of recursive productivity or “self-productivity” and complementarity and show how the skill multiplier (as defined in this section) and the notion of complementarity help to organize the empirical evidence surveyed in Section 2. These concepts are essential for understanding why early interventions are more effective than later interventions and why there is no trade-off between equity and efficiency in the early years of childhood but why there is such a trade-off in the later years.

In the models presented in this section, parents make decisions about their children. We ignore how the parents get to be who they are and the decisions of the children about their own children. We develop a more generationally consistent model in Section 3.2, after developing the basic framework of the technology of skill formation.

Suppose that there are two periods in a child’s life, “1” and “2”, before the child becomes an adult. Adulthood is a distinct third period. The child works for a fixed number of periods after the two periods of childhood. Models based on the analysis of Becker and Tomes (1979) assume only one period of childhood. We assume that there are two kinds of skills: S^C and S^N . For example, S^C can be thought of as cognitive skill and S^N as noncognitive skill. Our treatment of ability is in contrast to the view of the traditional literature on human capital formation that views IQ as innate ability. In our analysis, IQ is just another skill. What differentiates IQ from other cognitive and noncognitive skills is that IQ is subject to accumulation during critical periods. That is, parental and social interventions can increase the IQ of the child, but they can do so successfully only for a limited time. Recall our evidence that an enriched early intervention like the Abecedarian program raised IQ but Head Start and Perry Preschool – directed towards later ages – did not. Compare Figure 15A for the Abecedarian program with Figure 14A for the later-intervention Perry program.⁷⁰

Let I_t^k denote parental investments in child skill k at period t , $k = C, N$ and $t = 1, 2$. Let h be the level of human capital as the child starts adulthood. It depends on both components of (S_2^C, S_2^N) . The parents fully control the investment of the child. A richer model incorporates, among other features, investment decisions of the child as influenced by the parent through preference formation processes [see Cunha and Heckman (2004, 2006)].

We first describe how skills evolve over time. Assume that each agent is born with initial conditions $S_0 = (S_0^C, S_0^N)$. At each stage t let $S_t = (S_t^C, S_t^N)$ denote the vector

⁷⁰ One has to be careful in making this comparison because the Abecedarian program was much more intensive. One cannot separate out the effect that Abecedarian started at 4 months age (as opposed to Perry’s 3–4 years) from the greater resource intensity of the Abecedarian program.

of skill or ability stocks. The technology of production of skill k at period t is:

$$S_t^k = f_t^k(S_{t-1}, I_t^k) \quad (3)$$

for $k = C, N$ and $t = 1, 2$. We assume that f_t^k is twice continuously differentiable, increasing and concave in I_t^k .⁷¹ In this model, stocks of both skills and abilities produce next period skills and the productivity of investments. Cognitive skills can promote the formation of noncognitive skills and vice versa.

We define adult human capital h as a combination of different period 2 skills:

$$h = g(S_2^C, S_2^N). \quad (4)$$

The function g is assumed to be continuously differentiable and increasing in (S_2^C, S_2^N) . This model assumes that there is no comparative advantage in the labor market or in life itself.⁷²

Period 1 is a *critical period* for S_2^C if

$$\frac{\partial S_2^C}{\partial I_2^C} = \frac{\partial f_2^C(S_1, I_2^C)}{\partial I_2^C} \equiv 0 \quad \text{for all } S_1, I_2^C,$$

but

$$\frac{\partial S_1^C}{\partial I_1^C} = \frac{\partial f_1^C(S_0, I_1^C)}{\partial I_1^C} > 0 \quad \text{for some } S_0, I_1^C.$$

This says that investments in C are productive in period 1 but not in period 2. In the analysis of Section 2, the early periods (before age 8) are critical periods for IQ but not for achievement tests or for noncognitive skills.

Period 1 is a *sensitive period* for S_2^C if

$$\left. \frac{\partial S_2^C}{\partial I_2^C} \right|_{S_1=s, I_2^C=i} < \left. \frac{\partial S_1^C}{\partial I_1^C} \right|_{S_0=s, I_1^C=i}.$$

Thus, 1 is a sensitive period if, at the same level of inputs, investment is more productive in stage 1 than in stage 2. The evidence in Section 2 suggests that early investments in both cognitive and noncognitive abilities and skills are more productive than later investments.

As defined in the introduction, and clarified in the [Appendix A](#), direct complementarity of skill l acquired in period 1 on the output of investment k in producing skill k in

⁷¹ Twice continuous differentiability is a convenience.

⁷² Thus we rule out one potentially important avenue of compensation that agents can specialize in tasks that do not require the skills in which they are deficient. In [Appendix A](#) and in Section 1, we briefly consider a more general task function that captures the notion that different tasks require different combinations of skills and abilities.

period 2 is defined by

$$\frac{\partial^2 S_2^k}{\partial I_2^k \partial S_1^l} > 0, \quad k = C, N.$$

Early stocks of abilities and skills promote later skill acquisition by making it more productive. Students with greater early cognitive and noncognitive abilities are more efficient in later learning of both cognitive and noncognitive skills. Thus the enriched early environments of the Abecedarian, Perry and CPC programs promote greater efficiency in learning in high schools and reduce problem behaviors. See the evidence in [Figures 13–15](#) on reduction in remedial education and problem behavior for the treatment group in these programs.

This technology also is sufficiently rich to describe learning in rodents and rhesus monkeys as documented by [Meaney \(2001\)](#) and [Cameron \(2004\)](#). It also captures the critical and sensitive periods in animals documented by [Knudsen et al. \(2006\)](#). Emotionally nurturing early environments create preconditions for later cognitive learning. More emotionally secure young animals explore their environments more actively and learn more quickly. This is an instance of complementarity.

To fix ideas, consider the following specialization of our model. Ignore the effect of initial conditions and assume that first period skills are just due to first period investment:

$$S_1^C = f_1^C(S_0, I_1^C) = I_1^C$$

and

$$S_1^N = f_1^N(S_0, I_1^N) = I_1^N,$$

where I_1^C and I_1^N are scalars. For the second period technologies, we assume a CES structure:

$$\begin{aligned} S_2^C &= f_2^C(S_1, I_2^C) \\ &= \{\gamma_1 (S_1^C)^\alpha + \gamma_2 (S_1^N)^\alpha + (1 - \gamma_1 - \gamma_2) (I_2^C)^\alpha\}^{1/\alpha}, \\ &\text{where } 1 \geq \gamma_1 \geq 0, 1 \geq \gamma_2 \geq 0, 1 \geq 1 - \gamma_1 - \gamma_2 \geq 0, \end{aligned} \quad (5)$$

and

$$\begin{aligned} S_2^N &= f_2^N(S_1, I_2^N) \\ &= \{\eta_1 (S_1^C)^\sigma + \eta_2 (S_1^N)^\sigma + (1 - \eta_1 - \eta_2) (I_2^N)^\sigma\}^{1/\sigma}, \\ &\text{where } 1 \geq \eta_1 \geq 0, 1 \geq \eta_2 \geq 0, 1 \geq 1 - \eta_1 - \eta_2 \geq 0, \end{aligned} \quad (6)$$

where $\frac{1}{1-\alpha}$ is the elasticity of substitution in the inputs producing S_2^C and $\frac{1}{1-\sigma}$ is the elasticity of substitution of inputs in producing S_2^N where $\alpha \in (-\infty, 1]$ and $\sigma \in (-\infty, 1]$. Notice that I_2^N and I_2^C are direct complements with (S_1^C, S_1^N) irrespective of the substitution parameters α and σ , except in limiting cases.

The CES technology is well known and has convenient properties. It imposes direct complementarity even though inputs may be more or less substitutable depending on α or σ .⁷³ We distinguish between direct complementarity and CES-substitution/complementarity in this section. Focusing on the technology for producing S_2^C , when $\alpha = 1$, the inputs are perfect substitutes in the intuitive use of that term (the elasticity of substitution is infinite). The inputs S_1^C , S_1^N and I_2^C can be ordered by their relative productivity in producing S_2^C . The higher γ_1 and γ_2 , the higher the productivity of S_1^C and S_1^N respectively. When $\alpha = -\infty$, the elasticity of substitution is zero. All inputs are required in the same proportion to produce a given level of output so there are no possibilities for technical substitution, and

$$S_2^C = \min \{S_1^C, S_1^N, I_2^C\}.$$

In this technology, early investments are a *bottleneck* for later investment. Compensation for adverse early environments through late investments is impossible. These polar cases generalize the cases developed in Section 1.

The evidence from numerous studies previously cited shows that IQ is no longer malleable after ages 8–10. Taken at face value, this implies that if S^C is IQ, for all values of I_2^C , $S_2^C = S_1^C$. Period 1 is a critical period for IQ but not necessarily for other skills and abilities. More generally, period 1 is a critical period if

$$\frac{\partial S_t^C}{\partial I_t^C} = 0 \quad \text{for } t > 1.$$

For parameterization (5), this is obtained by imposing $\gamma_1 + \gamma_2 = 1$.

The evidence on adolescent interventions surveyed in Section 2 shows substantial positive results for such interventions on noncognitive skills (S_2^N) and at most modest gains for cognitive skills. Technologies (5) and (6) can rationalize this pattern. Since the populations targeted by adolescent intervention studies tend to come from families with poor backgrounds, we would expect I_1^C and I_1^N to be below average. Thus, S_1^C and S_1^N will be below average. Interventions make I_2^C and I_2^N relatively large for the treatment group in comparison to the control group in the adolescent intervention experiments. At stage 2, S_2^C (cognitive ability) is essentially the same in the control and treatment groups, while S_2^N (noncognitive ability) is higher for the treated group. Large values of $(\gamma_1 + \gamma_2)$ (associated with a small coefficient on I_2^C) or small values of $(\eta_1 + \eta_2)$ (so the coefficient on I_2^N is large) and high values of α and σ can produce this pattern. Another case that rationalizes the evidence is when $\alpha \rightarrow -\infty$ and $\sigma = 1$. Under these conditions:

$$S_2^C = \min \{S_1^C, S_1^N, I_2^C\}, \tag{7}$$

⁷³ See footnote 13 in Section 1.

while

$$S_2^N = \eta_1 S_1^C + \eta_2 S_1^N + (1 - \eta_1 - \eta_2) I_2^N. \quad (8)$$

The attainable period 2 stock of cognitive skill (S_2^C) is limited by the minimum value of S_1^C, S_1^N, I_2^C . In this case, any level of investment in period 2 such that $I_2^C > \min\{S_1^C, S_1^N\}$ is ineffective in incrementing the stock of cognitive skills. Period 1 is a bottleneck period. Unless sufficient skill investments are made in S_C in period 1, it is not possible to raise skill S_C in period 2. This phenomenon does not appear in the production of the noncognitive skill, provided that $(1 - \eta_1 - \eta_2) > 0$. More generally, the higher σ and the larger $(1 - \eta_1 - \eta_2)$, the more productive is investment I_2^N in producing S_2^N .

To complete the CES example, assume that adult human capital h is a CES function of the two skills accumulated at stage two:

$$h = \{\tau (S_2^C)^\phi + (1 - \tau) (S_2^N)^\phi\}^{\rho/\phi}, \quad (9)$$

where $\rho \in (0, 1)$, $\tau \in [0, 1]$, and $\phi \in (-\infty, 1]$. In this parameterization, $\frac{1}{1-\phi}$ is the elasticity of substitution across different skills in the production of adult human capital. Equation (9) reminds us that the market, or life in general, requires use of multiple skills. Being smart isn't the sole determinant of success. In general, different tasks require both skills in different proportions. One way to remedy early skill deficits is to make compensatory investments. Another way is to motivate people from disadvantaged environments to pursue tasks that do not require the skill that deprived early environments do not produce. A richer theory would account for this choice of tasks and its implications for remediation.⁷⁴ For the sake of simplifying our argument, we work with equation (9) that captures the notion that skills can trade off against each other in producing effective people. Highly motivated, but not very bright, people may be just as effective as bright but unmotivated people. That is one of the lessons from the GED program. [See Heckman and LaFontaine (2007), Heckman and Rubinstein (2001), Heckman, Stixrud and Urzua (2006)].

The analysis is simplified by assuming that investments are general in nature: $I_1^C = I_1^N = I_1$, $I_2^C = I_2^N = I_2$.⁷⁵ Cunha and Heckman (2004, 2006) develop the more general case of skill-specific investments which requires more notational complexity.

With common investment goods, we can solve out for S_1^C and S_1^N in terms of I_1 to simplify (5) and (6) to reach

$$S_2^C = \{(\gamma_1 + \gamma_2)(I_1)^\alpha + (1 - \gamma_1 - \gamma_2)(I_2)^\alpha\}^{1/\alpha} \quad (10)$$

⁷⁴ We sketch such a model in Appendix A.

⁷⁵ Thus when a parent buys a book in the first period of childhood, this book may be an investment in all kinds of skills. It is an investment in cognitive skills, as it helps the child get exposure to language and new words. It can also be an investment in noncognitive skills, if the book may contain a message on the importance of being persistent and patient.

and

$$S_2^N = \{(\eta_1 + \eta_2)(I_1)^\sigma + (1 - \eta_1 - \eta_2)(I_2)^\sigma\}^{1/\sigma}. \quad (11)$$

If we then substitute these expressions into the production function for adult human capital (9), we obtain

$$h = \{\tau[\tilde{\gamma}(I_1)^\alpha + (1 - \tilde{\gamma})(I_2)^\alpha]^{\phi/\alpha} + (1 - \tau)[\tilde{\eta}(I_1)^\sigma + (1 - \tilde{\eta})(I_2)^\sigma]^{\phi/\sigma}\}^{\rho/\phi}, \quad (12)$$

where $\tilde{\gamma} = \gamma_1 + \gamma_2$, $\tilde{\eta} = \eta_1 + \eta_2$. Equation (12) expresses adult human capital as a function of the entire sequence of childhood investments in human capital. Current investments in human capital are combined with the existing stocks of skills in order to produce the stock of next period skills.

A conveniently simple formulation of the problem arises if we assume that $\alpha = \sigma = \phi$ so that CES substitution among inputs in producing outputs and CES substitution among skill in producing human capital are the same. This produces the convenient and familiar-looking CES expression for adult human capital stocks:

$$h = \{\gamma I_1^\phi + (1 - \gamma)I_2^\phi\}^{\rho/\phi}, \quad (13)$$

where $\gamma = \tau\tilde{\gamma} + (1 - \tau)\tilde{\eta}$ and $\phi = \alpha = \sigma$. The parameter γ is a *skill multiplier*. It arises because I_1 affects the accumulation of S_1^C and S_1^N . These stocks of skills in turn affect the productivity of I_2 in forming S_2^C and S_2^N . Thus γ captures the net effect of I_1 on h through both self-productivity and direct complementarity.⁷⁶ $\frac{1}{1-\phi}$ is a measure of how easy it is to substitute between I_1 and I_2 where the substitution arises from both the task performance (human capital) function in equation (9) and the technology of skill formation. Within the CES technology, ϕ is a measure of the ease of substitution of inputs. In this analytically convenient case, the parameter ϕ plays a dual role. First, it informs us how easily one can substitute across different skills in order to produce one unit of adult human capital h . Second, it also represents the degree of complementarity

⁷⁶ To repeat an observation made in Section 1, direct complementarity between I_1 and I_2 arises if

$$\frac{\partial^2 h}{\partial I_1 \partial I_2} > 0.$$

As long as $\rho > \phi$, I_1 and I_2 are direct complements, because

$$\text{sign}\left(\frac{\partial^2 h}{\partial I_1 \partial I_2}\right) = \text{sign}(\rho - \phi).$$

This definition of complementarity is to be distinguished from the notion based on the elasticity of substitution between I_1 and I_2 , which is $\frac{1}{1-\phi}$. When $\phi < 0$, I_1 and I_2 are sometimes called complements. When $\phi > 0$, I_1 and I_2 are sometimes called substitutes. When $\rho = 1$, I_1 and I_2 are always direct complements, but if $1 > \phi > 0$, they are CES substitutes.

(or substitutability) between early and late investments in producing skills. In this second role, the parameter ϕ dictates how easy it is to compensate for low levels of stage 1 skills in producing late skills.

In principle, compensation can come through two channels: (i) through skill investment or (ii) through choice of market activities, substituting deficits in one skill by the relative abundance in the other through choice of tasks. We do not develop the second channel of compensation in this chapter, deferring it to later work.

When ϕ is small, low levels of early investment I_1 are not easily remediated by later investment I_2 in producing human capital. The other face of CES complementarity is that when ϕ is small, high early investments should be followed with high late investments. In the extreme case when $\phi \rightarrow -\infty$, (13) converges to $h = (\min\{I_1, I_2\})^\rho$. We analyzed this case in Section 1. The Leontief case contrasts sharply with the case of perfect CES substitutes, which arises when $\phi = 1$: $h = [\gamma I_1 + (1 - \gamma)I_2]^\rho$. When we impose the further restriction that $\gamma = 1/2$, we generate the model that is implicitly assumed in the existing literature on human capital investments that collapses childhood into a single period. In this special case, only the total amount of human capital investments, regardless of how it is distributed across childhood periods, determines adult human capital. In the case of perfect CES substitutes, it is possible in a physical productivity sense to compensate for early investment deficits by later investments, although it may not be economically efficient to do so.

When $\rho = 1$, we can rewrite (13) as

$$h = I_1 \{\gamma + (1 - \gamma)\omega^\phi\}^{1/\phi},$$

where $\omega = I_2/I_1$. Fixing I_1 (early investment), an increase in ω is the same as an increase in I_2 . The marginal productivity of late investment is

$$\frac{\partial h}{\partial \omega} = (1 - \gamma)I_1 \{\gamma + (1 - \gamma)\omega^\phi\}^{\frac{1-\phi}{\phi}} \omega^{\phi-1}.$$

For $\omega > 1$ and $\gamma < 1$, marginal productivity is increasing in ϕ and $(1 - \gamma)$. Thus, provided that late investments are greater than earlier investments, the more substitutable I_2 is with I_1 (the higher ϕ) and the lower the skill multiplier γ , the more productive are late investments. Figure 17A graphs the isoquants for $\frac{\partial h}{\partial \omega}$ when $\omega = 2$. It shows that a high ϕ trades off with a high γ . As $(\phi, 1 - \gamma)$ increases along a ray, $\frac{\partial h}{\partial \omega}$ increases. For a fixed skill multiplier γ , the higher ϕ , the higher the marginal productivity of second period investment.

If, however, $\omega < 1$, as in Figure 17B, then $\frac{\partial h}{\partial \omega}$ could be decreasing as $(\phi, 1 - \gamma)$ increases along a ray and the trade-off between ϕ and $(1 - \gamma)$ along a $(\frac{\partial h}{\partial \omega}, \omega)$ isoquant is reversed. If I_1 is large relative to I_2 (i.e., $\omega < 1$), for a fixed γ the marginal product of I_2 is decreasing in ϕ . More CES complementarity implies greater productivity (see Figure 17B).⁷⁷ The empirically relevant case for the analysis of investment in disadvantaged children is $\omega > 1$, as shown in Figure 17A, so greater CES-substitutability and

⁷⁷ One can show that at sufficiently low values of ϕ , the marginal productivity is no longer increasing in ϕ .

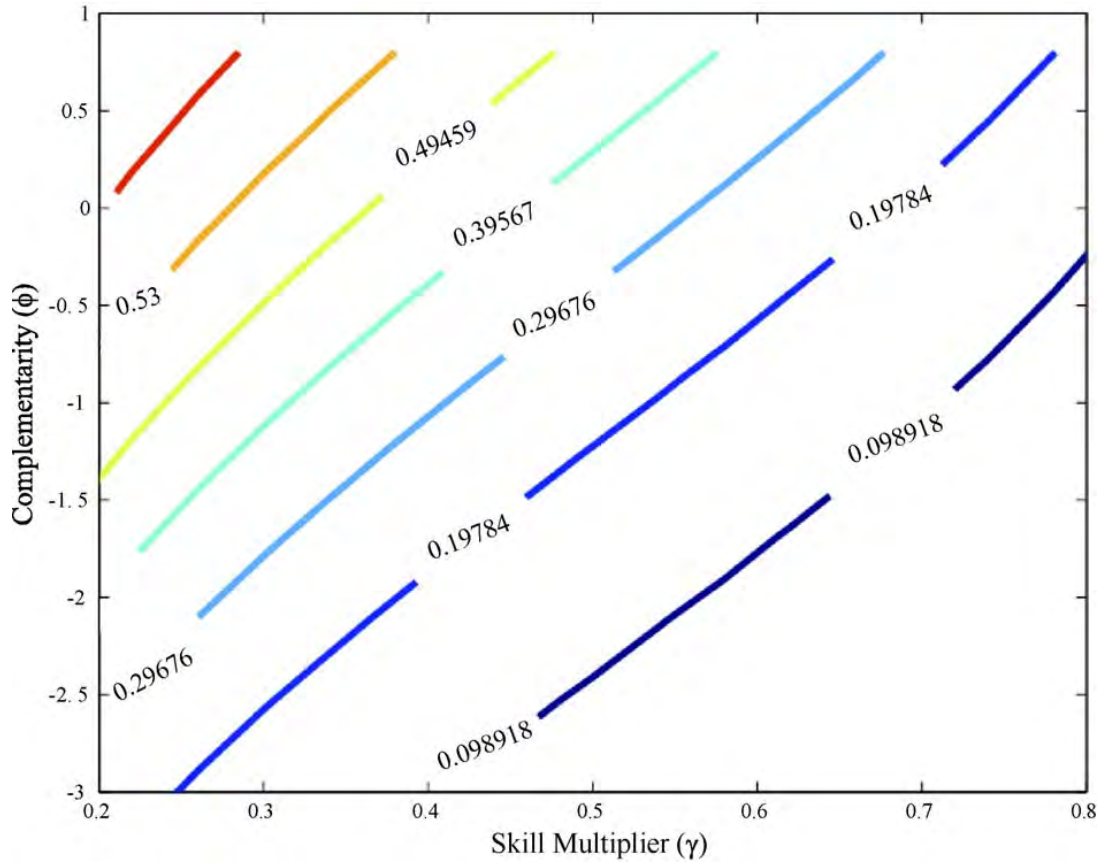


Figure 17A. The indifference curves of the marginal productivity of the ratio of late to early investments as a function of ϕ and γ when $I_2/I_1 = 2$.

Define $\omega = I_2/I_1$, the ratio of late to early investments in human capital. From the homogeneity of degree one we can rewrite the technology as:

$$h = I_1[\gamma + (1 - \gamma)\omega^\phi]^{1/\phi}.$$

The marginal product of the ratio of late to early investment, ω , holding early investment constant, is

$$\frac{\partial h}{\partial \omega} = (1 - \gamma)I_1[\gamma + (1 - \gamma)\omega^\phi]^{\frac{1-\phi}{\phi}} \omega^{\phi-1}.$$

This figure displays the indifference curves of $\frac{\partial h}{\partial \omega}$ when $\omega = 2$. Each indifference curve shows the corresponding level of $\frac{\partial h}{\partial \omega}$. Note that for a given value of γ the value of the function tends to increase as we increase ϕ . The function also increases as we decrease γ .

a smaller skill multiplier produce a higher marginal productivity of remedial second period investment.

It is important to distinguish the case when it is technologically efficient to compensate for adverse early environments from the case when it is economically efficient to do so. If γ is near 1, it may be very costly to remediate shortfalls in early investments even though it is technically possible to do so. We return to this point below.

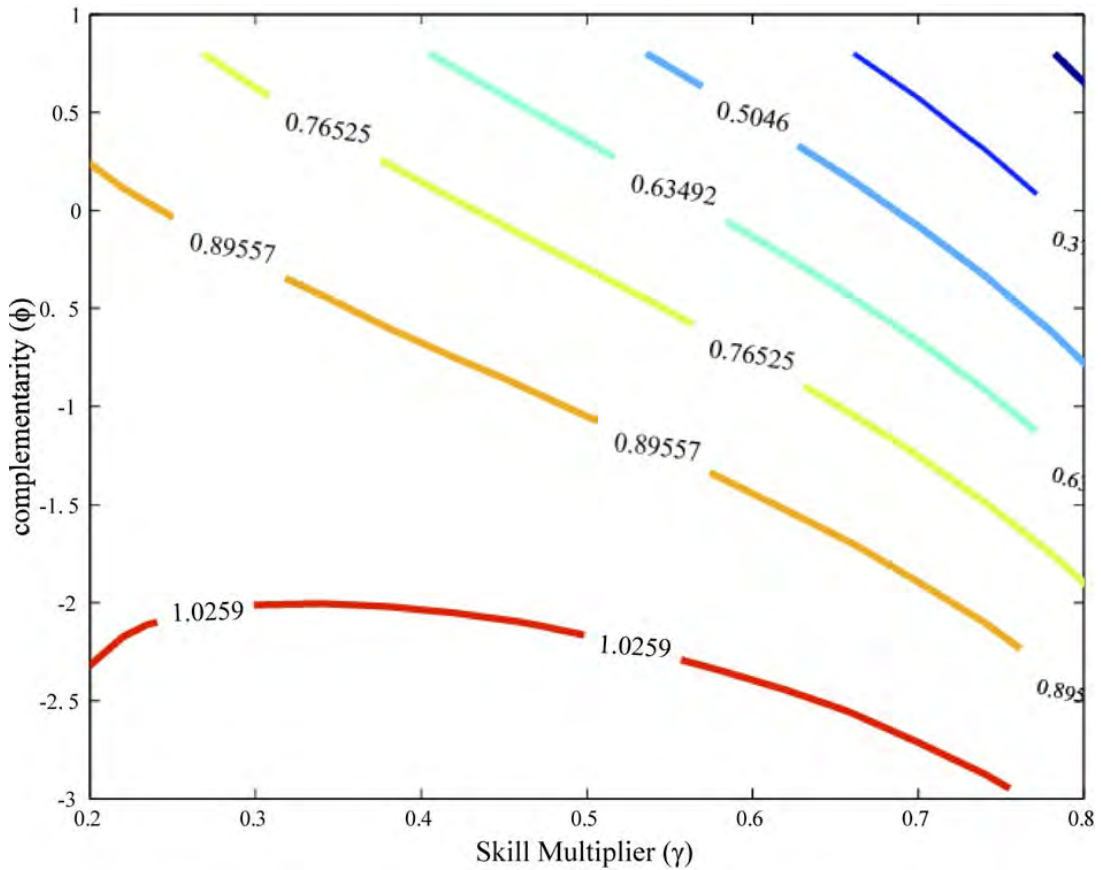


Figure 17B. The indifference curves of the marginal productivity of the ratio of late to early investments as a function of ϕ and γ when $I_2/I_1 = 1/2$.

Consider the CES specification for the technology of human capital formation:

$$h = [\gamma I_1^\phi + (1 - \gamma) I_2^\phi]^{1/\phi}.$$

Define $\omega = I_2/I_1$, the ratio of late to early investments in human capital. From the homogeneity of degree one we can rewrite the technology as:

$$h = I_1 [\gamma + (1 - \gamma) \omega^\phi]^{1/\phi}.$$

The marginal product of the ratio of late to early investment, ω , holding early investment constant, is

$$\frac{\partial h}{\partial \omega} = (1 - \gamma) I_1 [\gamma + (1 - \gamma) \omega^\phi]^{\frac{1-\phi}{\phi}} \omega^{\phi-1}.$$

This figure displays the indifference curves of $\frac{\partial h}{\partial \omega}$ when $\omega = 0.5$. Each indifference curve shows the corresponding level of $\frac{\partial h}{\partial \omega}$. Note that for a given value of γ the value of the function tends to decrease as we increase ϕ . However, the function may not be monotonic with respect to γ .

In analyzing the optimal timing of investment, it is convenient to work with the technology embodied in (13). We now show how the ratio of early to late investments varies as a function of ϕ , γ , and ρ . Consider the following model in which parents maximize

the present value of net wealth of their children.⁷⁸ In order to do that, parents decide how much to invest in period “1,” I_1 , how much to invest in period “2,” I_2 , and how much to transfer in risk-free assets, b , given total parental resources M . Period “1” could include *in utero* investments. Parents cannot extract resources from children, so $b \geq 0$. From period “3” to period T , the age of retirement from the workforce, persons are assumed to work full time. Let r denote the time-invariant interest rate, set exogenously and assumed to be constant for all periods, and let q denote the present value of future earnings per efficiency unit of adult human capital $\{w_t\}_{t=3}^T$:

$$q = \sum_{t=3}^T \left(\frac{1}{1+r} \right)^{t-3} w_t. \quad 79$$

Lifetime earnings of children when they start working at period “3” are given by $qg(I_1, I_2)$, where g is the function determining the adult stock of human capital. Discounted to period 1, the present value of lifetime earnings is $\frac{q}{(1+r)^2} g(I_1, I_2)$. The problem of the parents is to maximize the present value of the child’s net wealth:

$$\max_{I_1, I_2, b} \left\{ \frac{1}{(1+r)^2} [qg(I_1, I_2) + b] \right\},$$

subject to the standard budget constraint

$$I_1 + \frac{1}{1+r} I_2 + \frac{1}{(1+r)^2} b = M, \quad (14)$$

and the constraint that parents cannot leave negative bequests to their children

$$b \geq 0, \quad (15)$$

where $g(I_1, I_2)$ is as defined in equation (13) and is concave in I_1 and I_2 .

When $\phi = 1$, early and late investments are perfect CES substitutes. The optimal investment strategy for this technology in this simple environment is straightforward. The price of early investment is \$1. The price of the late investment is $\frac{1}{(1+r)}$. Thus the parents can purchase $(1+r)$ units of I_2 for every unit of I_1 . The amount of human capital produced from one unit of I_1 is γ , while $\$(1+r)$ of I_2 produces $(1+r)(1-\gamma)$ units of human capital. Therefore, the parent invests early if $\gamma > (1-\gamma)(1+r)$ and late otherwise. Two forces act in opposite directions. High productivity of initial investment (the skill multiplier) drives the agent toward making early investments. Intertemporal prices (the interest rate) drive the agent to invest late. It is optimal to invest early if $\gamma > \frac{1+r}{2+r}$.

⁷⁸ This setup is overly simplistic but allows us to focus on the important points. See [Caucutt and Lochner \(2004\)](#), [Cunha \(2004\)](#) and [Cunha and Heckman \(2004, 2006\)](#) for more general models.

⁷⁹ We abstract from endogenously determined on-the-job training, learning-by-doing, and assume that agents supply labor inelastically.

As $\phi \rightarrow -\infty$, the CES production function converges to the Leontief case and the optimal investment strategy is to set $I_1 = I_2$. CES complementarity dominates and the profile of investments is such that $\frac{I_1}{I_2}$ converges to one. In this extreme case, CES complementarity has a dual face. Investments in the young are essential. At the same time, later investments are needed to harvest early investments. On efficiency grounds, early disadvantages should be perpetuated, and compensatory investments at later ages are economically inefficient.

For $-\infty < \phi < 1$, the first-order conditions are necessary and sufficient given concavity of the technology in terms of I_1 and I_2 . Let μ, λ denote the Lagrange multipliers associated with restrictions (14) and (15), respectively. The first-order conditions for I_1, I_2 , and b are

$$\frac{q}{(1+r)^2} \rho \gamma \{ \gamma I_1^\phi + (1-\gamma) I_2^\phi \}^{\frac{\rho-\phi}{\phi}} I_1^{\phi-1} = \mu, \quad (16)$$

$$\frac{q}{(1+r)} \rho (1-\gamma) \{ \gamma I_1^\phi + (1-\gamma) I_2^\phi \}^{\frac{\rho-\phi}{\phi}} I_2^{\phi-1} = \mu, \quad (17)$$

$$\mu - 1 = \lambda(1+r)^2. \quad (18)$$

Notice that if restriction (15) is not binding, then $\lambda = 0, \mu = 1$ and optimal early and late investments are only functions of (q, r) . In this case, all unconstrained families that make bequests will invest the same in their children. The only difference is in the transfers of assets to their children. If $M_A > M_B$ then $b_A > b_B$.

For an interior solution, if we take the ratio of (16) to (17) and rearrange terms we obtain

$$\frac{I_1}{I_2} = \left[\frac{\gamma}{(1-\gamma)(1+r)} \right]^{\frac{1}{1-\phi}}. \quad (19)$$

Figure 18 plots the ratio of early to late investments as a function of the skill multiplier γ , under different values of the complementarity parameter ϕ . When $\phi \rightarrow -\infty$, we obtain the Leontief technology and there is high CES-complementarity between early and late investments. In this case, the ratio is not sensitive to variations in γ . CES-complementarity dominates, and the optimal investment profile distributes investments equally across different periods. When $\phi = 0$, the function g is given by the Cobb–Douglas function:

$$h = (I_1)^{\rho\gamma} (I_2)^{\rho(1-\gamma)}.$$

In this case, from equation (19), I_1/I_2 is close to zero for low values of γ , but explodes to infinity as γ approaches one.

Another way to express these conclusions is to work in terms of growth rates of investment, which yields the expression

$$\ln\left(\frac{I_1}{I_2}\right) = \frac{1}{1-\phi} \left[\ln\left(\frac{\gamma}{1-\gamma}\right) - \ln(1-r) \right]. \quad (20)$$

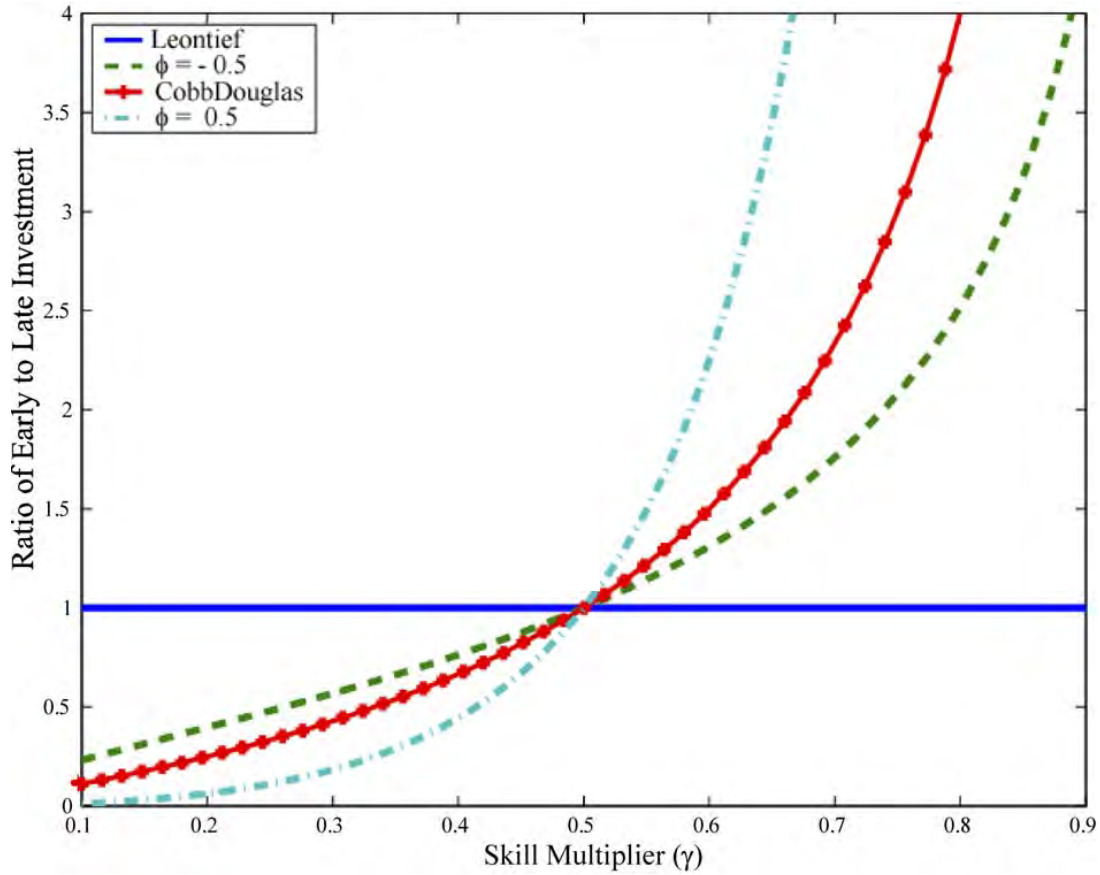


Figure 18. The ratio of early to late investment in human capital as a function of the skill multiplier for different values of complementarity.

This figure shows the optimal ratio of early to late investments, I_1/I_2 , as a function of the skill multiplier parameter γ , for different values of the complementarity parameter ϕ , assuming that the interest rate r is zero. The optimal ratio I_1/I_2 is the solution of the parental problem of maximizing the present value of the child's wealth through investments in human capital, h , and transfers of risk-free bonds, b . In order to do that, parents have to decide how to allocate a total of M dollars into early and late investments in human capital, I_1 and I_2 , respectively, and risk-free bonds. Let q denote the present value as of period "3" of the future prices of one efficiency unit of human capital: $q = \sum_{t=3}^T \frac{w_t}{(1+r)^{t-3}}$. The parents solve

$$\max \left(\frac{1}{1+r} \right)^2 [gh + b]$$

subject to the budget constraint

$$I_1 + \frac{I_2}{(1+r)} + \frac{b}{(1+r)^2} = M$$

and the technology of skill formation:

$$h = [\gamma I_1^\phi + (1-\gamma)I_2^\phi]^{\rho/\phi}$$

for $0 < \rho < 1$, $0 \leq \gamma \leq 1$, and $\phi \leq 1$. From the first-order conditions it follows that $\frac{I_1}{I_2} = \left[\frac{\gamma}{(1-\gamma)(1+r)} \right]^{\frac{1}{1-\phi}}$. This ratio is plotted in this figure when $\phi \rightarrow -\infty$ (Leontief), $\phi = -0.5$, $\phi = 0$ (Cobb–Douglas) and $\phi = 0.5$ and for values of the skill multiplier γ between 0.1 and 0.9.

This expression does not depend on ρ . In the special case $\gamma = \frac{1+r}{2+r}$, investment will be the same in both periods regardless of the value assumed by ϕ . More generally, the ratio of early to late investments varies with the complementarity between early and late investments, ϕ , with the skill multiplier for human capital, γ , and with the interest rate. *Ceteris paribus*, the higher the skill multiplier, γ , the higher the ratio of early to late investments. Intuitively, if early investments have a substantial impact in determining future stocks of human capital, optimality implies that early investments should also be high. The higher the interest rate, the lower the ratio of early to late investments. This result reflects the opportunity costs of investing today relative to investing tomorrow. The higher the interest rate today, the cheaper it is to postpone investments. *Ceteris paribus*, if $(\frac{\gamma}{1-\gamma}) > (1+r)$ and $(\frac{I_1}{I_2}) > 1$, the higher ϕ , the higher $(\frac{I_1}{I_2})$. If $(\frac{\gamma}{1-\gamma}) < (1+r)$, the higher ϕ , the lower $(\frac{I_1}{I_2})$.

The lessons we take from this simple analysis are summarized in Table 10. When CES complementarity is high, the skill multiplier γ plays a limited role in shaping the ratio of early to late investments. High early investments should be followed by high late investments. As the degree of CES complementarity decreases, the role of the skill multiplier increases, and the higher the multiplier, the more investments should be concentrated in the early ages.

This simple model also has implications for the timing of interventions. If $M_A > M_B$ and family A is unconstrained while family B is constrained, then for family B , $\lambda_B > 0$, $\mu_B = [1 + \lambda_B(1+r)^2]$. Consequently, in equilibrium, the marginal return to one dollar invested in the poor child from family B is above the marginal return to the same dollar invested in the rich child from family A , so family B underinvests compared to the less constrained family A .

Table 10
The ratio of optimal early and late investments I_1/I_2 under different assumptions about the skill formation technology

	Low self-productivity: $\gamma < \frac{1+r}{2+r}$	High self-productivity: $\gamma > \frac{1+r}{2+r}$
High degree of complementarity: $\phi < 0$	$\frac{I_1}{I_2} \rightarrow 1$ as $\phi \rightarrow -\infty$	$\frac{I_1}{I_2} \rightarrow 1$ as $\phi \rightarrow -\infty$
Low degree of complementarity: $0 \leq \phi \leq 1$	$\frac{I_1}{I_2} \rightarrow 0$ as $\phi \rightarrow 1$	$\frac{I_1}{I_2} \rightarrow \infty$ as $\phi \rightarrow 1$

This table summarizes the behavior of the ratio of optimal early to late investments according to four cases: I_1 and I_2 have high complementarity, but self-productivity is low; I_1 and I_2 have both high complementarity and self-productivity; I_1 and I_2 have low complementarity and self-productivity; and I_1 and I_2 have low complementarity, but high self-productivity. When I_1 and I_2 exhibit high complementarity, complementarity dominates and is a force towards equal distribution of investments between early and late periods. Consequently, self-productivity plays a limited role in determining the ratio I_1/I_2 (row 1). On the other hand, when I_1 and I_2 exhibit a low degree of complementarity, self-productivity tends to concentrate investments in the late period if self-productivity is low, but in the early period if it is high (row 2).

There is no trade-off between equity and efficiency in *early* childhood investments. Government policies to promote early accumulation of human capital should be targeted to the children of poor families. However, the optimal second period intervention for a child from a disadvantaged environment depends critically on the nature of human capital aggregation and function (13), the technology of skill production. If I_1 and I_2 are perfect CES complements, then a low level of I_1 cannot be compensated at any level of investment by a high I_2 .

On the other hand, suppose that $\phi = 1$, so the reduced form technology can be written with inputs as perfect CES substitutes:

$$h = [\gamma I_1 + (1 - \gamma) I_2]^\rho, \quad 0 \leq \gamma \leq 1. \quad (21)$$

Then a second-period intervention can, in principle, eliminate initial skill deficits (low values of I_1). At a sufficiently high level of second-period investment, it is technically possible to offset low first period investments. However, it may not be cost effective to do so. For example, if $\rho = 1$ and $q(1 - \gamma) < 1 + r$, then the gains from future earnings do not justify the costs of investment. It would be more efficient to give the child a bond that earns interest rather than to invest in human capital in order to put the child at a certain level of income. Carneiro and Heckman (2003) show that classroom size reductions at current levels of funding in the U.S. are an example of such a policy.

We previously discussed the concepts of critical and sensitive periods in terms of the technical possibilities of remediation. These were defined in terms of the technology of skill formation. Here, we consider the net effects operating through investment and market substitution. The higher ϕ , the greater are the possibilities for alleviating early disadvantage. When $\phi = 1$, as in this example, it is always technically possible to remediate early disadvantage. But it may not be economically efficient to do so. From an economic point of view, critical and sensitive periods should be defined in terms of the costs and returns of remediation, and not solely in terms of technical possibilities.

Cunha and Heckman (2004, 2006) estimate a log linear (Cobb–Douglas) version of technology (3) and establish the importance of sensitive periods for parental investments in cognitive and noncognitive skills. The sensitive periods for cognitive skills occur earlier in the life cycle of the child than do the sensitive periods for noncognitive skills. Cunha, Heckman and Schennach (2006) develop and apply a methodology for estimating the key substitution parameters. We next embed the technology developed in this section into a market setting where choices and credit constraints can be clearly articulated.

3.2. The technology of skill formation in overlapping generations economies

In this section we embed the technology (13) developed in the preceding section into simple dynamic economies. These simple economies serve as baselines for the discussion of two conceptually distinct market failures: credit constraints in a deterministic economy, and an economy with incomplete markets with uncertainty in the labor mar-

Table 11
The generational structure

Generation born at period	Periods				
	$t = 0$	$t = 1$	$t = 2$	$t = 3$	$t = 4$
-3	Old adult				
-2	Young adult	Old adult			
-1	Adolescent	Young adult	Old adult		
0	Child	Adolescent	Young adult	Old adult	
1		Child	Adolescent	Young adult	Old adult
2			Child	Adolescent	Young adult
3				Child	Adolescent
4					Child

ket, as analyzed in [Cunha \(2004\)](#), [Cunha and Heckman \(2004, 2006\)](#) and subsequent work by [Caucutt and Lochner \(2004\)](#).

3.2.1. Generational structure and the human capital production function

The environment we consider is an overlapping generations economy with an infinite number of periods, each one denoted $t \in \{0, 1, 2, \dots\}$. Each agent lives for four periods. In the first period of his life, the agent is a young child. In the second period of his life the agent is an adolescent. In the third period of his life, the agent is a young adult and has a child of his own. In the fourth period of his life the agent is an old adult. At the end of the old adult period, the agent dies and is replaced by the generation of his grandchild. Note that in every period there are agents of every possible demographic type (child, adolescent, young adult and old adult). Life goes on in the future in similar fashion. [Table 11](#) describes the demographics of the economy.

3.2.2. Formalizing the problem of the agent

First, we describe the way agents go through life. Children and adolescents do not work. They only receive investments in human capital which may include components of their consumption. When they become young adults they conceive one child. In this setup, neither children nor adolescents have volition and make no economic decisions at this stage of their life cycles. As long as parents' and children's objectives are aligned, this assumption is not crucial, but a more general model would allow for child volition and parental actions to promote preference alignment through incentives [[Akabayashi \(1996\)](#), [Weinberg \(2001\)](#)].

The young parent starts the third period of his life with a stock of human capital (or efficiency units) h , an inheritance in the form of physical assets b , and gives birth to one child. We assume that labor supply is perfectly inelastic, so that the labor income of the parents is given by wh , where w is the wage rate of one efficiency unit. Because the

focus is on steady states, we assume that $w_t = w$ for all $t = 0, 1, 2, \dots$. Given h and b , the young parent chooses consumption when he is young and old, (c_y, c_o) ; early and late investments, (I_1, I_2) , in the human capital of his child; and how much to bequeath in physical capital to his child, b' . “ s ” is the savings of the young parent. Let β be the discount factor and r the interest rate. The agent’s problem is to maximize the value of lifetime utility defined as

$$V(h, b) = \max \{u(c_y) + \beta u(c_o) + \beta^2 V(h', b')\},$$

subject to

$$c_y + I_1 + \frac{s}{1+r} = wh + b, \quad (22)$$

$$c_o + I_2 + \frac{b'}{1+r} = wh + s, \quad (23)$$

and technology (13).

Cunha and Heckman (2004) close the model by introducing a firm that operates under a constant returns to scale technology and uses both human and physical capital to produce a good that can be used for consumption, human capital investment, or physical capital investment. In this chapter, we focus our attention on the behavior of investments in the child’s human capital in an economy in which the equilibrium allocation is first best.

In this simple economy, the equation describing the ratio of the marginal productivity of investments is the same as equation (19) obtained in the simple static model:

$$\frac{I_1}{I_2} = \left(\frac{\gamma}{(1-\gamma)(1+r)} \right)^{\frac{1}{1-\phi}}.$$

Thus, the main conclusions of the simple, static model developed in Section 3.1 are valid in a more fully specified economic environment.

3.3. The technology of skill formation in a model with credit constraints

We now study how the technology of skill formation affects investment in human capital when we introduce market imperfections into the economy just described. Caucutt and Lochner (2004) use a general technology to analyze how the interaction between the technology of skill formation and credit constraints during different periods affects the life cycle profile of the sequence of investments in human capital. They assume that parents make monetary transfers to children every period. These transfers cannot be negative, because parents cannot extract resources from children. Here, for the sake of simplicity, we focus on the implications for the profile of investments when there exists a limit $d \geq 0$ on how much parents can borrow when children are young:

$$s \geq -d,$$

$$b' \geq 0.$$

Allocations over time will depend on whether or not borrowing constraints bind. Taking the first-order condition for savings s it follows that

$$u'(c_y) = \beta(1+r)u'(c_o) + \beta^{-1}\lambda,$$

where $\lambda \geq 0$ represents the Lagrange multiplier on the debt constraint. If $\beta(1+r) = 1$ and the technology is described by (13), it is straightforward to show that relative investments are generated by the following equation:

$$\log\left(\frac{I_1}{I_2}\right) = \frac{1}{1-\phi} \log\left(\frac{\gamma}{1-\gamma}\right) - \frac{1}{1-\phi} \log(1+r) + \frac{1}{1-\phi} \log \frac{u'(c_o)}{u'(c_y)}.$$

Note that in comparison to first order condition (20), we acquire a new term, given by the ratio of the marginal utility of consumption, which reflects the severity of credit constraints. Investment in early childhood will be reduced with age among constrained families compared with unconstrained families.

The effects of early constraints on later investment decisions will depend on the CES-complementarity or substitutability of investment across ages. When investments are very CES-substitutable, families will tend to respond to early constraints by re-allocating investments to later periods. In this case, investments during constrained periods should decline, while investments at later ages should increase to partially offset any reductions in human capital. On the other hand, when investments are very CES-complementary over time, any reduction in early investments makes later investments less productive. If investments are strongly complementary, investment may decline at all ages in response to constraints that only bind for a few.

3.4. The technology of skill formation in a model with market incompleteness

We now consider a stochastic version of this model with incomplete markets, following the analyses of Cunha (2004) and Cunha and Heckman (2004, 2006).⁸⁰ We focus here on the assumption that parental earnings are subject to temporary idiosyncratic shocks ε (when parents are young) and η (when parents are old). The ε and η are statistically independent. The support of ε is given by the interval $[\varepsilon_{\min}, \varepsilon_{\max}]$, with $\varepsilon_{\min} > 0$. The distribution of ε is given by F_ε . Similarly, we have that the support of η is given by the interval $[\eta_{\min}, \eta_{\max}]$, with $\eta_{\min} > 0$. The distribution of η is given by F_η . The market failure in their analysis is that there are no markets that allow agents to insure against realizations of ε or η . Furthermore, parents cannot leave debts to their children. Their setup extends the framework developed in the income fluctuation literature analyzed by Schechtman (1976), Bewley (1986), Clarida (1987), Laitner (1979, 1992), Huggett (1993), and Aiyagari (1994) to account for child investment decisions.

⁸⁰ Recent work by Caucutt and Lochner (2004) also considers a stochastic version of this model.

In a simplified version of [Cunha \(2004\)](#) and [Cunha and Heckman \(2004, 2006\)](#), the problem of the parent is to maximize the utility of the parents using the recursive representation for first period preferences:

$$V_1(h, b, \varepsilon) = \max_{c_y, I_1, s} \{u(c_y) + \beta E[V_2(h, s, I_1, \eta) | \varepsilon]\},$$

where c_y is the consumption of the parents while their children are young, subject to

$$c_y + I_1 + \frac{s}{1+r} = wh\varepsilon + b, \quad (24)$$

where s is saving and

$$s \geq -wh\eta_{\min}. \quad (25)$$

The second period parental utility problem in recursive form is

$$V_2(h, s, I_1, \eta) = \max_{c_o, I_2, b'} \{u(c_o) + \beta E[V_2(h', b', \varepsilon') | \eta]\}$$

where c_o is the consumption of the parents in the second period of their child's life cycle, subject to the constraints

$$c_o + I_2 + \frac{b'}{1+r} = wh\eta + s, \quad (26)$$

$$b' \geq 0, \quad (27)$$

and technology (13).

Restriction (25) is what [Aiyagari \(1994\)](#) calls the natural borrowing limit. It arises as a combination of the restrictions that parents cannot leave negative debts to their children and that consumption cannot be negative. Note that the natural borrowing limit varies with parental human capital h . The higher the parental human capital, the more parents can borrow to finance consumption and early investments. The first-order condition for bequest b' may bind or not. Assuming it does not bind, the first order condition is given by

$$-\lambda_2 \frac{1}{1+r} + \beta \frac{\partial E[V_2(h', b', \varepsilon') | \eta]}{\partial b'} = 0 \quad \text{if } b' > 0.$$

The fact that parents cannot extract resources from their descendants has consequences for the profile of investments in the human capital of the child. The inability of the parents to leave debts for their children in order to finance human capital investments makes both early and late investments a function of parental lifetime resources. Parents who are very poor tend to invest much less, both early and late, than parents who are better off. Consequently, gaps in skill formation arise even in the early ages of child development, a fact consistent with the evidence presented in Section 2 and in an entire literature (see, e.g. the essays in [Duncan and Brooks-Gunn, 1997a](#)).

Figure 19 is reproduced from [Cunha and Heckman \(2004\)](#), who study educational policies in a [Laitner \(1992\)](#) economy. It is based on their provisional estimates for the

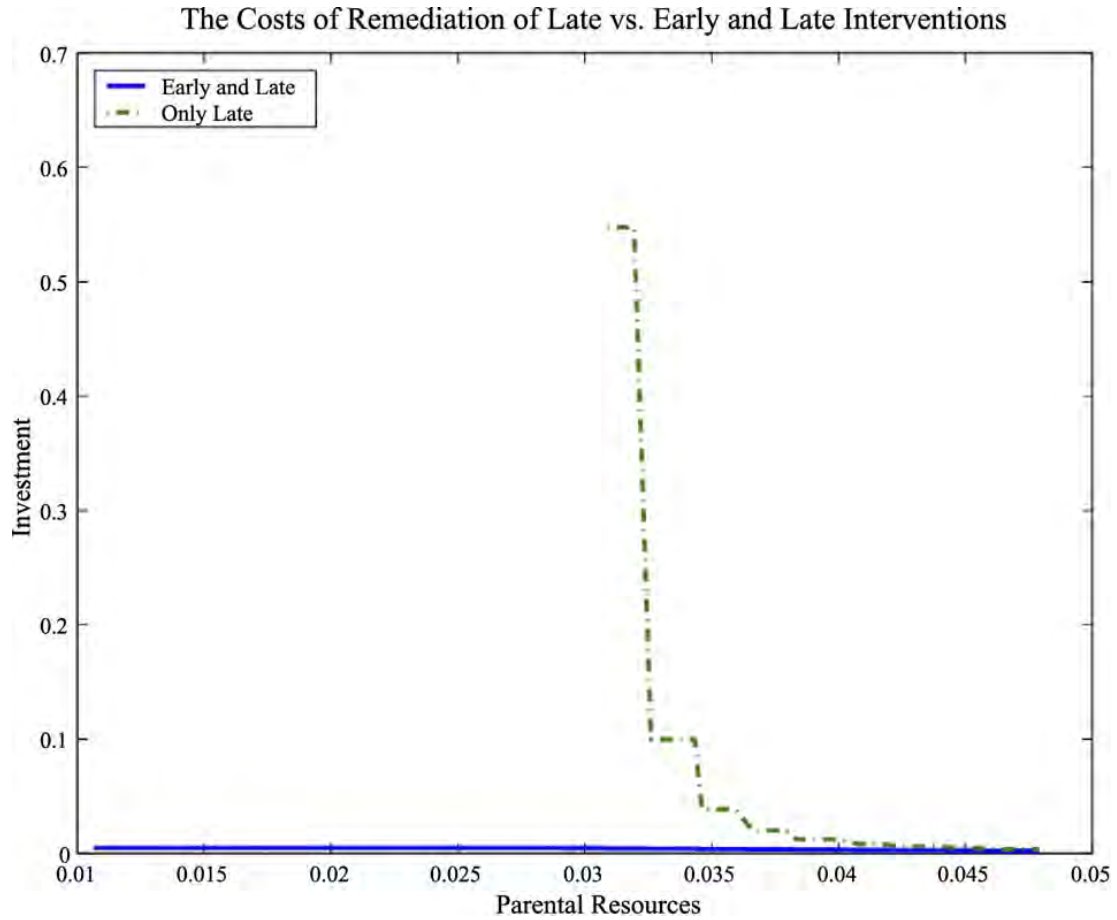


Figure 19. The costs of remediation of late vs. early and late interventions.

This figure is from [Cunha and Heckman \(2004\)](#), and is based on estimates reported above: $\rho = 0.7012$, $\gamma = 0.8649$, and $\phi = -0.4108$. It shows the costs of remediation when the government makes up for parental deficits in investments due to binding lifetime credit constraints. Formally, the young parents solve $V_1(h, b, \varepsilon) = \max\{u(c_y) + \beta E[V_2(h, s, I_1, \eta) \mid \varepsilon]\}$, subject to the young budget constraint $c_y + I_1 + \frac{s}{1+r} = wh\varepsilon + b$, and the natural borrowing limit $s \geq wh\eta_{\min}$. When old, the parents solve $V_2(h, s, I_1, \eta) = \max\{u(c_0) + \beta E[V_2(h', b', \varepsilon') \mid \eta]\}$, subject to the budget constraint when old, $c_0 + I_2 + \frac{b'}{1+r} = wh\eta + s$; the constraint that prevents parents from extracting resources from their children, $b' \geq 0$; and the technology of skill formation. This figure plots the remediation costs for parents that receive no bequest in risk-free bonds, so that $b = 0$. The goal is to calculate the short-run costs of implementing a policy that attains the counterfactual human capital stock of the child if parents had access to full insurance against realizations of idiosyncratic shocks. There are two ways the government can pursue this policy. In the first case, the government provides educational goods and services in both early and late investment periods. In the second case, the government intervenes only during the late investment period. The message from this figure is clear: when the government intervenes only in the late period, remediation costs are much higher than when the government acts in both periods for all levels of parental income. Furthermore, for parents with very low income, there is no amount of government-provided educational goods and services that can attain the objective of the policy. In this figure, it is assumed that the government policy is unexpected when parents allocate resources to investments. See [Cunha \(2004\)](#) for long-run effects of government remediation policies.

technology of skill formation.⁸¹ It shows the costs of remediation when the government makes up for parental deficits in investments due to binding lifetime credit constraints, so that $b = 0$ (that is, the parents receive no bequests from the grandparents).⁸² The graph plots the short-run costs, by a measure of parental resources, of a policy that attains the counterfactual human capital stock of the child that would arise if households had access to complete markets in an Arrow-Debreu sense.⁸³ There are two ways the government can pursue this policy. In the first case, the government provides educational goods and services in both early and late investment periods. In the second case, the government intervenes only during the late investment period (e.g., a tuition policy).

The lesson from their analysis is that when the government intervenes only in the late period but not the early period and attempts to achieve a first best solution at all levels of parental income, remediation costs are much higher than when the government intervenes in both periods. Furthermore, for parents with very low income, so that early investments are very low, there is no amount of government-provided educational goods and services that can attain the objectives of the policy due to the high level of CES-complementarity and self-productivity.⁸⁴

In long-run equilibrium, the possibility of substitution among investments at different stages of the life cycle raises challenges for designing an optimal economic policy. If in the first period agents know that late investments are subsidized, such subsidies may either encourage or discourage early investments. It will discourage early investment if I_1 and I_2 are close substitutes. It will encourage early investment if I_1 and I_2 are strong complements. Empirically, the latter appears to be the relevant case. Cunha (2004) shows that for the parameter values of Cunha and Heckman (2004), a tuition subsidy causes parents to increase the amount of early investments in human capital of the child. The case for tuition subsidies lies more in their effect on early childhood investment than in their effect on alleviating credit constraints operating on the family during the child's adolescent years.

4. Summary and conclusions

This paper reviews the evidence on the life cycle of human skill formation and interprets it using basic economic models. The new economics of the life cycle recognizes that childhood is a multistage process where early investments feed into later investments. Skill begets skill; learning begets learning. The early influential work of Becker and

⁸¹ In recent work Cunha, Heckman and Schennach (2006) develop more refined estimates of the technology of skill formation.

⁸² The estimates of the parameters of (13) reported in Cunha and Heckman (2004) are $\rho = 0.7012$, $\gamma = 0.8649$, and $\phi = -0.4108$.

⁸³ By complete markets in this case we mean that parents can buy insurance against the realizations of temporary shocks in earnings ε and η .

⁸⁴ Note, however, that this is not the pure Leontief case.

Tomes (1979, 1986) collapsed childhood into a single period and implicitly assumed that all investments at all ages of the child are perfect substitutes. This misses important features of the skill development process.

The evidence reported here is broadly consistent with the self-productivity of human capital investment and the complementarity of investments at different ages. Both factors combine to produce the phenomenon that skill begets skill. Complementarity implies that early investments need to be followed by later investments if the early investments are to pay off.

We formalize the concept of critical and sensitive periods and introduce the concept of the skill multiplier which captures the combined effects of complementarity and self-productivity on the child development process. Complementarity and the skill multiplier produce no trade-off between equity and efficiency at early ages of human development but a substantial trade-off at later ages. Once skills are crystallized, complementarity implies that the returns are highest for investment in the most able. At the youngest ages, it is possible to form ability and create the complementarity that characterizes late adolescent and early adult human capital investment processes. Thus early interventions targeted toward the disadvantaged can be highly effective. Later investments are not.

The main findings of the literature can be summarized succinctly. First, abilities matter. A large number of empirical studies document that cognitive ability affects both the likelihood of acquiring advanced training and higher education, and the economic returns to those activities. Both cognitive and noncognitive abilities matter in determining participation in crime, teenage pregnancy, drug use and participation in other deviant activities. The evidence that abilities matter tells us nothing whatsoever about whether they are genetically determined.

Second, ability is multidimensional. IQ has to be distinguished from what is measured by achievement tests, although it partly determines success on achievement tests. Noncognitive skills (perseverance, motivation, self-control and the like) have direct effects on wages (given schooling), schooling, teenage pregnancy, smoking, crime and achievement tests. Both cognitive and noncognitive skills affect socioeconomic success. Both are strongly influenced by family environments. The old dichotomy between an invariant, genetically determined ability and acquired skills is a false one that still continues to influence the literature in economics. Abilities and skills are both acquired. They are influenced both by genes and the environment.

Third, ability gaps in both cognitive and noncognitive skills across individuals and across socioeconomic groups open up at early ages. They are strongly correlated with family background factors, like parental education and maternal ability, which, when controlled for in a statistical sense, largely eliminate these gaps. Inputs of schooling quality and resources have relatively small effects on early ability deficits. Parenting practices have strong effects on emotional development and motivation. This correlational evidence is supported by the experimental evidence from the Perry Preschool Program and the Abecedarian program.

Fourth, the importance of family credit constraints in the child's adolescent years in explaining college attendance (and other) differentials across socioeconomic groups is

greatly exaggerated in the recent literature. While there is an identifiable group of families constrained in this fashion, it is not numerically large. Interventions targeted toward this group can be effective but will not substantially eliminate gaps in college attendance. The real binding constraint is the inability of children to buy favorable family environments at early ages.

Fifth, it is possible to partially compensate for adverse family environments. Evidence from randomized trials conducted on intervention programs targeted at disadvantaged children who are followed into adulthood, suggests that it is possible to eliminate some of the gaps due to early disadvantage. Enriched and sustained interventions at the youngest ages raise IQ. The Abecedarian program provided an enriched intervention for disadvantaged children starting at age 4 months. The children who received the intervention score consistently higher than the children who do not, even long after the treatment is discontinued. Later interventions like the Perry Preschool program show no lasting effect on IQ. However, effects on motivation and, hence, achievement test scores are found. Children are less likely to commit crime and have out of wedlock births and are more likely to participate in regular schooling. Early interventions have a substantial effect on adult performance and have a high economic return.

Sixth, different types of abilities appear to be manipulable at different ages. Thus, while factors affecting IQ deficits need to be addressed at very early ages for interventions to be effective, there is evidence that later interventions in the adolescent years can affect noncognitive skills as well as the knowledge measured by achievement tests. Achievement is determined by both cognitive and noncognitive factors. This evidence is rooted in the neuroscience that establishes the malleability of the prefrontal cortex into the early 20s. This is the region of the brain that governs emotion and self-regulation.

Seventh, the later the remediation, the less effective it is. Classroom remediation programs designed to combat early cognitive deficits have a poor track record. Public job training programs and adult literacy and educational programs, like the GED, that attempt to remediate years of educational and emotional neglect among disadvantaged individuals have a low economic return, and for young males, the return is negative. This evidence is consistent with strong complementarity of investment over the life cycle of the child.

Eighth, the economic returns to initial investments at early ages are high. The economic return to investment at older ages is lower. The technology of skill formation which we analyze in this essay suggests a strong skill multiplier effect of investment. Investment at an early age produces a high return through self-productivity and direct complementarity. Early investment in cognitive and noncognitive skills lowers the cost of later investment by making learning at later ages more efficient. The skill multiplier highlights the value of early investment. It also demonstrates that there is no trade-off between equity (targeting programs at disadvantaged families) and efficiency (getting the highest economic returns), provided that the investments are made at early ages. There is such a trade-off at later ages.

Ninth, CES-complementarity of early with late investments implies that early investments must be followed up by later investments in order to be effective. Nothing in the

new economics of human skill formation suggests that we should starve later educational and skill enhancement efforts. The main finding from the recent literature is that we should prioritize, and shift our priorities, in a marginal fashion by redirecting a given total sum of expenditure on skill investment to earlier ages relative to how it is currently allocated toward disadvantaged populations that do not provide enriched environments for their children.

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Appendix A

A.1. The general technology of skill formation

Let S_t be a $L \times 1$ vector of skills or abilities at stage t . Included are pure cognitive abilities (e.g., IQ) as well as noncognitive abilities (time preference, self control, patience, judgment). The notation is sufficiently flexible to include acquired skills like general education or a specific skill. Agents start out life with vector S_0 of skills (abilities). The S_0 are produced by genes and *in utero* environments which are known to affect child outcomes (see the essays in [Keating and Hertzman, 1999](#)).

Let I_t be a $K \times 1$ vector of investments at stage t . These include all inputs invested in the child including parental and social inputs. The technology of skill formation can be written as

$$S_t = f_t(S_{t-1}, I_t),$$

where f_t is a stage- t function mapping skill (ability) levels and investment at stage t into skill (ability) levels at the end of the period. For simplicity we assume that f_t is twice continuously differentiable in its arguments. Its domain of definition is the same for all inputs. The inputs may be different at different stages of the life cycle, so the inputs in I_t may be different from the inputs at period τ different from t .

Universal self-productivity at stage t is defined as

$$\frac{\partial S_t}{\partial S_{t-1}} = \frac{\partial f_t}{\partial S_{t-1}} > 0.$$

In the general case this is a $L \times L$ matrix. More generally, some components of this matrix may be zero at all stages while other components may always be positive. In principle, some skills could have negative effects in some periods. At some stages, some components may be zero while at other stages they may be positive.

Universal direct complementarity at stage t is defined by the $L \times K$ matrix:

$$\frac{\partial^2 S_t}{\partial S_{t-1} \partial I'_t} > 0.$$

Higher levels of S_t raise the productivity of I_t . Alternatively, higher levels of I_t raise the productivity of S_t . Again, in the general case, some components at some or all stages may have zero effects, and some may have negative effects. They can switch signs across stages.

This notation is sufficiently general to allow for the possibility that some components of skill are produced only at certain critical periods. Period t is critical for skill (ability) j if

$$\frac{\partial S_{t,j}}{\partial I_t} \neq 0, \quad \text{for some levels of } S_{t-1} = s_{t-1}, \quad I_t = i_t,$$

but

$$\frac{\partial S_{t+k,j}}{\partial I_{t+k}} = 0, \quad k > 0, \quad \text{for all levels of } S_{t-1} = s_t, \quad I_t = i_t.$$

Sensitive periods might be defined as those periods where, at the same level of input S_{t-1} , I_t , the $\frac{\partial S_t}{\partial I_t}$ are high. More formally, letting $S_{t-1} = s$, $I_t = i$, t is a sensitive period for skill (or ability) j if

$$\left. \frac{\partial S_{t+k,j}}{\partial I_{t+k}} \right|_{S_{t+k-1}=s, I_{t+k}=i} < \left. \frac{\partial S_{t,j}}{\partial I_t} \right|_{S_{t-1}=s, I_t=i}, \quad \text{for all } k \neq 0.$$

Clearly there may be multiple sensitive periods, and there may be sensitivity with respect to one input that is not true of other inputs.

An alternative definition of critical and sensitive periods works with a version of the technology that solves out $S_{t,j}$ as a function of lagged investments and initial conditions $S_0 = s_0$:

$$S_{t,j} = M_{t,j}(I_t, I_{t-1}, \dots, I_1, S_0), \quad S_0 = s_0, \quad j = 1, \dots, J.$$

Stage t^* is a *critical period* for $S_{t,j}$ if investments are productive at t^* but not at any other stage $k \neq t^*$. Formally,

$$\frac{\partial S_{t,j}}{\partial I_k} = \frac{\partial M_{t,j}(I_t, I_{t-1}, \dots, I_1, S_0)}{\partial I_k} \equiv 0, \quad k \neq t^*, \quad j = 1, \dots, J,$$

for all $S_0, I_1, \dots, I_t$, but

$$\frac{\partial S_{t,j}}{\partial I_{t^*}} = \frac{\partial M_{t,j}(I_t, I_{t-1}, \dots, I_1, S_0)}{\partial I_{t^*}} > 0, \quad j = 1, \dots, J,$$

for some $S_0, I_1, \dots, I_t$.

Stage t^* is a *sensitive period* for $S_{t,j}$ if at the same level of inputs, investment is more productive at stage t^* than at stage t . Formally, t^* is a sensitive period for $S_{t,j}$ if for $k \neq t^*$,

$$\left. \frac{\partial S_{t,j}}{\partial I_k} \right|_{S_0=S_0, I_k=i_k, k=1, \dots, t, k \neq t^*} \leq \left. \frac{\partial S_{t,j}}{\partial I_{t^*}} \right|_{S_0=S_0, I_k=i_k, k=1, \dots, t}.$$

The inequality is strict for at least one period $k = 1, \dots, t, k \neq t^*$.

This definition of critical periods agrees with the previous one. Our second definition of sensitive periods may not agree with the previous one, which is defined only in terms of the effect of investment on the next period's output. The second definition fixes the period at which output is measured and examines the marginal productivity of inputs in producing the output. It allows for feedback effects of the investment in j on output beyond j through self-productivity in a way that the first definition does not.

At each stage t , agents can perform certain tasks. The level of performance in task l at stage t is $T_{l,t} = T_{l,t}(S_t)$. For some tasks, and some stages, components of S_t may be substitutes or complements. Thus we distinguish complementarity or substitution in skills (abilities) in stage t in task performance from complementarity or substitution in skill production. Agents deficient in some skills may specialize in some tasks. This is an alternative form of remediation compared to remediation through skill investment.

A.2. Relationship with the Ben-Porath (1967) model

The conventional formulation of the technology of skill formation is due to Ben-Porath. Let h_t be a scalar human capital. This corresponds to a model with one skill (general human capital) and one task. In his setup, $T_t(S_t) = h_t(S_t)$. Ben-Porath makes the additional (implicit) assumption that $h_t(S_t) = h(S_t)$. His model postulates that human capital at time $t + 1$ depends on human capital at t , invariant ability (denoted θ), and investment at t , I_t . I_t may be a vector. The same type of investments are made at each stage. Skill is measured in the same units over time. His specification of the investment technology is

$$h_{t+1} = f(I_t, h_t, \theta),$$

where f is concave in I_t . The technology is specialized further to allow for depreciation of scalar human capital at rate σ . Thus we obtain

$$h_{t+1} = g(I_t, h_t, \theta) + (1 - \sigma)h_t.$$

When $\sigma = 0$, there is no depreciation. “ h_t ” is carried over (not fully depreciated) as long as $\sigma < 1$.

Self-productivity in his model arises when $\frac{\partial h_{t+1}}{\partial h_t} = \frac{\partial g(\theta, h_t, I_t)}{\partial h_t} + (1 - \sigma) > 0$. This comes from two sources: a carry over effect, $(1 - \sigma) > 0$, arising from the human capital that is not depreciated, and the effect of h_t on gross investment ($\frac{\partial g(\theta, h_t, I_t)}{\partial h_t} > 0$). If $g(I_t, h_t, \theta) = \phi_1(h_t, \theta) + \phi_2(I_t, \theta)$, there is no essential distinction between $(1 - \sigma)h_t$ and $g(I_t, h_t, \theta)$ as sources of self-productivity if we allow σ to depend on $\theta(\sigma(\theta))$.

Complementarity of all inputs is

$$\frac{\partial^2 g(I_t, h_t, \theta)}{\partial h_t \partial I_t'} > 0.$$

In a more general case, some components of this vector may be negative or zero. In the case of universal complementarity, the stock of h_t raises the marginal productivity of I_t . Direct complementarity and self-productivity, singly and together, show why skill begets skill. Our model generalizes the Ben-Porath model by (a) allowing for different skill formation technologies at different stages; (b) allowing qualitatively different investments at different stages; (c) allowing for both skill and ability formation and (d) considering the case of vector skills and abilities.

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What are the benefits from early childhood education?

- Early childhood education and care programmes (ECEC) have become more accessible in recent years, with high enrolment rates in both early childhood educational development and pre-primary education.
- The educational results of students at the age of 15 may be partially explained by attendance at pre-primary education, which sharply decreases the likelihood of low performance in the Programme for International Student Assessment (PISA).
- Pre-primary education can play a strong role in promoting equality at an early age, particularly by targeting disadvantaged groups such as first- and second-generation immigrants.
- Assuring and monitoring the quality of programmes is key to guaranteeing that early childhood education and care has a positive impact on both equity and performance in education.

Within the OECD, enrolment in early childhood education is very high.

The International Standard Classification of Education (ISCED) divides early childhood education programmes (ECE) into two groups according to their level of complexity and the age of the children enrolled: early childhood educational development (ISCED 0.1) and pre-primary education (ISCED 0.2). Both have an education component, although they have different focuses. Early childhood educational development programmes are usually designed for children under three years old and focus on communication skills, especially language acquisition, as well as initial motor activities and socio-emotional development.

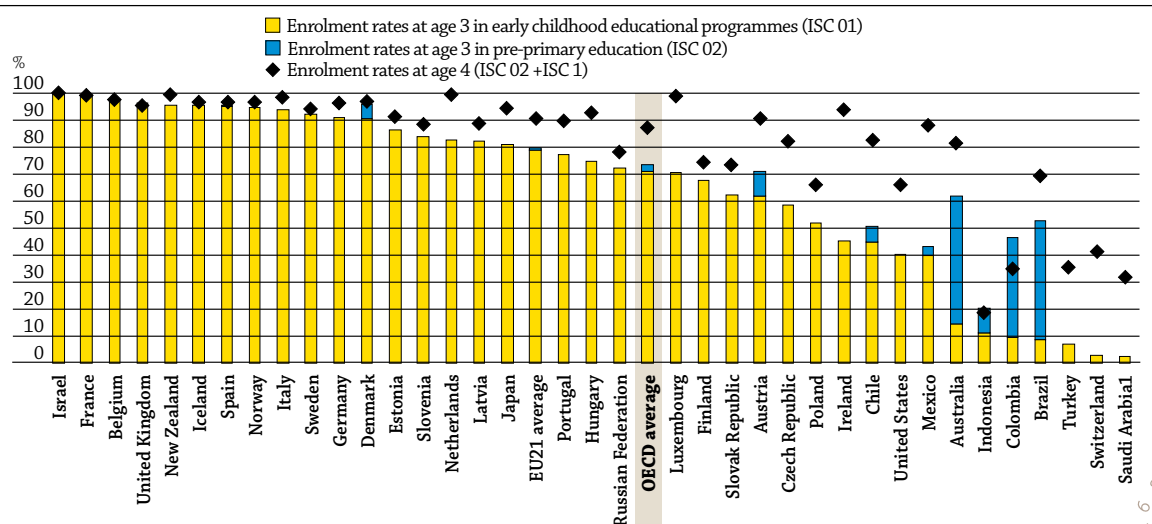
Pre-primary education is structured as an introductory programme to prepare students aged between three and six years old for compulsory education; they provide children with basic alphabetical and mathematical concepts and initial logical and reasoning skills (UNESCO, 2012). Programmes such as childcare are not included in ECE and not captured by the *Education at a Glance* data, although their impact is discussed in other publications and research papers. Childcare programmes are often analysed in combination with ECE programmes under the broader early childhood education and care (ECEC) category. Enrolment in early childhood education and care increased sharply in the 1970s and 1980s, coinciding with growing female participation in the labour market. Its original main objective was to provide care for young children, thus allowing parents to work and facilitating a balance between work and family responsibilities. In recent years, however, the focus of those programmes has shifted from parents' needs to children's development (OECD, 2011). This has coincided with greater government involvement aimed at guaranteeing that ECEC is equipping children with better skills and the competencies needed to start compulsory education, and addressing socio-economic inequality early on in children's development.

Figure 1 shows that in 2013 many OECD countries had close to universal coverage of early childhood education. On average, three-quarters of children aged 3 were enrolled in either ISCED 01 or ISCED 02, the latter being considerably more common in all countries except Australia, Brazil and Colombia. Among 4-year-olds, 20 of the 31 OECD countries with data available had enrolment rates of over 90%. However, there is still strong variation across OECD countries, and in Ireland, Mexico, Switzerland, Turkey and the United States less than half of all 3-year-olds were enrolled in an ECE programme.

ECEC helps children boost performance and develop social and emotional skills.

The success of ECEC in preparing students for higher levels of education has shifted the focus of those programmes from parents' to children's interests (OECD, 2011). Skills development at ECEC level is of particular importance as children are more sensitive at this stage than in later levels of education, meaning that they are more able to acquire fundamental skills that will be used throughout their educational and professional lives (OECD, 2015a).

The impact of early education in fostering a greater ability to learn in later stages is well summarised by Heckman's concept "Skills beget skills" (Heckman, 2008). The idea behind this expression is that skills achieved in early stages of education contribute to the development of other skills required in later educational levels and professional life. Moreover, evidence from the Effective Provision of Pre-School Education (EPPE) project confirms the particular role of early childhood education

Figure 1. **Enrolment rates in early childhood education (2013)**

1. Year of reference 2014.

Countries are ranked in descending order of the enrolment rates of 3-year-olds in pre-primary programmes.

Source: OECD (2015d), *Education at a Glance*, <http://dx.doi.org/10.1787/eag-2015-en>, Table C2.1.

in the performance of disadvantaged children before they enter primary school. Furthermore, the project shows that all children benefit from preschool, which enhances their intellectual development and improves their independence, concentration and sociability (Siraj-Blatchford, 2010).

Figure 2 illustrates the lasting impact of ECE, linking better performance in the Programme for International Student Assessment (PISA) at the age of 15 with previous participation in early childhood education. For most countries, there are fewer low performers in maths among children who attended more than one year of pre-primary education than among those who did not attend any pre-primary education at all (OECD, 2016a). The difference continues to be significant even when controlling for socio-economic status, gender, immigrant background, language spoken at home, family structure, location of student's school (rural area, town or city), grade repetition and programme orientation (vocational or general).

High-quality early childhood education also provides children with an opportunity to develop social and emotional skills such as openness to new experiences, conscientiousness, extraversion, agreeableness and neuroticism, all of which tend to foster individual and societal progress. *Skills for Social Progress: The Power of Social and Emotional Skills* (OECD, 2015a) gives some examples of the link between social and emotional skills and educational performance, employment and health. In fact, the early development of social and emotional skills is a better predictor of college completion in the United States than that of cognitive skills. In Norway, adults in their late twenties with well-developed skills such as extraversion and self-confidence are considerably less likely to be depressed. In general, this set of skills is also a strong predictor of success later in life, when adults join the labour market (OECD, 2015a).

Fighting inequality in outcomes requires an early start.

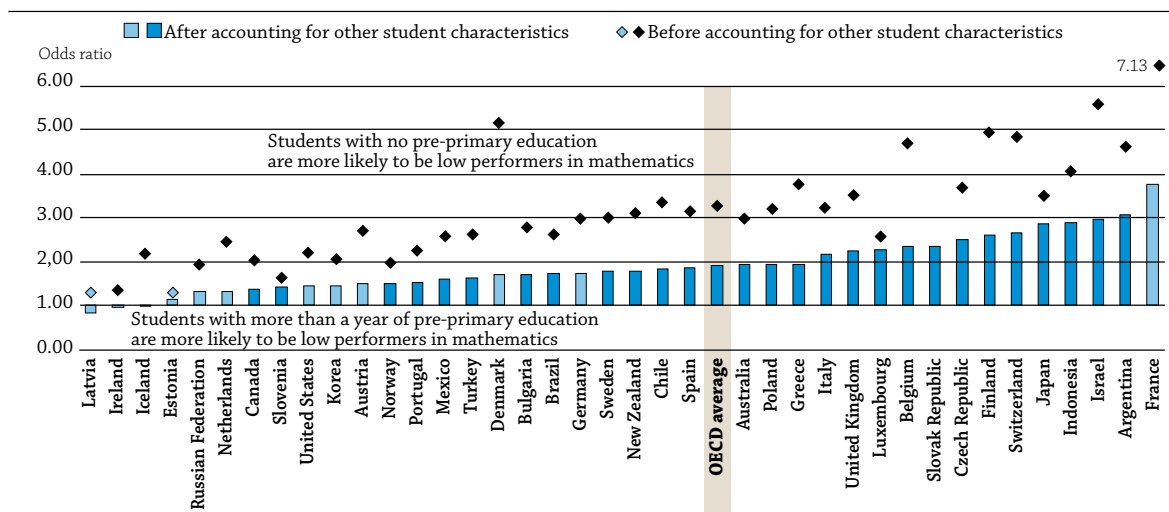
In an increasingly unequal world – in the last decade, the income of the richest 10% increased by one-tenth but stagnated for the other 90% and even decreased for the bottom 10% (OECD, 2016b) – ECEC is central to reducing inequality from the start. Early enrolment in school is one way governments can help children from disadvantaged families catch up with their peers before starting primary education. Differences in learning patterns need to be assessed and addressed at a young age in order to stop inequality increasing at higher educational levels and later on in the labour market.

Targeting immigrant students in the process.

Current trends point to a more integrated world, with increasing numbers of immigrants, who often belong to lower income groups in host countries (OECD, 2015c). On average, across the OECD, the share of the foreign-born population has increased from 6% to over 9% over the last 2 decades. Increased mobility leading to greater diversity requires particular efforts towards integration, especially in initial stages of education.



Figure 2. Pre-primary education and performance at the age of 15 (2012)



Notes: Statistically significant coefficients are marked in a darker tone.

Other student characteristics include: socio-economic status, gender, immigrant background, language spoken at home, family structure, location of student's school (rural area, town or city), grade repetition and programme orientation (vocational or general).

Countries and economies are ranked in ascending order of the odds ratio of students who had no pre-primary education (Panel A) or who had a year or less of pre-primary education (Panel B) performing below the proficiency baseline Level 2 in mathematics compared to students with more than a year of pre-primary education, after accounting for other student characteristics.

Source: OECD (2016a), *Low-Performing Students: Why They Fall Behind and How to Help Them Succeed*, PISA, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264250246-en>.

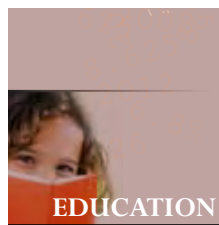
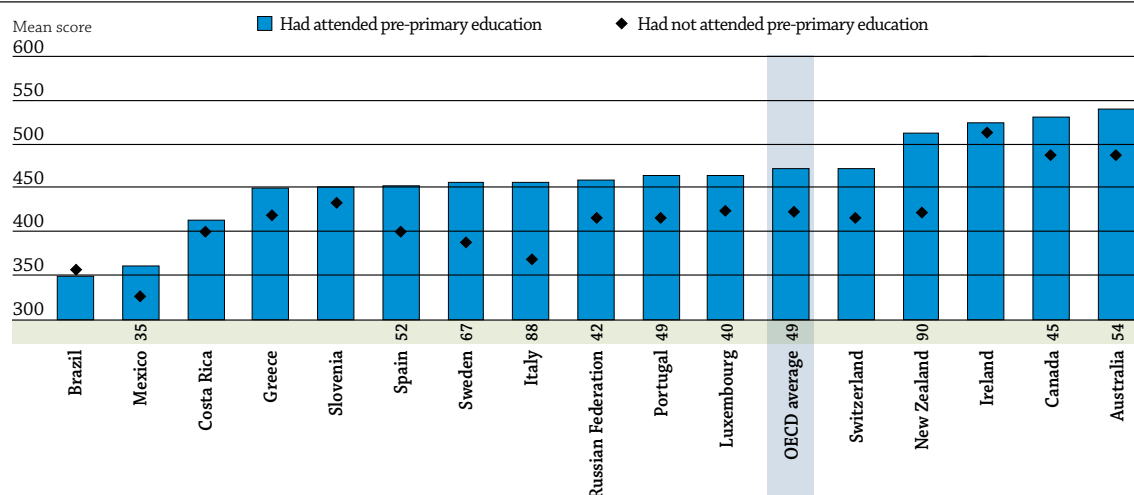
Integrating young immigrant children into their new communities is of key importance in the long run and their flexibility and the rapidity with which they are capable of learning a local language makes the task easier. One of the ways in which education systems can help is by encouraging their enrolment in pre-primary education programmes. In most countries, participation in those programmes among immigrant children is considerably lower than that among those without an immigrant background (OECD, 2015c).

Indeed, as Figure 3 shows, across OECD countries, immigrant students who reported that they had attended pre-primary education programmes scored 49 points higher in the PISA reading assessment than immigrant students who reported that they had not. This difference in the PISA reading score corresponds to roughly one more year of education. However, part of this difference is explained by socio-economic factors, given that in many countries local and migrant children from more privileged households are more likely to attend pre-primary school.

Focus on high-quality education.

Enrolment in early childhood education is not enough on its own; the quality of programmes must also be observed and monitored and the results used to improve them. Some quality indicators include the child-staff ratio, the duration of programmes and public spending per child. However, beyond gathering descriptive statistics, monitoring the quality and impact of pre-primary education systems is not a well-developed practice across OECD countries. Monitoring processes tend to focus more on compliance with regulations than on the quality of service delivery or assessing how well children's needs are being identified and met (OECD, 2015b).

A few OECD countries have developed systems to benchmark and monitor children's progress, including children from different socio-economic and ethnic groups. Some countries use school entry tests to focus on child development and to provide information on how young children are progressing. Australia, for example, uses a national adaptation of the Early Development Instrument (EDI). The EDI, originally developed in Ontario, Canada, is a measure of children's development as they enter school. Teachers complete a checklist measuring children's physical health and well-being, social competence, emotional maturity, language, cognitive and communication skills, and general knowledge. The results are aggregated to the group level (school, neighbourhood, city) to provide a population-based measure of children's development (OECD, 2015a). Despite being a useful measurement tool, EDI still has limitations as it uses information reported by teachers, rather than independent moderators.

Figure 3. **Pre-primary education and reading performance of immigrant students (2012)**

Note: Statistically significant score-point differences in reading performance between immigrant students who had attended pre-primary education and those who had not are shown next to the country/economy name.

Countries and economies are ranked in ascending order of the reading score of immigrant students who had attended pre-primary education.

Source: OECD (2015c), *Immigrant Students at School: Easing the Journey towards Integration*, OECD Reviews of Migrant Education, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264249509-en>.

The bottom line: Evidence shows that early childhood education leads to the development of cognitive, social and emotional skills at a young age as well as to better school performance later on. It also creates conditions for lifelong learning and better future professional achievement. Furthermore, efforts to ensure quality early childhood education programmes may help to decrease the level of inequality between students and reduce the impact of socio-economic differences in education.

For more information

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Next topic

Sub-national variations in educational attainment and labour market outcomes.

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Who wants to work in child care?

Pre-service early childhood teachers' consideration of work in the childcare sector

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AUSTRALIA IS CURRENTLY WITNESSING considerable change in conceptualisation of the role of child care. This is a response to the strong evidence from developmental science that demonstrates the lifelong impact of early experiences. The recent commitment made by the Council of Australian Governments (COAG) (Communiqué, December 2009a) to improved qualifications and quality of those working in child care is a manifestation of this shift and highlights the importance of the childcare workforce. This study focused on the considerations of a third year cohort of B.Ed (EC) pre-service teachers ($n = 55$), about entering the childcare workforce. It examines their willingness to work in child care and identifies barriers and incentives for so doing. Our results indicate that, although attitudes to maternal work and child care were largely positive, few would prefer to work in child care under the current conditions. Key barriers were the pay and work conditions, particularly as they compare to other forms of potential employment. Incentives were the opportunity for leadership, creativity and a commitment to advocate for the rights of children. Those more willing to consider work in child care were distinguished from those less willing by altruism—foregoing personal gain to advocate for improved quality as a child's right.

Introduction

The early years of life have long been hypothesised as an important life stage that affects functioning in adulthood. However, it is only in recent times that research has been able to provide evidence of the mechanisms that explain the connection between a child's early experience and their lifetime achievement and wellbeing. An accumulation of evidence from studies using a diversity of research designs, including animal studies (for example, Kaffman & Meaney, 2007; Meaney, 2001), longitudinal studies (for example, Kovan, Chung & Sroufe, 2009; NICHD Early Child Care Research Network, 2005), experimental interventions (for example, Belfield, Nores, Barnett & Schweinhart, 2006; Muennig, Schweinhart, Montie & Neidell, 2009; Olds et al., 2004) and natural experiments (for example, Rutter et al., 2007) alongside sophisticated neuro-imaging and statistical techniques, has shown that experiences in the period from conception to five years are foundational for brain development and, as a consequence, direct life trajectories. The amount and quality of early experiences have been shown by neuroscience studies to shape neural pathways (National Scientific Council on the Developing Child, 2007; Perry, 2002; Shonkoff & Phillips, 2000) while experiments and longitudinal statistical modelling

provide evidence of causal pathways from early experiences to lifelong learning outcomes and social-emotional functioning (for example, Belfield et al., 2006; Muennig et al., 2009; Olds et al., 2004; Reynolds, Suh-Ruu, & Topitzes, 2004). Poorer early experiences have been shown to reduce a child's life possibilities, while rich and responsive early environments increase them (National Scientific Council on the Developing Child, 2007; Shonkoff & Phillips, 2000). This evidence has led to the emergence of preventative science, the study of early intervention to optimise children's life chances through provision of positive early experience, and has also directed focus to educational and care policy and practices in the years from birth to school entry.

The recent Council of Australian Governments (COAG) communiqué on child care (2009a) and publication of the *National quality standard for early childhood education and care and school age care* (2009b) are direct responses to this evidence (see Senate Standing Committee on Education Employment and Workplace Relations, 2009). Over the past two years, policy conceptualisation of the role of child care in Australia has shifted from one that focused heavily on the function of enabling parental participation in the workforce to one that adopts the vision of the Organisation for Economic Cooperation and Development (OECD) 2006

report, *Starting Strong II*. This vision recognises quality early education and care as a right of the child and provision of high-quality early education experiences as a prudent investment that benefits the individual, society and the economy. Commensurately the shift of attention has been directed away from cost minimisation to focus on raising the quality of provision in child care (Ishimine, Tayler, & Thorpe, 2009; Thorpe, Cloney, & Tayler, in press). The recommendations of the COAG communiqué are that quality of childcare environments, particularly the relational environment, should be increased by improving child to staff ratios and increasing the qualification levels of the childcare workforce. The childcare workforce is, therefore, a centrepiece.

One important component of this strategy is increasing the number of qualified teachers who work within the childcare sector. Though the relationship is by no means simple or direct (see Early et al., 2007) there is evidence that the presence of qualified teachers in childcare settings is associated with higher levels of global quality, more responsive interactions and improved child outcomes (Barnett, 2003; Burchinal, Cryer, Clifford, & Howes, 2002). However, there may be barriers to entry of degree-qualified staff to child care. This is the focus of the current paper that questions Bachelor of Education degree students specialising in Early Childhood Education (B.Ed (EC)) about their experiences of child care, attitudes to child care and intentions to work in the childcare sector. The B.Ed (EC) qualifies teachers for work in early education settings across the age range birth to eight years. This includes childcare settings for children from birth to five years, specialist early education (preschool/ kindergarten) for three- to five-year olds and the first years of formal schooling from five to eight years. This study asks whether B.Ed (EC) pre-service teachers are willing to work in the childcare sector and examines the barriers and incentives for so doing.

There is currently a dearth of research evidence on pre-service and graduate early childhood teachers' attitudes and intentions to work in the childcare sector. While there is significant academic and popular literature on the effects of non-parental care on the child and emerging literature documenting parents' views about using child care (for example, Harris, 2008), an extensive literature search found only one peer-reviewed published paper (Hill & Veale, 1997) and two conference presentations (Field & Varga, 1997; Vajda, 2005) on this subject. Field and Varga (1997) and Hill and Veale (1997) consider attitudes to maternal work and use of child care, the former in a Canadian sample and the latter in an Australian sample. Both studies report that students held negative attitudes about maternal work and child care and concluded that such attitudes ran contrary

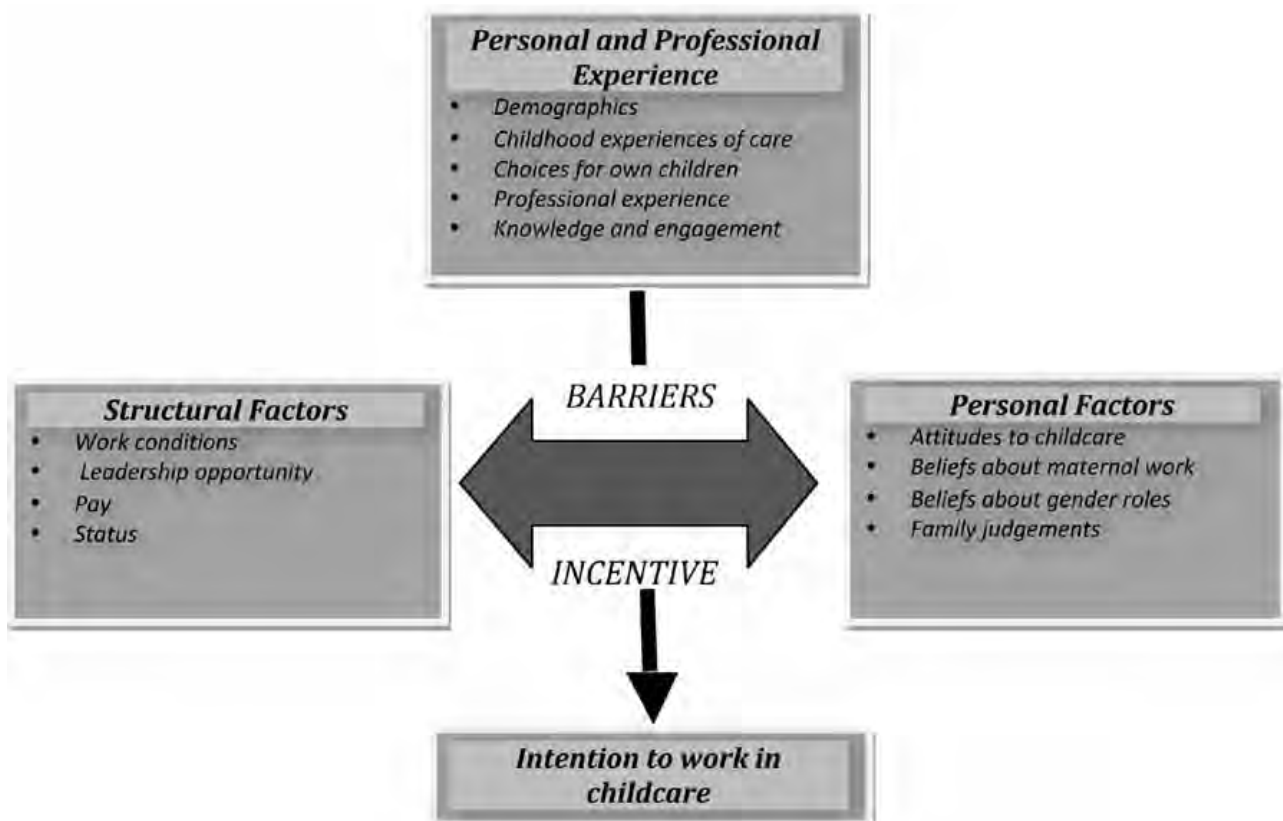
to positive engagement in early childhood education and care settings. The value of these studies is in indicating the potential role of personal value systems; however, the context of maternal employment has changed rapidly across the 13 years since these papers were written. Vajda (2005) presents a more recent study of eight pre-service teachers' views of doing practicum in a childcare centre. In this study the students saw maternal employment as a necessity but viewed child care negatively and were reluctant to participate in practicum. The study reported that students' views became more positive after they had experienced practicum and witnessed the value of the experience for children's learning. Though small, this study provides important insight into the mismatch between held views and reality of the childcare experience and directs attention to both the importance of value systems and direct experiences. In the current study, value systems and experience in child care were incorporated into the modelling and design.

In the absence of a strong extant literature, our research team developed a theoretical model of factors associated with intention to work in child care. This directed the study design and content of the questions asked of participants. In keeping with prior studies (Field & Varga, 1997; Hill & Veale, 1997; Vajda, 2005) our model, presented in Figure 1, commenced with the hypothesis that personal and professional experience of child care, along with professional education, would affect the valuing of child care as a professional option. A comprehensive set of variables capturing personal and professional experience were included. The model then introduced factors, both personal and structural, that might moderate this association. To measure belief systems about childcare provision, a self-report, attitudinal scale was developed that asked about views of the child and the value of child care.

Our study was exploratory and addressed four key questions:

1. Who is studying for a bachelor's degree in early childhood education and what are their motives?
2. What are the students' value systems relating to maternal employment, gender roles, childcare provision and usage of pre-service early childhood teachers?
3. What structural factors are the most salient in preventing or encouraging willingness to consider participation in the childcare workforce?
4. What proportions of pre-service teachers intend, or would consider, working in the childcare sector and what distinguishes them from those who would not consider this option?

Figure 1: Model of key factors influencing intention to work in childcare



Method

Participants

The participants were 55 Bachelor of Education (Early Childhood) students in their third year of study of a four-year degree at an Australian university. These represented 80% of the total year cohort ($n = 69$) of B.Ed (EC) students. As part of this course students undertook a unit of teaching and practicum in child care (Early Childhood Field Studies 3), alongside a unit in Research Methods in Early Childhood. All students were recruited when they attended the first lecture of the Research Methods unit. Non-participants were those who did not attend the first lecture ($n = 10$, 15%) and those who chose not to complete the questionnaire and returned it blank ($n = 4$, 5%). The cohort was almost totally female (96%, $n = 53$), had a mean age of 21.1 years (range 19–36 years, SD 3.2 years) and most ($n = 48$, 84.1%) had entered the degree from school. Of the cohort, two (2.95%) held a previous degree, nine (13.1%) had a Technical and Further Education qualification in child care and four (5.8%) of the students were parents.

Measure development

A pilot study was conducted in the year prior to

that on which we currently report. This study was exploratory and employed open-ended questions which were distributed to a cohort of 76 first-year B.Ed (EC) students. The open-ended responses guided our questionnaire development for close-ended response questions and has previously been reported (Ailwood & Boyd, 2007).

Questionnaire

The questionnaire was developed to measure the key components of the model of intentions to work in child care. Each section contained numerically coded questions to allow quantitative analyses, but also provided open-ended response sections to allow qualitative accounts. There were four key sections that mapped onto the model:

1. *Personal and professional experience.* The items obtained information on age, gender, number of children, use of child care for own children, qualifications, experience working in the childcare sector and other forms of work with children, membership of professional organisations, childhood experience of non-parental care, and reason for undertaking B.Ed (EC).
2. *Personal value and belief systems.* We measured five dimensions of values and beliefs:

- a. *Gender roles attitudes scale*. This was an 8-item scale assessing the beliefs about the role of men and women in paid employment, child care and household tasks.
 - b. *Cost of maternal employment (BCME—cost)*. This was a modification of the original BACMEC costs sub-scale (Greenberger, Goldberg, Crawford, & Granger, 1988). It included 14 items which were statements (for example, children learn more if their mothers stay at home with them) rated on a 5-point Likert scale (strongly agree through to strongly disagree).
 - c. *Benefits of maternal employment (BCME—benefit)*. This was a modification of the original BACMEC benefits sub-scale (Greenberger et al., 1988). It included 14 items which were statements (for example, children whose mothers work are more adaptable) rated on a 5-point Likert scale (strongly agree through to strongly disagree).
 - d. *Childcare attitudes*. This 7-item scale assessed beliefs about the purpose and value of childcare for children and families (for example, long day care supports children and families). These items were rated on a 5-point Likert scale (strongly agree through to strongly disagree).
 - e. *Judgement of family use of child care*. This was an 8-item scale asking respondents to judge on a 3-point scale (preferable, acceptable, and not acceptable) the acceptability of different family types using long day care. Family types included: depressed mother, single parent, low-income dual worker, average-income dual worker, high-income dual worker, non-working mother, non-working father and families wanting to promote their children's development.
3. *Structural barriers and incentives for employment in child care*. This was an 8-item scale that asked respondents to rate on a 5-point Likert scale (strong barrier through to strong incentive) how a range of structural features affected their willingness to work in child care. The items included level of pay, work conditions (flexibility, holiday tasks), work opportunities, leadership, and status (social status, 'not education').
 4. *Intention to work in child care*. A 4-point Likert scale (definitely will not work in childcare, prefer not, possibly, preferred place of employment) was used to assess willingness to work in child care.

Procedure

All students were recruited during attendance at the first lecture of the Research Methods unit. They were informed that the study was a longitudinal examination of

their views about child care and that there would be data collection points before and after a scheduled childcare practicum later in the semester. To enable anonymous participation, students were asked to generate a six symbol unique identification code comprised of the first three letters of their mother's maiden name and the last three numbers of their mobile phone (or if no mobile, their home phone). Questionnaires were completed and returned within the lecture. The same procedure and identifier was used at the second data collection which was conducted after the experiences of a childcare practicum in the penultimate lecture of the semester. This allowed linkage of data across the two time points.

Analyses

In analyses addressing research questions 1, 2 and 3, numeric data were entered into the SPSS statistical package to generate descriptive statistics and corresponding open-ended responses were read and emergent categories of response identified. In the reporting of qualitative data, examples of each category are presented in text. In addressing research question 4, frequencies of response to the outcome variable were obtained and subsequently two categories of student derived: those willing (preferred option, willing to consider) and those less willing (would not consider and prefer not to work in child care). Statistical analyses explored associations between these two categories and the demographic, structural and value measures. Qualitative data for those willing and less willing to work in child care was examined and distinguishing characteristics identified. Text is presented to illustrate these differences in presentation of results.

Results

Question 1: Who is studying for a B.Ed (EC) and what are their motives?

Summary statistics describing the cohort of students are presented in Table 1. This data indicates that those studying for a B.Ed with an early childhood speciality were a highly homogenous group who were female (97%), had entered their degree from school (84.1%) and had not experienced non-parental care as children (83.6%). Only a small minority held a previous degree (2.95%) or had a Technical and Further Education (TAFE) qualification in child care (13.1%) or were parents (5.8%). All (100%) enjoyed being with children, most had some formal experience of work with children (86%) and intended to be, or were already, parents (97%). The majority viewed their degree as leading to work in the Preparatory–Year 3 sector of education (85.%) rather than child care (11.1%); saw that a degree in Early Childhood Education suited their skills

(96.4%); and that the conditions of work (68.5%) would suit future plans to have a family (66.7%).

Variable	Category	<i>n</i>	%
Sex	Male	2	3.0
	Female	53	97.0
Have own children	yes	4	5.8
	no	51	94.2
Intention to have children	None	2	3.6
	One	4	7.3
	Two	25	45.5
	Three or more	24	43.6
Childhood experience of non-parental care	No non-parental care	46	83.6
	Family/ friend	3	5.5
	paid care	1	1.8
	long day-care	5	9.1
Experience with children	Work in childcare	10	21.3
	Teacher aide	6	12.5
	After school hours care	15	21.7
	Other paid work with children	27	39.1
	Voluntary work	24	34.8
Current Qualifications	TAFE - childcare	3	6.4
	TAFE- teacher aide	2	4.3
	TAFE - other	6	12.2
	Degree other than education	2	4.3
	Postgraduate degree	0	0.0
Member of professional organisation	yes	10	14.5
	no	45	85.5
B.Ed (EC) first choice of degree	yes	43	78.2
	no	12	21.8
Reason for choosing B.Ed (EC)	To work in childcare	6	11.1
	To work Pre-3	47	85.5
	Enjoy children	55	100.0
	Hours of work	37	68.5
	Fits with having a family	36	66.7
	Suits my skills	53	96.4

Qualitative data were derived from an open-ended question 'Please comment on any reasons for choosing early childhood education'. Of the total cohort, 35 students (64%) provided comment. Data was examined and coding categories derived. There were six categories: two relate to emotional and intellectual interest (passionate about children and children's rights, intellectual interest in child development and

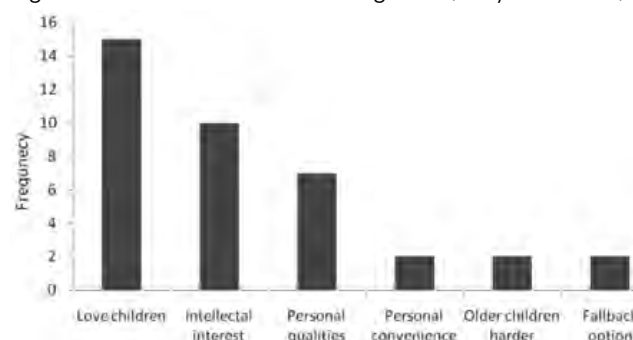
early education); two to personal needs (convenience for life plans, suits personal qualities) and two to comparison with alternative options (failed to get into preferred option, older children harder to teach). Some students provided multiple reasons and two provided responses that could not be coded. Figure 2 presents summary results. These indicate that concern for the rights of children, intellectual interest in education and child development, and personal qualities (for example creativity) were the key motives for choosing the degree:

I find that children are amazing in their theories, thoughts and provocations. I chose early childhood because I wanted to learn more about children and provide the best possible education for them (Student 3).

I feel that as a teacher I could impact positively on the lives and learning of young children. I also believe that children's learning and capabilities are of importance to me and wish to enhance these through teaching (Student 37).

I am a very creative person—teaching in the early years allows me to extend and utilise this skill (Student 48).

Figure 2: Motivation for undertaking B.Ed (Early Childhood)



In addition, a small number of students perceived a career in early childhood education as convenient, as easier than other areas of education or as a fallback to a preferred career option for which they had not qualified:

I really look forward to having my own family and being able to fit work in with family (Student 23).

Because children get worse as they get older (Student 34).

I didn't get into my first choice ... so did Anthropology and didn't see it going anywhere. Mum suggested doing teaching and it seemed like a good idea (Student 21).

Question 2: What are the value systems of pre-service early childhood teachers?

Summary statistics of the attitudinal measures are provided in Table 2. Across the sample the distribution

of gender attitude scores indicated that students held non-traditional, gender-role attitudes. On the gender attitudes measure a score range from 0–32 was possible. All participants scored in the higher range of the score distribution (range 19–32, mean 25.87, SD 2.98). This indicates that the students held beliefs that men and women had equal rights and role in workforce participation, household tasks and care of the child.

Table 2: Descriptive statistics for attitudinal measures

Variable	Range	Mean	SD
Gender attitude (0–32)	19–32	25.87	2.94
BCME – Cost (0–56)	2–31	14.02	5.8
BCME – Benefits (0–56)	6–39	25.7	7.7
Family judgement (0–56)	0–27	14.78	7.76
Childcare attitude (0–28)	15–26	20.63	2.3

Scores on the BCME indicated views about the costs and benefits of maternal employment on children's development and wellbeing. For both costs and benefits the potential scores were 0–56, with higher scores indicating higher levels of cost and benefit respectively. The scores for a cost of maternal employment to the child were in the lower end of this potential distribution (range 2–31, mean = 14.02, SD 5.8), suggesting that the group did not view the costs of maternal employment to children to be high. The variability within the group was low, suggesting this view was common across the group. In contrast, the sample was more divided about the benefits of maternal employment to the child with a wider distribution of scores (range 6–39) and a mean of 24.7 (SD 7.7).

Scores on the family judgement scale allowed potential scores from 0 (all families have right to use child care without judgement) to 56 (use of child care is unacceptable for any family). The scores were in the lower end of the distribution (range 0–27, mean = 14.78, SD 7.6) suggesting that most participants believed that parents from diverse family circumstance had a right to access child care.

Scores on attitudes to child care ranged from 0 to 28, with higher scores indicating more positive attitudes to the educational and social support function of child care. Among the cohort the range of scores was high (15–26) but the mean (20.63, SD 2.3), near the top of the distribution, suggested that most held positive views of child care.

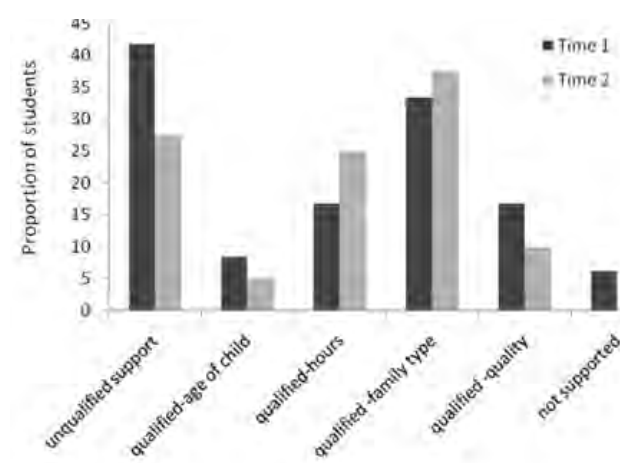
Qualitative accounts were obtained in response to the question 'Please comment on your views about parents' use of long day care for birth to three-year-olds'. Responses were provided by 48 (87%) of students at Time 1 and 40 (58%) at Time 2. These are summarised in Figure 3. The highest frequency of comments provided unqualified support for family

usage of long day care, as the following two comments indicate:

Everyone should have access to child care and I make no judgements about families who use child care (Student 1).

Day-care is necessary for many families to lead balanced lives and children can benefit greatly from quality care (Student 6).

Figure 3: Views about parent's usage of long day-care for 0–3-year-olds at Time 1 and Time 2



Many students felt that usage of long day care should be for restricted hours and some indicated it was not appropriate for children in the first year of life:

I have mixed beliefs and views on child care for birth to three-year olds. I believe it is important for children to have opportunity for social interaction however I think birth to one-and-a-half years is a little young to be there five days a week. Part-time child care, I believe, provides rich experiences (Student 13).

Many also indicated that long day care was only acceptable for usage of particular family types, such as single parents or families of working parents:

I think there should be limitations e.g. a single parent may use long day care five days per week whereas a non-working parent should limit to one full day or two half-days (Student 30).

Most parents I know of who use long day care are single parents or both working. I see child care as a waste of money if parents or relatives are able to take care of the child (Student 39).

Some acknowledged the potential benefit to children and children's right of access, and included comments about the need for high-quality provision:

It should not be about the parent but about the child and their right to education regardless of what their family circumstances are (Student 32).

Question 3: What structural factors are the most salient in preventing or encouraging willingness to consider participation in the childcare workforce?

Responses to the structural barriers and incentives of working in child care are presented in Figure 4. These suggest that the barriers are overwhelmingly structural factors: pay, work hours and poor status of the work. Figures 5 and 6 present coded qualitative responses to the question 'Please comment on the factors that are barriers or incentives to you working in child care'. These responses elaborated on the saliency of pay conditions and status as structural barriers:

I want to be paid according to my degree level. Money is a huge factor in today's society (Student 1).

The views society has on child care affect the levels of pay and working conditions ... if child care was viewed as an educational setting (because it is one!) then I would have no hesitation working in child care (Student 11).

Incentives for working in long day care are the flexibility and enjoyment of working with young children. However pay is a major barrier (Student 9).

The status and hours are really inflexible. The changing shifts and the pay do not correlate (Student 48).

Some students also indicated that they would not be among a 'community of teachers' or that work in long day care did not accord with their interests:

I would possibly work in child care if I could choose who I worked with (other education professionals) and had the choice of pedagogical decisions—then it would compel me to work there (Student 23).

As I really want to work in interventions and with children who have disability my interest is not in child care (Student 4).

Figure 4: Saliency of structural factors as barriers and incentives to work in child care

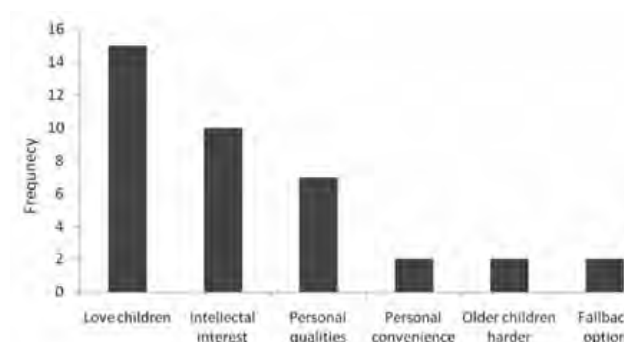


Figure 5: Barriers to working in child care: Qualitative account

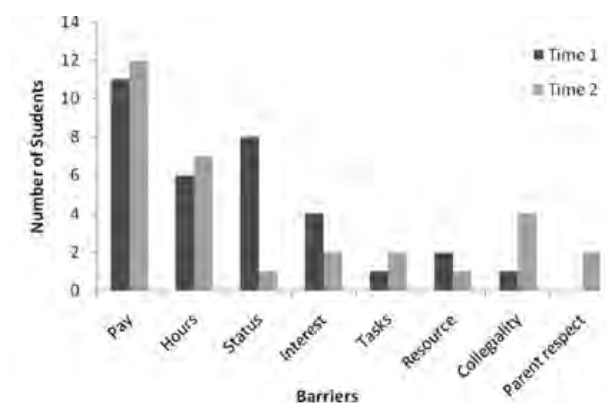
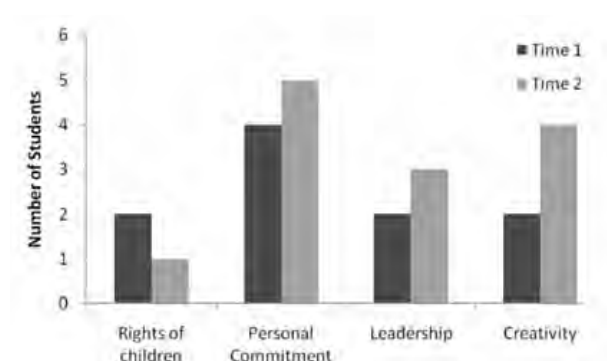


Figure 6: Incentives for working in child care



Two key themes emerged as incentives for working in child care: commitment (to the rights of the child and to early education) and personal opportunity (for leadership and creativity). These two broad themes were often combined. It was interesting to note that the number of responses relating to creativity and leadership increased at Time 2 when the students had experienced a practicum in a long day care setting:

After prac I feel I want to work in child care because I feel I can make a difference and provide children with richer experiences (Student 4).

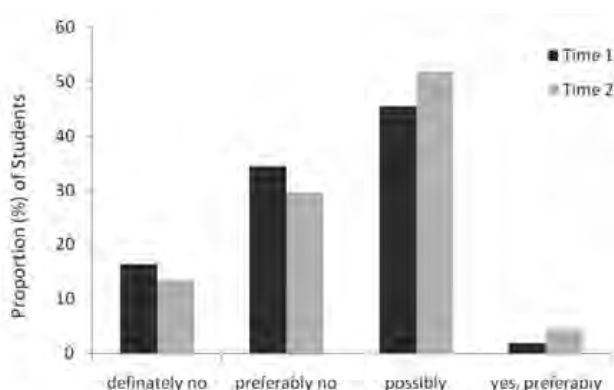
I loved it (working in child care)—listening to children's thinking and planning from this. I enjoyed incorporating the arts—it was fun and engaging (Student 40).

I like the fact that you have control over how you run your room. Schools are not so open-ended (Student 41).

Question 4: What proportion of pre-service teachers would work, or consider working, in the childcare sector and what distinguishes them from those less willing?

Figure 7 presents the responses to the question 'Would you consider working in centre-based long day care?' The results indicate that, at Time 1, while 16.7% would not consider this option and 35.2% would prefer alternative employment, just under half of the sample (48.9%) would consider working in child care. When asked Time 2, after practicum, there was a small but positive shift toward increased consideration of a childcare career option.

Figure 7: Response to question: Would you consider working in centre-based long day care?



Statistical analyses aimed to examine associations between the range of demographic, structural and attitudinal variables and the outcome variable, willingness to work in child care. Because there was so little demographic variability in the sample such associations could not be explored. There was also only limited variability in attitudinal variables (gender roles, attitudes to child care, family judgement). The association of these scores with a dichotomous variable, *willingness to work in child care*, were examined using independent t-test analyses in which groups were those less willing (definitely no and probably no) and those more willing (definitely yes and possibly) to consider child care. No significant differences were found on any of these analyses, probably reflecting small sample size and limited range of variability on attitudinal scores. Examination of structural factors similarly was limited by the small numbers and the largely homogenous response to many features of work in child care (pay and conditions) and did not yield statistically significant differences between those more and less willing to consider child care.

Qualitative data was analysed to identify any differences in text accounts that distinguished those willing and less willing to consider child care. A key feature to emerge from the comments of those willing to consider child care was the association with altruism: the placement of social advocacy and the needs of others above those of personal need. That is, those more willing to consider child care were no less concerned about the

pay conditions and status of child care than those who would not consider child care but were more motivated to overcome these barriers and forego personal gain. This was expressed both as professional commitment to leadership and desire to advocate for social change:

I'm starting to feel compelled to work in child care as I think the field needs as many early childhood professionals and I could advocate for the field (Student 41).

Prior to starting my degree I worked in a long day care centre. I didn't realise how far off the mark we were until now. Eventually I would like to run my own GOOD-QUALITY centre. I think from working in the centre and seeing how I wouldn't like to run things and the skills and knowledge I have and am still gaining from this course, I could run a fantastic centre (Student 51).

Those less willing were no less aware of the social value of child care but recognised that they did not have the personal or financial resources to consider this form of work with its attendant structural barriers:

I understand that it will take early childhood education-trained teachers to change child care but I am not enthusiastic about changing it enough to make a difference ... (Student 47).

It's all about money. You go to uni for four years, come out with a \$16,000 debt to go to work for \$29,000 a year. I can earn more pulling beers at my local pub. I loved prac and could really see myself in child care but then reality hits (Student 42).

Discussion

Australia has recently witnessed change in the conceptualisation of the function of childcare provision, from one focused primarily on enabling parental participation in the workforce to one that also focuses on providing quality educational opportunities for all children. This shift has directed policy attention away from cost minimisation to an agenda of quality improvement (COAG, 2009b). The development of an *Early Years Learning Framework* (Australian Government, 2009), the purchase of 685 ABC Developmental Learning Centres by a not-for-profit consortium and the recent COAG undertaking to reduce staff ratios and improve the quality of provision in centres are all manifestations of this change. Central to the quality improvement agenda is the provision of a more highly trained childcare workforce. The current study aimed to assess the willingness of those training as degree level early childhood education specialists to work in the childcare sector.

Our study commenced by examining the demographic characteristics and beliefs of those undertaking a

degree in early childhood education. We examined the characteristics of a cohort of students in the third year of their degree because this was the year in which they undertook coursework focused specifically on child care, including a practicum in a childcare setting. Our data suggest that the cohort were a highly homogenous group who were almost entirely female and entering the degree from school completion. While the homogeneity of the cohort may raise concern and suggest the need to attract a more diverse population into early childhood education, our findings do not suggest that the population characteristics of our cohort were associated with negative belief systems about maternal work, negative judgements of child care, or unwillingness to consider entering the childcare workforce. The cohort held uniformly high non-traditional gender role attitudes and were largely positive about the role child care can play in the wellbeing of children and families. The scores on the Benefits and Costs of Maternal Employment (BCME) scale indicated that few judged the costs of maternal employment to be negative for the child. It is interesting to note that these findings contrast both with prior studies (Field & Varga, 1997; Hill & Veale, 1997) and with qualitative data from our pilot study (Ailwood & Boyd, 2007), in which first year students expressed more negative views. It is possible that changing socioeconomic contexts across the 13 years since two of these studies accounts for the contrast in student views. However this explanation is unlikely to hold for two cohorts within the same university conducted a year apart. The differences in our first- and third-year student cohorts are most likely the effects of student learning across the two years of study. Within the third year cohort there was some variability in scores on measures of the benefits of maternal employment for the child and qualified responses in accounts given of appropriate usage of child care. Their responses align with research literature that suggests that long hours of day care from early in life may be detrimental to the child (see Belsky, 2001). The conflict between the rights of children to obtain early education within a childcare setting and the concerns about variability of quality in the Australian context were evident in both quantitative data and qualitative accounts.

Although very few of the students expressed a preference for working in the childcare sector, approximately half of the cohort was willing to consider this option. The barriers to entering the childcare workforce almost entirely related to the pay and conditions of work. A few also identified absence of a community of like professionals and low status as important. These results are not surprising but are nevertheless key issues for policy-makers and professional organisations to consider, if highly qualified professionals are to be attracted to the field. Perhaps more interesting in our results are the reports of incentives for working in child care. Work in the prior-to-school sector was seen as less restrictive and affording opportunity

for creativity and innovation. The students who were willing to consider working in child care also saw the importance of the early years of life and the opportunity to lead and make a difference for children, families and society. These beliefs were evident among responses prior to the students' experience of practicum in child care, but increased in number following this experience. The students in the study cohort were taught, on campus, by highly experienced childcare leaders. Their input may account for increased understanding of the potential of quality child care to support children's learning and explain differences between our data and that at entry to first year (Ailwood and Boyd, 2007). Alongside this, those who had a positive practical experience of child care during their practicum placement were more likely to consider entering the childcare workforce. This finding accords with the previous report of Vajda (2005). There is indication in our data that, in preparing degree-level early childhood specialists, a positive practicum experience and exposure to explicit teaching and professional leadership in child care are influential. Such strategies warrant further specific study and documentation.

Our study presents the first account of the views of a cohort of students preparing to enter the early childhood workforce. We have examined the barriers and incentives to participate in the childcare sector within this single year cohort. Our study was limited by the relatively small sample size and cross-sectional design. There is a need to increase the body of evidence with larger sample sizes, perhaps sampled from a range of training institutions. Longitudinal tracking of students as they progress through their course and the influence of direct teaching, exposure to leadership models and practicum, needs explicit study. The cohort on whom this study reports were captured at a time of great change in early childhood education and care in Australia. At the commencement of their degree the students participating in this study were in a context, particularly in the State of Queensland, in which a single, profit-driven, corporate childcare provider monopolised the childcare sector. As they leave to enter the workforce the early childhood education and care landscape is changing. The significance of the experiences of birth to three-year-olds, supported by strong evidence from developmental science, is now receiving the acknowledgement for which early childhood professionals have long argued. That half the pre-service early childhood teachers would consider work in the childcare sector is a positive starting point. The challenge is to make it a preferred career option among graduating degree-level early education specialists.

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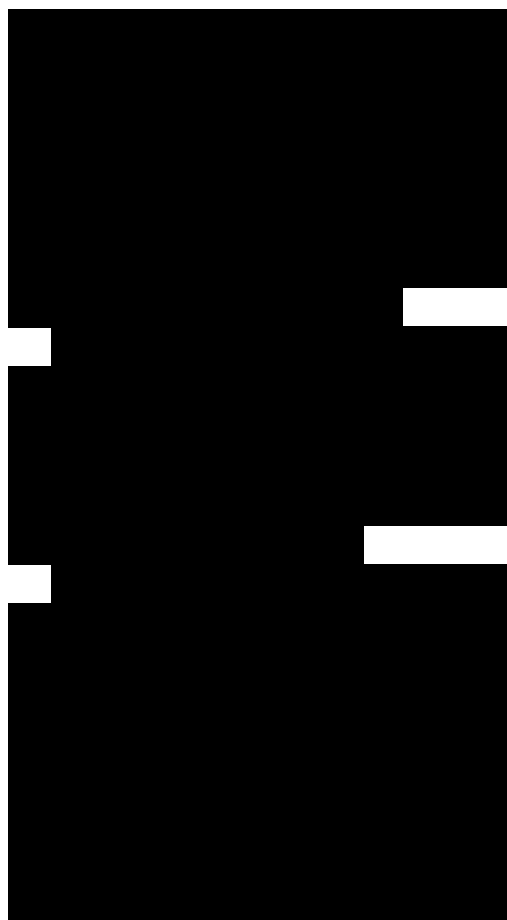
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The Economics of Inequality

The Value of Early Childhood Education

BY JAMES J. HECKMAN

From American Educator



James J. Heckman is the Henry Schultz Distinguished Service Professor of Economics at the University of Chicago, a Nobel Memorial Prize winner in economics, and an expert in the economics of human development. This article is based on "Schools, Skills, and Synapses," which Heckman wrote for the July 2008 issue of Economic Inquiry, available at <http://ftp.iza.org/dp3515.pdf>. Condensed, with permission, from the Spring 2011 issue of American Educator, the quarterly journal of the American Federation of Teachers, AFL-CIO.

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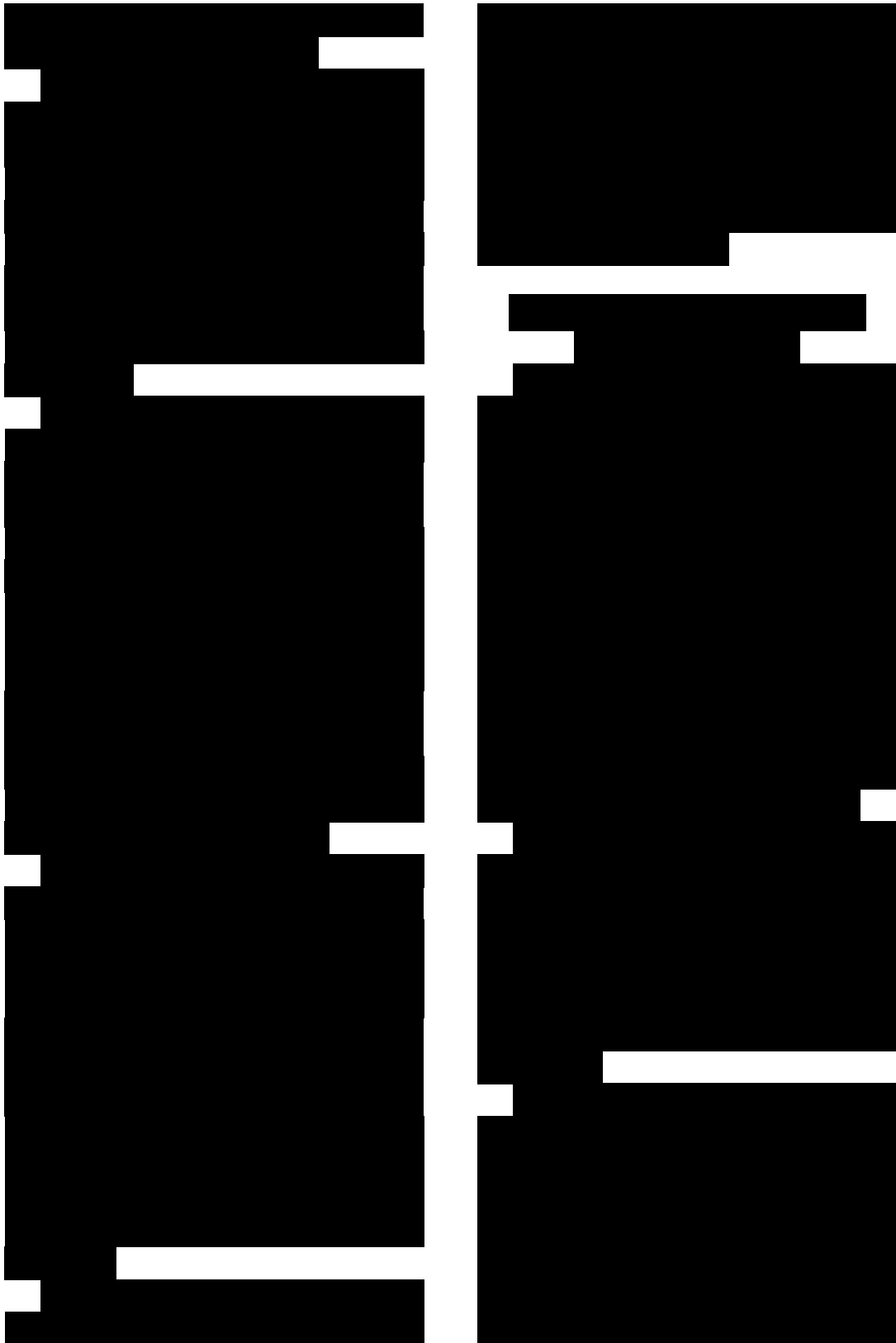
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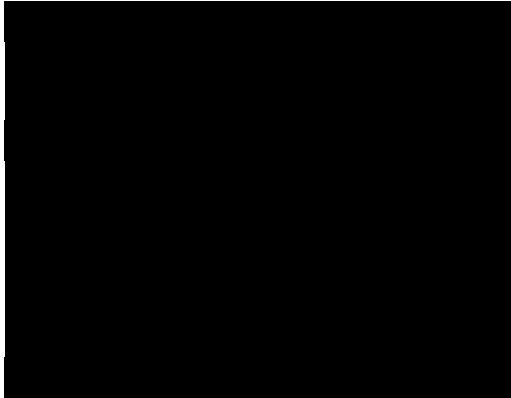
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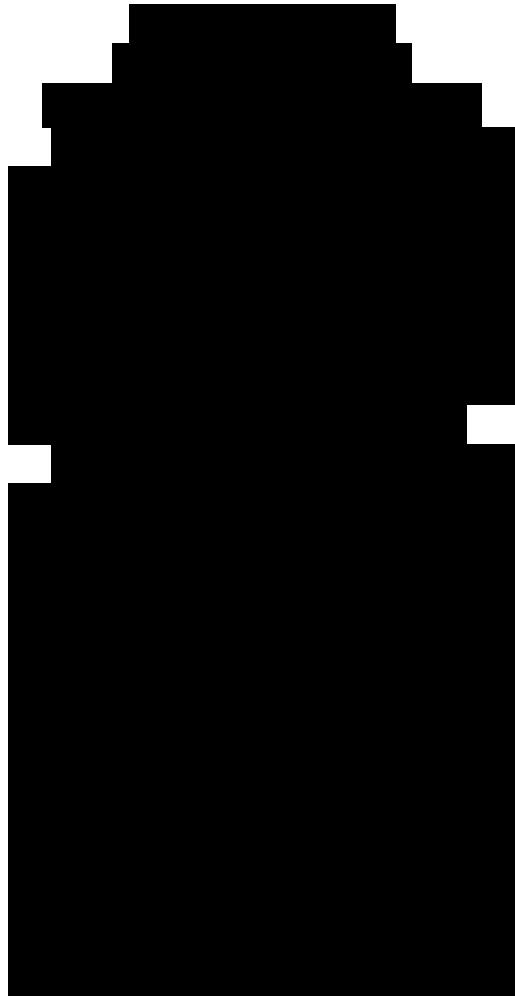
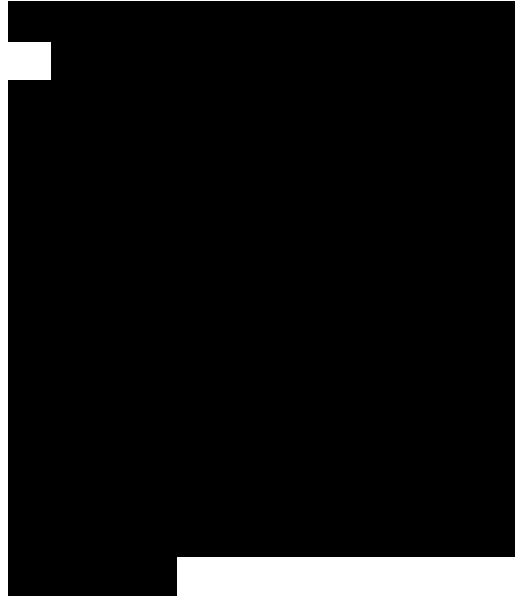
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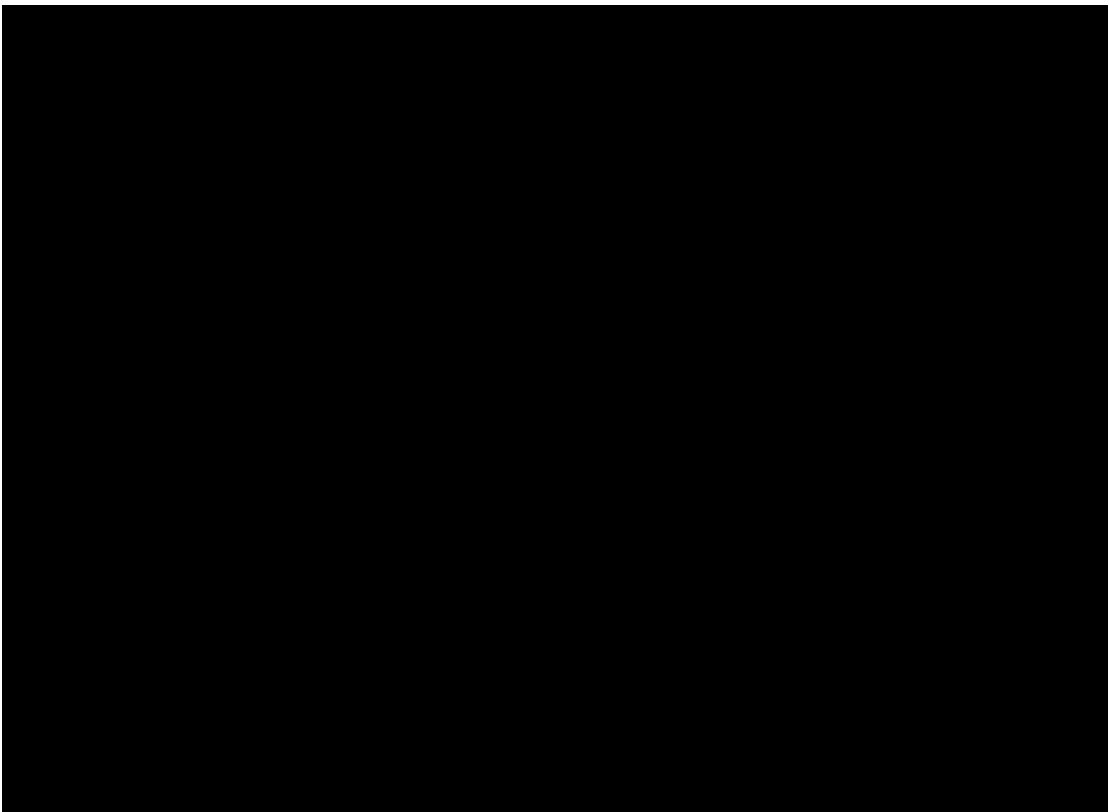
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The Economics of Inequality



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Early Bird Catches the Worm: The Causal Impact of
Pre-school Participation and Teacher Qualifications
on Year 3 National NAPLAN Cognitive Tests

Diana Warren and John P. Haisken-DeNew



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Abstract

Using data from the Longitudinal Survey of Australian Children (LSAC), this is the first analysis for Australia to evaluate the impact of attendance at pre-school programs on matched Year 3 nation-wide NAPLAN test outcomes in the domains of Numeracy, Reading, Spelling, Writing and Grammar. We additionally disaggregate the impact of specific teacher qualifications on children's cognitive outcomes. While one year of learning in Year 3 is represented by about 50 NAPLAN points, we find average pre-school domain effects as much as 10-15 points, mainly driven by the upper quantiles of the NAPLAN distribution. To address causality issues, we use Kernel matching, whereby the ATTs and ATUs are of the magnitude 10 to 20 NAPLAN points, which are reduced only modestly to about 15 points with additional controls for observed ability. NAPLAN score impacts on Numeracy, Reading and Spelling domains are the strongest and significant with the highest increases in NAPLAN scores being attained by children whose pre-school teachers had Diploma or Degree level (high) qualifications, identifying for the first time the crucial nature of teacher qualifications in driving nationally representative long-run pre-school treatment outcomes.

JEL classification: I21, I28, J24

Keywords: ATT, causal impact, pre-school, NAPLAN, specialised qualification

1. Introduction

Recent Australian statistics on voluntary pre-school take-up rates indicate that approximately 90% of pre-school aged children attend a pre-school or kindergarten program in one form or another, before formally entering into primary school.¹ Pre-school attendance may also facilitate cognitive development important for later life for the children involved, and may also allow mothers or other carers of young children to work more flexibly to combine work and family. Not only does pre-school attendance potentially facilitate cognitive development important for later life, but also these centres allow mothers (or other carers of young children) to work more flexibly to combine work and family. (Heckman et al., 2006)

Funding of pre-school programs in Australia is mixed, with some being private and some funded by the state and Federal governments. In the 2010-11 financial year, total state and federal government expenditure on pre-school and child care services was \$5.4 billion (AUD), with federal government expenditure accounting for 80% of total government expenditure. The provision of pre-school services accounted for 86% of total state and territory government expenditure across all children's services models, with Victoria and NSW spending \$221 million and \$168 million respectively in 2010-11. Given the substantial cost of public pre-school programs, it is of particular policy interest to examine the longer-run impacts of these programs with respect to later educational outcomes on the children attending pre-school, and to be able to determine whether these impacts can be classified as causal or simply associational.

While it is clear that the decision to enroll children in a pre-school is a non-random process, it is of great policy interest to identify any potential causal impact of this pre-schooling on children's later outcomes, however measured. As pre-school participation is voluntary, nonattendance may be a result of family circumstances that are negatively associated with development. For example, poor physical or mental health of the child's mother or main carer may prevent a child from attending pre-school. Furthermore, parents of children who are developmentally challenged at that point in development, may simply keep their children at home to allow them to "catch up", or even fear that their children may be simply overwhelmed in a more public environment such as a pre-school centre. On the other hand, centres with good reputations may be sought after by parents with challenged children, especially for the intensive treatment that they may potentially receive there. Thus non-participation might easily be associated with children's developmental issues which might persist several years into the future, confounding impact measurement. As the direction of selection is not clear *a priori*, it is all the more important to deal directly with the issue in the analysis.

¹ In some states these programs are referred to as kindergarten, in others they are called pre-school. Throughout this paper "pre-school" refers to any early childhood education program attended in the year prior to starting formal schooling.

This study uses data from the Longitudinal Study of Australian Children (LSAC), which identifies pre-school usage, and for the first time in 2012, is linked to 5 cognitive test outcomes from the National Assessment Program – Literacy and Numeracy (NAPLAN) test in the children's Year 3. Because the NAPLAN test is intended to be longitudinally and cross-sectionally comparable, approximately 50 points on the NAPLAN test represents one year of learning at Year 3 level. As there is not a purely random assignment process involved in pre-school enrolment, we use quasi-experimental methods of kernel matching to assess the extent to which the pre-schooling experience has impacted on the domain outcomes of Reading, Writing, Grammar and Punctuation, Spelling and Numeracy. We find evidence for: (a) significant average effects, (b) at various points in the distribution and (c) effects depending on the specific qualification of the pre-school teachers. Even some three years after the pre-schooling, we find lasting average domain effects in the order of 10-15 points, mainly driven by the upper end of the NAPLAN distribution. Using Kernel matching, the average treatment effects on the treated (ATTs) are of the magnitude 10 to 20 NAPLAN points, which are reduced only modestly to a maximum of about 15 points with additional explicit controls for ability. The highest increases in NAPLAN scores are attained by children whose pre-school teachers had Diploma level (high) qualifications. This is the first study of its kind for Australia and demonstrates the substantial positive impacts of pre-school on later schooling attainment and also the importance of qualified teaching personnel in the pre-school sector.

Section 2 gives a brief overview of the existing literature on evidence-based impacts of pre-school on children's later educational outcomes. Section 3 describes data from the Australian children's panel LSAC. Section 4 outlines the econometric analysis and discusses the results. Section 5 concludes.

2. Background

Many studies have shown that there are significant benefits for children who attend high quality pre-school programs, including better intellectual development and higher levels of concentration, sociability and independence. Some of the best known evidence of the benefits of high quality early education experiences on later development comes from targeted early intervention programs undertaken in the United States. These programs, which are intended for disadvantaged children, particularly those from single-parent or low-income families, include: (a) the HighScope Perry Pre-school Program, (b) the Abecedarian Project, (c) the Chicago Child Parent Centres and (d) the Head Start Program. This section will outline the previous American evidence for the effectiveness of programs targeted to the disadvantaged, the European and American more general large-scale program evidence and the Australian evidence. As there are likely to be large amounts of heterogeneity between pre-school institutions and even within the centres themselves, we address the issue of the role of pre-school teacher qualifications. Finally, crucial to this analysis is the issue of

selection bias and the need for quasi-experimental methods in the absence of the non-random assignment.

2.1 The Benefits of Targeted Intervention Programs in the USA

The HighScope Perry Pre-school Program originally involved 123 children from low-income households who were assessed to be at high risk of school failure. The children were randomly assigned either to a no-program control group or to a high-quality pre-school program which involved a weekday morning pre-school routine combined with weekly home visits by program staff. The teacher-child ratio in the intervention program classrooms was one adult for every five or six children; the teachers were professionally trained and qualified in early childhood education, and the program extended over two calendar years. The classrooms were arranged to support children's self-initiated learning activities as well as small-group and large-group activities, engaging children in experiences covering the areas of personal initiative, social relations, creative representation, movement and music, logic and mathematics, and language and literacy (Schweinhart et al., 2005). Children who participated in the Perry Pre-school Program were found to be better prepared for school and significantly outperformed the no-program group on various intellectual and language tests from their pre-school years up to age 7, on school achievement tests at ages 9, 10, and 14, and on literacy tests at ages 19 and 27 (Schweinhart et al., 2005). The long-term benefits of the program include higher levels of income, reduced crime rates and higher levels of family stability. At the ages of 27 and 40, the program group were more likely to be employed, had significantly higher median annual earnings, had more stable dwelling arrangements and significantly fewer arrests, than the group who did not participate in the program (Schweinhart et al., 2005).

The Abecedarian Project is another example of an early education intervention program administered to low-income children in the United States, with long-lasting benefits. In this program, 111 infants born between 1972 and 1977 were randomly assigned to either a treatment or control group. All of the children received child care and health services at a center with enriched resources, but the treatment group also received intense intervention, consisting of a pre-school and school-age education program (Campbell and Ramey, 1994). Follow up studies have shown a statistically significant difference in the IQ of children in the treatment group at the end of pre-school and also at the ages of 8 and 12. The children who participated in the intervention program also completed more years of education, and were more likely to attend a four-year college than the children in the control group (Campbell and Ramey, 1995).

Head Start Programs are targeted to local community needs and cater for several hundred thousand children across the United States in any one year (Elliot, 2006). These programs, which have been operating since 1965, typically provide half-day, centre-based early childhood education and care for

children from disadvantaged families in the two years before starting school (Deming, 2009). Program participants may also receive related health, parenting and other child and family support services. Several evaluations of Head Start programs, for example Zigler and Styfco (1993) and Barnett (1995), have found short-term improvements in cognitive development and early academic performance among children who attended Head Start. A more recent study by Deming (2009) examines the short and long-term effects of Head Start by comparing Head Start participants with their siblings who did not participate in the program. He finds that participation in Head Start generates significant short-term increases in test scores, as well as reductions in grade repetition and learning disability diagnosis, particularly for the most disadvantaged male children in the sample. In the long-term, male Head Start participants were eleven percentage points less likely to be out of the labour force and female Head Start participants were over thirteen percentage points more likely than their siblings to attend and complete at least one year of college.

The Chicago Child Parent Centres (CPC) program is a public kindergarten program aimed at children who are at risk of academic underachievement due to poverty and associated factors. This program, which has been running in Chicago Public schools since 1967, consists of a part-day pre-school program for children aged 3 and 4, and a follow on program in the early elementary school years. The pre-school program, which is run by teachers with college degrees and early childhood certification, emphasises basic skills in language and mathematics through relatively structured but diverse learning experiences that include whole-class instruction, small group activities and individualised activities (Reynolds et al., 2011). The follow-up program provides reduced class sizes and encourages parental involvement during the first three years of school. In a study of CPC participants born in 1979 and 1980, Reynolds et al. (2011) find that at age 28, the group who participated in the CPC program had significantly higher levels of educational attainment, which translated to higher economic status, including higher levels of annual income and occupational prestige; as well as a higher rate of health insurance coverage, significantly lower rates of drug and alcohol abuse and lower rates of crime relative to the comparison group who did not participate in the CPC program but attended a school based kindergarten.

2.2 The Effects of Typical Large-scale Pre-school Programs

While there is clear evidence of the benefits of high quality pre-school programs that are targeted to children from disadvantaged backgrounds, much less is known about the impact of typical large-scale pre-school programs. In a review of the long-term academic impacts of both model and large-scale public pre-school programs, Barnett (1998) found that public programs often had weaker effects than the generally higher quality targeted programs. One possible explanation for this difference is that targeted intervention programs are often more intensive than universal access programs, and are

usually targeted at sub-populations whose responsiveness to these programs may be higher than that of the population as a whole (Dumas and Lefranc, 2010).

Most studies of pre-school participation find a significant benefit for cognitive outcomes in the short-term. However, evidence about the long-term cognitive and social benefits of pre-school programs is mixed. Some studies, such as those of Sylva et al. (2008) and Berlinski, Galiani and Manacorda (2008) have concluded that pre-school attendance has long-term academic and social benefits for all children. Others, including Magnuson, Ruhm and Waldfogel (2007a and 2007b), have found that the academic benefits of pre-school attendance tend to fade over time, and that pre-school attendance may be associated with poorer behavioural outcomes in the long-term.

Based on evidence from the Effective Pre-school and Primary Education (EPPE) project, which involved approximately 3000 children in various types of early childhood education and care settings in the United Kingdom in 1987, Sylva et al. (2008) find that pre-school experience, compared to none, enhances all-round development in children. Attendance at a high quality pre-school (measured by the qualifications of staff, the proportion of trained teachers on staff and the quality of the interactions between staff and children) was found to be related to better reading, mathematics and behavioural outcomes, which persisted until at least age 11. In a study of the effect of pre-primary education on children's subsequent school outcomes in Uruguay, Berlinski, Galiani and Manacorda (2008) find a significant positive effect of pre-school attendance on completed years of primary and secondary education, with children who attended pre-school 27 percentage points more likely to be in school at the age of 15 compared to those who did not attend pre-school. Positive long-term effects of pre-school attendance have also been found for children in Argentina, with children who attended pre-primary education achieving higher test scores in Spanish and Mathematics and also better behavioural outcomes in terms of attention, effort, class participation, and discipline in the third grade (Berlinski, Galiani and Gertler, 2009).

Using data from the Early Childhood Longitudinal Study - Kindergarten Class of 1998-99 (ECLS-K), a large nationally representative sample of children who entered kindergarten the United States in 1998, Magnuson, Ruhm and Waldfogel (2007a) find that attendance at a pre-school program increases reading and numeracy skills at the time of school entry, but also increases behavioural problems. Furthermore, while the advantages in terms of academic skills had largely dissipated by the first grade, the behavioural problems persisted. Similarly, Osborn and Milbank (1987) assess the effects on cognitive and behavioural development at age 5 and 10 of several different types of pre-school programs in Great Britain in the 1970's and find that that pre-school attendance generally boosts cognitive attainment at ages 5 and 10, but behavioural problems at age 10 were more common among children who had attended pre-school. Goodman and Sianesi (2005) also find positive effects from early education among a cohort of British children born in 1958. Attendance at an early education

setting before entering school was found to lead to higher average test scores at age 7, which though diminished in size, remained significant up to age 16. However, parental reports of the incidence of poor social skills, particularly those related to aspects of self-control, were higher at age 7 and age 11 among children who had attended pre-school.

Several studies of universal pre-school programs have found that the benefits of pre-school attendance are most significant for children from disadvantaged backgrounds, with pre-school participation compensating to some extent for a less intellectually stimulating home environment. For example, using data from the United States ECLS-K, Magnuson, Ruhm and Waldfogel (2007a) find that the largest and most persistent academic gains from having attended pre-school were found for disadvantaged children. Also in the United States, Fitzpatrick (2008) finds that the introduction of universal pre-kindergarten in the state of Georgia led to lasting benefits on the academic achievement of children, particularly those from disadvantaged backgrounds. Based on evidence from the EPPE Project in the United Kingdom, Sylva et al. (2008) find that high quality pre-school was particularly beneficial in promoting better mathematics outcomes at age 11 for the most disadvantaged pupils and for children whose parents had not completed any post-school qualifications.

Using data from the German-Socio-Economic Panel (GSOEP), Spiess, Büchel and Wagner (2003) examine the relationship between kindergarten attendance and the 7th grade school placement of children in West Germany. The 7th grade is of particular interest, as regardless of German federal state, the children have at this point been streamed into one of the three academic levels of high school. They find that for children in immigrant households, being selected into the more academically demanding schools is significantly associated with kindergarten attendance prior to school enrollment, but this is not the case for children of German citizens. A study of a large-scale expansion of pre-school enrolment in France in the 1960's and 1970's (Dumas and Lefranc, 2010) finds a sizeable and persistent effect of pre-school attendance on subsequent schooling outcomes, particularly among children from worse off social groups.

2.3 Australian Evidence of the Effects of Pre-school Participation

Australian researchers have, at least prior to the availability of the Longitudinal Study of Australian Children (LSAC) data, not had access to rich longitudinal datasets with which to study the effects of pre-school participation on the subsequent educational outcomes of Australian children. As a result, relatively little is known about how pre-school participation affects children's outcomes later in life. Nevertheless, there is a small research literature of relevance identifying positive effects of early childhood education and care programs on short-term educational outcomes for Australian children.

Raban (2000) provides evidence of the success of the Pre-school Literacy Project (PLP), which was run in 40 pre-schools across Victoria between 1996 and 1999. This project involved encouraging pre-school teachers to introduce literacy into their programs through various means including introducing literacy materials into the “home corner”; placing a writing table in the room along with appropriate resources; introducing a post box for letter exchanges; and bringing the print around their room down to the children’s eye level. After one year of primary school, students who had attended a PLP pre-school had significantly higher scores on reading and writing tests as well as higher level oral language skills and more sophisticated phonological awareness than those students who did not attend a PLP pre-school. Furthermore, while the non-PLP students appeared to catch up with the PLP students after one year in school, during the second year in school, the PLP students maintained their advantage in reading and oral language proficiency.

Using data from the Child Care Choices Longitudinal Extension study, a study of the child care and early school experiences of children in urban and rural New South Wales from 2002 to 2008, Bowes et al. (2009) found that hours of care, multiple and changeable care arrangements and the quality of the carer-child relationship were important predictors of children’s achievement. Longer hours in early formal child care were found to be associated with poorer academic achievement, while longer hours of early informal care had a positive effect on social behaviour.

Boardman (2005) examined effect of full-day and half-day kindergarten programs on the literacy and numeracy outcomes of Tasmanian children who began their preparatory year of school in January 2004. In a comparison of Performance Indicators of Primary Schools (PIPS) test scores of 884 students across 38 schools, the results indicated that reading, numeracy and overall test scores were significantly higher among children who had attended full-day sessions of kindergarten the previous year.

Australian studies using the LSAC data have also shown evidence of the benefits of early childhood education and care programs for children in Australia. For example, Harrison et al., (2009) found that, children who were attending an early childhood or pre-school program at the age of 4 or 5 were more competent in their language ability than those who were not attending an early childhood program. However, vocabulary scores were negatively associated with longer weekly hours of attendance at child care or pre-school, particularly among children who were in care for more than 30 hours per week. Also using the LSAC data, Claessens (2009) examines the association between general cognitive ability and socio-emotional skills at the age of four or five and academic achievement four years later and finds that cognitive ability at the age of 4 or 5 is an important predictor of achievement in middle childhood. Quite differently, Leigh and Yamauchi (2009) use the LSAC data to examine the impact of non-parental care on children’s behavioural outcomes at the ages of 2 and 3 and find only small differences in the temperament of children who attended non-parental care and those who did

not. The negative association between behaviour and non-parental care was weaker in child care centres with smaller groups of children.

2.4 Teacher Qualifications

While most of the available evidence is in favour of pre-school teachers having some type of teaching or child care qualification, the debate about the most appropriate and effective type of qualification for pre-school teachers has not yet been definitively resolved. Several studies have demonstrated that specialized training in early childhood education and care is related to the quality of pre-school teachers' interactions with children. For example, children who are educated by teachers with both a Bachelor degree and specialized training in child development and early education have been found to be more sociable, exhibit a more developed use of language, and perform at a higher level on cognitive tasks than children who are cared for by less-qualified adults (Howes, 1997; Whitebook and Ryan, 2011). Child care staff with higher levels of education have been shown to engage in warmer interactions with children; and are likely to be less authoritarian and more able to demonstrate positive interaction styles (Abbott and Langston, 2005; Burchinal et al., 2005). This research, along with evidence about the long-term benefits of high quality targeted pre-school programs, has led to increased calls for pre-school teachers to have at least a Bachelor degree, preferably with a specialization in early childhood education (Barnett, 2003; Whitebook, 2003; Early et al., 2007).

However, recent studies of the relationship between pre-school teacher qualifications and children's cognitive outcomes have found contradictory results, and there is no conclusive evidence that a teacher with a Bachelor degree, or any other specific level of education, will ensure a high-quality pre-school classroom or better cognitive outcomes (Tout, Zaslow, and Berry, 2005; Early et al., 2006). In a study of 878 children attending state funded pre-kindergarten programs in the United States in 2002, Early et al. (2006) find that teachers' education level is linked to gains in children's numeracy skills, but not literacy or basic skills, across the pre-kindergarten year. They conclude that the National focus on literacy may result in pre-school teacher preparation programs at all levels concentrating on preparing teachers to work on language and pre-literacy skills, making teacher qualifications unimportant in predicting children's gains in literacy. Using seven major studies of classroom based educational programs for 4-year-olds in the United States, Early et al. (2007) find no convincing evidence of an association between pre-school teachers' education or major and children's academic gains.²

² Two of the studies indicated that quality was higher when the teacher had a Bachelor degree; one study indicated that quality was lower when the teacher had a Bachelor degree, and four studies found no association.

Early et al. (2007) conclude that policies focused solely on teachers' education will not suffice for improving classroom quality or maximising children's academic gains; but caution that these findings do not indicate that teacher's qualification levels are unimportant, and provide several explanations for the lack of association. First, many teachers completed their university training at a time when numeracy and pre-reading skills were deemphasized for young children. Second, the importance of the teacher-child relationship has possibly been underemphasized in early childhood teacher preparation programs, resulting in some degree qualified teachers with substantial content knowledge around academic instruction lacking the necessary skills for forming individual teacher-child relationships that can serve as the base for academic learning. Third, teachers may not receive sufficient on-the job support and may feel pressure to abandon what they were taught in their teacher education programs and adhere to the school's standards and teaching strategies. Finally, the lack of association between teacher qualification and children's outcomes may be a result of market forces. The higher wages and benefits provided in publicly funded programs, as compared with community-based child care, may attract and retain the best teachers without a Bachelor degree to the public system; while the lower wages provided in pre-kindergartens compared to elementary schools may lead high quality degree qualified teachers to teach older children (Early et al., 2007).

In Australia, early childhood education programs are often assumed by parents to be homogeneous in nature. However, they differ by community and state in terms of philosophical and educational approaches, the number of hours available, the location in which programs are provided, and the age at which children can enroll (Elliott, 2006). Pre-schools and kindergartens are operated by a variety of providers including schools, not-for-profit community groups and profit-making businesses; and may be stand-alone services, attached to schools or provided in child care centres. Because of these differences, pre-school children are likely to have widely varying experiences, with heterogeneous effects on learning and developmental outcomes.

In 2004, there were no nationally agreed or consistent standards for staffing across the child care and pre-school sector. The type and level of qualification of the teacher or carer was linked mainly to the age of the children, the size of the group and the type of setting, with older children typically being cared for by better qualified staff, but only in some settings and some states (Elliott, 2006). Across Federal Government approved pre-school services in 2004, the proportion of staff with relevant child care or teaching qualifications ranged from 69% in the Northern Territory to 46% in Victoria (Brennan, 2008). While long day care centres provide better support for the child care needs of working parents, there is a strong public perception that stand alone pre-schools have higher standards of educational quality than pre-school programs in long day care centres, mainly due to the fact that the legislated quality requirements for stand-alone pre-schools are higher than for long day care, with

no legislative requirement to employ a teacher in long day care in most jurisdictions (Dowling and O'Malley, 2009).³

In recognition of the importance of early childhood education, pre-school education in Australia is currently undergoing significant restructure. In November 2008, the Council of Australian Governments (COAG) endorsed a new National Partnership Agreement on Early Childhood Education. Under this agreement, the Commonwealth, State and Territory governments have committed to ensuring that by 2013, all children in the year before formal schooling will have access to a high quality early childhood education program delivered by a degree qualified early childhood teacher for 15 hours per week, 40 weeks of the year (COAG, 2009). A new National Quality Standard for early childhood education and care providers will also be introduced. By 1 January 2014, an early childhood teacher will need to be in attendance all of the time when long day care and pre-school services are being provided to 25 children or more, and at least some of the time when services are being provided to less than 25 children. Within each long day care centre or pre-school, half of all staff will need to have (or to be actively working towards) a diploma-level early childhood education and care qualification or above, and the remaining staff will all be required to have (or be actively working towards) a Certificate III level early childhood education and care qualification, or equivalent.

To meet this commitment, the Australian Government has announced additional university places in early childhood education courses, the removal of TAFE fees for Diplomas and Advanced Diplomas of Early Childhood Education and Care, and a 50% HECS-HELP remission for early childhood education teachers who are willing to work in rural and regional areas, Indigenous communities and areas of socio-economic disadvantage (Harrington, 2008). The state governments have also introduced scholarship and incentive programs to encourage people to qualify and work in early childhood teaching. For example, the Victorian state Government provides financial support for educators currently working in a Victorian early childhood education and care service who wish to upgrade or attain an approved early childhood qualification; as well as incentives of up to \$12,000 for graduate Early Childhood Teachers and \$6,000 for diploma qualified educators to take up and maintain employment in hard to staff areas.⁴

³ New South Wales is the only state that legally requires all centre-based care to employ a degree trained early childhood teacher once child numbers exceed 29. However, there is anecdotal evidence to suggest that long day care providers in New South Wales enroll 29 children or less precisely to avoid this requirement (Dowling and O'Malley, 2009).

⁴ The amount of the financial incentive offered to upgrade or attain a qualification in early childhood education and care ranges from \$1,000 for Certificate-Level qualifications, to \$3,000 for a Diploma of Early Childhood Education and Care (previously known as Diploma of Children's Services) and \$12,000 for an Early Childhood Teaching Degree. Upon completion of their qualifications, educators who received this support are required to work in a Victorian licensed or approved education and care service for 12 months (Certificate Level), 18 months (Diploma level) or 2 years (Degree level). To qualify for financial incentives, educators taking up employment in hard to staff areas are required to maintain employment in that area for a period of 12 months (Diploma-level qualification) or 2 years (Degree qualified teachers).

2.5 The Critical Issue of Selection Bias

One of the main issues faced by researchers attempting to identify the effects of non-compulsory, large-scale pre-school programs is that of selection bias. Children's pre-school experiences are not randomly determined. Parents who place a high value on their children's education may be more likely to enroll their children in a high quality pre-school program. Therefore, better educational outcomes are not likely to be due entirely to the pre-school program, but also to greater parental support. Children who attend high quality pre-school programs may also be more advantaged in terms of household income and parental education. This advantage may translate into superior levels of achievement and, if not adequately controlled for, may result in upwardly biased estimates of the effects of pre-school on later academic outcomes (Speiss et al., 2003; Berlinski et al., 2008; Magnuson et al., 2007a).

The simplest approach to addressing the selection issue is to include a rich set of control variables to account for potential confounding factors (see for example, Speiss et al., 2003 and Magnuson, Ruhm and Waldfogel, 2007b). However, despite the inclusion of such "observed" controls, there may be other "unobserved" characteristics which could result in an upward bias of the estimates of pre-school effects. Other strategies that have been used to overcome the problem of selection bias include the instrumental variables approach and propensity score matching. Examples of studies which have used an instrumental variables approach include those of Magnuson Ruhm and Waldfogel (2007a), who use state pre-school expenditure per child as their instrumental variable; Dumas and LeFranc (2010), who instrument pre-school attendance by the average age of pre-school entry by region and cohort; and Berlinski, Galliani and Manacorda (2008) who use average pre-school enrollment by locality and cohort as an instrument for treatment.⁵ Studies which have used propensity score matching to test for bias in their OLS estimates of the effects of pre-school participation on subsequent educational outcomes include those of Magnuson, Ruhm and Waldfogel (2007a), Loeb et al. (2007) and Goodman and Sianesi (2005).⁶

⁵ Of these three studies, only Dumas and LeFranc (2010) found that the instrumental variable estimates of the effect of pre-school participation, while positive and significantly significant, were smaller than those obtained in the OLS specification.

⁶ All three studies found that the predicted outcomes resulting from propensity score matching were quite similar to their OLS results and concluded that the OLS results were not upwardly biased as a result of using an inappropriate control group.

3. Data

Data used for this analysis is drawn from Waves 1 and 3 of Longitudinal Study of Australian Children⁷ (LSAC) survey, conducted in 2004 and 2008 respectively. LSAC gathers comprehensive, national Australian data on important aspects of a child's life, including their experiences within their families and communities; child care experiences and experiences in early education. The LSAC data also provide substantial information about various aspects of children's development, including physical and mental health; motor skills; social, cognitive and emotional development; and language, literacy, and numeracy. The first wave of LSAC interviews were conducted between March 2004 and January 2005. Families were subsequently interviewed every two years, and between-waves mail-out questionnaires were sent to families in 2005, 2007 and 2009. Information is collected for two cohorts of approximately 5000 children who were aged 0-1 (B Cohort) and 4-5 (K cohort) in 2004. We use the older sample of children, aged 4-5 in 2004. The age of the children at the time of interview ranges from 4 years and 3 months to 5 years and 8 months. In total, observations for 4983 children are available in wave 1. However, since the focus of this research is pre-school attendance and its effects on later cognitive outcomes, our sample is restricted to the 4157 children who had not yet begun formal schooling in 2004. See Gray and Smart (2009), Commonwealth of Australia (2012), and Hahn and Haisken-DeNew (2013) for further technical details on the LSAC data.

Cognitive outcomes are measured using National Assessment Program—Literacy and Numeracy (NAPLAN) Scores. In Wave 3 of LSAC, 81% of parents of kindergarten cohort children gave consent for their child's data to be linked with NAPLAN data for the duration of the study. Of the 4157 observations of children who were aged 4 or 5 and not yet in a pre-year 1 program in 2004, 3638 families (87.5%) were interviewed in 2008. Of the 3638 children, consent to match NAPLAN scores to the LSAC data was obtained from 2977 (81.8%) of parents, and 2696 children had valid NAPLAN information for all five domains. Of those 2696 children, 2229 were re-identified in year 3 in 2008.

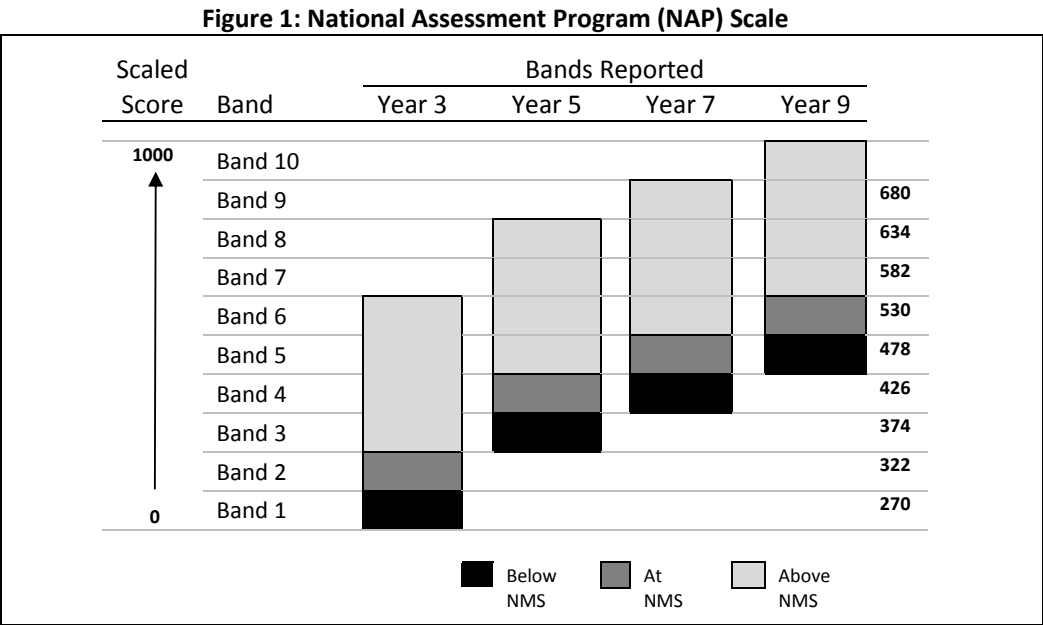
3.1 NAPLAN Scores

In May 2008, the National Assessment Program - Literacy and Numeracy (NAPLAN) commenced in Australian schools. Every year, students in Years 3, 5, 7 and 9 in government and non-government schools are assessed using common national tests in of Numeracy, Reading, Writing and Language Conventions (Spelling, Grammar and Punctuation). The NAPLAN tests broadly reflect aspects of literacy and numeracy common to the curriculum in each state or territory, with test formats and questions chosen so that they are familiar to teachers and students across Australia (ACARA, 2011). The tests are taken over a period of three days, with writing and language conventions tests taken on

⁷ See Hahn and Haisken-DeNew (2013) for information on how to extract data from the LSAC using PanelWhiz, a user-written Stata add-on.

the same day. At the Year 3 level, the Numeracy and Reading tests are 45 minutes in duration and the writing and language conventions tests each take 40 minutes. Tests for Numeracy, Reading and Language Conventions consist of multiple-choice questions and constructed response items. The NAPLAN Writing task requires students to write a response to a stimulus or prompt.⁸

The skills assessed in the four NAPLAN tests are mapped onto national achievement scales that span Years 3, 5, 7 and 9, with scores that range from 0 to 1000 (ACARA, 2008). The results of the Language Conventions test are divided into two separate scores — one for Spelling and one for Grammar and Punctuation. The scale for each domain is divided into ten bands to cover the full range of student achievement from Year 3 through to Year 9. In 2008, each of the scales was standardized independently to have a mean of 500 and a standard deviation of 100 (VCAA, 2010). At each year level, only six of the ten bands are used for reporting student achievement. The Year 3 report shows Bands 1 to 6, the Year 5 report shows Bands 3 to 8, the Year 7 report shows Bands 4 to 9, and the Year 9 report shows Bands 5 to 10. The National Minimum Standard (NMS) is defined for each domain as the second lowest National Assessment Program (NAP) band reported for a year level, as shown in Figure 1.



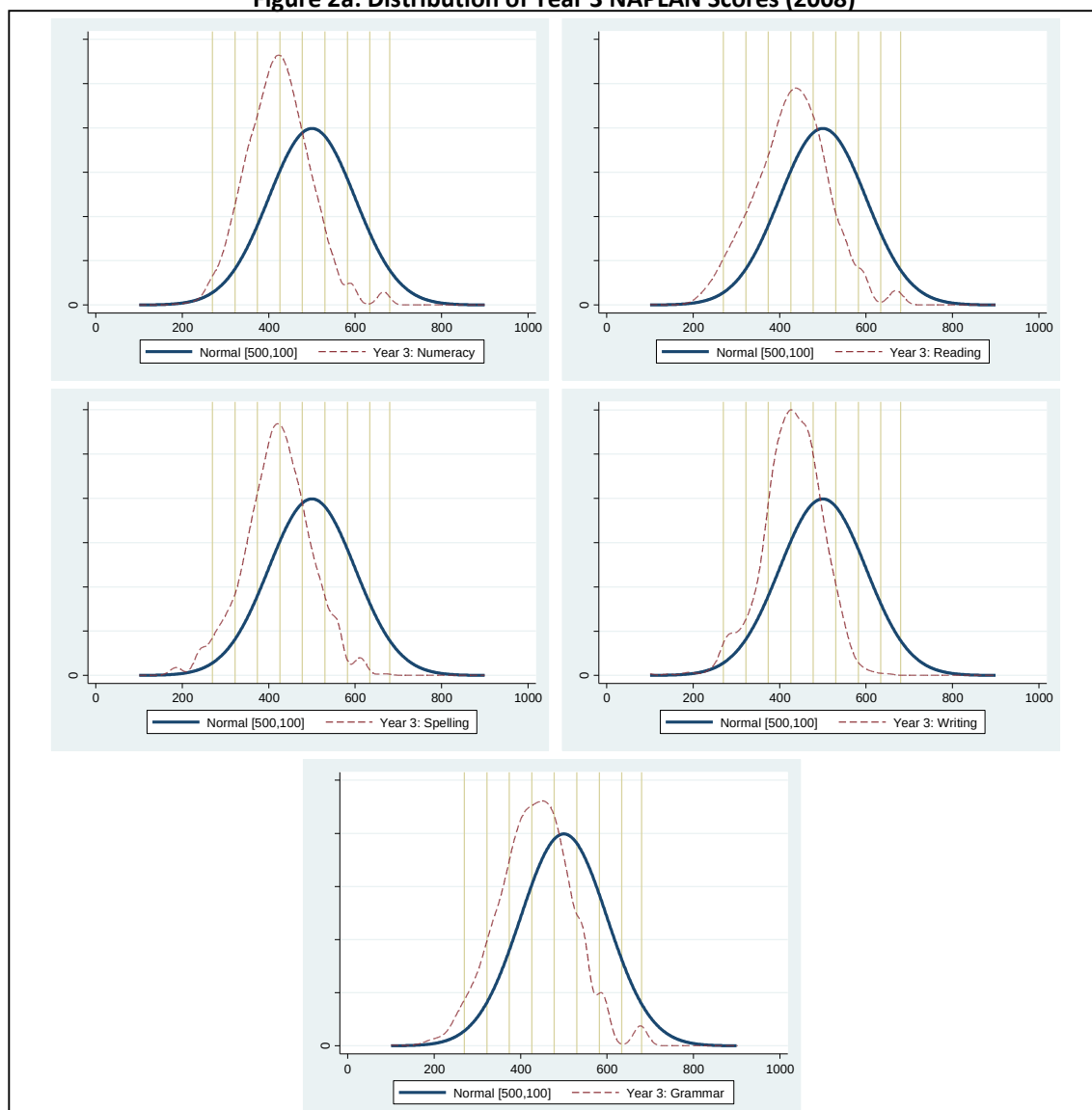
Source: VCAA (2010)

⁸ Optical mark recognition is used to score multiple choice items and optical character recognition and professional officers are used to score constructed response items. Writing is marked by professional officers, with ongoing monitoring of marking consistency across all marking centres (ACARA, 2008). Between 2008 and 2010, the writing task was a narrative assessed against 10 criteria: Audience, Text Structure, Ideas, Character and Setting, Vocabulary, Cohesion, Paragraphing, Sentence Structure, Punctuation and Spelling. From 2011, the NAPLAN Writing task has required students to respond to a stimulus with a piece of persuasive writing.

For Year 3 students, a scaled score in Band 1 (lower than a NAPLAN score of 270) is considered to be below the NMS, a score in Band 2 is at the NMS and scores in Bands 3 to 6 are above the NMS. Students at the NMS have typically demonstrated the basic elements of literacy and numeracy to participate at their year level, while those who do not achieve the National Minimum Standard may need intervention and support to help them achieve the literacy and numeracy skills they require to progress satisfactorily through their schooling (ACARA, 2008).

In Figure 2, the distribution of Year 3 2008 scores are plotted against a normal distribution with a mean of 500 – which is what the standardized scores for Years 3 to 9 should look like. The vertical lines in Figure 2 represent the pre-defined cut-points for the 10 NAP Bands. Of course, the Year 3 distributions are to the left of the distribution for all year levels.

Figure 2a: Distribution of Year 3 NAPLAN Scores (2008)



Average NAPLAN scores and the proportion of scores within each NAP band are shown in Table 1, according to whether the child had attended a pre-school or kindergarten in the year prior to their first year of school.⁹

Table 1: NAPLAN Scores, by Pre-school Attendance, Mean and proportion in each NAP band

		NAPLAN Band						Mean	
		Below	AT	Above					
		NMS	NMS	NMS					
		1	2	3	4	5	6	Total	
Numeracy									
Pre-school		1.64	5.53	18.67	26.86	25.52	21.78	100.0	422.79
No Pre-school		*4.26	*7.52	28.97	23.24	25.66	10.36	100.0	396.35
Total		1.89	7.60	27.25	23.77	25.54	20.70	100.0	420.27
Reading									
Pre-school		3.26	9.04	13.55	19.76	28.58	25.82	100.0	427.55
No Pre-school		*5.20	13.08	22.40	20.84	21.84	16.64	100.0	398.39
Total		3.45	9.42	14.38	19.86	27.94	24.95	100.0	424.79
Spelling									
Pre-school		2.65	7.88	13.61	26.90	27.02	21.94	100.0	422.46
No Pre-school		*4.22	13.58	23.88	26.60	15.66	16.04	100.0	397.64
Total		2.80	8.42	14.58	26.87	25.94	21.38	100.0	420.10
Writing									
Pre-school		2.20	4.05	13.44	26.22	27.74	26.35	100.0	429.84
No Pre-school		*3.22	*6.82	19.00	30.55	21.71	18.72	100.0	408.28
Total		2.30	4.31	13.97	26.63	27.17	25.63	100.0	427.81
Grammar and Punctuation									
Pre-school		2.53	6.06	14.40	25.72	19.21	32.07	100.0	434.00
No Pre-school		*6.14	*7.41	22.18	25.52	17.82	20.93	100.0	404.96
Total		2.88	6.19	15.14	25.70	19.08	31.01	100.0	431.24

Note: Population weighted results. * Cell count < 20.

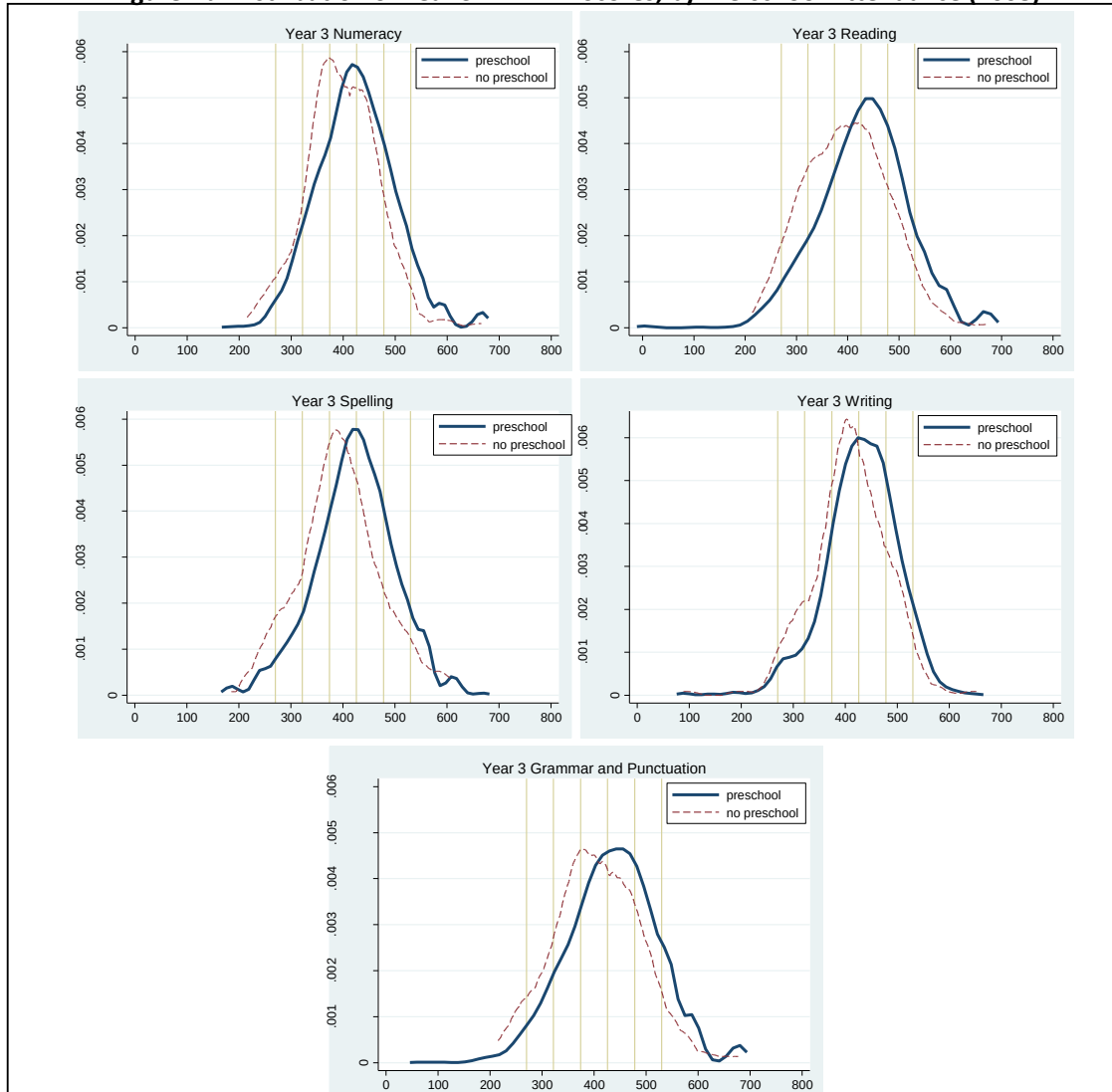
Compared to children who did not attend pre-school in 2004, average NAPLAN scores were 20 to 30 points higher among children who had attended some type of pre-school program.¹⁰ Looking at the distribution of test scores according to NAP band, it is clear that the proportion of children with scores in Band 6 is considerably higher among children who had attended pre-school. For example, only 10% of children who did not attend pre-school had Numeracy scores in Band 6, compared to 22% of children who had participated in a pre-school program.

Kernel density plots of test scores of children who did, and did not, attend a pre-school program are shown in Figure 2b. Across all five domains, the distribution of test scores for children who did not attend pre-school sits to the left of the distribution for children who did attend a pre-school program.

⁹ It should be noted that the sample used in this study is not perfectly representative of the target population. For children who completed their Year 3 NAPLAN tests in 2008, average scores for this sample were approximately 20 points higher than those reported for the Australian population by the Australian Curriculum Assessment and Reporting Authority (2008). This difference could possibly be a result of higher levels of attrition among families of children who achieved lower than average NAPLAN scores, but is more likely to be due to parents of children who received lower NAPLAN scores being more hesitant to agree to their child's NAPLAN Scores being matched with the LSAC data.

¹⁰ For all domains, mean scores for pre-school and no-pre-school are significantly different at the 1% level in a two-tailed test.

Figure 2b: Distribution of Year 3 NAPLAN Scores, by Pre-school Attendance (2008)



The descriptive evidence above indicates that compared to children who did not attend a pre-school program, children who went to pre-school in the year prior to their first formal year of schooling had significantly higher levels of academic achievement, as measured by NAPLAN scores in year 3. However, it is important to note that the simple differences in test scores between children who attended a pre-school program and those who did not should not be regarded as causal, as they may simply reflect other characteristics, such as household income and parental education, which may be correlated with both pre-school attendance and NAPLAN test scores. Sample characteristics indicate that children who did not attend pre-school were less advantaged than those who attended a pre-school program. For example, children who did not attend any type of pre-school program more commonly lived in low income and lone parent households, and children whose parents did not complete high school were less likely to have attended pre-school. To control for these differences in characteristics, multivariate regressions are conducted.

4. Empirical Application

4.1 Descriptive Estimations

Most studies of the effects of pre-school participation report average differences between pre-school and non-pre-school participants, controlling for differences in socio-demographic characteristics. However, the estimated average pre-school effect may not be representative of the effect of pre-school participation at specific parts of the NAPLAN score distribution. For example, it would be useful to know whether the positive association between pre-school attendance and test scores is larger at the lower end of the distribution or at the higher end.

The ordinary least squares (OLS) estimates take the following form:

$$y_i = \beta_1 + \beta_2 \text{PRE}_i + \beta_3 x_i + \varepsilon_i \quad (1)$$

where y_i is the NAPLAN score in Reading, Writing, Spelling, Grammar and punctuation or Numeracy for child i in year 3,

PRE_i is a dummy variable indicating attendance at pre-school in the year prior to formal schooling,

x_i is a vector of explanatory variables, and

ε_i is the error term.

The coefficients in (1) give the average marginal effect of the corresponding variables on test scores other things equal. For example, the regression coefficient, β_2 , estimates the marginal effect of pre-school attendance on NAPLAN test scores in Year 3.

In order to identify differences in the benefits of pre-school attendance at different points on the test score distribution, the method of quantile regression (proposed by Koenker and Bassett, 1978) is used. The quantile regression technique may be viewed as a natural extension of least squares estimation of conditional mean models, to the estimation of a group of models for conditional quantile functions. The conditional quantile is specified as a linear function of covariates. For the θ th quantile, a common way to write the model (Buchinsky, 1998) is

$$y_i = \beta_1 + x_i \beta_\theta + \varepsilon_{\theta i} \quad (2)$$

where y_i is the dependent variable (NAPLAN score)

β_θ is an unknown vector of regression parameters associated with the θ th quantile,

x_i is a vector of independent variables, and $\varepsilon_{\theta i}$ is the error term.

The interpretation of quantile regression estimation results is different to that of OLS as quantile coefficients provide information about effects at a certain point in the outcome distributions, not individuals. For example, a statistically significant pre-school indicator coefficient tells us that at that

particular test score quantile, children who attended pre-school have a higher test score than those who did not attend pre-school, holding all else constant.

As mentioned in Section 2.5, children's pre-school experiences are not randomly determined and one of the main issues faced by researchers attempting to identify the effects of non-compulsory, large-scale pre-school programs is that of selection bias. The instrumental variable method is potentially useful for addressing this issue, provided strong and identifying instruments are available. However, in the data available for this analysis, such instruments do not exist because most measurable factors that affect the probability of attending pre-school can also arguably influence later cognitive outcomes. Therefore, to address the issue of selection bias, we rely on Kernel-based propensity score matching to estimate the Average Effect of Treatment on Treated (ATT). Thus using observed characteristics, we compare those children who had similarly high propensities to attend pre-school and did indeed attend, to those who were otherwise observationally equivalent, but did not attend pre-school. It is assumed by design that the observed characteristics used in the matching process are sufficient to identify the matching process.

The explanatory variables used in the econometric models can be categorised into four groups: (a) characteristics of the child (gender, age, Aboriginal or Torres Strait Islander Status, birth weight and whether the child was in poor health in 2004); (b) characteristics of the household (household size, household income, indicators of the presence of younger or older siblings, whether the child was living in a lone parent household in 2004 and whether a language other than English is spoken in the home); (c) characteristics of the mother (education level, age at the time the child was born and employment status in 2004) and (d) regional characteristics to account for differences in the provision and availability of pre-school programs in different states (state of residence, whether the family was living in a metropolitan area).¹¹

4.2 Empirical Results: Average OLS and Distributional Quantile Effects

The results of the average OLS and quantile estimations of pre-school effects at various cut-points are summarised in Table 2.¹² For each NAPLAN domain, the quantiles estimated are chosen to correspond to the cut-points for NAPLAN bands. Therefore the estimated quantiles vary according to the domain being considered. For example, the estimates in column 2 represent the point at which the National Minimum Standard is attained (the cut point between Band 1 and Band 2). For the domains of Numeracy and Writing, 4% of students had scores at or below this cut point. For the other domains, 5% of students had NAPLAN scores at or below this threshold. Examining Figure 2a shows how the individual NAPLAN score distributions match up to the pre-defined Bands 1 through 10.

¹¹ Appendix Table A1 provides a detailed description of the explanatory variables and sample summary statistics.

¹² Detailed results are provided in Appendix Tables A2 to A6.

After controlling for a rich set of socio-demographic characteristics, a significant positive association between pre-school attendance and Year 3 NAPLAN outcomes remains across all five domains. The magnitude of the “pre-school advantage” ranges from 11 points for Writing to 19 points for Reading. That is, compared to children who did not attend pre-school, the average test scores of children who did attend pre-school were 11 points higher for Writing and 19 points higher for Reading. One way to think about the magnitude of these effects is that the cut point for the National Minimum Standard increases from 270 points (out of a hypothetical score maximum of 1000 points) in Year 3 to 374 points in Year 5. Therefore, the effect of one year of primary school at this level could be considered equivalent to 52 NAPLAN points (374-270=104, divided by 2 years (3 to 5) equals 52 points/year).

Table 2: OLS and Quantile Estimates, Effect of Pre-school Attendance on Year 3 NAPLAN Scores

Numeracy	Average	Lev 1/2 (Q04)	Lev 2/3 (Q10)	Lev 3/4 (Q28)	Lev 4/5 (Q54)	Lev 5/6 (Q79)
	13.647**	6.362	0.231	12.042*	10.621**	20.852***
	(5.591)	(19.014)	(14.407)	(6.223)	(5.320)	(7.718)
R ² / pseudo R ²	0.137	0.086	0.069	0.083	0.074	0.075
Reading	Average	Lev 1/2 (Q05)	Lev 2/3 (Q14)	Lev 3/4 (Q28)	Lev 4/5 (Q49)	Lev 5/6 (Q75)
	18.697***	-0.407	17.761	27.408***	22.957***	16.845***
	(4.536)	(12.139)	(12.037)	(8.526)	(6.571)	(4.786)
R ² / pseudo R ²	0.146	0.102	0.092	0.090	0.077	0.060
Spelling	Average	Lev 1/2 (Q05)	Lev 2/3 (Q13)	Lev 3/4 (Q27)	Lev 4/5 (Q54)	Lev 5/6 (Q80)
	17.316***	22.588	19.426*	18.525***	20.675***	24.063***
	(6.398)	(14.034)	(10.768)	(6.910)	(6.849)	(10.614)
R ² / pseudo R ²	0.110	0.103	0.084	0.067	0.056	0.052
Writing	Average	Lev 1/2 (Q04)	Lev 2/3 (Q08)	Lev 3/4 (Q22)	Lev 4/5 (Q48)	Lev 5/6 (Q75)
	10.868**	10.406	19.773	12.867	11.036**	10.963
	(4.272)	(13.851)	(12.610)	(9.360)	(5.175)	(10.494)
R ² / pseudo R ²	0.110	0.103	0.084	0.067	0.056	0.052
Grammar and Punctuation	Average	Lev 1/2 (Q05)	Lev 2/3 (Q11)	Lev 3/4 (Q28)	Lev 4/5 (Q50)	Lev 5/6 (Q69)
	14.351**	33.642***	12.060	11.324	17.411**	9.528
	(5.823)	(11.122)	(15.292)	(8.040)	(7.641)	(9.496)
R ² / pseudo R ²	0.151	0.099	0.097	0.092	0.083	0.074

Bootstrap Standard Errors (N = 20) in parentheses. ***, **, and * represent statistical significance at the 1%, 5% and 10% levels respectively. Wald tests reject the null hypothesis of equality of the pre-school coefficient across the five quantiles considered.

The quantile estimates indicate that for some domains, the benefits of pre-school attendance are most significant at the top end of the test score distribution. For example, for Numeracy, the magnitude of the pre-school coefficient is largest at the cut point between Bands 5 and 6. This result suggests that for Numeracy, it is the strongest students who benefit most from attending pre-school, while students at the lower end of the distribution seem to gain no significant advantage.

For Reading, the results are quite different. While the pre-school coefficient is statistically significant at the three cut points that are above the National Minimum Standard, the magnitude of the effect is largest at the cut point between Bands 3 and 4. That is, students whose test scores are just above the National Minimum Standard gain the most from having attended pre-school, and the magnitude of the effect, while still significant, is lower at the top end of the test score distribution.

For Spelling, as was the case with Reading and Numeracy, the pre-school coefficient is significant at the three cut points which represent test scores that are above the National Minimum Standard, and significant at the 10% level for children whose test scores are at the cut point between Bands 2 and 3. So, while the benefits of having attended pre-school are largest at the top end of the distribution, children whose Spelling scores are at the lower end of the distribution also appear to gain some benefit from attending pre-school.

Compared to children who had not attended pre-school, those who went to pre-school had average test scores approximately 11 points higher for Writing and 14 points higher for Grammar and Punctuation. For these domains, it appears that children whose test scores are around the median are the ones who gain the most from attending pre-school.¹³ Three years after the treatment of attending pre-school, these students appear to be doing substantially better than children who had not attended pre-school.

The results concerning other explanatory variables included in the model are also interesting in their own right. On average, boys score higher than girls in Numeracy; while girls score higher than boys in Writing, Spelling, and Grammar. Children of Aboriginal or Torres Strait Islander background have substantially lower scores for Spelling, Grammar and Numeracy. Compared to children who do not speak a language other than English at home, children who speak a second language have significantly higher Spelling scores.¹⁴ On average, children who weighed less than 2.5kg at birth scored lower in Reading, Grammar and Numeracy than children who weighed 2.5 kg or more. The age of the child is also a significant factor, with average test scores increasing by 2 to 3 points for each additional month.

Household characteristics are also important. Compared to children who were the eldest or only child in the household, those who had an older resident sibling in the year prior to their first year of school had lower average test scores in Reading, Spelling and Grammar. This may be because children with older siblings receive less one-on-one time with their parents than first-born or only children, and there might also be differences in the type and quality of activities, including pre-school, that second and subsequent children participate in during early childhood. On the other hand, children who had younger resident siblings in the year before formal schooling had significantly higher scores for Grammar. This result could be due to a “tutoring effect”, whereby older siblings gain by teaching their younger siblings. Across all five domains, there was a small but significant effect of household income, with average test scores increasing by approximately 1 point with every \$100 of weekly

¹³ Although there appears to be a significant and large advantage in terms of Grammar scores for children whose test scores were below the National Minimum Standard, this result should be interpreted with caution due to the limited number of observations at the lowest part of the test score distribution.

¹⁴ Average Reading and Writing scores were also higher. However, this difference was only significant at the 10% level.

household income. However, it should be noted that the income coefficient may reflect the association of parental employment to child outcomes, rather than the causal impact of income itself.

The level of education of the child's mother is shown to be a very important factor determining educational outcomes. Across all five domains children whose mother had a degree had significantly higher test scores. Compared to children whose mother's highest level of education was Year 11 or below, average test scores of children whose mother had a degree-level qualification were 33 points higher for Numeracy, 41 points higher for Reading, 22 points higher for Spelling, 30 points higher for Writing and 36 points higher for Grammar. There are several explanations for the mother's strong influence. First, children whose parents have a higher level of education may have a higher level of innate ability, resulting in higher test scores. Second, children whose parents have a higher level of education may provide a better home learning environment for their children. Third, children whose parents have a higher level of education may place a higher value on their children's education and therefore choose to provide better educational opportunities for their children, including higher quality pre-school.

4.2.1 Controlling for Innate Ability

It is likely that the estimated benefits from pre-school attendance implied by the previous results are partly due to the innate ability of the child. In order to account for unobserved ability, the models were re-estimated with an additional control for the child's score in the *Who Am I?* (WAI) test taken at the time of the 2004 interview.

The WAI test is a measure of cognitive development created by the Australian Council for Educational Research (ACER) in 1997 (de Lemos and Doig 1999). The test was developed based on previous research about the use of copying and writing tasks for the assessment of children's developmental level and school readiness.¹⁵ The test is administered in the form of an eleven page booklet in which children are asked to write their name, copy shapes (a circle, cross, square, triangle and diamond) and write letters, numbers, words and sentences with simple instructions and encouragement from their interviewer.¹⁶ Each response is assessed on a four-point scale relating to the skill required for the task. A score of 0 is assigned if no attempt was made on the item. Final test scores are transformed to a scale with a mean of 64 and standard deviation of 8 (Rothman, 2007). This test has several advantages over other measures of cognitive development in early childhood. It is

¹⁵ Children's ability to copy regular geometrical forms has been shown to be strongly associated with cognitive development and subsequent school achievement; letter recognition has been found to be strongly related to later achievement in reading; and there is a proven link between children's early attempts at writing and their understanding of the way in which spoken sounds are represented in print (Doig, 2005).

¹⁶ In the standard *Who Am I?* test, the final task requires children to draw a picture of themselves — a task that is commonly used as a measure of developmental level (Doig, 2005). For the LSAC testing, this task was replaced with a sentence to be copied ('John is big'), presumably because the copying task would be faster and easier to score. Responses to the new item were judged in the same manner as other items, with levels from 0 to 4 (Rothman, 2007).

easy to administer and user friendly for young children; scores are stable over time and uniform across different evaluators; and it provides a reliable measure of development which is valid across cultural groups and among children whose knowledge of English is limited (Doig, 2005).¹⁷ When the WAI measure is included in the set of explanatory variables, the explanatory power of the model increases substantially (Table 3).¹⁸ This is to be expected, as a substantial proportion of a child's NAPLAN results must be explained by innate ability.

Table 3: OLS and Quantile Estimates, Effect of Pre-school Attendance on Year 3 NAPLAN Scores (including *Who Am I?* test score in 2004 in the set of explanatory variables)

Numeracy	Average	Lev 1/2 (Q04)	Lev 2/3 (Q10)	Lev 3/4 (Q28)	Lev 4/5 (Q54)	Lev 5/6 (Q79)
	9.970**	7.768	8.822	7.154	7.567	13.027**
	(4.207)	(8.018)	(9.459)	(7.548)	(6.796)	(6.285)
R ² / pseudo R ²	0.251	0.161	0.150	0.153	0.137	0.150
Reading	Average	Lev 1/2 (Q05)	Lev 2/3 (Q14)	Lev 3/4 (Q28)	Lev 4/5 (Q49)	Lev 5/6 (Q75)
	14.691**	5.915	10.451	12.373	16.154*	13.563
	(6.233)	(14.192)	(9.089)	(9.156)	(8.770)	(9.811)
R ² / pseudo R ²	0.242	0.162	0.173	0.158	0.131	0.109
Spelling	Average	Lev 1/2 (Q05)	Lev 2/3 (Q13)	Lev 3/4 (Q27)	Lev 4/5 (Q54)	Lev 5/6 (Q80)
	13.652***	13.672	13.502	19.566*	21.690***	12.005
	(5.027)	(18.268)	(8.671)	(10.169)	(5.675)	(13.037)
R ² / pseudo R ²	0.230	0.189	0.174	0.142	0.125	0.123
Writing	Average	Lev 1/2 (Q04)	Lev 2/3 (Q08)	Lev 3/4 (Q22)	Lev 4/5 (Q48)	Lev 5/6 (Q75)
	7.785	9.508	16.498	13.480*	11.284*	6.342
	(5.021)	(14.425)	(14.646)	(7.891)	(6.335)	(8.184)
R ² / pseudo R ²	0.236	0.179	0.181	0.134	0.122	0.116
Grammar and Punctuation	Average	Lev 1/2 (Q05)	Lev 2/3 (Q11)	Lev 3/4 (Q28)	Lev 4/5 (Q50)	Lev 5/6 (Q69)
	9.958	6.690	16.467	8.020	6.594	9.410
	(6.687)	(19.920)	(12.344)	(9.864)	(6.220)	(9.461)
R ² / pseudo R ²	0.260	0.172	0.172	0.161	0.143	0.124

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.

When innate ability is accounted for using the *Who Am I?* score, the magnitude of the pre-school coefficient is reduced by approximately 4 points. For Numeracy, Reading and Spelling, but not for Writing or Grammar, the pre-school coefficient remains positive and statistically significant. This result implies that our previous estimates of the impact of pre-school attendance on Year 3 Writing and Grammar scores may be upwardly biased because of unobserved ability. However, it should be noted that because the WAI test was conducted at the time of the 2004 LSAC interview (between March 2004 and January 2005), the WAI test results may be influenced by pre-school participation to some degree.¹⁹

¹⁷ The cross-cultural validity of the *Who Am I?* test has been, in part, confirmed by the Canadian longitudinal survey through comparisons with the Peabody Picture Vocabulary Test. *Who Am I?* shows little bias due to language factors. In studies examining the cognitive development of Chinese children in Hong Kong and Anglo-Indian children in India, *Who Am I?* was adapted to non-Roman alphabets and ideographic writing. This appears to be unique in mathematics assessment at any level (Doig, 2005).

¹⁸ For all five domains, the coefficient on the *Who Am I?* score is positive and significant, with each WAI point associated with an increase in the NAPLAN score of approximately 4 points.

¹⁹ For children who had not attended preschool, the average WAI score was 61.2, compared to 63.6 for children who attended preschool. The mean WAI scores are significantly different at the 1% level in a two-tailed test.

4.3 Empirical Results: Causal Impacts by Propensity Score Matching

The average treatment effect on treated (ATT) and the average effect of treatment on untreated (ATU) resulting from Kernel matching of treatment and control cases are estimated for all five NAPLAN domains.²⁰ The propensity score is estimated using a probit model controlling for the age and gender of the child, birth weight, birth order, health, ATSI status, whether a language other than English is spoken at home; age, health and education level of the mother; household structure (household size, lone parent household) and location (state and region of residence and the number of homes the child has lived in since birth).²¹ We account directly for otherwise unobserved ability by including the child's score on the *Who Am I?* test in the set of variables used for matching. However, it should be noted that these test scores are likely to be affected by pre-school participation. The ATT estimates presented in Table 4 can be interpreted as the difference in the mean NAPLAN scores between the set of students who attended pre-school and the observationally equivalent matched set of students who did not attend pre-school. The ATU estimates can be interpreted as the average increase NAPLAN scores of children who did attend preschool, if they had indeed attended preschool.

The key assumption of propensity score matching is that both the outcome of interest and the treatment assignment do not depend on unobservable characteristics. If a treated individual and a potential control unit have the same propensity score, then the difference between the treatment and control outcome means is an unbiased estimator of the treatment effect. However, even under the best circumstances, a propensity score analysis may not necessarily address selection bias on unobservable characteristics and thus may not produce causal estimates of the effect of pre-school participation.

²⁰ We use Kernel matching, a non-parametric matching approach that creates matches for the treatment using (biweight) kernel weighted averages of those not in the treatment (Heckman, Ichimura, and Todd, 1998). Kernel matching compares the outcome of each treated person to a weighted average of the outcomes of all individuals in the control group, with the highest weight being placed on those with scores closest to the treated individual. One major advantage of this approach is the lower variance, which is achieved because more information is used (Heinrich, et al., 2010). The Nearest Neighbour matching method was also tested. However, Kernel matching was more effective in building balanced treatment and control groups and reducing the standardized bias.

²¹ To ensure that only variables that are unaffected by participation (or the anticipation of participation) are included in the matching model, variables should either be fixed over time or measured before participation (Caliendo and Kopeinig, 2005). For this reason, we do not match on mother's employment status or household income as the mother's decision to work, and hence household income, may be affected by the child's attendance at pre-school. Indicators of household structure are included in the matching variables – it is assumed that these have not changed between the time the child began pre-school and the date of interview. Excluding these variables from the matching does not substantially change the magnitude or significance of the estimates.

Table 4: Comparison of OLS estimates and Average Treatment Effects on Treated (ATT) and Untreated (ATU)

	Without "Who Am I"			With "Who Am I"		
	OLS	ATT	ATU	OLS	ATT	ATU
Numeracy	13.649^{**} (5.591)	18.154^{***} (5.830)	19.304^{***} (5.429)	9.970^{**} (4.207)	15.213^{***} (5.342)	16.635^{***} (4.762)
Reading	18.697^{***} (4.536)	20.942^{***} (6.474)	24.917^{***} (5.973)	14.691^{**} (6.233)	18.012^{***} (7.217)	21.101^{***} (5.561)
Spelling	17.316^{***} (6.398)	20.153^{***} (6.682)	21.550^{***} (6.150)	13.652^{***} (5.027)	17.507^{***} (6.195)	17.360^{***} (4.330)
Writing	10.868^{**} (4.272)	13.132^{**} (5.593)	15.750^{**} (5.860)	7.785 (5.021)	10.067[*] (6.195)	11.957^{***} (4.220)
Grammar and Punctuation	14.351^{**} (5.823)	12.149 (7.023)	20.218^{***} (6.164)	9.9581 (6.687)	9.563 (7.193)	15.464^{***} (5.150)
% bias after matching		2.406 (2.124)			2.360 (1.880)	

Note: ^{***}, ^{**} and ^{*} represent statistical significance at the 1%, 5% and 10% levels respectively. Bootstrap standard errors (N=50) in parentheses. ATT estimates are based on Kernel matching of treatment and control cases (Normal density with a bandwidth of 0.06).

For the domains of Reading, Spelling and Numeracy, the Average Treatment Effect on Treated (ATT) is statistically significant and slightly larger in magnitude than the OLS estimates. However, for Grammar, the estimated ATT is not statistically significant. This indicates that our estimates of the effects of pre-school participation in this domain is likely to be biased, and the association between pre-school attendance and test scores for Grammar domains should not be interpreted as causal. Estimates of the Average Treatment Effect on the untreated (ATU) are slightly larger than the ATT estimates and statistically significant across all five domains. This result suggests that the children who missed out on attending preschool are actually the ones who would have gained the most from attending.

When the *Who Am I?* score is included in the set of matching variables, the ATT and ATU estimates are reduced only by 2 to 4 points, depending on the domain being considered, the ATT estimates for Numeracy, Spelling and Reading remain statistically significant at the 5% level, and the ATU estimates remain statistically significant for all five domains. This result suggests that any bias resulting from unobserved ability is not likely to have a dramatic effect on our estimates of the effects of pre-school participation.

The home learning environment is likely to have a significant impact on children's test scores. However, the home environment may potentially be affected by pre-school participation, for example, the child's preschool teacher suggests that the child may benefit from attending a particular activity. For this reason, the ATT and ATU estimates are presented separately with the addition of controls for the home learning environment (how often the child is read to; the amount of extra-curricular activities such as sport and music classes the child attends; out of home activities such as going to the movies or the library; at home activities including reading, playing games, drawing and listening to music with parents; and the number of hours per week the child spends watching television and using a computer) in Table 4a.

Table 4a: Average Treatment Effects on Treated (ATT) and Untreated (ATU) – Including Controls for the Home Learning Environment

	Without “Who Am I”			With “Who Am I”		
	OLS	ATT	ATU	OLS	ATT	ATU
Numeracy	13.649^{**} (5.591)	14.955^{***} (6.441)	16.499^{***} (4.597)	9.970^{**} (4.207)	12.433[*] (7.157)	13.058^{***} (4.623)
Reading	18.697^{***} (4.536)	18.773[*] (7.177)	21.286^{***} (5.135)	14.691^{**} (6.233)	16.059[*] (8.520)	18.102^{***} (5.185)
Spelling	17.316^{***} (6.398)	19.086^{**} (7.758)	20.138^{***} (5.831)	13.652^{***} (5.027)	15.870^{**} (7.466)	17.015^{***} (5.741)
Writing	10.868^{**} (4.272)	10.078[*] (6.391)	13.712[*] (5.641)	7.785 (5.021)	7.663 (6.702)	10.538[*] (4.861)
Grammar and Punctuation	14.351^{**} (5.823)	8.954 (7.468)	16.014^{***} (5.535)	9.9581 (6.687)	6.386 (7.401)	12.160^{**} (5.551)
% bias after matching		2.694 (1.934)			2.666 (2.085)	

Note: ^{***}, ^{**} and ^{*} represent statistical significance at the 1%, 5% and 10% levels respectively. Bootstrap standard errors (N=50) in parentheses. ATT estimates are based on Kernel matching of treatment and control cases (Normal density with a bandwidth of 0.06).

When controls for the home learning environment are included in the set of matching variables, the magnitude of the ATT and ATU estimates are reduced by approximately 2 to 3 points. After controlling the home learning environment and the ability of the child, the ATT estimates for Numeracy, Reading and Spelling remain statistically significant and the ATU estimates remain statistically significant for all five domains. The proportion of children in our sample who attended pre-school is very high (over 90%). In order to reduce bad matches between the treatment and control group, and focus on the effects of pre-school participation for those with a lower probability of attending pre-school and therefore most at risk of underachievement in their early school years, we estimate the average treatment effect on treated after removing the top 25% of propensity scores. When the ATT is estimated using only the lower 75% of propensity scores, thereby eliminating matches between children who did not go to pre-school and children with a very high probability of attending pre-school, the quality of the matching (measured by the percentage reduction in bias after matching) is improved only slightly. The ATT increases in magnitude and is statistically significant for all five domains (not shown in tables). This suggests that our estimates of the effects of pre-school attendance may in fact be underestimated for those most at risk of underachievement.

In summary, after controlling for a rich set of socio-demographic characteristics, we find a significant positive association between pre-school attendance in the year before starting formal schooling and Year 3 NAPLAN test scores. The magnitude of the effect varies according to the domain being considered, with the most significant effects in the domains of Reading, Spelling and Numeracy. Quantile regressions show that for Numeracy, children whose test scores are at the higher end of the distribution benefit most from attending pre-school, while for Spelling and Reading, children whose test scores are around the middle of the distribution also benefit from attending pre-school.

Estimation of the Average Treatment Effect on the Treated using propensity score matching indicates that children who attended pre-school score *causally* about 20 points higher in Reading, Spelling and Numeracy compared to children who did not attend pre-school. This effect is reduced only modestly, to around 15 points, when we explicitly control for ability.

4.4 The Role of Pre-school Teacher Qualifications

In this section we examine the impact of the qualification of the pre-school teacher on Year 3 NAPLAN outcomes. We would expect that children attending pre-school programs with teachers having higher qualifications would attain higher test scores, compared to those whose pre-school teachers had lower qualifications.

The effects of specific teacher qualifications are estimated by replacing the ‘pre-school’ indicator in our previous estimates with a set of five dummy variables indicating the qualification level of the pre-school teacher. The LSAC questionnaire included a separate questionnaire to be filled out by the child’s main teacher. However, the response rate for the teacher questionnaire in Wave 1 was only 68.8% and for the sample used in the previous estimations of pre-school participation, information about the qualification level of the teacher is only available for 1389 observations. To address proactively the issue of missing data, multiple imputation was used to impute the qualification level of the teacher for children whose teacher information was not available.²²

Before proceeding to the estimation of the effects of teacher qualifications, the average NAPLAN scores according to the qualification level of the teacher (for children whose teacher qualification information was available) are presented in Table 5.

Among children who had attended a pre-school program in the year prior to formal schooling, average NAPLAN scores were highest among those whose pre-school teacher had a diploma-level qualification in early childhood education or child care, and lowest for those whose teacher had only a certificate-level qualification. Compared to children whose pre-school teacher had a diploma-level qualification, average NAPLAN test scores were slightly lower for children whose pre-school teacher had a degree qualification. However, for most domains this difference is not statistically significant.²³

²² Multiple Imputation generally outperforms other approaches such as listwise deletion and setting missing values to the mean, each of which can lead to bias and false identification of significant differences (Croy and Novins, 2005). Imputations are based on gender, ATSI status, LOTE, child health, child age, state of residence, metropolitan area, household size, lone parent household, presence of younger and older siblings, household income, mothers education, mothers employment status in 2004, mothers age when the child was born, weekly hours of pre-school and the type of pre-school attended (day care, school or non-school). Ten imputed data sets were created and regression and ATT coefficients were combined using Rubin’s Rules, which adjust standard errors to account for variation between and across imputed datasets. Rubin (1987) shows that when the rate of missing information is 30%, the efficiency of an estimate based on 10 imputations is approximately 97%.

²³ Only for Reading is the difference in test scores between children whose teacher had a diploma-level qualification and those whose teacher had a teaching degree (not specialising in early childhood education) statistically significant at the 5% level. For Numeracy, the difference in test scores between children whose pre-school teacher had a diploma-level

Table 5: Year 3 NAPLAN Scores, by Pre-school Teacher Qualification (means)

	Numeracy	Reading	Spelling	Writing	Grammar and Punctuation
No Pre-school	396.35 ^{***}	398.39 ^{***}	397.64 ^{***}	408.28 ^{***}	404.96 ^{***}
Early Childhood Teaching Degree (ECD)	421.60 [*]	428.68	420.34	430.75	430.45 [*]
Other Teaching Degree (TCD)	412.61 [*]	418.93 ^{**}	414.33	436.42	431.51
Adv. Diploma, Diploma, Ass. Dip in child care or early childhood teaching (CC)	428.66	435.69	424.36	430.73	441.60
Certificate level qualification in child care or early childhood teaching (CERT)	409.55 [*]	402.36 ^{**}	403.04 [*]	416.17 [*]	405.82 ^{**}
Other (OTH)	423.73 [*]	427.72	423.23	426.99	434.74

Note: Population weighted results. The 'Other' category includes teachers with no post school qualifications (some of whom were studying for a relevant qualification) as well as individuals who had qualifications in other fields e.g. nursing. ^{***}, ^{**} and ^{*} indicate that the mean is different from the 'Adv. Diploma, Diploma, Ass. Dip in child care or early childhood teaching' group at the 1%, 5% and 10% levels respectively in a two-tailed t-test.

In Table 6, descriptive and non-causal OLS and quantile estimates of the effects of specific teacher qualifications are presented. The control group is children who did not attend pre-school. Therefore the estimates can be interpreted as the difference in average test scores between students who did not attend pre-school at all and students whose pre-school teacher had a specific qualification. The results indicate that compared to children who did not attend pre-school, Year 3 NAPLAN scores are significantly higher among children whose pre-school teacher had a either a degree in Early Childhood Education or a diploma-level qualification in child care or early childhood education, particularly for the domains of Numeracy, Reading and Spelling.

For Numeracy, we find that compared to children who did not attend pre-school, those who attended pre-school with a teacher with a degree in Early Childhood education scored an average of 12 points higher, and children whose pre-school teacher had a diploma level qualification had average scores 17 points higher. As was the case for the simple pre-school versus no pre-school estimates, the quantile estimates indicate that for Numeracy, the benefits of pre-school attendance with a diploma or degree qualified teacher are greatest at the higher end of the distribution. At the cut point between Bands 5 and 6, children who attended pre-school with a teacher with a degree qualification in early childhood education had average test scores 19 points higher than children who had not attended pre-school, and children whose pre-school teacher had a diploma-level qualification had test scores 25 points higher than children who had not attended pre-school.

qualification and those whose teacher had a degree level qualification is significant at the 10% significance level. For Grammar and punctuation, the difference in test scores between children whose teacher had a degree in early childhood education and children whose pre-school teacher had a diploma qualification is significant at the 10% level.

Table 6: Effect of specific pre-school teacher qualifications on Year 3 NAPLAN scores

Numeracy	Average	Lev 1/2 (Q04)	Lev 2/3 (Q10)	Lev 3/4 (Q28)	Lev 4/5 (Q54)	Lev 5/6 (Q79)
ECD	12.065** (5.841)	-7.784 (14.678)	-4.714 (10.380)	9.717 (6.917)	9.127 (6.497)	18.900** (7.702)
TCD	14.692* (8.710)	3.311 (22.342)	6.685 (18.591)	15.450* (9.040)	6.420 (10.276)	19.001 (11.700)
CC	17.398*** (6.296)	6.367 (14.576)	4.863 (10.421)	13.806* (7.969)	13.776** (6.727)	25.504*** (8.129)
CERT	12.069 (12.504)	12.033 (26.295)	-1.999 (18.453)	14.912 (20.981)	12.280 (12.469)	7.704 (18.307)
OTH	11.366 (7.369)	-1.587 (16.521)	2.476 (15.629)	15.134* (8.906)	6.790 (8.498)	18.714* (10.883)
R ² / pseudo R ²	0.143	0.101	0.079	0.086	0.079	0.078
Reading	Average	Lev 1/2 (Q05)	Lev 2/3 (Q14)	Lev 3/4 (Q28)	Lev 4/5 (Q49)	Lev 5/6 (Q75)
ECD	17.476** (6.859)	-8.637 (12.821)	13.582 (10.598)	24.586** (10.497)	20.008*** (7.745)	16.382* (8.805)
TCD	19.459* (10.048)	7.009 (20.179)	16.968 (14.711)	24.597 (18.876)	20.772* (12.560)	18.450 (11.460)
CC	22.678*** (7.188)	7.303 (11.483)	16.630 (11.888)	31.269*** (10.860)	27.528*** (8.764)	22.432*** (8.577)
CERT	13.967 (15.106)	-3.001 (79.850)	13.685 (29.794)	23.634 (18.301)	17.210 (16.833)	6.699 (18.400)
OTH	17.200* (8.977)	-1.451 (20.319)	17.104 (12.544)	24.493* (12.648)	23.228** (9.961)	16.363 (12.175)
R ² / pseudo R ²	0.147	0.100	0.093	0.095	0.081	0.064
Spelling	Average	Lev 1/2 (Q05)	Lev 2/3 (Q13)	Lev 3/4 (Q27)	Lev 4/5 (Q54)	Lev 5/6 (Q80)
ECD	16.709** (6.241)	21.466 (16.544)	21.482 (13.898)	16.029** (7.060)	19.467*** (7.206)	21.120** (10.518)
TCD	18.756** (9.078)	27.491 (24.691)	27.018 (18.602)	17.554* (10.248)	19.307 (12.368)	19.803 (13.552)
CC	19.612*** (6.746)	23.446 (16.603)	23.929* (14.473)	22.978*** (7.693)	20.337*** (7.666)	23.545** (11.252)
CERT	16.402 (12.879)	26.469 (37.873)	32.574 (23.356)	23.707 (16.970)	19.525 (15.258)	19.580 (17.230)
OTH	14.833* (7.971)	24.723 (20.808)	27.203* (14.928)	13.183 (9.175)	20.401** (10.077)	16.846 (13.494)
R ² / pseudo R ²	0.113	0.098	0.086	0.070	0.057	0.061
Writing	Average	Lev 1/2 (Q04)	Lev 2/3 (Q08)	Lev 3/4 (Q22)	Lev 4/5 (Q48)	Lev 5/6 (Q75)
ECD	11.032** (5.432)	13.798 (13.704)	21.951* (11.778)	13.835 (8.827)	11.221** (5.566)	11.040 (8.355)
TCD	21.694*** (7.495)	19.728 (20.334)	38.100*** (16.181)	20.591* (12.356)	25.214** (10.501)	18.545* (10.600)
CC	11.170* (5.842)	10.508 (13.400)	16.234 (12.386)	9.827 (9.365)	10.769 (6.806)	11.152 (9.088)
CERT	8.021 (11.656)	7.595 (36.037)	10.569 (29.960)	7.877 (22.276)	6.369 (11.649)	7.281 (15.441)
OTH	8.777 (6.789)	3.505 (16.704)	19.362 (16.192)	11.821 (10.232)	5.569 (7.361)	7.922 (9.778)
R ² / pseudo R ²	0.148	0.142	0.130	0.083	0.077	0.070
Grammar	Average	Lev 1/2 (Q05)	Lev 2/3 (Q11)	Lev 3/4 (Q28)	Lev 4/5 (Q50)	Lev 5/6 (Q69)
ECD	11.047 (6.845)	18.046 (12.902)	0.969 (12.764)	9.988 (9.059)	14.167* (8.297)	6.745 (9.869)
TCD	16.625 (10.393)	34.587* (17.975)	14.252 (15.335)	12.920 (14.671)	9.430 (13.673)	8.802 (16.047)
CC	18.482** (7.477)	34.210** (14.703)	10.847 (13.055)	11.801 (10.342)	20.035** (8.604)	16.209* (9.719)
CERT	4.665 (14.797)	13.402 (31.098)	2.492 (26.554)	4.601 (18.774)	11.917 (21.889)	3.491 (22.238)
OTH	11.717 (8.945)	32.700** (16.662)	19.356 (14.796)	12.501 (10.254)	6.293 (11.173)	1.678 (12.187)
R ² / pseudo R ²	0.157	0.105	0.104	0.096	0.087	0.082

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively. Teacher Qualifications: Early Childhood Teaching Degree (ECD); Other Teaching Degree (TCD); Adv. Diploma, Diploma, Ass. Dip in child care or early childhood teaching (CC); Certificate level qualification in child care or early childhood teaching (CERT); Other (OTH).

For Reading, Table 6 shows that compared to children who did not attend a pre-school program, children whose teacher had a relevant degree or diploma level qualification scored 17 to 23 points higher in their Year 3 NAPLAN tests. For Reading, the benefits of having a suitably qualified pre-school teacher are more evenly distributed over the test score distribution. Children whose NAPLAN scores are just above the National Minimum Standard (that is, at the cut point between Bands 3 and 4) benefit most from having a pre-school teacher with an appropriate qualification; and while there are also significant benefits for children with test score around the median (between Bands 4 and 5) and at the higher end of the distribution, the magnitude of the effect decreases as NAPLAN scores increase.²⁴

Compared to children who did not attend pre-school, those who had a pre-school teacher with a relevant degree or diploma qualification scored an average of 17 to 20 points higher in their Year 3 Spelling tests. As was the case for Reading, the benefits from having a suitably qualified teacher were significant for children whose test scores were just above the National Minimum Standard (between Bands 3 and 4), around the median (Bands 4 and 5) and also at the higher end of the distribution. However, for spelling, the magnitude of the “pre-school effect” was highest at the top end of the distribution.

The NAPLAN Writing test is quite different to the other NAPLAN tests as it requires children to compose a piece of persuasive text in response to a stimulus or prompt. The results for Writing are also different to those for the other NAPLAN domains. While children whose pre-school teacher had a degree or diploma level qualification in early childhood education or child care had average scores approximately 11 points higher than children who did not attend pre-school, children whose pre-school teacher had a degree qualification without a specialization in early childhood (presumably a primary school teaching degree) had average test scores 22 points higher. It may be the case that children whose pre-school teacher had training that focused on teaching slightly older children gained a better foundation for creative writing.

For Grammar, it appears that only children whose pre-school teacher had a diploma-level qualification scored significantly higher than children who did not attend pre-school at all. The results indicate that children at the lowest end of the distribution benefit the most from having attended pre-school. However, this result should be interpreted with caution due to the limited number of observations at the low end of the test score distribution.

²⁴ It is possible that children whose test scores are at or below the National Minimum Standard also benefit from having attended preschool with a suitably qualified teacher. However, because there are very few observations for children with test scores at or below the NMS, particularly among those with TCD and CERT qualifications, the estimates for the lower bands should be interpreted with caution.

It is interesting to note that the benefits of pre-school are most significant among children whose teacher specialized in child care or early childhood education, and in general, children whose pre-school teacher had a teaching degree without a specialization in early childhood education did not benefit as much. A possible explanation for this result is that, compared to primary school teachers, teachers with specialist training in early childhood education are likely to have a greater awareness of developmentally appropriate teaching practices for young children, resulting in better outcomes. It may also be the case that, as suggested by Early et al. (2007), teachers who are trained to teach older children may focus more on academic instruction and less on forming individual teacher-child relationships that provide the foundation for academic learning.

When ability is controlled for with the inclusion of the *Who Am I?* test score in the set of explanatory variables, the magnitude of the descriptive OLS estimates are reduced by approximately 4 points (see Appendix Table A7). These results indicate that even after controlling for the ability of the child, there is a significant positive association between having attended pre-school with an appropriately qualified teacher (i.e. a degree or diploma with a specialisation in early childhood education or child care) and average NAPLAN outcomes for Spelling and Reading in Year 3. For the Numeracy domain, the effect of having a degree-qualified teacher is no longer statistically significant, but the effect of having a teacher with a diploma-level qualification remains significant, with children whose test scores are at the top end of distribution gaining the most benefit. For Writing, the benefit from having a pre-school teacher with a (primary) teaching degree remains significant. However, for Grammar there appears to be almost no significant benefit from having attended pre-school.

To address again the issue of selection bias, Kernel based Propensity Score Matching is used to estimate the Average Treatment Effect on Treated (ATT), comparing each specific teacher qualification with children who did not attend pre-school at all.²⁵ That is, for each qualification, we calculate the ATT by restricting the subsample to that particular qualification (the treated group) and the group of children who did not attend pre-school (the control group).

Because our OLS and quantile estimates indicate that for some domains, children whose pre-school teacher had a relevant degree or diploma qualification gained the most from having attended pre-school; and among children whose pre-school teacher had a degree, those whose teacher had a degree specialising in early childhood education generally do better, we also estimate the ATT with a treatment group consisting of children whose teacher had a relevant degree or diploma qualification (ECD, TCD or CC)²⁶ and also with a treatment group representing teachers with a specialist

²⁵ Lechner (2001) suggests in the multiple treatment case, a practical alternative to the estimation of a multinomial probit model is the estimation of a series of binomial models. He finds that there is little difference in the relative performance of the two approaches.

²⁶ Teacher Qualifications: Early Childhood Teaching Degree (ECD); Other Teaching Degree (TCD); Adv. Diploma, Diploma, Ass. Dip in child care or early childhood teaching (CC); Certificate level qualification in child care or early childhood teaching (CERT); Other (OTH).

qualification in early childhood education or child care (ECD or CC). The ATT for these treatment groups are first estimated using the group of children who did not attend pre-school as the control group; and then using “all others” as the control group. The results are summarised in Table 7.

Table 7: Average Treatment Effect on Treated, Specific Teacher Qualifications

	Numeracy	Reading	Spelling	Writing	Grammar	% bias after matching
ECD	15.193**	19.438***	17.525**	8.213	6.539	3.290
vs. no pre-school	(6.414)	(7.424)	(7.905)	(11.865)	(8.433)	(2.338)
TCD	18.356*	22.636*	19.239	19.507*	15.468	5.105
vs. no pre-school	(10.157)	(12.963)	(12.996)	(10.549)	(14.750)	(3.512)
CC	21.191***	23.641***	20.115**	9.652	14.996	2.683
vs. no pre-school	(7.270)	(8.457)	(8.512)	(7.182)	(9.573)	(1.547)
CERT	12.635	17.449	18.110	7.814	2.372	7.129
vs. no pre-school	(14.999)	(18.757)	(15.375)	(17.910)	(18.274)	(6.690)
OTH	14.587	14.860	16.983*	10.214	12.270	3.575
vs. no pre-school	(9.982)	(10.588)	(9.597)	(9.027)	(10.571)	(2.274)
ECD/TCD/CC	17.836***	20.894***	17.575**	8.840	10.124	2.317
vs. no pre-school	(5.684)	(6.591)	(7.242)	(5.867)	(7.766)	(1.804)
ECD/CC	17.888***	21.223***	18.306**	9.486	10.038	2.516
vs. no pre-school	(6.358)	(7.417)	(7.526)	(6.812)	(7.802)	(1.755)
ECD/TCD/CC	8.642**	11.141**	9.572*	6.139	6.740	0.829
vs. all others	(4.374)	(5.575)	(4.928)	(3.938)	(5.281)	(0.932)
ECD/CC	7.460*	9.750*	7.536*	1.706	6.447	0.959
vs. all others	(3.951)	(5.680)	(4.204)	(7.304)	(4.721)	(0.817)

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively. ATT estimates are based on Kernel matching of treatment and control cases (Gaussian Kernel with a bandwidth of 0.06). Teacher Qualifications: Early Childhood Teaching Degree (ECD); Other Teaching Degree (TCD); Adv. Diploma, Diploma, Ass. Dip in child care or early childhood teaching (CC); Certificate level qualification in child care or early childhood teaching (CERT); Other (OTH).

The ATT estimates confirm our OLS results concerning the impact of specific teacher qualifications. Compared to children who did not attend pre-school, children who had a pre-school teacher with a relevant degree or diploma qualification had significantly higher average scores in their Year 3 NAPLAN tests for Numeracy, Reading and Spelling. For Writing, it was children whose pre-school teacher had a teaching degree that did not specialize in early childhood education who gained the most. However, for Grammar there was no significant effect for any specific pre-school teacher qualification.

When the group of children whose pre-school teacher had a relevant degree or diploma qualification is compared to those who did not attend pre-school at all, the ATT estimates indicate that the gain from having attended pre-school is approximately 17 points for Numeracy and Spelling and 21 points for Reading. However, for the domains for Writing and Grammar there is no significant effect. Similar results are achieved when children whose teacher had a teaching degree but did not specialize in early childhood education are excluded from the treatment group. When the ATT is estimated using “relevant degree or diploma” (ECD, TCD or CC) as the treatment group and “all others” as the

control group, the estimated gains from having a pre-school teacher with a relevant qualification are 9 points for Numeracy and Spelling and 11 points for Reading.

After controlling for ability with the inclusion of the *Who Am I?* score in the set of matching variables, the magnitude of the ATT estimates is reduced by 3 to 5 points (Table 8).

Table 8: Average Treatment Effect on Treated, Specific Teacher Qualifications — including the *Who Am I?* Score in the set of matching variables

	Numeracy	Reading	Spelling	Writing	Grammar	% bias after matching
ECD	12.453*	17.108**	14.976**	6.330	4.487	3.568
vs. no pre-school	(6.819)	(7.890)	(7.324)	(11.472)	(8.634)	(1.973)
TCD	15.539	19.314	16.256	16.606	11.887	4.646
vs. no pre-school	(10.070)	(13.219)	(12.407)	(10.674)	(15.786)	(3.141)
CC	16.543**	18.585**	15.443*	6.372	10.589	2.470
vs. no pre-school	(7.794)	(8.238)	(8.850)	(6.386)	(9.283)	(1.524)
CERT	12.369	17.293	18.731	8.500	0.952	6.350
vs. no pre-school	(16.031)	(19.669)	(15.518)	(17.481)	(16.712)	(6.327)
OTH	14.192	13.898	17.522*	8.778	10.772	4.574
vs. no pre-school	(9.398)	(10.973)	(10.330)	(8.789)	(10.973)	(3.167)
ECD/TCD/CC	14.096**	17.856**	14.583**	7.585	7.341	2.569
vs. no pre-school	(5.869)	(7.308)	(6.920)	(6.109)	(7.867)	(1.441)
ECD/CC	14.051**	17.807**	14.515**	6.899	7.130	2.546
vs. no pre-school	(6.566)	(7.871)	(6.976)	(6.743)	(8.590)	(1.564)
ECD/TCD/CC	6.888	9.150	7.458	4.511	5.026	0.785
vs. all others	(4.294)	(5.651)	(4.729)	(3.759)	(4.731)	(0.709)
ECD/CC	6.351*	8.4234*	6.418*	0.649	7.130	0.894
vs. all others	(3.405)	(4.853)	(3.644)	(7.144)	(8.590)	(0.731)

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively. ATT estimates are based on Kernel matching of treatment and control cases (Gaussian Kernel with a bandwidth of 0.06). Teacher Qualifications: Early Childhood Teaching Degree (ECD); Other Teaching Degree (TCD); Adv. Diploma, Diploma, Ass. Dip in child care or early childhood teaching (CC); Certificate level qualification in child care or early childhood teaching (CERT); Other (OTH).

The estimated effects of having had a pre-school teacher with a degree in early childhood education remain significant at the 10% level for Numeracy and Reading; and the effects of having a diploma-qualified pre-school teacher remain significant for Numeracy, Reading and Spelling. However, the estimated effects of having a degree-qualified pre-school teacher who did not specialize in early childhood education are no longer statistically significant. This result supports the conclusion that there are significant benefits to be gained from pre-school teachers who are specifically trained in developmentally appropriate teaching practices for young children. Using the group of children whose pre-school teacher had a degree or diploma qualification specializing in early childhood education or child care (ECD or CC) as the treatment group and the group who did not attend pre-school at all as the control group, and controlling for ability, the estimated benefits range from 14 points for Numeracy and Spelling to 18 points for Reading.

5. Research Conclusions and Policy Implications

We find a significant positive association between pre-school attendance and Year 3 NAPLAN scores, particularly in the domains of Numeracy, Reading and Spelling. Descriptive quantile estimates show that for Numeracy, it is children whose test scores are at the higher end of the test score distribution who benefit the most from attending pre-school. However, for Reading and Spelling, children whose test scores are just above the National Minimum Standard who benefit most from having attended pre-school. We also find that the qualifications of the pre-school teacher are very important. Children whose pre-school teacher had a degree in Early Childhood Education or a Diploma in Early Childhood Education or Child Care gained the most from attending pre-school, while children whose teacher had only a certificate level qualification or no relevant qualification showed no significant benefit in terms of Year 3 NAPLAN scores.

To address directly the issue of causality not captured in our descriptive estimations, we use Kernel propensity score matching techniques to compare children who actually participated in pre-school programs to those who did not, yet based on observable characteristics, who had similar propensities to attend pre-school. Using Kernel matching, we have calculated the Average Treatment Effect on the Treated (ATT) and the Average Treatment Effect of the Untreated (ATU) for the treatment of having participated in a pre-school program on the domain-specific NAPLAN outcome. This is the first paper to calculate these estimates for Australia, which is based on a *nationally representative* panel of children (LSAC) and their NAPLAN schooling outcomes. These results are much more compelling than those of targeted, small sample, or program-specific analyses.

For the domains of Reading, Spelling, Writing and Numeracy, the causal Average Treatment Effect on Treated (ATT) is statistically significant and of the magnitude 13 to 20 NAPLAN points. However, for Grammar, the estimated ATT is not statistically significant. The Average Treatment Effect on the Untreated (ATU) provides an estimate of how much higher the NAPLAN scores of children who did not attend pre-school might have been if they had in fact attended pre-school. The ATUs are statistically significant across all five NAPLAN domains and slightly larger than the ATT estimates. This result implies that it is the children who missed out on attending pre-school who would have gained the most in terms of later cognitive outcomes.

Directly controlling for the *Who Am I?* ability score in the matching process, the previous causal ATT and ATU estimates are reduced by 2 to 4 points, depending on the domain being considered, but the ATT estimates for Numeracy, Spelling and Reading still remain statistically significant at the 5% level and ATU estimates remain significant across all five domains. This result suggests that in general, any bias resulting from *unobserved* ability is not likely to have a dramatic effect on our estimates of the effects of pre-school participation. These causal ATT estimates are substantial, given

that one year of schooling at this level is represented by 52 NAPLAN points, with pre-school amounting to 30-40% of the learning impact of one additional year of schooling, *3 years after the fact*.

To assess the effect of teacher qualifications in the pre-school programs, we have estimated the ATTs for five separate levels of teacher qualification (without including controls for *Who am I?* ability scores). The strongest effects are found for teachers having Early Childhood Teaching Degree (ECD), Other Teaching Degree (TCD) and Advanced Diploma in child care or early childhood teaching (CC) in the domains for Numeracy, Reading and Spelling. For Writing and Grammar, there were less stable, yet positive effects for some of the qualifications. Those children having participated in programs in which teachers had only a Certificate level qualification in child care or early childhood teaching (CERT), or had no relevant childcare qualification, later received indistinguishably similar NAPLAN scores to those children who had not participated at all in a pre-school program.

After including *Who am I?* ability scores in the matching, the NAPLAN effects of having a teacher with a teaching degree (not specializing in early childhood education) are no longer statistically significant. This suggests that it is children who attended a pre-school program with a degree or diploma qualified teacher, specializing in early childhood education or child care, who gain the most from attending pre-school. Thus, the actual training specialisation of the teacher is also important, with immediate policy relevance.

These findings are somewhat different to those of Early et al. (2007), who find no conclusive evidence of an association between pre-school teacher qualifications, or major, and cognitive outcomes in the same (pre-school) year. Further, Early et al. (2006) find that pre-school teacher education level is linked to gains in math skills, but not literacy skills in the pre-school year.

The main difference between this study and those of Early et. al. (2006 and 2007) is that our focus is on the longer-term effects of pre-school teacher qualifications on children's cognitive outcomes (as opposed to cognitive outcomes in the pre-school year). While several studies of large-scale pre-school programs have shown that pre-school attendance has long-term academic benefits (e.g. Sylva et al., 2008; Berlinski et al., 2008; Goodman and Sianesi, 2005); and others have shown the long-term benefits of small scale, targeted pre-school programs with degree-qualified teachers specialising in early childhood education (Schweinhart et al. 2005; Campbell and Ramey, 1995; Barnett, 1995; Reynolds et al, 20011), this is the first study to provide direct comparisons of the effect of the type of qualification held by the pre-school teacher on later cognitive outcomes.

These results confirm the importance of high quality pre-school programs for later cognitive outcomes. The Council of Australian Governments (COAG) agreement ensuring that all children in Australia have access to a high quality early childhood education program delivered by a degree qualified early childhood teacher in the year before formal schooling and the introduction of the new National Quality Standard for early childhood education and care providers in Australia (in January

2014) are likely to have substantial long-term benefits, particularly for children who would not have had the opportunity to attend a pre-school with a suitably qualified teacher if these reforms had not taken place. Even 3 years after the pre-schooling has taken place, NAPLAN scores of Year 3 children are significantly higher than those who had not received the treatment.

In terms of later (NAPLAN) outcomes, pre-school teachers/carers should have at least a diploma level qualification for maximal program impact. Some children - possibly those who would gain the most from attending a high quality pre-school program - might still miss out because of “loopholes” in the new National Quality Framework that will be introduced in January 2014. For example, child care and pre-school centres in Australia will be able to overcome the requirement for an early childhood teacher to be present at all times if: (a) there are fewer than 25 children attending the facility; or (b) if a high proportion of staff are not actually qualified but “actively working towards” a relevant qualification, likely leading to the quality of the program being lower. These conditions exist due to an acute current undersupply of qualified staff. Thus this will likely require targeted government policy to encourage people (a) to obtain higher level qualifications, i.e. continue with incentives to study child care and early childhood education, and (b) for child care workers to work in rural and remote areas. With a sufficient number of qualified staff, quality standards could be improved even further to ensure that children who are most at risk of underachievement are not disadvantaged.

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APPENDIX

Table A1: Data Description and Summary Statistics (N=2009)

Description	Mean	Std. Dev.
Attended Pre-school in 2004	0.907	0.291
Male: Male = 1 Female = 0	0.522	0.500
ATSI: Aboriginal or Torres Strait Islander (1/0)	0.024	0.154
LOTE: Speaks a language other than English at home (1/0)	0.097	0.297
Low birth weight (< 2.5 kg)	0.057	0.231
Parent reported child health 2004 (fair or poor = 1, else 0)	0.026	0.158
Age of child in January 2004 (months)	49.819	3.088
Lone parent household in 2004	0.116	0.320
Household size 2004	4.424	1.106
Younger resident siblings 2004	0.478	0.500
Older resident siblings 2004	0.566	0.496
Mothers education level (Control = year 11 or below)		
Year 12	0.146	0.353
Non-degree post school qualification	0.352	0.478
Degree qualification	0.311	0.463
Mother employed in 2004	0.444	0.497
Mother's age at the time child was born	30.941	5.111
State of residence in 2004 (Control = NSW)		
Vic (Victoria)	0.276	0.447
Qld (Queensland)	0.114	0.317
Other	0.231	0.422
Living in a metropolitan area in 2004	0.634	0.482
Weekly household income 2004 (\$)	1351.656	648.438
Who Am I (WAI) Test Score 2004	63.402	7.406

Table A2: OLS and Quantile Estimates: Effect of Pre-school Participation on Year 3 NAPLAN Scores - Numeracy

	OLS	Lev 1/2 (Q04)	Lev 2/3 (Q10)	Lev 3/4 (Q28)	Lev 4/5 (Q54)	Lev 5/6 (Q79)
Pre-school	13.6486** (5.5914)	6.3623 (19.0140)	0.2313 (14.4066)	12.0417* (6.2225)	10.6213** (5.3202)	20.8521*** (7.7177)
Male	8.8567*** (2.8932)	-4.5889 (5.7304)	-0.4894 (4.4232)	6.3133 (4.2344)	7.8446* (4.2501)	16.7297*** (4.6645)
ATSI	-28.3847*** (8.8555)	-23.2920 (14.8243)	-33.6590** (15.6543)	-44.8188*** (8.5850)	-37.9233*** (9.4787)	-23.6436** (11.1130)
LOTE	7.0828 (5.0607)	19.7937** (9.4024)	7.3665 (7.5973)	3.1991 (6.9266)	-0.4642 (7.6974)	14.5160 (10.1979)
Low Birth Weight	-20.4372*** (6.3703)	-20.5021** (8.2446)	-27.2792* (14.8005)	-23.0197** (9.1510)	-10.7599 (7.9136)	-24.2635** (9.5146)
Poor Health	-5.2502 (9.6027)	-38.8401 (42.1716)	0.3690 (32.4414)	0.3766 (10.5076)	-17.0924 (10.7674)	-0.9582 (22.3702)
Child Age	2.6049*** (0.5236)	2.6246** (1.2408)	2.4150*** (0.9041)	2.3551*** (0.5098)	2.5718*** (0.6151)	2.3287*** (0.7594)
Metropolitan	4.1714 (3.3156)	0.7226 (7.9646)	6.2213 (6.8671)	4.5274 (4.8446)	2.0600 (4.0343)	3.1967 (3.5311)
Lone parent HH	-4.8492 (5.4124)	4.8563 (11.5046)	-11.0864 (11.1911)	-3.6618 (8.6790)	4.4657 (5.3127)	-0.5094 (7.9550)
HH Size	-3.4955 (2.1616)	-2.5404 (4.0111)	-3.4342 (3.3128)	-2.3182 (2.2618)	-5.5429*** (1.9107)	-6.6440** (2.8733)
Younger Siblings	6.0321 (3.9255)	13.5531 (8.6890)	10.4710* (6.1997)	9.5809 (6.4785)	14.3581** (5.7825)	3.9922 (5.4621)
Older Siblings	-4.2737 (4.8971)	8.1668 (10.7682)	3.3860 (8.4991)	-5.1542 (6.2211)	-1.0348 (6.8048)	-4.4797 (7.1287)
Mother Employed	1.5877 (3.2586)	-12.5122 (9.2535)	-1.7284 (6.2120)	6.6371 (5.3853)	0.2034 (4.5540)	-2.6188 (3.7570)
Mother Age	0.4940 (0.3526)	0.2593 (0.8122)	0.3125 (0.7235)	0.8400 (0.5525)	0.6968 (0.4382)	0.6771 (0.4919)
Household Income	0.0137*** (0.0026)	0.0151** (0.0068)	0.0092* (0.0053)	0.0149*** (0.0040)	0.0185*** (0.0041)	0.0125*** (0.0026)
Vic	2.1803 (4.0392)	-2.5649 (8.9227)	-4.3223 (7.2276)	0.2773 (6.5345)	3.8140 (6.0146)	6.1786 (6.2987)
Qld	-7.8285 (6.3256)	-26.6606* (13.7420)	-16.9703 (10.9499)	-14.2247 (12.6176)	-1.0192 (9.9874)	-2.1932 (8.6100)
Other States	-15.0013*** (4.0066)	-5.8990 (7.7363)	-24.6932*** (6.4806)	-15.5982*** (4.3827)	-10.9852*** (3.9773)	-13.1003** (5.2755)
MQual – Year 12	13.3268** (6.2147)	5.8148 (12.4938)	6.1170 (11.7581)	11.5987 (7.8966)	11.9405 (8.5555)	20.3347** (8.0161)
MQual –non Degree	7.0120 (4.2920)	0.3041 (9.5963)	6.8250 (8.5586)	5.9702 (6.7953)	6.5081 (6.2163)	8.7010 (7.7133)
MQual - Degree	32.8688*** (4.7372)	35.8358*** (11.5892)	35.8944*** (8.2855)	30.0434*** (8.1245)	29.4761*** (6.8750)	36.3178*** (6.4634)
Constant	245.4187*** (28.7163)	141.8095** (67.7475)	199.1044*** (52.5671)	203.9873*** (30.2093)	245.6282*** (34.4114)	309.3208*** (37.6876)
Observations	2004	2004	2004	2004	2004	2004
R ²	0.137	--	--	--	--	--
Pseudo R ²	--	0.086	0.069	0.083	0.074	0.075

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.

Table A3: OLS and Quantile Estimates: Effect of Pre-school Participation on Year 3 NAPLAN Scores - Reading

	OLS	Lev 1/2 (Q05)	Lev 2/3 (Q14)	Lev 3/4 (Q28)	Lev 4/5 (Q49)	Lev 5/6 (Q79)
Pre-school	18.6968*** (4.5358)	-0.4074 (12.1392)	17.7614 (12.0372)	27.4076*** (8.5255)	22.9571*** (6.5710)	16.8449*** (4.7855)
Male	-22.1149*** (3.6810)	-27.1904*** (5.9636)	-23.8317*** (5.6150)	-23.8036*** (5.8169)	-19.0461*** (4.4396)	-11.5300** (5.7603)
ATSI	-20.4227 (14.2121)	6.1672 (26.5019)	-16.1849 (15.1900)	-31.9636* (16.7043)	-27.8427 (18.2137)	-19.1157 (17.0230)
LOTE	9.4993* (5.7307)	29.9240*** (10.1208)	23.8068*** (6.6279)	10.3099* (5.8152)	2.8449 (8.9504)	6.5084 (11.9111)
Low Birth Weight	-20.9592*** (7.2824)	-24.4471* (14.5013)	-17.4363 (15.4049)	-16.8424*** (6.3978)	-27.2927*** (7.7830)	-19.0010 (14.2705)
Poor Health	-17.6872 (13.3026)	-77.4485 (67.0245)	15.4227 (34.3276)	6.1192 (22.3960)	-10.3348 (11.5094)	-15.2832 (13.8157)
Child Age	2.8208*** (0.6722)	1.9191 (1.2996)	2.3106** (0.9277)	2.7975*** (0.8095)	2.5568*** (0.7066)	2.1664*** (0.7190)
Metropolitan	6.3021 (3.9981)	3.1368 (9.2555)	6.2689 (6.7439)	5.9473 (5.7746)	9.7140** (4.9017)	7.1723 (5.5049)
Lone parent HH	-11.5765 (7.9026)	-20.4313 (13.9259)	-9.0042 (13.0510)	-2.8847 (13.8200)	-1.8455 (8.9722)	-14.8116* (7.6024)
HH Size	-4.5988* (2.7023)	-7.0041* (4.1195)	-4.0971 (5.2465)	-4.6602 (3.7195)	-2.2196 (3.0543)	-5.6027 (3.9761)
Younger Siblings	8.6075 (5.3536)	4.2784 (9.6541)	7.5748 (8.1344)	10.0379 (7.3340)	4.9721 (5.7367)	14.0871** (6.2177)
Older Siblings	-13.9150** (5.6791)	3.7124 (9.7140)	-15.1404 (11.6938)	-12.7340 (8.5336)	-13.8131** (6.0275)	-9.0786 (7.8352)
Mother Employed	0.1955 (3.2955)	-8.3454 (10.2319)	-1.8179 (6.2169)	1.5552 (5.9797)	6.1296 (4.8563)	1.1311 (4.4463)
Mother Age	1.0132*** (0.3798)	0.0497 (0.9683)	0.8102 (1.0670)	1.5405** (0.5975)	0.7624* (0.4261)	0.7085 (0.4459)
Household Income	0.0116*** (0.0029)	0.0158* (0.0081)	0.0232*** (0.0052)	0.0122*** (0.0046)	0.0122*** (0.0037)	0.0077* (0.0044)
Vic	1.7311 (4.2914)	-5.7287 (10.2896)	0.2530 (8.1128)	0.8558 (6.9494)	3.1544 (5.8751)	0.4475 (3.6826)
Qld	-4.7472 (6.2833)	-22.2300** (10.6651)	-2.5708 (12.1709)	-4.7246 (9.7829)	-1.7187 (8.5479)	-4.3615 (8.3482)
Other States	-11.6178** (5.0336)	-26.7537*** (10.1760)	-17.3374 (11.4003)	-14.4765* (8.5194)	-12.0186** (5.8794)	-2.3922 (8.3640)
MQual – Year 12	21.6772*** (7.3489)	26.7302* (15.4928)	22.7694* (12.4574)	21.0400** (10.1922)	15.6458*** (5.7658)	16.8888* (9.0333)
MQual –non Degree	11.5751** (5.3550)	13.2447 (12.7803)	12.8080 (12.9797)	7.4720 (9.6498)	7.5099 (6.1726)	7.9462 (6.9971)
MQual - Degree	41.4180*** (5.6704)	54.6009*** (12.2864)	42.5651*** (10.2742)	38.4483*** (10.0201)	31.2971*** (7.1094)	31.7491*** (7.2387)
Constant	240.2302*** (34.1965)	204.9653** (82.0771)	171.2698*** (60.3059)	173.8578*** (37.2479)	244.5711*** (32.6991)	337.1866*** (35.6415)
Observations	2008	2008	2008	2008	2008	2008
R ²	0.146	--	--	--	--	--
Pseudo R ²	--	0.102	0.092	0.090	0.077	0.060

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.

Table A4: OLS and Quantile Estimates: Effect of Pre-school Participation on Year 3 NAPLAN Scores - Spelling

	OLS	Lev 1/2 (Q05)	Lev 2/3 (Q13)	Lev 3/4 (Q27)	Lev 4/5 (Q54)	Lev 5/6 (Q80)
Pre-school	17.3164*** (6.3975)	22.5880 (14.0342)	19.4255* (10.7682)	18.5254*** (6.9098)	20.6746*** (6.8485)	24.0632** (10.6135)
Male	-15.7370*** (2.9851)	-24.1005*** (7.4785)	-24.9432*** (7.3824)	-16.6605*** (4.5602)	-13.8545*** (4.3391)	-9.5784** (4.5987)
ATSI	-24.3388** (10.8379)	-9.9366 (14.7443)	-23.4339 (18.2234)	-38.9643** (17.2799)	-35.7257** (14.7115)	-17.1556 (20.3343)
LOTE	26.7858*** (5.9737)	21.8618** (10.6685)	24.0047*** (7.8193)	18.9806** (7.7975)	23.6292*** (6.6641)	38.4559*** (13.3670)
Low Birth Weight	-5.7200 (7.4927)	-30.0321 (19.3373)	-13.8853 (16.3691)	-1.1720 (8.8634)	-2.9871 (7.3969)	-17.3366 (12.4560)
Poor Health	2.4838 (12.9907)	-41.7853 (45.4412)	19.9558 (37.8416)	1.8158 (13.5491)	0.9397 (10.4376)	11.0809 (15.0933)
Child Age	1.7659*** (0.6468)	0.6618 (1.6860)	1.3791 (0.9418)	1.9136** (0.8351)	1.7455** (0.8281)	1.5824 (1.1563)
Metropolitan	8.1729** (3.3516)	-4.3272 (8.7934)	-1.7948 (6.0992)	7.4328* (4.3419)	11.2738*** (3.4691)	10.7160** (5.4053)
Lone parent HH	-8.3832 (5.6462)	-13.0445 (19.8962)	-15.5385 (12.5088)	-10.8409* (6.4948)	-13.6567* (7.4627)	-2.2121 (12.3278)
HH Size	-1.0574 (2.2580)	-3.1184 (5.6142)	-2.8007 (4.2556)	-1.9460 (2.8241)	-2.0090 (3.4492)	1.3751 (4.4314)
Younger Siblings	4.5572 (4.8304)	1.9763 (7.5856)	6.0266 (5.3132)	8.8908* (4.6231)	11.3996** (5.6487)	-2.2560 (9.3378)
Older Siblings	-9.8757** (4.2689)	-3.9673 (16.6315)	-14.3518** (7.2883)	-3.4582 (4.8433)	-0.1954 (6.6955)	-15.8196* (8.1965)
Mother Employed	3.1634 (3.6911)	-1.1386 (8.7724)	-5.6136 (5.6533)	1.3842 (5.3224)	6.6697* (3.6049)	1.4701 (5.9661)
Mother Age	0.4984 (0.4376)	0.6079 (0.7866)	0.8990* (0.5317)	0.0077 (0.5058)	0.3132 (0.4876)	0.8468 (0.5584)
Household Income	0.0090*** (0.0030)	0.0123* (0.0067)	0.0165*** (0.0046)	0.0114*** (0.0033)	0.0054* (0.0031)	0.0076 (0.0054)
Vic	-8.9208*** (3.4496)	-16.5733 (10.4986)	-9.4985 (6.2418)	-9.7074** (4.1858)	-5.4648 (4.1234)	-4.6417 (4.9154)
Qld	-23.1367*** (6.0172)	-39.9446*** (13.7881)	-30.1353** (13.8604)	-23.3308*** (7.7413)	-15.3707** (7.0043)	-23.6641*** (7.4401)
Other States	-15.6959*** (4.3978)	-35.7879*** (10.5136)	-26.6167*** (7.9102)	-20.9842*** (5.3559)	-14.2275*** (4.3935)	-6.2455 (6.2622)
MQual – Year 12	12.2227** (5.6186)	30.9188** (14.6941)	16.8448* (9.2732)	14.6392** (6.5460)	10.7009 (6.5933)	4.5785 (8.1149)
MQual –non Degree	4.7390 (4.8776)	17.2152 (13.4445)	8.0001 (7.1945)	8.5188 (5.4202)	0.3109 (3.9371)	3.5648 (5.6671)
MQual - Degree	22.1294*** (4.6873)	56.6149*** (14.5778)	29.5963*** (8.2631)	25.4164*** (7.2539)	14.0080*** (5.0163)	18.6161*** (4.6875)
Constant	296.9208*** (36.0027)	231.0967** (105.4656)	237.8690*** (54.4361)	259.0581*** (43.1025)	307.1458*** (30.8427)	341.5719*** (50.1802)
Observations	2009	2009	2009	2009	2009	2009
R ²	0.110	--	--	--	--	--
Pseudo R ²	--	0.103	0.084	0.067	0.056	0.052

Bootstrap Standard Errors (N = 20) in parentheses. ***, **, and * represent statistical significance at the 1%, 5% and 10% levels respectively.

Table A5: OLS and Quantile Estimates: Effect of Pre-school Participation on Year 3 NAPLAN Scores - Writing

	OLS	Lev 1/2 (Q04)	Lev 2/3 (Q08)	Lev 3/4 (Q22)	Lev 4/5 (Q48)	Lev 5/6 (Q75)
Pre-school	10.8684** (4.2722)	10.4058 (13.8513)	19.7729 (12.6104)	12.8665 (9.3602)	11.0353** (5.1751)	10.9633 (10.4936)
Male	-25.8512*** (2.9953)	-42.5377*** (10.1334)	-43.4982*** (8.9258)	-33.2402*** (3.9491)	-21.5482*** (3.5052)	-21.3776*** (4.0992)
ATSI	-12.3980 (9.4197)	-18.4568 (16.9240)	-38.2757* (21.9847)	-31.5232* (17.4077)	-6.8321 (13.1081)	0.8455 (13.3772)
LOTE	9.1061* (4.9308)	18.1901* (9.9120)	9.3908 (9.8120)	13.0716* (7.4608)	8.2517 (6.9357)	9.4318 (8.2442)
Low Birth Weight	-5.0405 (5.7675)	-31.9237** (13.5553)	-28.6808 (18.0400)	0.6540 (11.7678)	5.7402 (8.1546)	-8.0435 (5.3168)
Poor Health	1.2656 (10.1315)	36.7408 (76.3715)	16.1354 (15.0578)	4.4149 (13.4216)	2.0307 (8.6407)	1.8805 (9.4436)
Child Age	2.3833*** (0.5853)	0.8925 (1.4582)	1.6987 (1.3785)	2.3346*** (0.7614)	2.1954*** (0.7060)	2.1764*** (0.7139)
Metropolitan	8.0885*** (2.9266)	9.6342 (7.8542)	14.3453** (5.9142)	9.0824** (4.5411)	8.0763** (3.2650)	5.0839 (4.5335)
Lone parent HH	-8.9628* (4.9819)	-0.7076 (13.1194)	-4.9089 (11.9580)	-11.5633 (7.2445)	-8.9087 (7.3961)	-15.5861** (6.1266)
HH Size	-3.6957* (1.9695)	-3.4495 (4.0482)	-6.1581 (4.1937)	-0.0116 (3.1369)	-1.9303 (1.7934)	-4.9192** (2.1832)
Younger Siblings	4.8925 (3.9698)	-7.6166 (9.1329)	0.0154 (9.9322)	-2.4521 (4.8118)	7.9426* (4.5620)	7.1165* (3.6764)
Older Siblings	-5.2170 (4.5503)	-6.8617 (9.5996)	-2.4276 (8.7091)	-10.2247** (4.6971)	-4.7815 (5.1295)	-8.7355** (3.8041)
Mother Employed	0.5279 (3.0937)	-3.7532 (8.0549)	-8.3070 (8.5040)	-2.0462 (2.6895)	0.0462 (3.6324)	0.8642 (3.6935)
Mother Age	0.5443* (0.2932)	0.2302 (0.8267)	0.2738 (0.7092)	0.4646 (0.4219)	0.6590* (0.3889)	1.0127*** (0.3877)
Household Income	0.0077*** (0.0026)	0.0177* (0.0097)	0.0147** (0.0071)	0.0069** (0.0033)	0.0032 (0.0029)	0.0064* (0.0035)
Vic	-8.4076** (3.2809)	-15.8809 (11.4433)	-19.0231** (8.8852)	-17.6882*** (3.4784)	-7.5047* (4.2946)	-4.0837 (4.6750)
Qld	-11.9321* (6.4559)	-29.6326* (16.2042)	-26.8584* (15.4240)	-8.5726 (8.6141)	-9.9551 (8.2617)	-9.0075 (8.6271)
Other States	-21.3176*** (3.4658)	-30.0110*** (11.4837)	-30.4559*** (9.6968)	-28.6495*** (4.5202)	-24.9315*** (5.8370)	-15.4253** (6.7677)
MQual – Year 12	8.6374 (5.6702)	0.0163 (13.3577)	8.9792 (11.4555)	9.3036* (5.1798)	5.2934 (6.4309)	4.5187 (7.2347)
MQual –non Degree	10.7451*** (4.0944)	3.2942 (9.3660)	12.5052 (9.4867)	8.7896* (5.2563)	9.9579* (5.9420)	6.5831 (5.9944)
MQual - Degree	29.8876*** (3.7840)	36.2465*** (8.1699)	40.8664*** (7.3579)	28.8379*** (4.0520)	30.8323*** (6.6219)	22.2662*** (5.0456)
Constant	293.7488*** (29.0304)	272.0017*** (71.4484)	251.4479*** (65.0396)	253.9443*** (37.8150)	293.1116*** (31.1706)	342.2246*** (32.8772)
Observations	2005	2005	2005	2005	2005	2005
R ²	0.144	--	--	--	--	--
Pseudo R ²	--	0.132	0.122	0.080	0.075	0.067

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.

Table A6: OLS and Quantile Estimates: Effect of Pre-school Participation on Year 3 NAPLAN Scores - Grammar

	OLS	Lev 1/2 (Q05)	Lev 2/3 (Q11)	Lev 3/4 (Q28)	Lev 4/5 (Q50)	Lev 5/6 (Q69)
Pre-school	14.3510** (5.8234)	33.6420*** (11.1217)	12.0596 (15.2920)	11.3236 (8.0400)	17.4114** (7.6405)	9.5281 (9.4960)
Male	-23.3770*** (3.6741)	-27.9629*** (7.2739)	-24.4614*** (7.0908)	-22.4009*** (5.8753)	-28.0045*** (5.1630)	-20.9510*** (6.4589)
ATSI	-44.6289*** (12.0791)	-36.6466** (14.5042)	-47.1203*** (16.8373)	-53.3928*** (16.7786)	-58.5457*** (14.2745)	-53.1436*** (12.4277)
LOTE	8.1516 (6.0853)	17.2281 (10.8641)	22.3007 (15.1246)	6.2482 (8.5722)	3.6073 (8.0867)	5.1906 (7.1220)
Low Birth Weight	-16.7634** (7.8602)	-7.2582 (16.7274)	-9.0836 (11.3507)	-9.8889 (8.7588)	-10.2432 (10.4877)	-8.8012 (13.5203)
Poor Health	8.7075 (11.8849)	45.9097*** (12.0886)	29.4067** (11.6099)	13.8249 (13.2124)	7.9554 (12.0817)	6.9705 (17.3882)
Child Age	2.9738*** (0.5879)	1.8195 (1.2103)	2.4465** (1.1387)	2.9889*** (0.7011)	3.0403*** (0.8878)	2.7936*** (0.8663)
Metropolitan	7.0770* (4.0495)	7.9013 (8.1917)	6.3994 (4.6850)	5.1646 (5.1887)	8.6933* (4.6963)	7.3402 (4.6523)
Lone parent HH	-3.3951 (7.7869)	-2.0449 (11.4206)	-17.1397 (14.8781)	-7.4870 (14.2345)	-0.3663 (10.4804)	-3.8416 (9.3756)
HH Size	-2.5968 (2.4431)	1.8430 (4.1589)	-2.3867 (3.8249)	-4.8870 (3.0641)	-5.9048* (3.1695)	-2.9303 (4.8853)
Younger Siblings	10.7862** (4.8593)	7.3333 (12.3796)	11.5225 (10.2732)	13.6150** (5.3578)	13.4257*** (4.8588)	9.0571 (6.2736)
Older Siblings	-11.8166** (4.6565)	-15.2990 (10.3160)	-13.6753 (10.0923)	-9.8781 (6.4358)	-6.9705 (5.9805)	-13.7897* (7.1307)
Mother Employed	1.8246 (3.5328)	3.0832 (9.7840)	6.0180 (6.3141)	0.4297 (6.2138)	0.0438 (5.2201)	1.7020 (6.0003)
Mother Age	0.9241** (0.3649)	0.4715 (0.8387)	0.4554 (0.6053)	1.2152** (0.5435)	1.1002*** (0.3855)	1.1688*** (0.4502)
hhinc04	0.0135*** (0.0035)	0.0132 (0.0085)	0.0149** (0.0070)	0.0173*** (0.0050)	0.0117*** (0.0042)	0.0098** (0.0047)
Vic	2.6396 (3.8246)	1.8783 (10.5950)	7.6944 (8.6307)	3.1970 (5.9451)	-4.0922 (5.2772)	-3.0987 (5.0660)
Qld	-15.8445*** (5.8112)	-16.2180 (13.9585)	-25.3408** (10.7564)	-19.2800** (8.2735)	-6.6424 (6.4646)	-13.2725* (6.9592)
Other States	-20.0503*** (5.8112)	-22.4030** (10.3674)	-21.0982*** (7.0915)	-21.0866*** (5.8009)	-20.5026*** (5.4489)	-19.7504*** (6.3636)
MQual – Year 12	13.7405** (6.0076)	-0.2585 (13.0613)	11.9269 (12.9250)	5.7611 (7.6061)	17.4117** (7.8605)	17.3733* (9.2624)
MQual –non Degree	11.0202*** (3.9595)	-5.7042 (12.8941)	8.2989 (8.7507)	7.8384 (7.8050)	10.8458* (6.3292)	11.2034* (5.9509)
MQual - Degree	36.1964*** (4.5013)	31.1204** (12.0958)	30.1159*** (9.2320)	33.4708*** (6.5422)	33.5955*** (5.5122)	35.8448*** (7.5440)
Constant	236.3522*** (33.3673)	156.9901** (66.0748)	181.8838*** (66.9489)	189.4196*** (48.2082)	241.9613*** (50.5343)	289.7694*** (52.2777)
Observations	2008	2008	2008	2008	2008	2008
R ²	0.151	--	--	--	--	--
Pseudo R ²	--	0.099	0.097	0.092	0.083	0.074

Bootstrap Standard Errors (N = 20) in parentheses. ***, **, and * represent statistical significance at the 1%, 5% and 10% levels respectively.

Table A7: OLS and Quantile Estimates - with *Who Am I?*

Numeracy	OLS	Lev 1/2 (Q04)	Lev 2/3 (Q10)	Lev 3/4 (Q28)	Lev 4/5 (Q54)	Lev 5/6 (Q79)
ECD	8.639 (5.495)	4.755 (12.482)	6.190 (10.887)	7.229 (8.011)	6.191 (6.145)	11.992 (8.3675)
TCD	10.344 (7.935)	10.567 (17.299)	7.462 (15.998)	8.128 (10.969)	3.753 (8.614)	14.611 (11.173)
CC	12.786** (5.968)	13.533 (13.508)	7.259 (12.703)	8.040 (9.230)	10.945 (7.291)	17.913** (8.694)
CERT	12.239 (11.743)	11.816 (23.047)	8.260 (20.867)	14.380 (14.5051)	11.356 (12.359)	7.750 (19.194)
OTH	7.039 (6.876)	10.590 (15.860)	6.102 (12.216)	8.1253 (9.9496)	4.966 (8.546)	9.909 (10.781)
Reading	OLS	Lev 1/2 (Q05)	Lev 2/3 (Q14)	Lev 3/4 (Q28)	Lev 4/5 (Q49)	Lev 5/6 (Q75)
ECD	13.817** (6.504)	3.625 (16.114)	14.053 (9.803)	13.987 (9.158)	14.545 (10.033)	11.182 (9.295)
TCD	14.836 (9.370)	2.944 (20.125)	5.927 (16.216)	15.023 (14.437)	16.342 (11.235)	8.748 (11.631)
CC	17.789*** (6.870)	7.628 (16.675)	13.640 (10.321)	18.101* (9.676)	21.384** (9.992)	15.431 (9.730)
CERT	14.104 (14.285)	16.193 (81.769)	13.588 (18.497)	15.047 (17.460)	12.534 (17.676)	12.610 (19.727)
OTH	12.689 (8.315)	18.835 (17.667)	7.661 (13.522)	9.764 (10.924)	15.928 (12.725)	12.133 (11.234)
Spelling	OLS	Lev 1/2 (Q05)	Lev 2/3 (Q13)	Lev 3/4 (Q27)	Lev 4/5 (Q54)	Lev 5/6 (Q80)
ECD	13.122** (5.798)	9.802 (15.999)	14.680 (10.225)	18.868** (7.805)	21.461*** (7.533)	11.521 (10.268)
TCD	14.118* (8.433)	8.445 (18.526)	12.279 (13.261)	17.753 (11.993)	19.895* (11.998)	13.314 (13.121)
CC	15.021** (6.293)	13.010 (16.678)	15.862 (10.107)	20.193** (8.168)	23.099*** (7.753)	13.364 (10.812)
CERT	16.426 (11.507)	26.503 (32.270)	20.308 (17.579)	31.764 (20.347)	18.330 (13.303)	14.231 (20.130)
OTH	10.420 (7.453)	16.086 (19.247)	20.124* (11.555)	16.997* (9.529)	19.532** (8.640)	4.450 (12.474)
Writing	OLS	Lev 1/2 (Q04)	Lev 2/3 (Q08)	Lev 3/4 (Q22)	Lev 4/5 (Q48)	Lev 5/6 (Q75)
ECD	8.085 (5.163)	10.632 (15.743)	16.587 (11.847)	14.537 (9.749)	11.270** (5.691)	4.731 (9.308)
TCD	18.083** (7.131)	26.254 (20.352)	28.240* (16.996)	25.831* (15.094)	24.459*** (8.169)	14.788 (11.770)
CC	7.068 (5.594)	3.151 (16.958)	8.101 (12.165)	7.520 (11.136)	8.993 (6.407)	7.490 (9.261)
CERT	7.957 (10.686)	0.140 (44.532)	11.273 (26.178)	10.881 (18.825)	13.229 (13.031)	1.213 (14.904)
OTH	5.139 (6.404)	8.209 (19.410)	15.527 (14.353)	15.011 (11.755)	6.093 (7.544)	1.309 (11.341)
Grammar	OLS	Lev 1/2 (Q05)	Lev 2/3 (Q11)	Lev 3/4 (Q28)	Lev 4/5 (Q50)	Lev 5/6 (Q69)
ECD	6.763 (6.468)	8.811 (15.819)	8.605 (13.527)	6.831 (9.354)	6.049 (6.795)	5.552 (9.491)
TCD	11.501 (9.734)	13.703 (23.778)	15.457 (16.867)	1.752 (12.229)	4.387 (11.395)	10.178 (15.983)
CC	13.086* (7.113)	18.493 (20.151)	15.493 (13.666)	9.139 (10.287)	11.724 (8.109)	15.240 (10.197)
CERT	4.186 (13.819)	3.323 (39.213)	14.847 (28.044)	2.580 (20.386)	5.870 (20.781)	10.345 (18.033)
OTH	6.657 (8.405)	13.158 (21.461)	21.790 (15.625)	8.040 (9.885)	-0.381 (9.763)	2.262 (12.450)

Bootstrap Standard Errors (N = 20) in parentheses. ***, ** and * represent statistical significance at the 1%, 5% and 10% levels respectively.

Australian Early Development Census National Report 2015

A Snapshot of Early Childhood Development in Australia

Bundle B - 5376



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Since 2002, the Australian Government has worked in partnership with eminent child health research institutes – Centre for Community Child Health, The Royal Children's Hospital, Melbourne; and the Telethon Kids Institute, Perth – to deliver the Australian Early Development Index (AEDI) programme to communities nationwide.

On 1 July 2014, AEDI programme became known as the Australian Early Development Census (AEDC), and was launched through a new website. The Australian Government continues to work with its partners, and with state and territory governments to implement the AEDC.

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Foreword



Like all parents I know that one of my most important responsibilities is to support my children's development. I want reassurance they are on track physically, socially and cognitively, and if there are gaps, I want to know what I can do to help.

As the Minister for Education and Training I want to understand how Australian children are developing and what the Government and the community can do to assist.

That's where the Australian Early Development Census is vital.

While the 2015 data shows improvements in areas like literacy and numeracy through languages and communications skills, it also highlights that there is work we all need to do to give young Australians the best possible start.

That's why the Turnbull Government's investment in early childhood education and care over the next four years will be almost \$40 billion, including more than \$3 billion extra to ensure the system is more accessible, affordable and fairer for Australian families. This is the single largest investment in early learning and child care that this country has ever seen. We have also committed \$843 million over the next two years

to guarantee Federal support for 15 hours a week of quality preschool education for children in the year before school.

What is also important is that parents are involved and active in their child's learning. The Turnbull Government has focused so strongly on parental engagement as we all know that families and carers are some of the key influences on a child's education.

The data is an excellent resource for government, teachers, school, communities, researchers and educational experts. We will use it to identify where our children are doing well and where they need more support. Adding to the 2009 and 2012 data with this latest set of information will help us all head off educational disadvantage before it becomes entrenched.

The Census is a tool we can all use to get into the detail of where our children are doing well, and where they need more support.

I would like to thank our partners for their help in compiling this report – the state and territory governments, Telethon Kids Institute, Perth and the Centre for Community Child Health at the Royal Children's Hospital Melbourne.

Along with this national report, there are community maps and profiles with a wealth of information about children's progress in each of the five domains measured. There is emerging trend data on developmental vulnerability at the community, state/territory and national level since 2009, as well as more general information.

The 2015 AEDC report and supporting material is free to download from the AEDC website www.aedc.gov.au.

I'll be using this data to build on work underway at a government level and with our partners in the broader community. Like all Australians I want the best for our children and the Australian Early Development Census will help us achieve that goal.

A handwritten signature in blue ink, reading "Simon Birmingham".

Senator the Hon Simon Birmingham
Minister for Education and Training

Executive summary

“A majority of children are developmentally on track for each of the five AEDC domains, for each of the three collections. The strongest emerging trend over the period 2009 to 2015 was in the language and cognitive skills (school-based) domain”

The Australian Early Development Census (AEDC) measures the development of children in Australia in their first year of full-time school. AEDC data is collected using an adapted version of the Early Development Instrument, which was developed in Canada.

The AEDC provides important information to communities, governments and schools to support their planning and service provision. The early environments and experiences children are exposed to shape their development. The AEDC is considered to be a measure of how well children and families are supported from conception through to school age.

Research shows that investing time, effort and resources in children's early years, when their brains are developing rapidly, benefits children and the whole community. Early developmental gains support children through their school years and beyond.

The AEDC helps schools, communities and policy makers understand how children are developing before they start their first year of full-time school, what is being done well and what can be improved.

Data from the AEDC can help identify the types of services, resources or support to meet the needs of communities.

Emerging trends: Key findings

With data sets covering three collections, results from 2009, 2012 and 2015, the AEDC can be compared to identify emerging trends in early childhood development across Australia.

A majority of children are developmentally on track for each of the five AEDC domains, for each of the three collections.

The strongest emerging trend over the period 2009 to 2015 was in the language and cognitive skills (school-based) domain, with the proportion of children developmentally on track increasing from 77.1 per cent in 2009 to 84.6 per cent in 2015.

There was also a positive trend in the communication skills and general knowledge domain, with the proportion of developmentally vulnerable children decreasing from 9.2 per cent in 2009 to 8.5 per cent in 2015.

For the emotional maturity domain, the initial increase in the proportion of children developmentally on track (from 75.6 per cent in 2009 to 78.1 per cent in 2012) was not sustained, falling back to 76.4 per cent in 2015.

For the social competence domain, the overall proportion of children developmentally on track in 2015 (75.2 per cent) is a small decrease from 2009 (75.4 per cent).

The physical health and well-being domain was the most stable domain over the three collections. There was no change in the proportion of developmentally vulnerable children between 2009 and 2012, with a small, statistically significant increase from 9.3 per cent to 9.7 per cent from 2012 to 2015.

Following a decrease in the proportion of children developmentally vulnerable on one or more domain(s) from 23.6 per cent in 2009 to 22.0 per cent in 2012, there was no change in 2015 (22.0 per cent).

The proportion of children developmentally vulnerable on two or more domains decreased from 11.8 per cent in 2009 to 10.8 per cent in 2012, followed by a small increase in 2015 to 11.1 per cent.

Executive summary

Over the period 2009 to 2015, the gap between the proportion of developmentally vulnerable children in the most disadvantaged areas, relative to the least disadvantaged areas, widened across all five domains.

A widening gap is also apparent for children in Very Remote Australia, relative to children in Major Cities.

The gap between Indigenous and non-Indigenous children is starting to close for some AEDC measures. For example, the gap between Indigenous and non-Indigenous children on the language and cognitive skills (school-based) domain fell from 20.7 percentage points in 2009 to 14.5 percentage points in 2015.



Background on the AEDC

“In 2009, Australia became the first country in the world to collect national data on the developmental health and wellbeing of all children as they start their first year of full-time school.”

The importance of early childhood development

Early childhood development is increasingly recognised as a key predictor of future outcomes for children. Research has shown that investing time, effort and resources in the early years of a child's life has significant impacts on their behaviour, learning, health and wellbeing, as they transition from childhood to adulthood. Supporting early childhood development thus lays the basis for children to grow up with the skills to succeed, bringing benefits for them and the community as a whole.

About the AEDC

The AEDC is a national measure of children's development, as they enter their first year of full-time school. The data for the AEDC is collected every three years using the Australian version of the Early Development Instrument (EDI), adapted from Canada. Participation is voluntary with data collected through the cooperation of parents and the active involvement of the government, Catholic and independent schools sectors across Australia.

In 2009, Australia became the first country in the world to collect national data on the developmental health and wellbeing of all children as they start their first year of full-time school. The success of the collection laid the foundation for the Australian Government's commitment to ongoing AEDC data collection cycles. In 2012, the AEDC undertook the second collection followed by the third collection in 2015.

The AEDC highlights what is working well and what needs to be improved or developed to support children and their families, and helps communities know how their children are progressing. As a population-based measure, the AEDC is not designed to be an individual diagnostic tool. As such, results are reported publicly at a community level, acknowledging Australia's diverse cultural context. The AEDC provides evidence to guide planning and service-provision to ensure children are supported through their early years, school years and beyond.

About the AEDC domains

The Australian version of the Early Development Instrument consists of approximately 100 questions across five key domains, which are closely linked to child health, education and social outcomes. The domains are:

- physical health and wellbeing
- social competence
- emotional maturity
- language and cognitive skills (school-based)
- communication skills and general knowledge.

The AEDC domains, domain icons and domain descriptions are outlined in Table 1.

For each of the five AEDC domains, children receive a score between zero and ten, where zero is most developmentally vulnerable. AEDC results are reported as percentage of children who are considered to be 'developmentally on track', 'developmentally at risk' and 'developmentally vulnerable' on each domain.

The AEDC domains have been shown to predict children's later outcomes in health, wellbeing and academic success.

For further information about the domains and domain characteristics (developmentally on track, at risk and vulnerable) please refer to the fact sheet *About the AEDC domains*¹.

History of the AEDC

The third national roll-out of the AEDC benefits from more than 13 years of implementing the AEDC in Australia and the Early Development Instrument (EDI) in Canada. In 2002, the EDI was tested through a number of pilot studies across the northern metropolitan suburbs of Perth in Western Australia. This resulted in the Australian Government funding the *Australian Early Development Index: Building Better Communities for Children* project between 2004 and 2008. Through this project, a number of validation studies and national trials across 60 communities were undertaken to ensure rigorous adaptation of the Canadian EDI to the Australian context.

Following the success of these studies the Australian Government funded the national roll-out of the Australian Early Development Index (AEDI) in 2009. An Indigenous Adaptation Study was also

undertaken to assess the cultural validity of the EDI for Indigenous children, and adapt it to make it relevant to Australia's diverse cultural population. The success of the 2009 collection led to the Australian Government's commitment to funding the ongoing national measurement of the health and wellbeing of children in Australia. In 2012, the AEDI was rolled out for a second time, using the same approach as the first collection. Instruments were completed based on teacher's knowledge and observation of children, along with

demographic information from their school enrolment forms. To clearly distinguish the AEDC programme of work from the data collection, the instrument used in the census (the Australian version of the Early Development Instrument), the Australian Early Development Index (AEDI) was renamed the Australian Early Development Census (AEDC) in July 2014. In 2015, the third round of the AEDC was completed, providing the first opportunity to start tracking emerging trends across the six years (2009-2015) for the five AEDC domains.

Table 1: Descriptions of the AEDC developmental domains.

Domain	Icon	Domain description
Physical health and wellbeing		Children's physical readiness for the school day, physical independence and gross and fine motor skills.
Social competence		Children's overall social competence, responsibility and respect, approach to learning and readiness to explore new things.
Emotional maturity		Children's pro-social and helping behaviours and absence of anxious and fearful behaviour, aggressive behaviour and hyperactivity and inattention.
Language and cognitive skills (school-based)		Children's basic literacy, interest in literacy, numeracy and memory, advanced literacy and basic numeracy.
Communication skills and general knowledge		Children's communication skills and general knowledge based on broad developmental competencies and skills.

AEDC score

AEDC domain scores are calculated for each domain for each individual child where enough valid responses have been recorded.

In the first data collection cycle a series of cut-off scores was established for each of the five domains:

- children falling below the 10th percentile were categorised as 'developmentally vulnerable'
- children falling between the 10th and 25th percentile were categorised as 'developmentally at risk'
- all other children were categorised as 'developmentally on track'.

The cut-off scores set in 2009 provide a reference point against which later AEDC results can be compared. These have remained the same across the three collection cycles.

How the AEDC results are reported

AEDC results are presented as the number and percentage of children who are developmentally on track, developmentally at risk and developmentally vulnerable in

¹ www.aedc.gov.au/abtdom

each domain. Further, two summary indicators are presented to show the percentage of children who are developmentally vulnerable on one or more domain(s) and developmentally vulnerable on two or more domains. Domain information about children with special needs is not included in the AEDC results because of the already identified substantial developmental needs of this group. However, teachers complete demographic information on children with special needs to enable communities to be responsive to all children in their community. Upon request, researchers may access data on special needs children. Further information can be found at [Understanding the AEDC Results](#)¹.

How to compare results across years

With data sets covering three collections, results from 2009, 2012 and 2015 can be compared to assess changes in child development over time.

Communities across Australia will see some change in the percentage of children who are developmentally

on track, at risk or vulnerable in 2015 compared to previous years. In some cases this difference will be small and in others, it will be more substantial.

To assist in making informed decisions about whether there has been a large enough change in the percentage of children considered developmentally on track, at risk or vulnerable over time to be considered significant, a method described as the critical difference has been developed.

The critical difference is the minimum percentage point change required between collection cycles (2009, 2012 and 2015) for the results to represent a 'significant change' in children's development.

For more information on the calculation of the critical difference, refer to the AEDC technical report **Calculation of the Critical Difference?**

In the 2012 AEDC National Report, the remoteness and Socio-Economic Indexes for Areas (SEIFA) category for each child was derived from their local community to enable comparisons to 2009, as detailed geographical information was not

available for children participating in the 2009 collection at the time. Between the 2012 and 2015 collections a large amount of work was done to identify more detailed geographical information for children that participated in the 2009 collection. It is more accurate to identify remoteness and SEIFA for each child at a more detailed level, and as such the SEIFA and remoteness are reported at the SA¹ level now that this data is available across all three collections.

How to use the AEDC data

The AEDC can be used by communities, schools, government and non-government agencies and policy makers, in conjunction with other resources (such as state/territory and national statistics) to plan and evaluate efforts to create optimal early childhood development outcomes. At the government level, the AEDC provides a sound basis for strategic planning, policy creation and policy evaluation. Policy makers can use AEDC results to help allocate resources and services to more effectively meet the needs of

children and families. Governments of all levels can use the AEDC data to inform their strategic plans, to monitor the progress of communities over time and to assess the impact of policy changes.

The AEDC data is a powerful tool for initiating conversations and partnerships across education, health and community services. Providing a common ground from which key stakeholders can work together, the AEDC can enable governments at all levels, policy makers and communities to form partnerships to plan and implement activities, programmes and services to help shape the future and wellbeing of children in Australia.

For further information on how to use the AEDC results refer to the **AEDC User Guide**³.

¹ www.aedc.gov.au/about-the-aedc/how-to-understand-the-aedc-results

² www.aedc.gov.au/trcd

³ www.aedc.gov.au/resources/aedc-userguide

Demographics of Australian children included in the AEDC

Participation in AEDC across Australia

Table 2 shows the distribution of children included for the AEDC by state and territory.

As can be seen, the majority of participants resided in New South Wales, Victoria and Queensland.

Further, it is evident that participation in the AEDC by each state and territory has remained consistent across the three collection cycles.

Table 3 outlines the number of children, teachers and schools contributing to the AEDC results nationally.

Demographic snapshot

Table 4 shows the demographic profile, at a national level, of children who were included in the AEDC.

As can be seen there has been a slight increase in the proportion of Indigenous children, children born in another country and those with English as a second language.

The Australian population is one of the most culturally and linguistically diverse in the world and this is represented in the children included in the AEDC. The number of children with a Language Background Other

Table 2: Demographic profile of children in the AEDC (2009, 2012, 2015).

Geography	Number and %	2009	2012	2015
Australia	Number	261,147	289,973	302,003
	Per cent	97.5	96.5	96.5
New South Wales (NSW)	Number	86,931	94,323	95,897
	Per cent	99.9	97.3	96.8
Victoria (VIC)	Number	61,242	67,960	71,786
	Per cent	94.2	92.9	94.3
Queensland (QLD)	Number	55,464	61,607	65,214
	Per cent	99.1	97.6	97.1
Western Australia (WA)	Number	27,575	32,160	33,816
	Per cent	99.6	99.0	98.7
South Australia (SA)	Number	16,211	18,925	19,678
	Per cent	87.8 [^]	96.9	96.4
Tasmania (TAS)	Number	5,917	6,429	6,425
	Per cent	99.6	98.4	99.0
Australian Capital Territory (ACT)	Number	4,611	5,106	5,604
	Per cent	104.2 [*]	99.9	99.3
Northern Territory (NT)	Number	3,196	3,463	3,583
	Per cent	92.2	95.9	98.0

[^] There are four school intakes per year in South Australia (one per term) in 2009 and 2012. To complete an instrument, it is recommended that the teacher has known the child for at least one month. And children who started school in Term 2 may not have been at school for sufficient time to be included in the AEDC data collection.

^{*} More children were included in the AEDC than the estimated number of eligible children.

Than English (LBOTE) and those with an English Only background is provided in Table 5.

It should be noted that Indigenous children who have LBOTE status are part of the LBOTE group. That is, it is possible for children to be both Indigenous and have LBOTE status.

Age

Nationally, across all three data collections the mean age of children (at the time the AEDC instruments were completed) was 5 years and 7 months (refer to Table 6). The mean age of children in each state and territory was consistent across all three data collections. However, there was some variation in mean age between states and territories with the highest being 5 years and 11 months, whilst the lowest was 5 years and 4 months. These differences in mean age by state and territory reflect the different starting ages for children in their first year of full-time school.

Table 3: Number of children, schools and teachers participating in AEDC nationally (2009, 2012, 2015).

Total number of children included	2009	2012	2015
Total number of children included	261,147	289,973	302,003
Teachers contributing to the results	15,522	16,425	16,968
Schools contributing to the results	7,422	7,417	7,510

Table 4: Demographic profile of children in the AEDC (2009, 2012, 2015).

Category	Number of children			Per cent		
	2009	2012	2015	2009	2012	2015
Sex – Male children	134,031	148,985	154,846	51.3	51.4	51.3
Sex – Female children	127,116	140,988	147,157	48.7	48.6	48.7
Indigenous children	12,416	15,490	17,351	4.8	5.3	5.7
Children born in another country	17,119	21,718	22,549	6.6	7.5	7.5
Children with English as a second language	33,526	41,506	45,226	12.8	14.3	15.0

Table 5: Language diversity of children in the AEDC (2009, 2012, 2015).

Category	Number of children			Per cent		
	2009	2012	2015	2009	2012	2015
LBOTE – Total ¹	46,967	55,489	64,881	18.0	19.1	21.5
LBOTE – Not proficient in English	7,596	7,893	8,252	2.9	2.7	2.7
LBOTE – Proficient in English	38,513	46,880	56,127	14.7	16.2	18.6
English Only – Total ²	214,180	234,484	237,122	82.0	80.9	78.5
English Only – Not proficient in English	10,489	11,031	10,920	4.0	3.8	3.6
English Only – Proficient in English	202,241	221,990	225,562	77.4	76.6	74.7

¹ Total for LBOTE includes children that are NOT proficient in English, ARE proficient in English, as well as children whose proficiency in English is unknown.

² Total children who speak only English at home includes children that are NOT proficient in English, ARE proficient in English, as well as children whose proficiency is unknown.

Children with additional or special needs

Table 7 shows the number and proportion of children included in the AEDC with special needs status and the number and proportion of children needing further assessment. Children with special needs status are those who have chronic medical, physical or intellectual disabilities that require special assistance, based on medical diagnosis. The proportion of special needs status children decreased slightly from 4.9 per cent in 2012, to 4.7 per cent in 2015. The proportion of children identified by teachers as requiring further assessment increased from 10.3 per cent in 2012, to 11.6 per cent in 2015.

Table 6: Mean age of children in the AEDC, grouped by child's residential state/territory (2009, 2012, 2015).

Child's residential state/territory	2009	2012	2015
Australia	5 years 7 months	5 years 7 months	5 years 7 months
New South Wales (NSW)	5 years 6 months	5 years 7 months	5 years 7 months
Victoria (VIC)	5 years 9 months	5 years 9 months	5 years 9 months
Queensland (QLD)	5 years 5 months	5 years 5 months	5 years 5 months
Western Australia (WA)	5 years 4 months	5 years 4 months	5 years 4 months
South Australia (SA)	5 years 7 months	5 years 7 months	5 years 7 months
Tasmania (TAS)	5 years 11 months	5 years 11 months	5 years 11 months
Australian Capital Territory (ACT)	5 years 7 months	5 years 8 months	5 years 7 months
Northern Territory (NT)	5 years 5 months	5 years 5 months	5 years 5 months

Table 7: Children with additional or special needs.

Category	Number of children			Per cent		
	2009	2012	2015	2009	2012	2015
Children with special needs status	11,484	14,173	14,065	4.4	4.9	4.7
Children needing further assessment (e.g. medical and physical, behaviour management, emotional and cognitive development)	27,218	29,628	34,793	10.5	10.3	11.6

Emerging trends in early childhood development across Australia



With data sets covering three collections, results from 2009, 2012 and 2015 can be compared to identify emerging trends in early childhood development across Australia.

At the national level, the strongest emerging trend over the period 2009 to 2015 was in the language and cognitive skills (school-based) domain, with developmental vulnerability decreasing from 8.9 per cent in 2009, to 6.8 per cent in 2012, and 6.5 per cent in 2015. There was also a significant decrease in the proportion of children developmentally at risk, from 14.0 per cent in 2009, to 10.6 per cent in 2012 and 8.9 per cent in 2015. There was a corresponding increase in the proportion of children developmentally on track from 77.1 per cent in 2009 to 82.6 per cent in 2012 to 84.6 per cent in 2015.

There was also a positive trend over the three collections in the communication skills and general knowledge domain, with the proportion of developmentally vulnerable children decreasing from 9.2 per cent in 2009, to 9.0 per cent in 2012, to 8.5 per cent in 2015. Whilst there was an increase in the proportion of children developmentally at risk from 15.8

per cent in 2009 to 16.3 per cent in 2012, this was followed by a large decline to 15.1 per cent in 2015. The overall proportion of children developmentally on track increased from 75.0 per cent in 2009 to 76.3 per cent in 2015.

The largest shift in the proportion of developmentally vulnerable children between the two most recent collections occurred in the emotional maturity domain, from 7.6 per cent in 2012 to 8.4 per cent in 2015. This remains below the 2009 level (8.9 per cent). The pattern for the proportion of developmentally at risk children was similar, starting at 15.5 per cent in 2009, decreasing to 14.2 per cent in 2012, then increasing in 2015 to 15.3 per cent, just below the 2009 level. The initial increase in the proportion of children developmentally on track from 2009 (75.6 per cent) to 2012 (78.1 per cent) was not sustained, and whilst it fell back to 76.4 per cent in 2015, it remains above the 2009 level.

After decreasing from 9.5 per cent to 9.3 per cent from 2009 to 2012, the proportion of children developmentally vulnerable on the social competence domain increased to 9.9 per cent in 2015. There was a similar pattern for the proportion

of children developmentally at risk, falling initially from 15.2 per cent in 2009 to 14.3 per cent in 2012, before increasing to 15.0 per cent in 2015. The overall proportion of children developmentally on track in 2015 (75.2 per cent) is slightly higher than in 2009 (75.4 per cent).

Over the period 2009 to 2015, the physical health and well-being domain was the most stable domain overall. There was no change in the proportion of developmentally vulnerable children between 2009 and 2012, with a small, statistically significant increase from 9.3 per cent to 9.7 per cent from 2012 to 2015. The proportion of children developmentally at risk increased from 13.0 per cent to 13.4 per cent from 2009 to 2012, before falling back to the 2009 level in 2015. After decreasing from 77.7 per cent to 77.3 per cent between 2009 and 2012, the proportion of children developmentally on track was unchanged in 2015 at 77.3 per cent. Following a decrease in the proportion of children developmentally vulnerable on one or more domain(s) from 23.6 per cent in 2009 to 22.0 per cent in 2012, there was no change in 2015 (22.0 per cent).

Emerging trends

There was a broadly similar pattern for the proportion of children developmentally vulnerable on two or more domains, with a decrease from 11.8 per cent in 2009 to 10.8 per cent in 2012, followed by a small increase in 2015 to 11.1 per cent.

Over the period 2009 to 2015, the gap between the proportion of developmentally vulnerable children in the most disadvantaged areas, relative to the least disadvantaged areas, widened across all five domains. This was also the case for the proportion of children vulnerable on one or more domain(s), and the proportion of children vulnerable on two or more domains. By way of example, for the language and cognitive skills (school-based) domain, children in the most disadvantaged areas in 2009 were 2.9 times more likely to be developmentally vulnerable, relative to children in the least disadvantaged areas. By 2015, children in the most disadvantaged areas were 4.1 times more likely to be developmentally vulnerable, relative to children in the least disadvantaged areas.

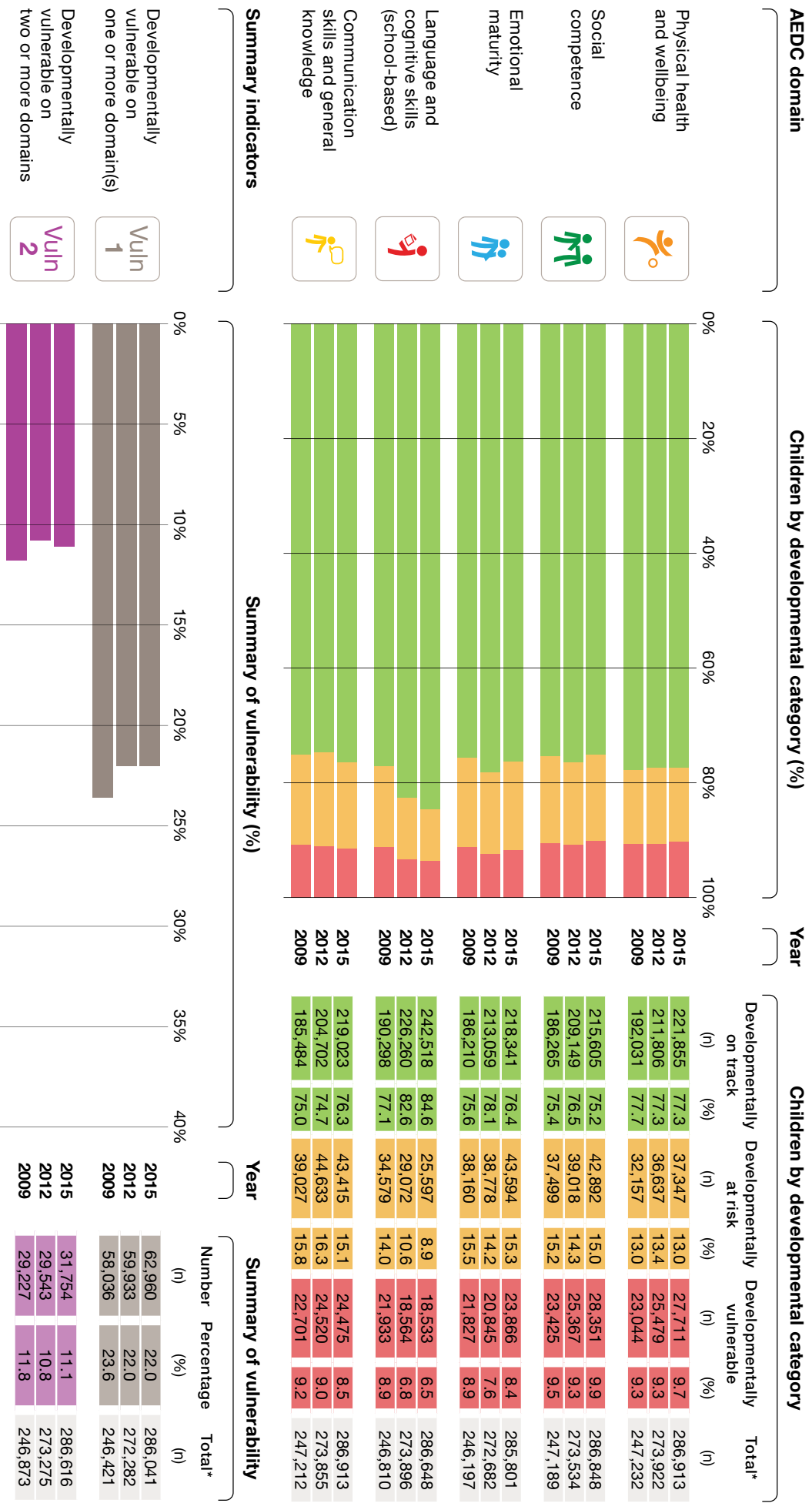
A widening gap is also apparent for other background variables, particularly remoteness. Again for the language and cognitive skills (school-based) domain, children in Very Remote Australia in 2009 were 3.8 times more likely than children in Major Cities to be developmentally vulnerable, increasing to 4.8 times more likely in 2015.

There is some initial indication that the gap between Indigenous and non-Indigenous children may be starting to close for some measures. For example, the gap between Indigenous and non-Indigenous children on the language and cognitive skills (school-based) domain fell from 20.7 percentage points in 2009, to 16.5 percentage points in 2012 and 14.5 percentage points in 2015. For children developmentally vulnerable on one or more domain(s), the gap was 25.0 percentage points in 2009, closing to 21.3 percentage points by 2015. Similarly, for children developmentally vulnerable on two or more domains, the gap was 18.6 percentage points in 2009, closing to 16.0 percentage points by 2015.





National emerging trends by domain and developmental vulnerability (2009, 2012, 2015)



National emerging trends on the physical health and wellbeing domain



This domain measures children's physical readiness for the school day, physical independence, and gross and fine motor skills.

Table 8 provides an explanation of the characteristics of the physical health and wellbeing domain in relation to children who would be considered developmentally on track, at risk or vulnerable.

Summary of key findings: Physical health and wellbeing domain

- While there was no overall change in the percentage of children vulnerable on the physical health and well-being domain between 2009 and 2012, there was a small but statistically significant increase between 2012 and 2015 (9.3 to 9.7 per cent).
- The increase in developmental vulnerability from 2012 to 2015 was accompanied by a corresponding decrease in the percentage of children considered developmentally at risk on this domain (13.4 to 13.0 per cent).

- There was no change in the percentage of children who were on track. This moderate increase in developmental vulnerability in 2015 can be seen in nearly all of the child demographic variables listed in Table 9.
- There is a strong linear relationship between social disadvantage and physical health and wellbeing. Children living in the most socio-economically disadvantaged locations were more than twice as likely to be developmentally vulnerable than those from the least disadvantaged areas. The increase in developmental vulnerability was not restricted to children from disadvantaged areas but occurred in nearly all social strata.
- Similarly, there is a strong linear relationship between remoteness (distance from a major city) and scores on the physical health and well-being domain. Children living in Very Remote Australia were 2.6 times more likely to be developmentally vulnerable than children living in Major Cities. The increase in developmental vulnerability between 2012 and 2015 was not restricted to children in Remote and Very Remote locations. It also occurred in Major Cities and Inner Regional areas.

Table 8: Characteristics of the physical health and wellbeing domain.

Developmentally on track	Almost never have problems that interfere with their ability to physically cope with the school day. These children are generally independent, have excellent motor skills, and have energy levels that can get them through the school day.
Developmentally at risk	Experience some challenges that interfere with their ability to physically cope with the school day. This may include being dressed inappropriately, frequently late, hungry or tired. Children may also show poor coordination skills, have poor fine and gross motor skills, or show poor to average levels of energy levels during the school day.
Developmentally vulnerable	Experience a number of challenges that interfere with their ability to physically cope with the school day. This may include being dressed inappropriately, frequently late, hungry or tired. Children are usually clumsy and may have fading energy levels.

- Boys continue to be nearly twice as likely as girls to be developmentally vulnerable on this domain. The percentage for boys considered developmentally vulnerable increased significantly from 11.9 to 12.5 per cent between 2012 and 2015. There was a corresponding decline in 2015 in the percentage of boys who were on track.
- As in earlier years, Indigenous children in 2015 were twice as likely as non-Indigenous children to be developmentally vulnerable (21.0 and 9.0 per cent respectively). The percentage of Indigenous children vulnerable on this domain increased significantly between 2012 and 2015 but did not return to the highest level recorded in 2009.
- In 2015 children with a Language Background Other Than English (LBOTE) were no more likely than other children to be developmentally vulnerable in their physical health and wellbeing (9.8 compared with 9.6 per cent). This gap has been diminishing steadily since 2009.
- Focusing on the 9.8 per cent of LBOTE children who were developmentally vulnerable on this domain, those who were not proficient in English were four times more likely to be developmentally vulnerable (30.7 per cent) than LBOTE children who were proficient in English (7.1 per cent).
- Levels of developmental vulnerability were generally higher on this domain in 2015 than 2009 for the following groups of children: those who live in more disadvantaged or Very Remote locations, boys rather than girls, and children who were not proficient in English.

Table 9, shows the percentage of developmentally on track, at risk and vulnerable children on the physical health and wellbeing domain for the last three AEDC data collections (2009, 2012 and 2015).



Table 9: *Physical health and wellbeing domain results (2009, 2012, 2015).*

Category	Subcategory	Number of children			Developmentally on track (%)			Developmentally at risk (%)			Developmentally vulnerable (%)		
		2009	2012	2015	2009	2012	2015	2009	2012	2015	2009	2012	2015
Overall	Australia	247,232	273,922	286,913	77.7	77.3	77.3	13.0	13.4	13.0	9.3	9.3	9.7
Socio-economic status	Quintile 1 (most disadvantaged)	50,786	53,739	53,900	72.2	68.9	69.2	14.6	16.1	15.4	13.2	15.0	15.4
	Quintile 2	47,047	51,715	53,272	75.6	75.1	74.9	14.0	14.3	14.0	10.4	10.6	11.1
	Quintile 3	47,672	52,904	56,416	77.7	78.0	78.2	13.3	13.6	13.0	9.0	8.4	8.9
	Quintile 4	48,887	55,724	59,793	79.9	80.4	81.0	12.4	12.3	11.6	7.7	7.3	7.4
	Quintile 5 (least disadvantaged)	52,066	59,217	62,472	82.8	83.4	82.2	10.8	11.0	11.5	6.4	5.7	6.3
Geographic location	Major Cities	169,641	188,976	200,269	78.7	78.3	78.3	12.7	13.1	12.8	8.6	8.6	8.9
	Inner Regional	47,037	51,228	52,730	76.6	75.8	76.2	13.6	14.2	13.3	9.8	10.0	10.5
	Outer Regional	23,794	26,395	26,599	75.0	75.0	74.5	13.5	13.7	13.9	11.5	11.3	11.6
	Remote	3,983	4,468	4,425	74.3	75.3	74.2	12.5	13.5	12.7	13.2	11.2	13.1
Sex	Very Remote	2,748	2,855	2,890	61.6	63.6	61.6	16.6	15.7	15.0	21.8	20.7	23.4
	Male	124,682	138,001	144,435	73.8	73.5	73.0	14.4	14.6	14.4	11.8	11.9	12.5
	Female	122,550	135,921	142,478	81.6	81.2	81.7	11.6	12.1	11.6	6.8	6.7	6.8
Indigenous background	Indigenous	11,228	14,052	15,902	60.6	62.6	62.3	17.5	17.0	16.7	21.9	20.4	21.0
	Non-Indigenous	236,004	259,870	271,011	78.5	78.1	78.2	12.8	13.2	12.8	8.7	8.7	9.0
	LBOTE – Total ¹	44,022	52,471	62,074	76.1	76.3	76.6	13.4	13.7	13.6	10.6	9.9	9.8
Language diversity	LBOTE – Not proficient in English	6,339	6,664	7,111	49.5	48.6	45.9	21.3	21.9	23.4	29.2	29.5	30.7
	LBOTE – Proficient in English	37,586	45,685	54,926	80.6	80.4	80.6	12.0	12.5	12.3	7.4	7.1	7.1
	English Only – Total ²	203,210	221,451	224,839	78.0	77.6	77.5	12.9	13.3	12.9	9.1	9.2	9.6
	English Only – Not proficient in English	6,484	6,830	7,209	28.0	26.3	24.4	22.0	22.2	20.8	50.0	51.5	54.7
	English Only – Proficient in English	196,581	214,276	217,587	79.7	79.2	79.3	12.6	13.0	12.6	7.7	7.8	8.1

¹ Total for LBOTE includes children that are NOT proficient in English. ADE proficient in English, as well as children whose proficiency in English is unknown.

² Total children who speak only **Bundle B - 5393** ³ NOT proficient in English. ARE proficient in English, as well as children whose proficiency is unknown.

National emerging trends on the social competence domain



This domain measures children's overall social competence, responsibility and respect, approaches to learning, and readiness to explore new things.

Table 10 provides an explanation of the characteristics of the social competence domain in relation to children who would be considered developmentally on track, at risk or vulnerable.

Summary of key findings: Social competence domain

- The percentage of children who were developmentally vulnerable on the social competence domain increased from 9.5 and 9.3 per cent in 2009 and 2012 to 9.9 per cent in 2015. This change was more pronounced in larger jurisdictions.
- The increase in developmental vulnerability from 2012 to 2015 was also accompanied by a larger proportion of children developmentally at risk (14.3 to 15.0 per cent) and a corresponding decline in the percentage of children who were developmentally on track on the social competence domain (76.5 to 75.2 per cent). These changes can be seen in most of the child demographic variables listed in Table 11.

- The linear relationship between socio-economic disadvantage and social competence was evident once again. Children living in the most socio-economically disadvantaged locations were more than twice as likely to be developmentally vulnerable than those from the least disadvantaged areas. The most noticeable change from 2012 to 2015 was a fall in the proportion of children from the least disadvantaged locations who were developmentally on track (82.7 to 80.5 per cent). The 2.2 per cent decline can be seen
 - in corresponding increases in the proportion of children who were developmentally vulnerable (5.8 to 6.7 per cent) or developmentally at risk (11.6 to 12.8 per cent).
 - The same linear relationship between remoteness (distance from a major city) and social competence was also evident. Children living in Very Remote Australia were 2.6 times more likely to be developmentally vulnerable than children living in Major Cities. The percentage of children who were developmentally vulnerable or developmentally

Table 10: Characteristics of the social competence domain.

Developmentally on track	Almost never have problems getting along, working, or playing with other children; is respectful to adults, is self-confident, and is able to follow class routines; and is capable of helping others.
Developmentally at risk	Experience some challenges in the following areas: getting along with other children and teachers, playing with a variety of children in a cooperative manner, showing respect for others and for property, following instructions and class routines, taking responsibility for their actions, working independently, and exhibiting self-control and self-confidence.
Developmentally vulnerable	Experience a number of challenges with poor overall social skills. For example children who do not get along with other children on a regular basis, do not accept responsibility for their own actions and have difficulties following rules and class routines. Children may be disrespectful of adults, children, and others' property; have low self-confidence and self-control, do not adjust well to change; and are usually unable to work independently.

Social competence domain

at risk was significantly higher in 2015 than 2012 irrespective of the remoteness of the location and generally higher than in 2009. Children in Major Cities and Outer Regional areas tended towards an increase in the proportion who were developmentally at risk (13.7 to 14.5 per cent and 15.2 to 16.5 per cent respectively). Children from Inner Regional and Very Remote areas tended towards an increase in developmental vulnerability (9.1 to 10.2 per cent and 18.7 to 24.4 per cent respectively).

- Boys continue to be more than twice as likely as girls to be developmentally vulnerable on this domain. The percentage for boys developmentally vulnerable on the domain increased significantly from 12.7 to 13.6 per cent between 2012 and 2015. The percentage considered to be at risk also increased to the same degree and there was a corresponding decline in the percentage of boys who were on track. The same general pattern was apparent for girls but at half of the magnitude recorded for boys.

- Indigenous children in 2015 were more than twice as likely as non-Indigenous children to be developmentally vulnerable on this domain (20.5 and 9.3 per cent respectively). The percentage for Indigenous children vulnerable on this domain increased significantly by 1.8 per cent between 2012 and 2015. There was a corresponding decline in the percentage of children who were on track in 2012. However, the percentage of Indigenous children developmentally at risk was lower and the percentage developmentally on track remained higher in 2015 than in 2009.
- In 2015 children with a Language Background Other Than English (LBOTE) were more likely than other children to be developmentally vulnerable on this domain (11.7 and 9.4 per cent). The gap has persisted since 2009.
- Focusing on the 11.7 per cent of LBOTE children who were vulnerable on this domain, those who were not proficient in English were four times more likely to be developmentally vulnerable (38.5 per cent) than LBOTE children who were proficient in English (8.3 per cent).
- With very few exceptions, levels of developmental vulnerability were higher in 2015 than 2009 in virtually all of the comparisons described above.

Table 11 shows changes in the percentages of developmentally on track, at risk and vulnerable children on the social competence domain for the last three AEDC data collections (2009, 2012 and 2015).

The gap has persisted since 2009.

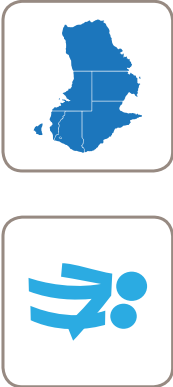


Table 11: Social competence domain results (2009, 2012, 2015).

Category	Subcategory	Number of children			Developmentally on track (%)			Developmentally at risk (%)			Developmentally vulnerable (%)		
		2009	2012	2015	2009	2012	2015	2009	2012	2015	2009	2012	2015
Overall	Australia	247,189	273,534	286,848	75.4	76.5	75.2	15.2	14.3	15.0	9.5	9.3	9.9
Socio-economic status	Quintile 1 (most disadvantaged)	50,769	53,671	53,886	69.2	67.8	66.9	17.5	17.9	18.0	13.3	14.3	15.2
	Quintile 2	47,037	51,676	53,252	73.1	74.2	72.9	16.4	15.2	16.0	10.6	10.6	11.0
	Quintile 3	47,669	52,817	56,402	75.6	77.5	76.0	15.2	14.0	14.7	9.2	8.5	9.3
	Quintile 4	48,882	55,634	59,781	77.8	79.4	78.3	14.2	13.0	13.8	8.0	7.6	7.9
	Quintile 5 (least disadvantaged)	52,059	59,115	62,468	81.0	82.7	80.5	12.6	11.6	12.8	6.4	5.8	6.7
Geographic location	Major Cities	169,619	188,709	200,235	76.4	77.3	76.1	14.7	13.7	14.5	8.9	8.9	9.3
	Inner Regional	47,027	51,175	52,720	74.3	75.8	74.5	15.8	15.2	15.3	9.9	9.1	10.2
	Outer Regional	23,792	26,336	26,595	72.7	73.8	72.0	16.2	15.2	16.5	11.1	10.9	11.6
	Remote	3,983	4,466	4,424	69.9	73.3	70.8	18.6	16.0	17.3	11.5	10.7	11.8
Sex	Very Remote	2,740	2,848	2,874	59.9	59.8	55.3	20.0	21.5	20.4	20.1	18.7	24.4
	Male	124,665	137,817	144,409	68.3	69.6	67.8	18.8	17.8	18.6	13.0	12.7	13.6
Indigenous background	Female	122,524	135,717	142,439	82.6	83.5	82.6	11.5	10.7	11.3	5.9	5.8	6.1
	Indigenous	11,211	14,041	15,892	58.7	60.7	59.2	21.2	20.7	20.4	20.2	18.7	20.5
Language diversity	Non-Indigenous	235,978	259,493	270,956	76.1	77.3	76.1	14.9	13.9	14.6	9.0	8.8	9.3
	LBOTE – Total ¹	43,996	52,383	62,042	71.9	73.3	72.7	16.3	15.5	15.6	11.8	11.2	11.7
	LBOTE – Not proficient in English	6,330	6,640	7,087	38.2	38.2	34.8	26.8	27.0	26.7	35.0	34.8	38.5
	LBOTE – Proficient in English	37,571	45,642	54,919	77.6	78.4	77.6	14.5	13.9	14.1	7.9	7.8	8.3
English Only – Proficient in English	English Only – Total ²	203,193	221,151	224,806	76.1	77.2	75.8	14.9	14.0	14.8	9.0	8.8	9.4
	English Only – Not proficient in English	6,483	6,825	7,208	25.8	28.2	24.2	28.7	26.6	27.1	45.5	45.2	48.7
	English Only – Proficient in English	196,572	214,022	217,556	77.8	78.8	77.6	14.5	13.6	14.4	7.8	7.6	8.1

¹ Total for LBOTE includes children that are NOT proficient in English, ARE proficient in English, as well as children whose proficiency in English is unknown.
² Total children who speak only English at home includes children that are NOT proficient in English, AI **Bundle B - 5396** ¹ whose proficiency is unknown. AEDC National Report 2015 | 21

National emerging trends on the emotional maturity domain



This domain measures children's pro-social and helping behaviour, anxious and fearful behaviour, aggressive behaviour and hyperactivity and inattention.

Table 12 provides an explanation of the characteristics of the emotional maturity domain in relation to children who would be considered developmentally on track, at risk or vulnerable.

Summary of key findings: Emotional maturity domain

- Although below 2009 levels (8.9 per cent), the largest shift in 2015 occurred in the emotional maturity domain. The percentage of children who were developmentally vulnerable increased from 7.6 per cent in 2012 to 8.4 per cent in 2015. All but one jurisdiction recorded an increase in developmental vulnerability on this domain.
- The increase in developmental vulnerability from 2012 to 2015 was accompanied by a larger proportion of children developmentally at risk (14.2 to 15.3 per cent) and a corresponding decline in the percentage of children who were developmentally on track on the emotional maturity

- domain (78.1 to 76.4 per cent). These changes occurred in nearly all of the child demographic variables listed in Table 13.
- The linear relationship between socio-economic disadvantage and emotional maturity was evident once again. Children living in the most socio-economically disadvantaged locations were twice as likely to be developmentally vulnerable than those from the least disadvantaged areas. Paralleling the social competence domain, the group which recorded the largest shift in emotional maturity from 2012 and 2015 were children from more privileged areas. The percentage of children who were developmentally on track fell from 83.2 per cent in 2012 to 80.8 per cent in 2015. The 2.5 per cent decline can be seen in corresponding increases in the proportion of children who were developmentally vulnerable (5.1 to 6.1 per cent) or developmentally at risk (11.6 to 13.2 per cent).
- The same linear relationship between remoteness (distance from a major city) and emotional maturity was also evident. Children living in Very Remote Australia were nearly three times more likely to be developmentally vulnerable than children living in Major Cities.

Table 12: Characteristics of the emotional maturity domain.

Developmentally on track	Almost never show aggressive, anxious, or impulsive behaviour. Children will have good concentration and will often help other children.
Developmentally at risk	Experience some challenges in the following areas: helping other children who are hurt, sick or upset, inviting other children to join in activities, being kind to other children, and waiting their turn in activities. They will sometimes experience problems with anxious behaviours, aggressive behaviour, temper tantrums, or problems with inattention or hyperactivity.
Developmentally vulnerable	Experience a number of challenges related to emotional regulation. For example problems managing aggressive behaviour, being prone to disobedience and/or easily distracted, inattentive, and impulsive. Children will usually not help others and are sometimes upset when left by their caregiver.

The increase between 2012 and 2015 in the percentages of children who were developmentally vulnerable or at risk was not restricted to Remote locations but occurred uniformly across all geographical locations.

- The largest gender difference across the five AEDC domains occurred in the emotional maturity domain. Boys were 3.4 times more likely than girls to be developmentally vulnerable on this domain and nearly twice as likely to be classified as developmentally at risk. While most of the increase in developmental vulnerability between 2012 and 2015 can be attributed to boys (11.8 to 12.9 per cent), both boys and girls shared a one per cent increase in the percentage considered developmentally at risk.
- The smallest difference between Indigenous and non-Indigenous children was on the emotional maturity domain, but in 2015 Indigenous children were still twice as likely to be developmentally vulnerable as non-Indigenous children (16.9 and 7.9 per cent respectively). The percentage for Indigenous children shifted back to 2009

levels (17.1 per cent), increasing from 15.6 per cent in 2012 to 16.9 per cent in 2015. However, the percentage of Indigenous children developmentally at risk was lower and the percentage developmentally on track remained higher in 2015 than in 2009.

- In 2015 children with a Language Background Other Than English (LBOTE) were no more likely than other children to be developmentally vulnerable on this domain (8.5 and 8.3 per cent).
- Focusing on the 8.5 per cent of LBOTE children who were vulnerable on this domain, those who were not proficient in English were nearly four times more likely to be developmentally vulnerable (23.8 per cent) than LBOTE children who were proficient in English (6.5 per cent).
- With very few exceptions, levels of developmental vulnerability were lower in 2015 than 2009 in virtually all of the comparisons described above.

Table 13 shows changes in the percentages of developmentally on track, at risk and vulnerable children on the emotional maturity domain for the last three AEDC data collections (2009, 2012 and 2015).

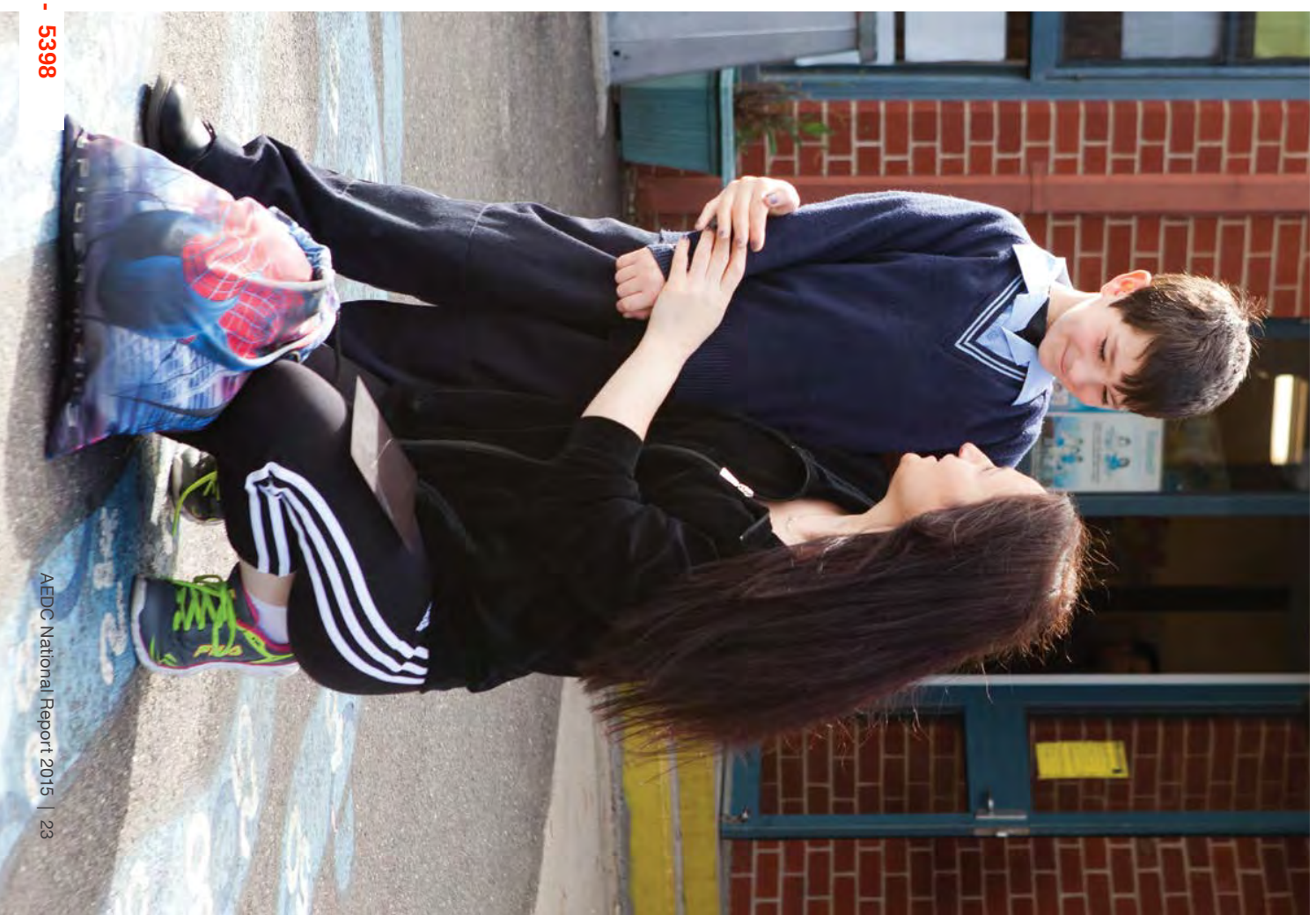


Table 13: Emotional maturity domain results (2009, 2012, 2015).

Category	Subcategory	Number of children			Developmentally on track (%)			Developmentally at risk (%)			Developmentally vulnerable (%)		
		2009	2012	2015	2009	2012	2015	2009	2012	2015	2009	2012	2015
Overall	Australia	246,197	272,682	285,801	75.6	78.1	76.4	15.5	14.2	15.3	8.9	7.6	8.4
Socio-economic status	Quintile 1 (most disadvantaged)	50,531	53,447	53,663	70.2	71.4	69.8	17.9	17.4	18.3	11.9	11.2	12.0
	Quintile 2	46,865	51,482	53,057	73.8	76.2	74.6	16.6	15.2	16.1	9.6	8.6	9.3
	Quintile 3	47,479	52,656	56,214	75.8	78.8	77.0	15.5	14.0	15.0	8.7	7.2	8.0
	Quintile 4	48,691	55,501	59,544	77.9	80.4	78.9	14.4	13.2	14.2	7.7	6.4	6.9
	Quintile 5 (least disadvantaged)	51,866	58,979	62,270	80.4	83.2	80.8	13.2	11.6	13.2	6.4	5.1	6.1
Geographic location	Major Cities	168,977	187,951	199,431	76.6	79.0	77.4	15.1	13.8	14.9	8.3	7.2	7.8
	Inner Regional	46,855	51,168	52,602	74.7	77.1	75.6	15.9	14.7	15.5	9.4	8.2	9.0
	Outer Regional	23,689	26,324	26,541	73.4	75.8	73.8	16.6	15.5	16.6	10.1	8.7	9.6
	Remote	3,947	4,449	4,398	69.3	75.7	71.6	17.7	15.6	17.9	12.9	8.7	10.5
Sex	Very Remote	2,703	2,790	2,829	59.1	61.9	55.9	22.5	19.5	22.0	18.4	18.6	22.1
	Male	124,059	137,205	143,784	66.7	69.6	67.5	19.8	18.6	19.7	13.5	11.8	12.9
	Female	122,138	135,477	142,017	84.7	86.7	85.5	11.1	9.8	10.8	4.2	3.4	3.8
Indigenous background	Indigenous	11,121	13,981	15,841	60.3	64.7	62.5	22.6	19.7	20.7	17.1	15.6	16.9
	Non-Indigenous	235,076	258,701	269,960	76.4	78.9	77.2	15.2	13.9	14.9	8.5	7.2	7.9
Language diversity	LBOTE – Total ¹	43,717	52,039	61,686	73.2	75.9	75.0	17.3	16.2	16.5	9.5	7.9	8.5
	LBOTE – Not proficient in English	6,243	6,562	7,024	46.2	48.0	43.9	30.4	30.9	32.4	23.3	21.1	23.8
	LBOTE – Proficient in English	37,383	45,350	54,625	77.7	80.0	79.0	15.1	14.0	14.5	7.2	6.0	6.5
	English Only – Total ²	202,480	220,643	224,115	76.2	78.7	76.8	15.1	13.8	14.9	8.7	7.6	8.3
	English Only – Not proficient in English	6,431	6,777	7,175	35.6	40.1	34.7	30.3	29.6	31.2	34.1	30.3	34.1
	English Only – Proficient in English	195,912	213,362	216,898	77.5	79.9	78.2	14.6	13.2	14.4	7.9	6.9	7.5

¹ Total for LBOTE includes children that are NOT proficient in English.² Total children who speak only **Bundle B - 5399** ^a NOT proficient in English, ARE proficient in English, as well as children whose proficiency is unknown.

National emerging trends on the language and cognitive skills (school-based) domain



This domain measures children's basic literacy, interest in literacy, numeracy and memory, advanced literacy and basic numeracy.

Table 14 provides an explanation of the characteristics of the language and cognitive skills (school-based) domain in relation to children who would be considered developmentally on track, at risk or vulnerable.

Summary of key findings: Language and cognitive skills (school-based) domain

- The percentage of children who were developmentally vulnerable on the language and cognitive skills (school-based) domain decreased dramatically from 8.9 per cent in 2009 to 6.8 per cent in 2012 and continued to fall to 6.5 per cent in 2015. The improvement in 2015 was mainly restricted to two jurisdictions.
- The decrease in developmental vulnerability from 2012 to 2015 was accompanied by a large decline in the proportion of children developmentally at risk (10.6 to 8.9 per cent) and a corresponding increase in the percentage of children who were on track on this domain (82.6 to

84.6 per cent). These changes occurred uniformly in all of the child demographic variables listed in Table 15.

- The linear relationship between socio-economic disadvantage and language and cognitive skills was quite marked. At the extremes, children living in the most socio-economically disadvantaged locations were four times as likely to be developmentally vulnerable than those from the least disadvantaged areas. Modest falls in developmental vulnerability occurred in all but the least socially disadvantaged locations. The proportion of children considered developmentally at risk on this domain decreased at all socio-economic levels. The improvement was especially pronounced (two per cent) among children living in the most disadvantaged locations.

Table 14: Characteristics of the language and cognitive skills (school-based) domain.

Developmentally on track	Children will be interested in books, reading and writing, and basic math; capable of reading and writing simple sentences and complex words. Will be able to count and recognise numbers and shapes.
Developmentally at risk	Have mastered some but not all of the following literacy and numeracy skills: being able to identify some letters and attach sounds to some letters, show awareness of rhyming words, know writing directions, being able to write their own name, count to 20, recognise shapes and numbers, compare numbers, sort and classify, and understand simple time concepts. Children may have difficulty remembering things, and show a lack of interest in books, reading, maths and numbers, and may not have mastered more advanced literacy skills such as reading and writing simple words or sentences.
Developmentally vulnerable	Experience a number of challenges in reading/writing and with numbers; unable to read and write simple words, will be uninterested in trying, and often unable to attach sounds to letters. Children will have difficulty remembering things, counting to 20, and recognising and comparing numbers; and usually not interested in numbers.

- The same linear relationship between remoteness (distance from a major city) and language and cognitive skills was also evident. Children living in Very Remote Australia were nearly five times more likely to be developmentally vulnerable than children living in Major Cities. Children in Very Remote areas were the only group which recorded a significant increase in developmental vulnerability between 2012 and 2015. Levels of developmental vulnerability decreased for children living in Major Cities and regional areas (Inner Regional and Outer Regional). The percentage of children considered to be developmentally at risk fell in all geographic locations. The most dramatic shifts occurred in Outer Regional and Remote areas between 2009 and 2012 and in Outer Regional and Very Remote areas between 2012 and 2015.
 - The smallest difference between boys and girls across the five AEDC domains was on the language and cognitive skills (school based) domain, where boys were 1.7 times more likely to be developmentally vulnerable than girls. The percentage of boys who were developmentally vulnerable decreased from 11.3 per cent in 2009 to 8.5 per cent in 2012 and 8.1 per cent in 2015. The percentage of boys considered to be at risk on this domain also decreased sharply over the same period. The same general pattern was apparent for girls.
 - The largest difference between Indigenous and non-Indigenous children was on the language and cognitive skills (school-based) domain. Indigenous children in 2015 were nearly four times more likely to be developmentally vulnerable than non-Indigenous children (20.2 and 5.7 per cent respectively). These figures obscure a marked decline in the percentage of Indigenous children considered developmentally vulnerable since 2009. The percentages fell from 28.6 per cent in 2009, to 22.4 per cent in 2012 to 20.2 per cent in 2015. There was a similar decline in the percentage of children developmentally at risk and a corresponding increase in the on track percentages.
 - In 2015 children with a Language Background Other Than English (LBOTE) were more likely than other children to be developmentally vulnerable on this domain (8.7 and 5.8 per cent respectively). The gap has been diminishing steadily since 2009.
 - Focusing on the 8.7 per cent of LBOTE children who were vulnerable on this domain, those who were not proficient in English were nearly eight times more likely to be developmentally vulnerable (38.1 per cent) than LBOTE children who were proficient in English (4.9 per cent).
 - The percentages of children who were developmentally vulnerable or at risk were significantly lower in 2015 than 2009 in all of the comparisons described above.
- Table 15 shows changes in the percentages of developmentally on track, at risk and vulnerable children on the language and cognitive skills (school-based) domain for the last three AEDC data collections (2009, 2012 and 2015).



Table 15: Language and cognitive skills (school-based) domain results (2009, 2012, 2015).

Category	Subcategory	Number of children			Developmentally on track (%)			Developmentally at risk (%)			Developmentally vulnerable (%)		
		2009	2012	2015	2009	2012	2015	2009	2012	2015	2009	2012	2015
Overall	Australia	246,810	273,896	286,648	77.1	82.6	84.6	14.0	10.6	8.9	8.9	6.8	6.5
	Quintile 1 (most disadvantaged)	50,675	53,691	53,846	69.2	72.5	74.8	16.8	14.9	12.9	14.0	12.7	12.4
	Quintile 2	46,960	51,728	53,218	74.2	80.0	82.1	15.4	12.0	10.1	10.4	8.0	7.8
	Quintile 3	47,595	52,913	56,366	77.5	83.4	85.6	14.1	10.4	8.7	8.5	6.1	5.8
	Quintile 4	48,806	55,716	59,730	80.2	86.4	88.2	13.1	9.0	7.6	6.7	4.6	4.2
Socio-economic status	Quintile 5 (least disadvantaged)	51,999	59,226	62,429	84.3	89.9	91.0	10.8	7.2	6.0	4.9	2.9	3.0
	Major Cities	169,399	188,943	200,112	79.3	84.2	86.0	13.1	10.0	8.4	7.7	5.9	5.6
	Inner Regional	46,954	51,281	52,671	75.6	81.4	83.5	14.7	11.2	9.5	9.7	7.4	7.0
	Outer Regional	23,732	26,365	26,584	70.1	78.0	81.1	17.6	12.7	10.3	12.3	9.3	8.6
	Remote	3,964	4,457	4,402	64.0	74.0	75.3	19.3	14.1	12.9	16.6	11.9	11.9
Geographic location	Very Remote	2,730	2,850	2,879	48.4	55.7	56.8	22.0	18.3	16.3	29.6	26.0	26.9
	Male	124,476	137,986	144,304	72.4	79.0	81.4	16.3	12.5	10.5	11.3	8.5	8.1
	Female	122,334	135,910	142,344	81.8	86.2	87.8	11.7	8.7	7.4	6.4	5.1	4.8
	Indigenous	11,174	14,017	15,869	48.0	58.1	62.8	23.3	19.5	17.0	28.6	22.4	20.2
	Non-Indigenous	235,636	259,879	270,779	78.5	83.9	85.9	13.6	10.1	8.5	7.9	5.9	5.7
Indigenous background	LBOTE – Total ¹	43,905	52,423	61,999	72.5	77.9	80.8	15.1	12.5	10.5	12.4	9.6	8.7
	LBOTE – Not proficient in English	6,292	6,624	7,080	32.4	36.5	37.3	26.4	26.8	24.6	41.2	36.7	38.1
	LBOTE – Proficient in English	37,529	45,666	54,882	79.3	83.9	86.4	13.2	10.4	8.7	7.5	5.7	4.9
	English Only – Total ¹	202,905	221,473	224,649	78.1	83.7	85.7	13.8	10.2	8.5	8.1	6.1	5.8
	English Only – Not proficient in English	6,458	6,808	7,196	21.9	27.7	28.4	24.6	24.6	22.8	53.5	47.7	48.9
Language diversity	English Only – Proficient in English	196,317	214,143	217,414	79.9	85.5	87.6	13.4	9.7	8.0	6.6	4.8	4.4

¹ Total for LBOTE includes children that are NOT proficient in English, ARE proficient in English, as well as children whose proficiency in English is unknown.

² Total children who speak only English at home includes children that are NOT proficient in English, AI

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National emerging trends on the communication skills and general knowledge domain



This domain measures children's communication skills and general knowledge based on broad developmental competencies and skills measured in the school context.

Table 16 provides an explanation of the characteristics of the communication skills and general knowledge domain in relation to children who would be considered developmentally on track, at risk or vulnerable.

Summary of key findings: Communication skills and general knowledge domain

- The percentage of children who The percentage of children developmentally vulnerable on the communication skills and general knowledge domain decreased from 9.2 per cent in 2009 to 9.0 per cent in 2012 and continued to fall to 8.5 per cent in 2015.
- The decrease in developmental vulnerability from 2012 to 2015 was accompanied by a large decline in the proportion of children developmentally at risk (16.3 to 15.1 per cent) and a corresponding increase in the percentage of children who were on track on this domain (74.7 to 76.3 per cent). These changes

- occurred relatively uniformly in most of the child demographic variables listed in Table 17.
- The linear relationship between socio-economic disadvantage and communication skills and general knowledge was again quite apparent. At the extremes, children living in the most socio-economically disadvantaged locations were three times as likely to be developmentally vulnerable than those from the least disadvantaged areas. Modest falls in developmental vulnerability between 2012 and 2015 occurred in all but the least socially disadvantaged locations.
- The proportion of children considered developmentally at risk on this domain also decreased in 2015 by at least one per cent at all socio-economic levels except for children living in the least disadvantaged locations. There was a corresponding increase of up to 2.1 per cent between 2012 and 2015 in the proportion of children who were on track on this domain.
- The same linear relationship between remoteness (distance from a major city) and communication skills and general knowledge was also evident. Children living in Very Remote

Table 16: Characteristics of the communication skills and general knowledge domain.

Developmentally on track	Children will have excellent communication skills, can tell a story and communicate easily with both children and adults, and have no problems with articulation.
Developmentally at risk	Have mastered some but not all of the following communication skills: listening, understanding and speaking effectively in English, being able to articulate clearly, being able to tell a story and to take part in imaginative play. Children may not know some basic general knowledge about the word such as knowing that leaves fall in autumn, apple is fruit, and dogs bark.
Developmentally vulnerable	Children will have poor communication skills and articulation; have limited command of English (or the language of instruction), have difficulties talking to others, understanding, and being understood; and have poor general knowledge.

- Australia were 2.6 times more likely to be developmentally vulnerable than children living in Major Cities. Children from Remote and Very Remote areas in Australia recorded significant increases in developmental vulnerability between 2012 and 2015 while levels of developmental vulnerability decreased for children living in urban and regional areas. The percentage of children considered to be developmentally at risk fell in all geographic locations in 2015 except for those who live in Very Remote locations. There was a corresponding increase of up to two percent between 2012 and 2015 in the proportion of children who were on track on this domain.
- There was also a relatively small gap between boys and girls on the communication skills and general knowledge domain. Boys were again 1.7 times more likely to be developmentally vulnerable than girls. The percentage of boys who were developmentally vulnerable decreased from 11.7 per cent in 2009 to 11.3 per cent in 2012 and 10.8 per cent in 2015. The percentage of boys considered to be at risk on this domain decreased from 18.7 per cent in 2012 to 17.4 per cent in 2015. There was a corresponding increase of 1.7 per cent from 2012 to 2015 in the proportion of boys who were on track on this domain. The same general pattern was apparent for girls.
 - Indigenous children in 2015 were 2.4 times more likely to be developmentally vulnerable than non-Indigenous children on this domain (19.3 and 7.9 per cent respectively). However, there has been a noticeable decline in developmental vulnerability on this domain among Indigenous children since 2009. The percentages fell from 21.3 per cent in 2009, to 19.9 per cent in 2012 to 19.3 per cent in 2015. There was a similar decline in the percentage of children developmentally at risk and a corresponding increase in the on track percentages.
 - The largest difference between children with a Language Background Other Than English (LBOTE) and children who speak only English at home was on the communication skills and general knowledge domain. LBOTE children in 2015 were more than twice as likely to be developmentally vulnerable on this domain as other children (16.2 and 6.4 per cent respectively). The gap has been narrowing by at least one percentage point in each AEDC collection since 2009.
 - Focusing on the 16.2 per cent of LBOTE children who were vulnerable on this domain, those who were not proficient in English were universally reported by teachers as developmentally vulnerable on this domain (91.9 per cent in 2015). This pattern has persisted since 2009.
 - The percentages of children who were developmentally vulnerability or at risk were consistently lower in 2015 than 2009 in nearly all of the comparisons described above.

Table 17 shows changes in the percentages of developmentally on track, at risk and vulnerable children on the communication skills and general knowledge domain for the last three AEDC data collections (2009, 2012 and 2015).



Table 17: Communication skills and general knowledge domain results (2009, 2012, 2015).

Category	Subcategory	Number of children			Developmentally on track (%)			Developmentally at risk (%)			Developmentally vulnerable (%)		
		2009	2012	2015	2009	2012	2015	2009	2012	2015	2009	2012	2015
Overall	Australia	247,212	273,855	286,913	75.0	74.7	76.3	15.8	16.3	15.1	9.2	9.0	8.5
Socio-economic status	Quintile 1 (most disadvantaged)	50,783	53,733	53,895	67.0	63.9	66.0	18.8	20.6	19.2	14.2	15.5	14.8
	Quintile 2	47,041	51,723	53,269	72.2	71.7	73.4	17.3	18.0	16.5	10.4	10.4	10.1
	Quintile 3	47,665	52,881	56,420	75.5	75.4	77.3	15.9	16.4	14.9	8.7	8.2	7.8
	Quintile 4	48,883	55,708	59,800	78.4	78.9	80.5	14.5	14.5	13.4	7.1	6.6	6.2
	Quintile 5 (least disadvantaged)	52,062	59,187	62,469	81.8	82.8	83.0	12.7	12.6	12.3	5.5	4.6	4.7
Geographic location	Major Cities	169,613	188,894	200,259	75.4	75.2	76.8	15.4	16.0	14.9	9.2	8.8	8.3
	Inner Regional	47,033	51,251	52,733	75.1	74.7	76.7	16.6	17.0	15.3	8.3	8.3	8.0
	Outer Regional	23,795	26,379	26,599	74.1	73.5	74.8	16.4	16.5	15.9	9.5	9.9	9.4
	Remote	3,987	4,466	4,424	73.5	73.2	74.5	16.0	17.8	14.8	10.5	9.0	10.7
Sex	Very Remote	2,750	2,865	2,898	58.5	61.6	58.3	19.3	19.2	19.9	22.1	19.3	21.8
	Male	124,678	137,959	144,440	70.1	70.1	71.8	18.2	18.7	17.4	11.7	11.3	10.8
Indigenous background	Female	122,534	135,896	142,473	80.0	79.5	80.9	13.3	13.9	12.9	6.6	6.6	6.2
	Indigenous	11,228	14,057	15,902	55.9	57.6	59.5	22.9	22.5	21.1	21.3	19.9	19.3
Language diversity	Non-Indigenous	235,984	259,798	271,011	75.9	75.7	77.3	15.5	16.0	14.8	8.6	8.4	7.9
	LBOTE – Total ¹	43,999	52,443	62,063	59.8	60.9	64.1	20.2	20.9	19.6	20.0	18.2	16.2
	LBOTE – Not proficient in English	6,333	6,658	7,110	1.4	1.3	1.2	7.3	6.9	6.8	91.3	91.9	91.9
English Only – Proficient in English	LBOTE – Proficient in English	37,583	45,707	54,928	69.7	69.6	72.3	22.4	22.9	21.3	7.9	7.5	6.4
	English Only – Total ²	203,213	221,412	224,850	78.3	78.0	79.7	14.8	15.2	13.9	6.8	6.8	6.4
	English Only – Not proficient in English	6,485	6,840	7,219	1.2	1.1	0.8	8.5	7.6	8.4	90.3	91.3	90.8
English Only – Proficient in English	English Only – Proficient in English	196,608	214,331	217,606	80.9	80.5	82.3	15.0	15.4	14.1	4.1	4.1	3.6

¹ Total for LBOTE includes children that are NOT proficient in English, as well as children whose proficiency in English is unknown.

² Total children who speak only **Bundle B - 5405** ³ NOT proficient in English, ARE proficient in English, as well as children whose proficiency is unknown.

National emerging trends: Developmental vulnerability



Vuln
1

Vuln
2

The proportions of children who are developmentally vulnerable on one or more developmental domain(s) and developmentally vulnerable on two or more developmental domains are provided in Table 18. These children are considered to be at particularly high-risk developmentally.

Summary of key findings: Developmental vulnerability

- In 2015 approximately one in five (22.0 per cent) children were developmentally vulnerable on one or more domain(s). One in nine (11.1 per cent) were developmentally vulnerable on two or more domains. There was no change between 2012 and 2015 in the proportion of children developmentally vulnerable on one or more domain(s) but there was a small increase in the proportion vulnerable on two or more domains (10.8 to 11.1 per cent in 2015). The 2015 figures were well below those recorded in 2009 for children developmentally vulnerable on one or more (22.0 and 23.6 per cent) and two or more domains (11.1 and 11.8 per cent). Table 18 displays the same basic information for each of the child demographic variables.

- Children living in the most socio-economically disadvantaged locations in 2015 were twice as likely as those from the least disadvantaged areas to be developmentally vulnerable on one or more domain(s) (32.6 and 15.5 per cent respectively). They were three times more likely to be developmentally vulnerable on two or more domains (18.4 and 6.7 per cent respectively). The percentages were almost identical in 2012 in most of the socio-economic strata but consistently lower than those recorded in 2009.
- The only real exception was children who live in less disadvantaged locations. The proportion of children developmentally vulnerable on one or more domain(s) increased from 14.3 per cent in 2012 to 15.5 per cent in 2015. The proportion developmentally vulnerable on two or more domains increased from 5.9 to 6.7 per cent. Despite these changes there was little evidence that the gap between children from relatively advantaged and disadvantaged areas had closed. For children who were developmentally vulnerable on one or more domain(s), the gap between those who lived in the most and least disadvantaged areas had widened from 15.4 per cent in 2009 to 19.0 per cent in 2012 and narrowed to 17.1 percent in 2015.
- Children living in Very Remote areas in Australia in 2015 were twice as likely as those living in Major Cities to be developmentally vulnerable on one or more domain(s) (47.0 and 21.0 per cent). They were also three times more likely to be developmentally vulnerable on two or more domains (31.8 and 10.2 per cent). Compared with 2012, a higher proportion of children who live in Remote or Very Remote areas were developmentally vulnerable on one or more or two or more domains in 2015. Children who live in Inner Regional areas recorded a significant increase in the proportion who were developmentally vulnerable on two or more domains (11.2 to 11.7 per cent in 2015). Despite these changes, the 2015 figures were well below those recorded in 2009 except for children from Very Remote areas. The gap between children who live in Major Cities and those in Outer Regional and



Remote areas has not closed since 2009. For children who were developmentally vulnerable on one or more domain(s), the gap between Major Cities and Very Remote areas has widened from 22.9 per cent in 2009 to 23.4 per cent in 2012 and to 26.0 percent in 2015.

- In 2015, boys were twice as likely as girls to be developmentally vulnerable on one or more (28.5 and 15.5 per cent) and two or more domains (15.3 and 6.8 per cent). Comparing 2012 with 2015, there were small but statistically significant increase in the proportion of boys developmentally vulnerable on one or more (28.2 to 28.5 per cent) and two or more domains (14.8 to 15.3 per cent). There was very little change between 2012 and 2015 for girls. While the 2015 figures were well below those recorded in 2009 for both boys and girls, the gap between boys and girls has remained static since 2009 at 13.0 per cent for those developmentally vulnerable on one or more domain(s) and at about 8.5 per cent for those vulnerable on two or more domains.

- Indigenous children in 2015 were twice as likely as non-Indigenous children to be developmentally vulnerable on one or more (42.1 and 20.8 per cent) and two or more domains (26.2 and 10.2 per cent). Comparing 2012 with 2015, there was a significant decrease in the proportion of Indigenous children who were developmentally vulnerable on one or more domain(s) (43.2 to 42.1 per cent in 2015). There was no change in the proportion developmentally vulnerable on two or more domains. The 2015 figures for Indigenous children were well below those recorded in 2009. The gap has been closing steadily since 2009. For children developmentally vulnerable on one or more domain(s), the gap between Indigenous and non-Indigenous children was 25.0 per cent in 2009, 22.4 per cent in 2012 and 21.3 per cent in 2015.
- In 2015 children with a Language Background Other Than English (LBOTE) were more likely than other children to be developmentally vulnerable on one or more (27.8 and 20.4 per cent) and two or more domains (14.2 and 10.2 per cent). The gap

has been closing steadily since 2009. For children developmentally vulnerable on one or more domain(s), the gap between LBOTE children and those who only spoke English was 10.6 per cent in 2009, 9.2 per cent in 2012 and 7.4 per cent in 2015.

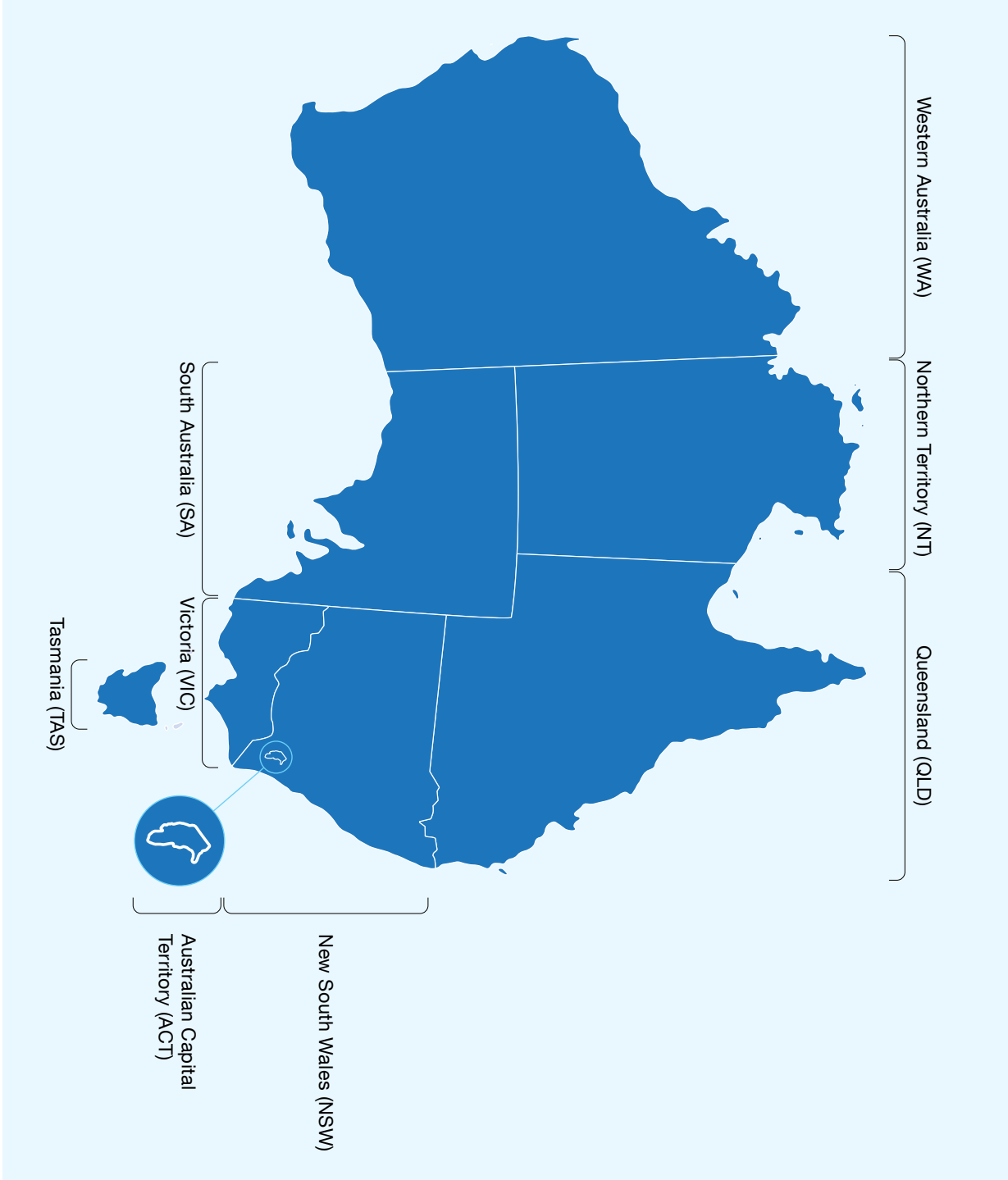
- Some 94 per cent of children reported as not proficient in English from both LBOTE and English speaking backgrounds, were reported as developmentally vulnerable on one or more domain(s). Almost all of these children were reported as developmentally vulnerable on the communication skills and general knowledge domain. These children are more likely to be developmentally vulnerable or at risk on all of the AEDC domains.

Table 18: AEDC results for children vulnerable on one or more domain(s) and two or more domain(s) (2009, 2012, 2015).

Category	Subcategory	Number of children with valid scores (one or more domain(s))			Developmental vulnerability on one or more domain(s) (%)			Number of children with valid scores (two or more domains)			Developmental vulnerability on two or more domains (%)		
		2009	2012	2015	2009	2012	2015	2009	2012	2015	2009	2012	2015
Overall	Australia	246,421	272,282	286,041	23.6	22.0	22.0	246,873	273,275	286,616	11.8	10.8	11.1
	Quintile 1 (most disadvantaged)	50,623	53,467	53,764	32.1	33.2	32.6	50,687	53,562	53,821	17.6	18.2	18.4
Socio-economic status	Quintile 2	46,913	51,442	53,100	26.1	24.8	24.8	46,993	51,616	53,216	13.4	12.5	12.9
	Quintile 3	47,502	52,566	56,242	23.0	20.8	20.9	47,606	52,765	56,362	11.3	9.8	10.2
	Quintile 4	48,724	55,383	59,575	20.1	17.9	17.9	48,808	55,609	59,742	9.5	8.3	8.3
	Quintile 5 (least disadvantaged)	51,893	58,808	62,305	16.7	14.3	15.5	52,007	59,101	62,417	7.4	5.9	6.7
Geographic location	Major Cities	169,114	187,837	199,649	22.5	21.1	21.0	169,414	188,535	200,064	11.0	10.1	10.2
	Inner Regional	46,886	50,948	52,593	23.9	22.4	22.4	46,972	51,134	52,689	12.3	11.2	11.7
	Outer Regional	23,704	26,232	26,555	26.9	24.9	25.2	23,758	26,313	26,584	14.1	13.1	13.3
	Remote	3,962	4,441	4,392	31.0	26.0	27.5	3,970	4,460	4,412	16.5	13.5	15.4
Sex	Very Remote	2,729	2,824	2,852	45.3	44.5	47.0	2,731	2,833	2,867	29.7	28.0	31.8
	Male	124,249	137,119	143,970	30.2	28.2	28.5	124,485	137,620	144,261	16.2	14.8	15.3
Indigenous background	Female	122,172	135,163	142,071	16.8	15.7	15.5	122,388	135,655	142,355	7.4	6.8	6.8
	Indigenous	11,190	14,011	15,874	47.4	43.2	42.1	11,181	14,011	15,875	29.6	26.0	26.2
Language diversity	Non-Indigenous	235,231	258,271	270,167	22.4	20.9	20.8	235,692	259,264	270,741	11.0	10.0	10.2
	LBOTE – Total ¹	43,853	52,107	61,839	32.2	29.5	27.8	43,897	52,277	61,946	16.7	14.6	14.2
	LBOTE – Not proficient in English	6,334	6,661	7,107	93.7	93.7	94.1	6,291	6,608	7,060	59.0	58.0	59.2
	LBOTE – Proficient in English	37,435	45,370	54,704	21.8	20.0	19.1	37,518	45,579	54,850	9.6	8.3	8.4
English Only – Not proficient in English	English Only – Total ²	202,568	220,175	224,202	21.7	20.2	20.4	202,976	220,998	224,670	10.8	9.9	10.2
	English Only – Not proficient in English	6,482	6,837	7,219	93.8	93.7	93.8	6,467	6,810	7,207	75.2	72.3	74.7
	English Only – Proficient in English	195,958	213,116	216,951	19.3	17.9	18.0	196,381	213,930	217,425	8.7	7.9	8.1

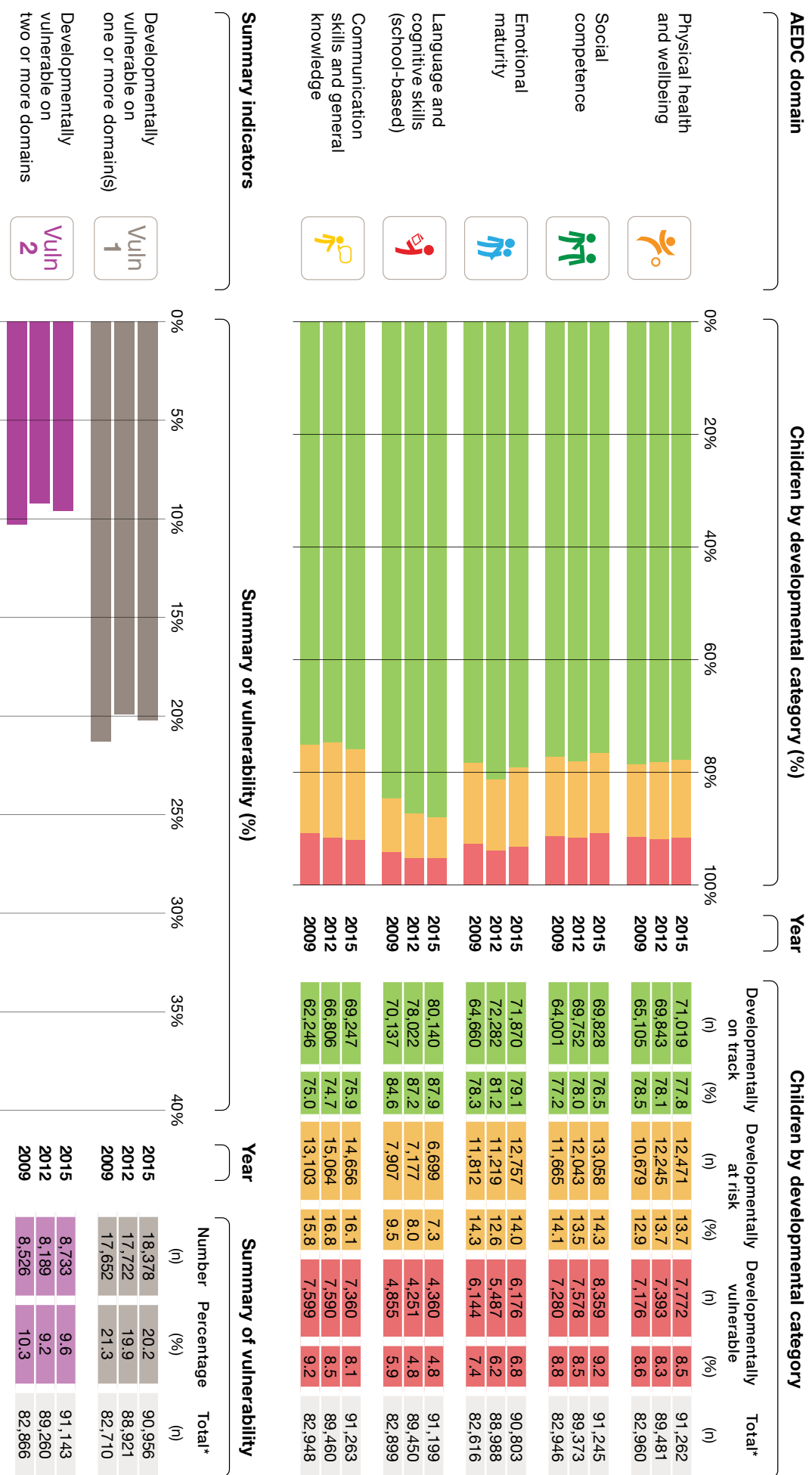
¹ Total for LBOTE includes children that are NOT proficient in English, ARE proficient in English, as well as children whose proficiency in English is unknown.
² Total children who speak only English at home includes children that are NOT proficient in English, AI

State and territory emerging trends





NSW emerging trends (2009, 2012, 2015)



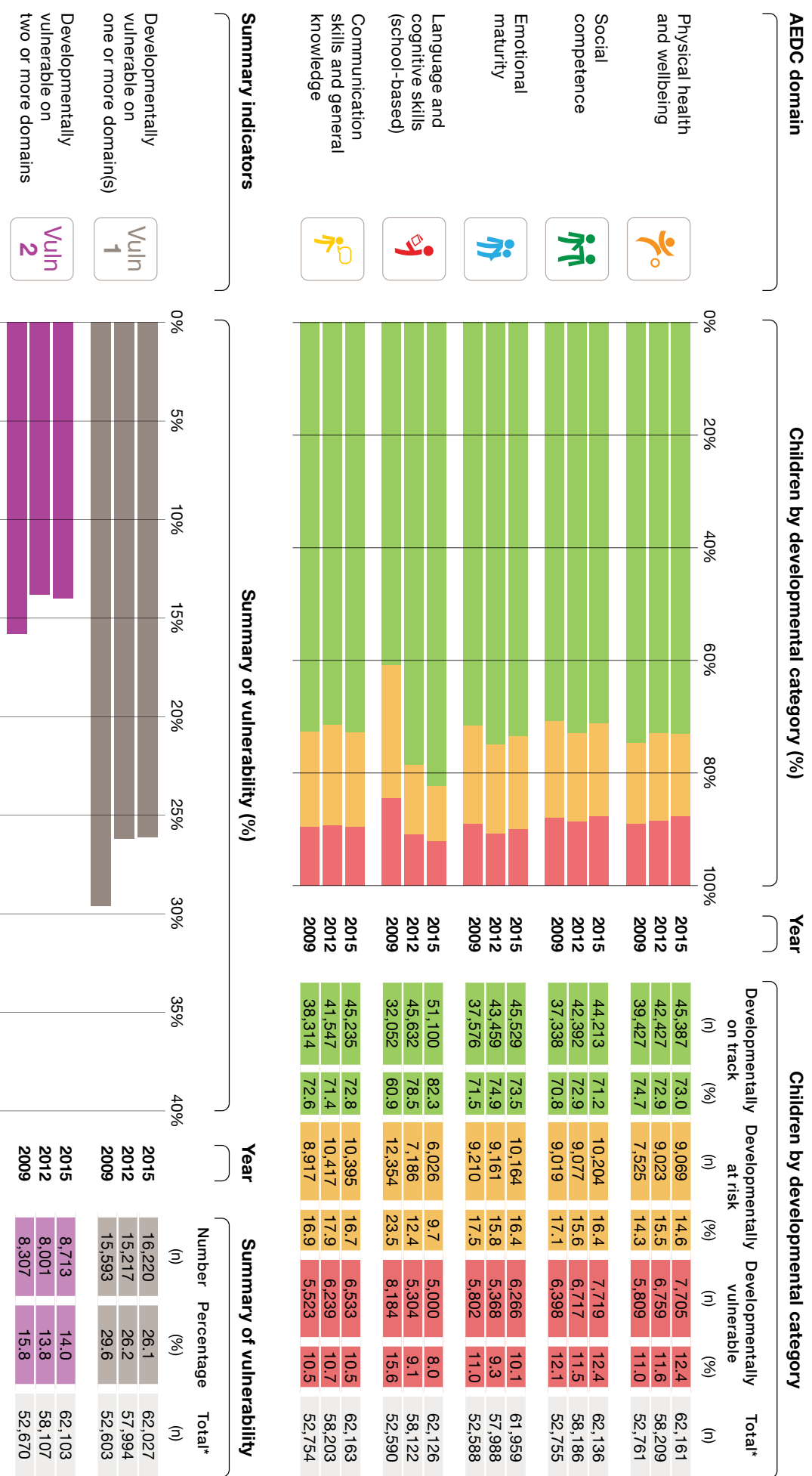


VIC emerging trends (2009, 2012, 2015)

*Total children with valid scores



QLD emerging trends (2009, 2012, 2015)





WA emerging trends (2009, 2012, 2015)

Children by developmental category (%)

Year

Children by developmental category

[illegible]

Summary indicators

Summary of vulnerability (%)

Year

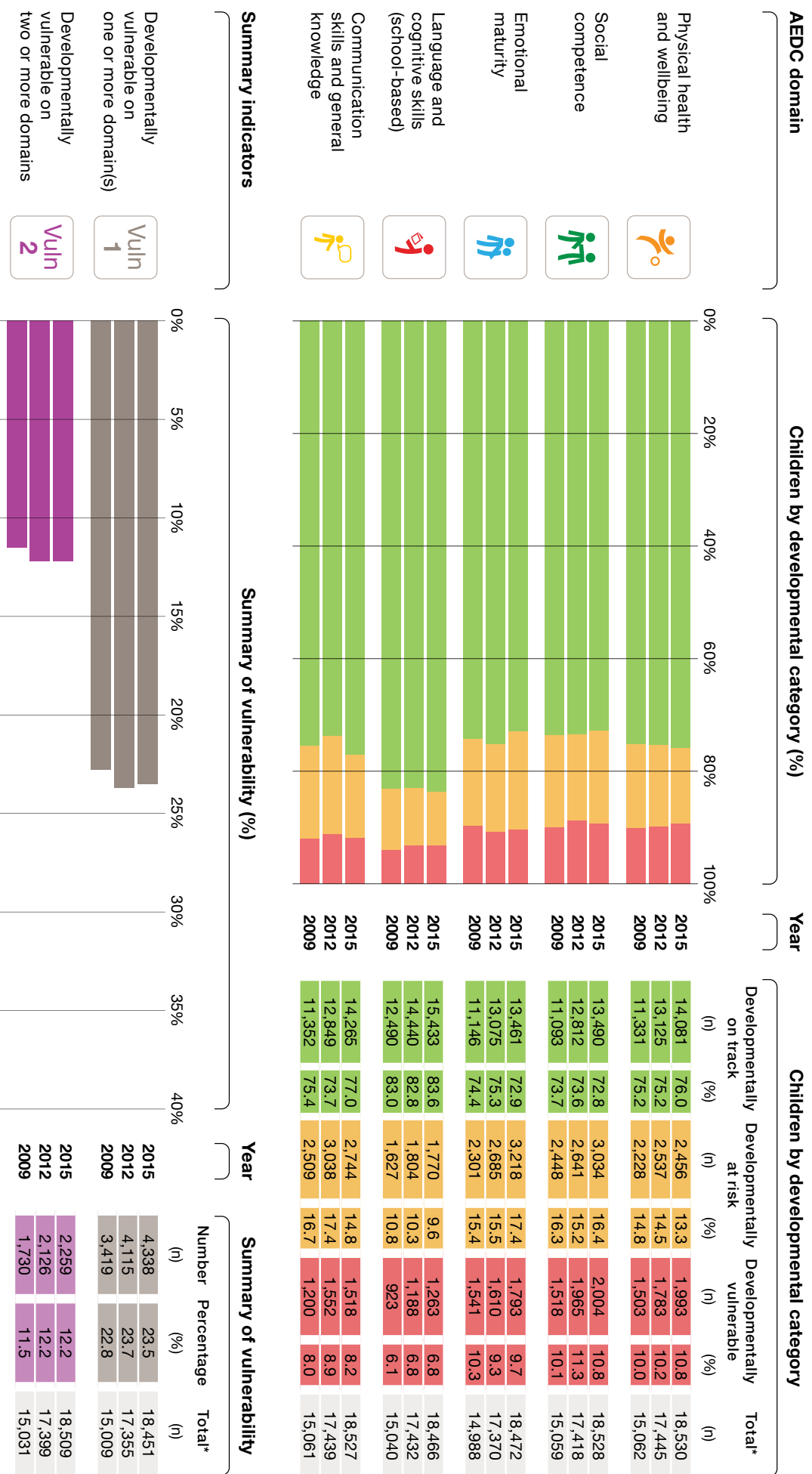
Summary of vulnerability

	Number			Percentage			Total*		
	(n)			(%)			(n)		
Developmentally vulnerable on one or more domain(s)	2015	6,895		21.3			32,373		
	2012	7,048		23.0			30,631		
	2009	6,445		24.7			26,052		
Developmentally vulnerable on two or more domains	2015	3,403		10.5			32,478		
	2012	3,449		11.2			30,770		
	2009	3,177		12.2			26,091		

*Total children with valid scores



SA emerging trends (2009, 2012, 2015)



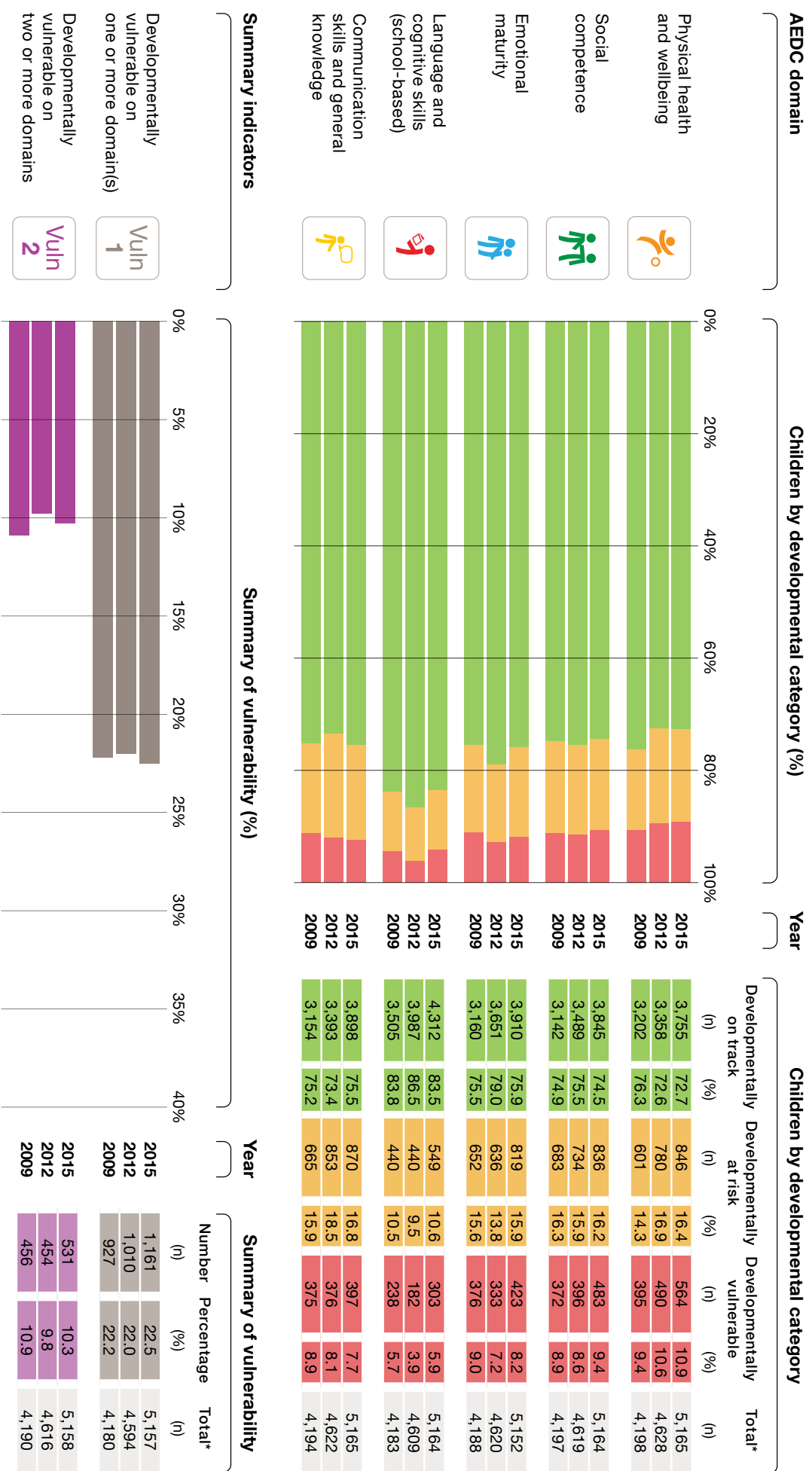


TAS emerging trends (2009, 2012, 2015)





ACT emerging trends (2009, 2012, 2015)





NT emerging trends (2009, 2012, 2015)



Appendix 1: AEDC additional resources

A variety of resources are available online to help you understand AEDC results and learn more about the scope and purpose of the programme. The resources listed below are just some of those available. These can be accessed through the [AEDC web site](#)¹ or alternatively by clicking on the links provided.

Refer to the [AEDC user guides](#)² for ideas and strategies on how to respond to AEDC data.

For detailed information on AEDC results reporting, refer to the fact sheet *Understanding the results*³.

The fact sheet *Definition of AEDC terms*⁴ is a valuable guide that describes terminology used throughout the programme.

The [AEDC Community Results Tables](#)⁵ summarise results for each AEDC community and the local communities within it. As part of the online [Data Explorer](#)⁶, this searchable resource allows comparisons across years and

communities. The 2015 AEDC community data was published in March 2016.

AEDC publications

Important AEDC resources include:

- [Sector messages](#)⁷
- [Calculation of the critical difference](#)⁸
- [Fact sheet library](#)⁹
 - [About the AEDC data collection](#)¹⁰
 - [About the AEDC domains](#)¹¹
 - [Definition of AEDC terms](#)¹²
 - [Emerging trends from the AEDC](#)¹³
- [Understanding community boundaries](#)¹⁴
- [Understanding the results](#)¹⁵

AEDC videos

- [Emerging trends in the AEDC](#)¹⁶
- [Introduction to the AEDC](#)¹⁷
- [Informing your planning](#)¹⁸
- [Minister's message](#)¹⁹
- [Understanding the data](#)²⁰

Key AEDC web pages (Main AEDC web site²¹)

- [AEDC community results tables](#)²²
- [Communities FAQs](#)²³
- [History of the AEDC](#)²⁴
- [Protective and risk factors for children](#)²⁵
- [Resources for communities](#)²⁶
- [Using your AEDC results](#)²⁷
- [Validation and trial of the AEDC](#)²⁸

¹ [www.aedc.gov.au](#)
² [www.aedc.gov.au/resources/user-guides](#)
³ [www.aedc.gov.au/unders](#)
⁴ [www.aedc.gov.au/detterm](#)
⁵ [www.aedc.gov.au/tables](#)
⁶ [www.aedc.gov.au/data](#)

⁷ [www.aedc.gov.au/sectormsgs](#)
⁸ [www.aedc.gov.au/trcd](#)
⁹ [www.aedc.gov.au/factsheets](#)
¹⁰ [www.aedc.gov.au/abtdata](#)
¹¹ [www.aedc.gov.au/abtdom](#)
¹² [www.aedc.gov.au/detterm](#)
¹³ [www.aedc.gov.au/emerging-trends](#)
¹⁴ [www.aedc.gov.au/uchb](#)
¹⁵ [www.aedc.gov.au/unders](#)

¹⁶ [www.aedc.gov.au/v14](#)
¹⁷ [www.aedc.gov.au/v11](#)
¹⁸ [www.aedc.gov.au/v12](#)
¹⁹ [www.aedc.gov.au/v15](#)
²⁰ [www.aedc.gov.au/v13](#)
²¹ [www.aedc.gov.au](#)
²² [www.aedc.gov.au/tables](#)
²³ [www.aedc.gov.au/commfags](#)
²⁴ [www.aedc.gov.au/history](#)
²⁵ [www.aedc.gov.au/prsk](#)
²⁶ [www.aedc.gov.au/rfc](#)
²⁷ [www.aedc.gov.au/ug](#)
²⁸ [www.aedc.gov.au/valid](#)

Appendix 2: Glossary

AEDC community

AEDC communities are a geographic area, usually equivalent to a Local Government Area (LGA), made up of Local Communities (see 'Local Community' definition).

AEDC cut-off scores

For each of the five AEDC domains, children receive a score between 0 and 10 where 0 is most developmentally vulnerable.

The cut off scores set in 2009 provide a reference point against which later AEDC results can be compared. These have remained the same across the three collection cycles. For example, using the cut off scores established in 2009, in the 2015 AEDC only 6.5 per cent of children were considered developmentally vulnerable on the language and cognitive development domain, a decrease from 8.9 per cent in 2009.

AEDC domains

The AEDC measures five areas, or domains, of early childhood development that form the foundations for later good health, education and social outcomes.

These domains are:

- physical health and wellbeing
- social competence
- emotional maturity
- language and cognitive skills (school-based)
- communication skills and general knowledge.

More information about these domains¹ can be found on the AEDC web site.

Australian Early Development Census (AEDC)

A population measure of young children's development based on a teacher completed Instrument across five developmental domains (AEDC domains). Prior to 1 July 2014, the AEDC was known as the Australian Early Development Index (AEDI).

Australian version of the Early Development Instrument (the Early Development Instrument, which has been adapted for use in Australia)

A teacher-completed Instrument that consists of approximately 100 questions measuring the five developmental domains. To ensure teacher judgement is moderated across Australia, teachers receive online training prior to completing the Instruments.

Community profiles and maps

All AEDC data collected in a geographic area are collated and analysed at the suburb or small area locality (Local Community) of the child. This is reported back to the community through AEDC Community Profiles and AEDC maps.

The AEDC Community Profiles report the percentage of children on track, developmentally at risk and developmentally vulnerable for each developmental domain.

¹ www.aedc.gov.au/abtdom

Control for age variability at school entry

The ages of children in their first year of full-time school vary. As age is a factor contributing to children's development, the published AEDC results control for age.

Critical difference

The critical difference is the minimum level of change required between any two cycles of AEDC results for the comparative result to be significant. The difference between the percentage of children vulnerable across the cycles is statistically significant if it exceeds the critical difference. For further information see the **Calculation of the critical difference**¹ Technical Report.

Developmentally vulnerable on one or more domain(s) (Vuln 1)

The percentage of children who are classified as developmentally vulnerable on one or more AEDC domain(s). Developmentally vulnerable on one or more domain(s) (Vuln 1) are part of the Summary Indicators (See 'Summary indicators' definition).

Developmentally vulnerable on two or more domains (Vuln 2)

The percentage of children who are classified as developmentally vulnerable on two or more AEDC domains. Also see Summary indicator for more information. Developmentally vulnerable on two or more domains (Vuln 2) are part of the summary indicators (See 'Summary indicators').

Early Development Instrument

The Early Development Instrument (EDI) was developed in Canada to measure the developmental health and wellbeing of populations of young children. An Australian adapted version of the EDI is the teacher completed instrument used in the AEDC programme, see the Australian version of the Early Development Instrument.

English as a Second Language (ESL)

Children are considered to have ESL status where English is not their first language and they need additional instruction in English; or where English is not their first language, they have conversational English, but are not yet proficient in English.

Geographic location

Geographic location for the AEDC is based on the Australian Statistical Geographical Standard (ASGS) Remoteness Areas, developed by the Australian Bureau of Statistics (ABS) to classify places of remoteness. Geographical areas are given a score based on the road distance to service towns of different sizes. Scores for regions are derived by averaging scores from a one square kilometre grid.

The five Remoteness Areas are:

1. Major Cities – relatively unrestricted accessibility to a wide range of goods and services and opportunities for social interaction.
2. Inner Regional – some restrictions to accessibility of some goods, services and opportunities for social interaction.
3. Outer Regional – significantly restricted accessibility of goods, services and opportunities for social interaction.
4. Remote – very restricted accessibility of goods, services and opportunities for social interaction.
5. Very Remote – very little accessibility of goods, services and opportunities for social interaction.

The ASGS Remoteness Areas classification is an all of Australia view. As such, remote parts of Tasmania are remote because of their location in the context of Australia, not their location in Tasmania.

Language background other than English (LBOTE)

Children are considered 'LBOTE' if they speak a language other than English at home, or if they speak English at home but are still considered to have ESL status. Indigenous children who have LBOTE status are part of the LBOTE group. For example, it is possible for children to be both Indigenous and have LBOTE status.

Local community

A small area locality, usually representing a suburb or town. For its results to be reported Local Communities must have a minimum of 15 children and two teachers. Results are not reported if more than 20 per cent of children were identified as children with special needs.

¹ www.aedc.gov.au/trcd

Population of children enrolled to begin school

The population of Australian children enrolled to begin their first year of full-time school is data provided by the 2015 School Census, inclusive of government, Catholic and independent schools across Australia.

This number is used to determine the extent to which AEDC is reflective of the entire population of Australian children starting school in 2015.

Proficient in English

Proficient in English refers to what is expected of the average monolingual English speaker in a similar phase of development. For the AEDC, children are considered proficient in English if teachers answered “average” or “good/very good” to the Australian version of the Early Development Instrument question: “How would you rate this child’s ability to use language effectively in English?”

This question refers to the child’s use of the appropriate words and expressions at appropriate times, as well as the child’s contribution to conversations. Effective use is defined as “use sufficient to convey the desired message”. Only basic

grammatical concepts need to be adhered to, so long as the meaning is clear. Teachers were asked specifically to consider English language skills.

Quintiles

Quintiles are used for the AEDC comparisons to Socio-Economic Indexes for Areas (SEIFA) (see definition for SEIFA). The lowest quintile (Quintile 1) represents the most socio-economically disadvantaged areas; the highest quintile (Quintile 5) represents the least socio-economically disadvantaged areas.

Reported results

Reported results refer to the information that is made publically available at a community level from the AEDC data collection. This includes:

- Demographic data for all children included in the census
- AEDC domain scores – includes scores only from children with valid domain scores, and for those who don’t have any diagnosed special need.

Summary indicators

Summary indicators are a measure of developmental vulnerability for children across the five AEDC domains (See ‘developmentally vulnerable on one or more domain(s) (Vuln 1)’ and ‘developmentally vulnerable on two or more domains (Vuln 2)’).

Socio-Economic Indexes for Areas (SEIFA)

The AEDC classifies socio-economic status according to the Socio-Economic Indexes for Areas (SEIFA), developed by the Australian Bureau of Statistics (ABS). They are a set of measures, derived from Census information, that summarise different aspects of socioeconomic conditions in an area. The Index for Relative Socio-Economic Disadvantage, which is used in AEDC results, looks at Census information that

reflects disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Every geographical area in Australia is given a SEIFA score that ranks the disadvantage of an area, compared with other areas in Australia.

Special needs

A child requiring special assistance because of chronic medical, physical or intellectually disabling conditions (e.g. autism, cerebral palsy, Down syndrome), based on a medical diagnosis or medical diagnoses.

Valid domain scores

Scores are flagged as invalid for children who have been in the class for less than one month, are less than four years old or where teachers complete less than 75 per cent of the items in any given domain.



Bundle B - 5422

Our Children • Our Communities • Our Future

For more information about the Australian Ear!

Bundle B - 5423

se visit the AEDC web site: www.aedc.gov.au