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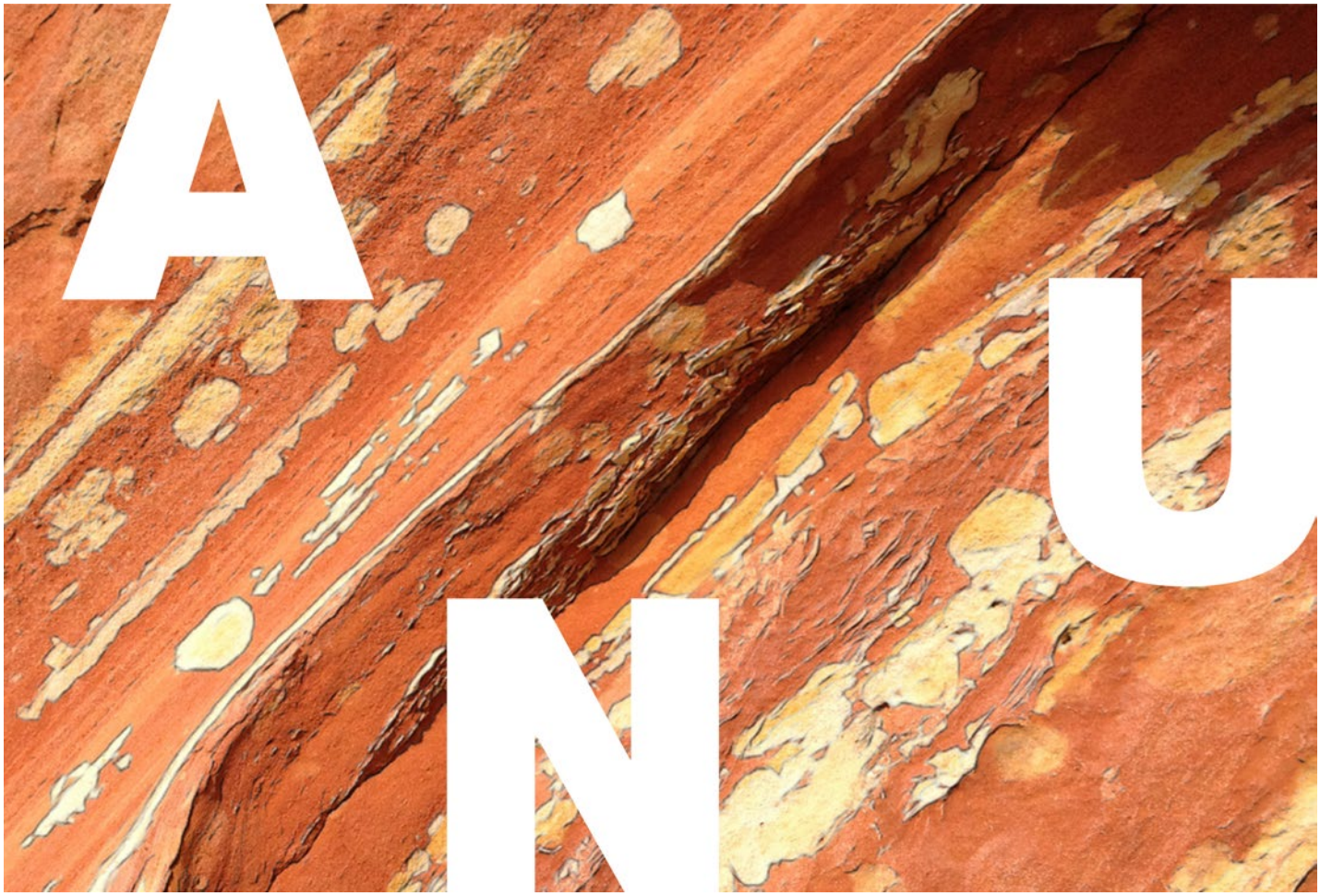

THE RELATIONSHIP BETWEEN EARLY CHILDHOOD EDUCATION AND CARE (ECEC) AND THE OUTCOMES OF INDIGENOUS CHILDREN: EVIDENCE FROM THE LONGITUDINAL STUDY OF INDIGENOUS CHILDREN (LSIC)

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The relationship between early childhood education and care (ECEC) and the outcomes of Indigenous children: evidence from the Longitudinal Study of Indigenous Children (LSIC)

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Abstract

This study presents the most robust evidence to date of the importance of engaging Indigenous children in early childhood education and care (ECEC) programs to boost cognitive and developmental outcomes in the short term (2 years after ECEC participation) and longer term (3–5 years after ECEC participation). We highlight differences between whether a child attended preschool or child care, and explore how the number of hours attended affects cognitive and developmental outcomes. Preschool attendance was associated with better short-term cognitive outcomes, as well as better cognitive and developmental outcomes in the longer term. There were not, however, significant effects associated with the number of preschool hours attended. Child-care attendance was associated with longer term cognitive and developmental improvements, but there is also some evidence that spending too long at child care can be detrimental to children's developmental and cognitive outcomes.

Keywords: early childhood education, Longitudinal Study of Indigenous Children

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Acronyms

ACER	Australian Council for Educational Research
ANU	The Australian National University
CAEPR	Centre for Aboriginal Economic Policy Research
ECEC	early childhood education and care
LORI	Level of Relative Isolation
LSAC	Longitudinal Study of Australian Children
LSIC	Longitudinal Study of Indigenous Children
PAT-M	Progressive Achievement Test in Mathematics
PAT-R	Progressive Achievement Test in Reading
SDQ	Strengths and Difficulties Questionnaire

Contents

Tables and figures

Introduction and policy context

Across all levels of government, early childhood education and care (ECEC) has been gaining policy prominence. Most recently, the 2015 Productivity Commission inquiry report into ECEC highlighted its importance for children and their carers, and suggested reforms to increase the productivity associated with early childhood funding, participation, attendance and quality. A key recommendation of the Productivity Commission report was to amend ECEC funding so that, as with public schools, the government funds a per-child subsidy regardless of the provider (Productivity Commission 2014). Specific to Indigenous policy, ensuring physical ECEC access to remote communities, increasing primary school attendance, and improving reading, writing and numeracy of Indigenous children are three of the six Closing the Gap targets aimed at eliminating the socioeconomic disparity between Indigenous and non-Indigenous Australians.

The positive effects of ECEC participation have been validated internationally and for the aggregate population of Australian children. However, the quality, type and number of hours attended were important mediating variables. There is still little research on how ECEC participation relates to the subgroup of Indigenous children's cognitive and developmental outcomes, despite its potentially significant effect. This is partly due to a historical gap in longitudinal and experimental data for the population. Biddle and Cameron (2012a) showed that, for a representative sample of 15-year-olds, the gap in confidence and educational expectations, dropout rates, and tertiary acceptance ranks between Indigenous and non-Indigenous Australians becomes statistically insignificant after controlling for educational experience. Thus, there is indirect evidence for the importance of ECEC for this population.

With regards to the Closing the Gap targets, ensuring access to ECEC is just a first policy step in engaging Indigenous families with young children. Biddle (2007) explains the importance of the presence of local Indigenous personnel in boosting preschool attendance, providing evidence of the need to understand Indigenous-specific determinants in designing effective ECEC policy. Indigenous parents often express fear that schooling will undermine Indigenous culture and values (Grace & Trudgett 2011).[1] Internationally, ECEC programs specifically designed to target disadvantaged or minority groups have recorded more successful intervention outcomes than large-scale projects. Hence, to effectively boost the educational outcomes of Indigenous children, ECEC programs should also incorporate components that are specifically valued by Indigenous families (for programs in the United States, see Reynolds et al. 2011; for France, see Dumas & LeFranc 2010).

Despite the importance placed on ECEC and the limits of such an access measure, even this target does not appear likely to be met. While Closing the Gap targets have a central role in the Australian Government's development of Indigenous policy, and impact Indigenous policy at other levels of government, these targets use administrative data to estimate the number of children registered in an ECEC program as the numerator and outdated population estimates of the number of children eligible for ECEC as the denominator (Biddle & Bath 2013). There is therefore considerable uncertainty when tracking the targets. Thus, to better understand the effect of ECEC participation in the short term and longer term for Indigenous children, we use data from the Longitudinal Study of Indigenous Children (LSIC). This is the only data source that has detailed information on a range of cognitive and developmental outcomes for a large sample of Indigenous children who have been followed through time. Longitudinal data have the key advantage that we can control observable characteristics at the time of ECEC participation, which could be driving selection into ECEC programs, or the cognitive and noncognitive outcomes that we measure.

Because an expansion of preschool funding is at the forefront of national ECEC policy reform and a key component of the Closing the Gap targets, we first estimate the relationship between preschool attendance and a range of cognitive and developmental outcomes 2 years after preschool enrolment (short-term analysis), and 3–5 years after preschool enrolment (longer term analysis). We find that preschool attendance has a consistently large effect on reading and literacy proficiency in both the short and longer term. Given that English is not the first language for some Indigenous children, it is important to note that the short-term literacy proficiency outcome (i.e. the Renfrew vocabulary test) allows children to answer in other languages as well. There is also weaker evidence of a positive longer term effect of preschool on mathematics and abstract reasoning, as well as on positive developmental outcomes. Once the relationship between hours spent at preschool, and cognitive and developmental short-term outcomes is explored, we find that the number of hours spent at preschool is a statistically insignificant variable. This result points to the importance of attending preschool in driving better cognitive and developmental outcomes, and to the less important role of the number of preschool hours attended.

Because some proposed policy reforms include subsidies for child-care programs, we estimate the short- and longer term effects of child-care participation, and find evidence of positive longer term effects of child-care attendance on cognitive and developmental measures (although some effects are not statistically significant). We also analyse the effect of hours spent at child care on longer term outcomes, finding some weak evidence of a negative effect of spending too long at child care on cognitive and developmental outcomes. Finding a significant negative effect of child-care hours, but an insignificant one for preschool hours, is partly a result of the stricter educational curriculum for all children enrolled in preschool, and of the capped number of hours that characterise preschool but not child-care centres.

The rest of this paper is organised as follows: first, we provide a more detailed overview of the role of ECEC in child development. We then provide an overview of the LSIC data and discuss their advantages and drawbacks. Next, we present a descriptive summary of the determinants of preschool and child-care participation for Indigenous families, followed by the analysis of the short- and longer term effect of preschool participation on cognitive and developmental outcomes. The analysis of the effects of child-care participation follows. Lastly, we provide concluding comments and some policy implications.

The role of ECEC in child development

There is strong international evidence of the positive impact that ECEC participation can have on children's development, although certain qualifications apply. The literature is not necessarily specific to Indigenous children, yet the cognitive and developmental insights it provides encompass a broad group of developmental and cognitive outcomes, serving as a guide to create robust analysis of the impact of ECEC on the Indigenous population. We acknowledge that these outcomes are not Indigenous-specific, and that they do not measure the degree of acquisition of the rich cultural and social skills that are taught and emphasised in Indigenous communities. We focus on this broad group of cognitive and developmental outcomes because ECEC engagement has been linked with better educational attainment later in life, which in turn results in (1) improved Indigenous-specific measures of wellbeing; and (2) better health and employment opportunities that contribute to closing the existing gap between Indigenous and non-Indigenous outcomes on a range of socioeconomic indicators (Dockery 2010, Biddle & Cameron 2012a).

Heckman and Mosso (2014) present a life-cycle model with dynamic skill formation, where the skills a child is exposed to early in life shape the efficiency with which other skills are acquired in adolescence and adulthood. Early education and parenting therefore play crucial roles in determining outcomes later in life. Children from low socioeconomic backgrounds, for example, will often be exposed to lower-than-optimal levels of investment in formal education, calling for interventions to close gaps in skills that are crucial to accumulate early in youth to succeed in later years of schooling, which, in turn, increase the opportunities available to adults. In particular, the authors emphasise the importance of investing in very early interventions to boost cognitive outcomes, noting that noncognitive outcomes (such as sociability, self-control and discipline) can be effectively boosted in later stages of youth.

Boocock (1995) overviews international studies (excluding the United States) on the impact ECEC has for child development, and details a strong relationship between ECEC participation and better cognitive outcomes, including higher scores in reading and mathematics achievement tests, especially for low-income children. Barnett (1998) reviews the effects of ECEC programs in the United States and how they impact the development of children in low-income families. He finds significant and positive short-term effects, and positive long-term effects across those programs that begin early in a child's life. Small-scale programs also tend to have more significant impact than large-scale programs, which is most likely due to better quality, irrespective of the program type.

More recently, Burger (2010) reviews international studies on the impact of ECEC for disadvantaged children, finding that, across the studies, short-term cognitive gains were observed consistently, while only some of the programs had longer term cognitive impacts. Across studies comparing disadvantaged and nondisadvantaged participants, minorities and those from a lower socioeconomic background made particularly large gains in cognitive outcomes. Moreover, there is evidence that, for well-implemented programs such as the Abecedarian and the Perry preschool programs, the cognitive gains can last into adulthood (Campbell et al. 2002, Heckman et al. 2012). In a meta-analysis on the effect of 120 preschool programs across five decades, Camilli et al. (2010) find smaller but consistent improvement in children's social skills, along with large cognitive improvements. Furthermore, the gains in children's social and emotional outcomes tend to be more long lasting (beyond 7 years of age), unlike some of the cognitive gains, which significantly decline as participants age and

are often negligible in the long term (i.e. for ages 7 and above). This result indicates that, while the cognitive gains from ECEC are mostly confined to easing transition to schooling and need reinforcement through further education to be maintained, social skills learnt at an early age are less prone to depreciate, possibly because they can be more easily reinforced outside the school system.

These positive noncognitive outcomes (such as motivation, discipline, self-control and self-esteem) that are enhanced by ECEC participation play an important role in determining long-term outcomes (Berlinski et al. 2009, Heckman et al. 2006). For this reason, recent results from a nationally representative sample in the United States that point to the detrimental noncognitive effects of spending too many hours in child-care centres demonstrate that the effects of ECEC participation are complex and can be affected by the number of hours attended. In particular, spending long hours at child-care centres led to negative sociobehavioral effects, including worse interpersonal skills and self-control (Loeb et al. 2007).

Specific to the Australian population, Bowes et al. (2009) find that children who participated in ECEC showed better language abilities, although the effects of ECEC participation were negative for children who spent more hours in formal ECEC centres. Although the study does not comment on whether there is a threshold of hours attended when the effects of ECEC become detrimental, we know that in some formal ECEC centres—particularly long day–care centres—children tend to spend much longer there on average than they do at preschool, where the maximum number of hours that can be attended are capped. Another study finds that Year 3 numeracy and literacy scores were much higher for children who had attended ECEC programs (Warren & Haisken-DeNew 2013). Moreover, to better engage Indigenous families in ECEC programs in a culturally sensitive way that builds on the specific skills that Indigenous children possess, there is a fundamental need to include components such as Indigenous personnel (Biddle 2007); curriculums that embrace Indigenous learning communities, which support greater involvement by Indigenous parents (Biddle 2010); and engagement with Indigenous families and other members of the community, as this will help overcome the cultural barriers to mainstream schooling that are very common among Indigenous communities (Dockett et al. 2010).

The Longitudinal Study of Indigenous Children

Although ECEC is important in child development, the net effect may not always be positive, depending on the balance between hours spent in ECEC, play, cognitive tasks and a culturally specific curriculum. There is also a need to control for selection into ECEC when evaluating its impact. Understanding the effect of ECEC is therefore a careful empirical exercise, requiring good-quality information over time. An important source of this information is the LSIC.

Study sample and demographic information

The LSIC sample comprises two cohorts of Indigenous children from 11 different areas around Australia. Although the sample is not nationally representative, it closely resembles the distribution of Indigenous children aged 0–5 years in urban, rural and remote Australia in 2008 (when the study commenced). Table 1 shows the age distribution of the two cohorts over the six waves available, as well as the number of available observations at each wave; from here on, the older cohort is denoted the kid cohort, and the younger cohort is denoted the baby cohort.

The short-term analysis looks at outcomes 2 years after the preschool age of children using both cohorts, and the longer term outcomes are measured for the kid cohort 3–5 years after the children's preschool age. LSIC information is based on the responses of the study child, their parents/carers and their schoolteachers. The interviews are spaced so that results between two consecutive waves are very close to being one year apart (Department of Social Services 2015). The total number of observations in Table 1 includes both cohorts and aims to show the high number of retention rates through time (roughly 75% retention at wave 6); however, the number of usable observations for the subsequent analysis does not always include the whole sample. Whether an observation is usable depends on the outcome variable that is being analysed, as well as on whether the effects are short or longer term; detailed information on the number of observations used for each model can be found in Appendixes 2–6. We analyse whether the observable characteristics of children who cannot be included in our subsequent analysis are statistically different from those children who are included in the analysis. All longitudinal studies suffer from some level of attrition, or lost observations through time; however, as long as these lost observations are random, attrition will not have a significant effect on our findings or interpretations. For teacher-reported outcomes, for example, we find that,

with the exception of the LORI (Level of Relative Isolation) index of isolation, there is little evidence of nonrandom attrition or sampling bias (results are presented in detail in the next section).

TABLE 1: Longitudinal Study of Indigenous Children cohorts by age and total number of study children at each wave

Year	2008	2009	2010	2011	2012	2013
Wave	1	2	3	4	5	6
Kid cohort ages	3–5	4–6	5–7	6–8	7–9	8–10
Baby cohort ages	0–2	1–3	2–4	3–5	4–6	5–7
Total number of children in baby cohort	954	868	813	749	728	737
Total number of children in kid cohort	717	655	591	534	530	502
Total number of children (both cohorts)	1671	1523	1404	1283	1258	1239

It is useful to understand the demographics of the LSIC sample that has usable information. Table 2 describes the demographic controls used for the short-term outcomes; these controls are also used in the longer term analysis, although some of their values change over time (e.g. the age of the study child). The controls are overall very similar across the two cohorts, with a notable cohort difference in preschool and child-care attendance—the baby cohort attended preschool and child care at much higher rates than the kid cohort. This likely reflects the effect of policy change during the period. There is also a much higher proportion of baby cohort parents with Year 12 or higher qualifications, and the overall number of children in the baby cohort is much larger across all of the control variables.

TABLE 2: Descriptive summary of controls used in short-term analysis for both cohorts

Control variable	Older (kid) cohort			Younger (baby) cohort		
	Number of observations	Mean	Standard deviation	Number of observations	Mean	Standard deviation
Child-care attendance	261	0.234	0.424	258	0.326	0.470
Preschool attendance	452	0.420	0.494	633	0.586	0.493
Study child is female (1 = study child is female; 0 = study child is male)	591	0.494	0.500	813	0.494	0.500
Age of study child	591	6.032	0.594	645	6.098	0.433
Primary parent/carer is male (1 = primary parent/carer is male; 0 = Primary parent/carer is female)	557	0.031	0.172	674	0.013	0.115
Primary parent/carer is non-Indigenous (1 = primary parent/carer is non-Indigenous; 0 = primary parent/carer is Indigenous)	557	0.162	0.368	674	0.191	0.394
Secondary parent/carer is non-Indigenous (1 = secondary parent/carer is non-Indigenous; 0 = secondary parent/carer is Indigenous)	555	0.142	0.350	674	0.159	0.366
Secondary parent/carer is not partnered (1 = secondary parent/carer is not partnered; 0 = secondary parent/carer is partnered)	555	0.450	0.498	674	0.417	0.493
Primary parent/carer liked school as a child (1 = primary parent/carer liked school as a child; 0 = primary parent/carer did not like school as a child)	563	0.723	0.448	640	0.658	0.475
Primary parent/carer has good health (1 = primary parent/carer has good health; 0 = primary parent/carer has poor or fair health)	554	0.726	0.447	673	0.707	0.455
Primary parent/carer has fair health (1 = primary parent/carer has fair health; 0 = primary parent/carer has poor or good health)	554	0.126	0.333	673	0.129	0.336
Primary parent/carer speaks English and Indigenous language with similar fluency (1 = primary parent/carer speaks English and Indigenous language with similar fluency; 0 = primary parent/carer speaks English or Indigenous language best)	556	0.103	0.304	776	0.115	0.319
Primary parent/carer speaks Indigenous language best (1 = primary parent/carer speaks Indigenous language best; 0 = primary parent/carer speaks English best, or speaks English and Indigenous language with similar fluency)	556	0.813	0.390	776	0.821	0.384
Primary parent/carer is not employed (1 = primary parent/carer is not employed; 0 = primary parent/carer is employed)	583	0.633	0.482	805	0.568	0.496

	Older (kid) cohort			Younger (baby) cohort		
Control variable	Number of observations	Mean	Standard deviation	Number of observations	Mean	Standard deviation
LORI index of isolation: 2 (1 = LORI index of isolation is 2; 0 = LORI index of isolation is 1, 3 or 4)	557	0.531	0.499	674	0.476	0.500
LORI index of isolation: 3 (1 = LORI index of isolation is 3; 0 = LORI index of isolation is 1, 2 or 4)	557	0.117	0.321	674	0.159	0.366
LORI index of isolation: 4 (1 = LORI index of isolation is 4; 0 = LORI index of isolation is 1, 2 or 3)	557	0.074	0.261	674	0.073	0.260
Household experienced money shortage (1 = household experienced money shortage; 0 = household experienced neither money shortage nor surplus, or household experienced money surplus)	537	0.177	0.382	669	0.130	0.337
Household experienced money surplus (1 = household experienced money surplus; 0 = household experienced neither money shortage nor surplus, or household experienced money shortage)	537	0.354	0.479	669	0.395	0.489
Primary parent/carer has moved in the past 12 months (1 = primary parent/carer has moved in the past 12 months; 0 = primary parent/carer has not moved in the past 12 months)	544	0.129	0.335	674	0.196	0.397
Primary parent/carer has completed Year 12 or higher education (1 = primary parent/carer has completed Year 12 or higher education; 0 = primary parent/carer has not completed Year 12 or higher education)	543	0.440	0.497	626	0.669	0.471
Weekly number of hours spent at preschool	na	na	na	668	10.606	11.077

LORI = Level of Relative Isolation; na = not applicable

Outcome measures and sample selection issues

The outcome measures used in the short-term and longer term analysis are listed in Table 3; detailed information on each outcome measure can be found in Appendix 1. These outcome measures were chosen because of the broad cognitive and developmental outcomes that they jointly cover, which provides robust information on the effects of ECEC. These outcomes are also reliable measures of the developmental and cognitive abilities of children and have been widely validated. For example, the Longitudinal Study of Australian Children (LSAC) has successfully implemented cognitive measures developed by the Australian Council for Educational Research (ACER). Our LSIC analysis uses the ACER-developed Progressive Achievement Tests in Mathematics and Reading (PAT-M and PAT-R, respectively) (Australian Institute of Family Studies 2013). ACER has approved the Renfrew vocabulary test as a suitable way to measure language development independent of English proficiency, and the Renfrew test has also been validated in language development studies internationally (Buckley et al. 2013). The Matrix test is part of the 4th edition of the Wechsler Intelligence Scale for Children—the most widely used test of children's intellectual ability—and it was chosen as a language-independent assessment of intellectual aptitude (Wechsler 2003). The teacher-reported cognitive measures enrich the information gathered from parents and from the other tests, and teacher evaluations have also been integrated in evaluating children under the LSAC (Australian Institute of Family Studies 2013). On the developmental front, the Strengths and Difficulties Questionnaire (SDQ) total difficulties score—the prosocial scale is part of

the SDQ total difficulties score—has been validated internationally, and used in clinical and social research to evaluate children's developmental and emotional difficulties (Goodman 2001). Finally, a child's assessment of whether they always feel happy about going to school (as opposed to only feeling happy sometimes or never) is included in this study, because self-reported wellbeing in youth is closely linked to other socioeconomic and developmental outcomes (for the case of self-reported youth life-satisfaction, see Proctor et al. 2009), and because a child's connectedness to school is linked to positive health and cognitive outcomes (Catalano et al. 2004).

Given the potential cultural biases embedded in some standardised tests and measures of developmental outcomes, the LSIC was carefully designed to incorporate outcome measures that are culturally relevant for Indigenous children, while continuing to examine the formation of important skills taught in formal education facilities, such as vocabulary and reading progress, mathematical ability and social skills. For example, the Renfrew vocabulary test allows Indigenous children to answer in other languages and was chosen as appropriate for Indigenous children in consultation with education experts from ACER. The PAT-R tests were shortened and modified to better suit Indigenous children, and a new scale of scores was produced for the LSIC sample. For developmental scales, where appropriate, 'questions have been adapted to the Indigenous context or shortened to meet time constraints' (Department of Social Services 2015:30).

TABLE 3: Cognitive and noncognitive outcome measures

Developmental outcomes	Strengths and Difficulties Questionnaire total difficulties score Prosocial scale Child is always happy at school
Reading and literacy ability outcomes	Teacher-reported language and literacy Renfrew vocabulary test Progressive Achievement Test in Reading
Abstract reasoning and maths ability outcomes	Teacher-reported maths Progressive Achievement Test in Mathematics Abstract reasoning (Matrix test)

The LSIC should be treated as a community sample, rather than being fully representative of Australia's Indigenous children. Because the usable information in subsequent analysis varies by outcome measure and by ECEC institution analysed (i.e. preschool or child care), it is necessary to test for sampling bias—that is, to test whether the analysis that uses a small subsample is roughly similar to the overall LSIC sample. Consistently, the teacher-reported maths and reading outcomes suffered from very small sample sizes (see Appendixes 2–6), and are thereby especially susceptible to sampling bias.[2] Table 4 shows controls where statistically significant differences existed between those who were included and those who were not included in the teacher-reported analysis; statistically insignificant differences are indicated by blank cells.[3]

Overall, very few controls indicate sampling bias. Persistent differences are most notable for the LORI measure of remoteness, with those included in the teacher-reported outcomes being less likely to live in remote areas. This may be due to difficulties in contacting teachers for children living in rural or remote areas. While the analysis that follows should be generalised with care for very specific subgroups of Indigenous children, the results from Table 4 provide evidence that the subsamples used for various outcome measures are still largely representative of the overall LSIC sample.

TABLE 4: Testing for sampling bias of teacher-reported outcomes—coefficient estimates

	Preschool analysis		Child-care analysis	
Control variable	Short term	Longer term	Short term	Longer term
ECEC attendance				
Study child is female				
Age of study child				
Primary parent/carer is male		0.82**		
Primary parent/carer is non-Indigenous		0.41*		
Secondary parent/carer is non-Indigenous				
Secondary parent/carer is not partnered				
Primary parent/carer liked school as a child				
Primary parent/carer has good health				
Primary parent/carer has fair health				
Primary parent/carer speaks English and Indigenous language with similar fluency				
Primary parent/carer speaks Indigenous language best	0.47*	1.27***		
Primary parent/carer is not employed				
LORI index of isolation: 2				
LORI index of isolation: 3	–0.34*			
LORI index of isolation: 4	–0.86***		–0.75**	
Household experienced money shortage				
Household experienced money surplus				
Primary parent/carer has moved in the past 12 months				
Primary parent/carer has completed Year 12 or higher education				
Weekly number of hours spent at ECEC	na	na	na	
Child is part of the kid cohort	–0.18*	na	na	

ECEC = early childhood education and care; LORI = Level of Relative Isolation; na = not applicable
Notes:
1. Blank cells indicate that the scores are not statistically significant.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.

Choice of ECEC participation

Before analysing the effects of ECEC participation, it is important to understand the factors associated with the decision to enrol a child in ECEC. Despite the increased policy focus on higher Indigenous preschool participation, there are still disparities between Indigenous and non-Indigenous children's ECEC participation, and this level has not improved in recent years. Using the 2001 Census, Biddle (2007) finds that 3–5-year-old Indigenous children have lower levels of preschool attendance, which can be largely explained by lower household income and education levels of parents, as well as higher levels of geographical disadvantage. The author also finds that the presence of a local Indigenous preschool worker significantly increases the probability of preschool attendance, but that most students do not have local access to Indigenous personnel. According to more recent census data, if the geographical distribution of Indigenous children is set equal to the geographical distribution of non-Indigenous children, in 2006, 66.3% of Indigenous children would have attended preschool, whereas in 2011, 65% would have attended. Not only are these numbers significantly lower than the non-Indigenous attendance rate of 72.0%, there is also no increase in the Indigenous participation during this period.[4]

Similar to the census data, the LSIC provides information on the factors that affect whether Indigenous children are enrolled in ECEC or not. Table 5 shows the main reasons primary parents/carers of the baby cohort had chosen not to enrol their children in preschool (this subgroup of the baby cohort comprises 238 children and accounts for about 30% of the total observations in the baby cohort at wave 4). Financial, preschool supply shortage or

transport costs do not stand out as the main reasons why parents choose not to send their children to preschool. The main reasons seem to be personal justifications, which government policies to increase preschool access or lower related costs may have a hard time influencing. For example, in the top category ('child is too young'), about 88% of the children not attending preschool were over 4 years of age, and certainly met the minimum age requirement to attend preschool.

TABLE 5: Why primary parents/carers choose not to enrol their children in preschool

Reason	Percentage
Child is too young	51.7
Have decided not to send child yet	14.7
Child does not need it	12.6
Child would be unsettled at school	5.9
Not available locally	4.6
Costs are too high	3.8
Cannot get a place	3.4

Furthermore, for those parents that do choose to participate in ECEC, it is not necessarily their child's intellectual development or smooth transition to school that motivates them to do so. Table 6 shows that parental work commitments and developing children's social skills were the main reasons why primary parents/carers choose child care in more than 80% of responses (this subgroup of the baby cohort comprises 165 children and accounts for about 22% of the total observations in the baby cohort at wave 4).

TABLE 6: Why primary parents/carers choose to send their children to child care

Reason	Percentage
Parental work commitments	42.4
Good for child's social development to mix with other children of same age	40.0
A good way to prepare child for school	6.1
To give parent a break or time alone	5.5
Parental study commitments	3.0
Parent looking for work	1.2
Good for child's intellectual or language development	1.2
So parent can attend to own, partner's or other relative's health needs	0.6

Although we do not have data to test this hypothesis, it is most likely that, for some Indigenous families living in Indigenous communities, informal care (e.g. through other family members or through other members of their Indigenous community) may be more accessible than for non-Indigenous families, and parents may therefore feel they do not require formal ECEC for their children to become better socialised or prepared for school. However, given the high rate of Indigenous geographic mobility, as well as of mixed partnerships (i.e. having one Indigenous and one non-Indigenous parent) (Biddle & Johnstone 2014), it is not surprising that work commitments and a need for children to socialise are important determinants for some Indigenous parents to use formal ECEC arrangements, since traditional forms of informal child care and socialisation for children are not always available.

Estimation methodology

The statistical methods we use are explained in detail (where relevant) in subsequent sections, but it is important to give some preliminary explanations regarding the overall approach of our data analysis. To test the effects of ECEC participation on Indigenous children, we used a standard regression modelling framework. This methodology was used because, unlike other statistical frameworks, it allows for a more intuitive interpretation of the estimated effects of ECEC participation and can appropriately incorporate the panel structure of the LSIC. Other regression techniques may yield new insights on the effects of ECEC on Indigenous children, and we are also testing other techniques that could make our analysis more robust. Throughout this study, we tested various specifications of the models we used; that is, we included different sets of controls as well as nonlinear specifications of the controls to ensure that the modelling framework that we present in the following sections did not drive the qualitative results we reached.

Effects of preschool participation on the short- and longer term developmental and cognitive outcomes of Indigenous children

Short-term relationships between preschool attendance and outcomes

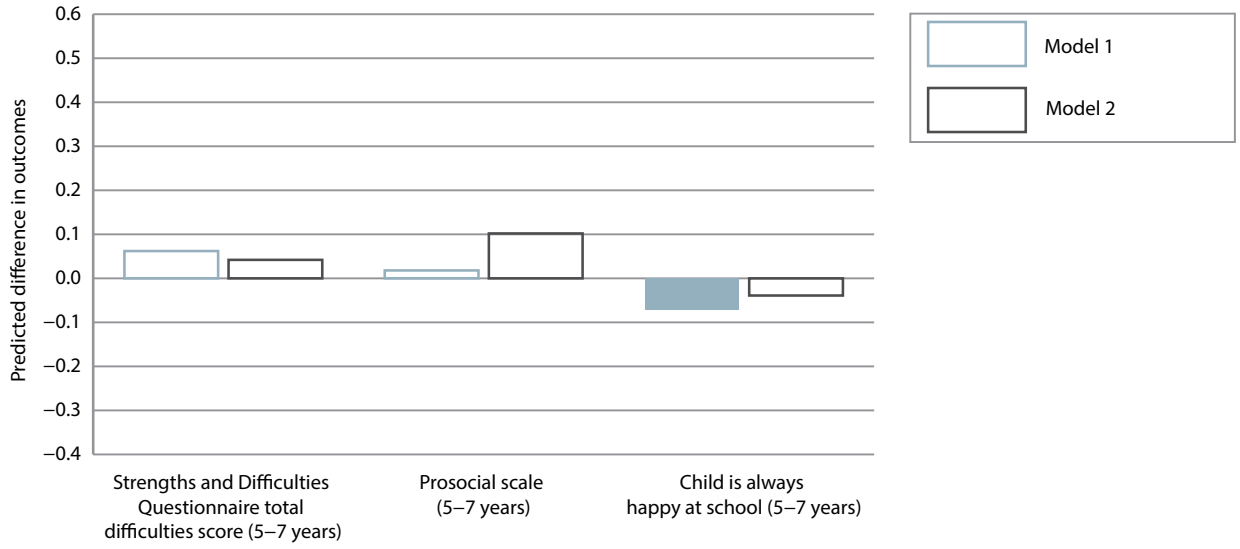
Although the choice of ECEC participation is itself highly relevant in the current policy context, understanding whether higher ECEC participation will improve the cognitive and developmental outcomes of Indigenous children is most important in justifying its increased Australian Government policy focus. We begin analysing the short-term effects of preschool for Indigenous children, by using a model that 'pools', or keeps together, the kid and baby cohorts and measured outcomes at ages 5–7 years (2 years after preschool enrolment). All scores are standardised to permit comparisons of marginal effects across the different outcomes.[5] The effect of preschool on various cognitive and noncognitive outcomes is estimated using two models:[6]

- Model 1 only controls for preschool participation.
- Model 2 controls for preschool participation, gender, a child's age, parent/carer characteristics (objective and subjective), parent/carer use of English/Indigenous language, remoteness, financial position, geographic mobility and the cohort a child belongs to (i.e. kid or baby cohort).[7]

When possible, the controls included are from the same wave of preschool attendance. A few of the controls, however, were not available in the wave when preschool would have been attended. When this occurs, the time difference between these controls and the preschool attendance control have been kept the same across the two cohorts.

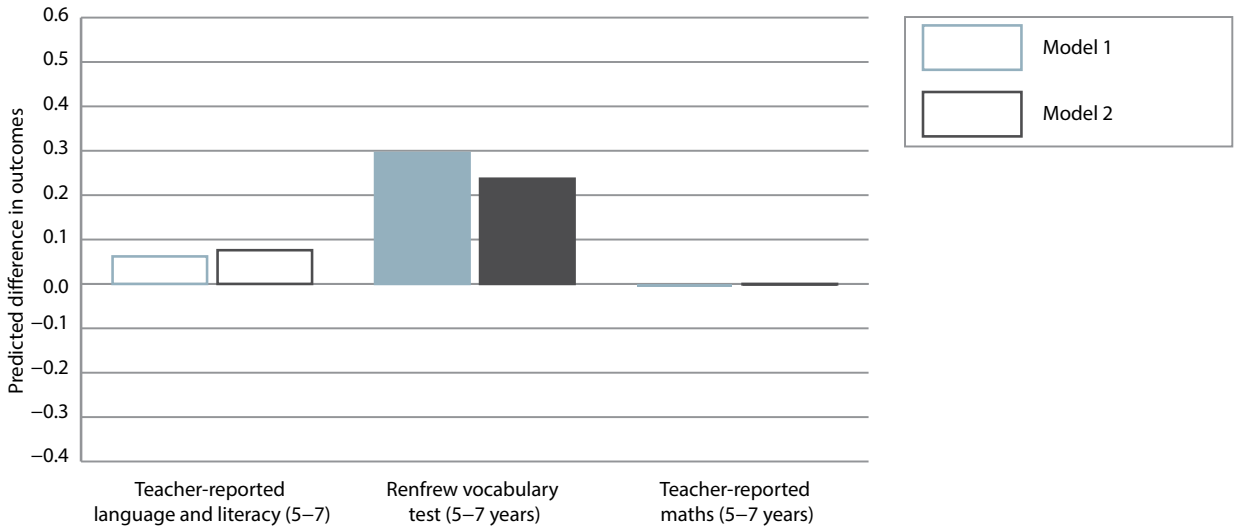
Fig. 1 shows the effects of preschool attendance on developmental outcomes, and Fig. 2 shows the effects of preschool on cognitive outcomes. Given that all outcome measures have been standardised, the vertical axis of all of our marginal effect graphs measure the number of standard deviations above or below the mean resulting from participating in a particular ECEC type (i.e. preschool or child care). The shaded bars represent statistical significance between preschool and the outcome variables, whereas the hollow bars represent no statistically significant relationship.[8] There is a small but significant negative effect of preschool for the 'Child is always happy at school' outcome variable using model 1, but this effect disappears once demographic controls are added in model 2. Using both models, there is a large, positive and statistically significant effect of preschool on a child's vocabulary (whether in English or an Indigenous language), yet preschool has no other significant effects on any of the other outcome variables, nor are there any observed large weak associations (weak associations refer to marginal effects that are not statistically significant). In particular, under both models, the 'teacher-reported maths' outcome variable has the smallest marginal effect, and it is also statistically insignificant.

FIG. 1: Short-term effect of preschool attendance on developmental outcomes



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

FIG. 2: Short-term effect of preschool attendance on cognitive outcomes



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

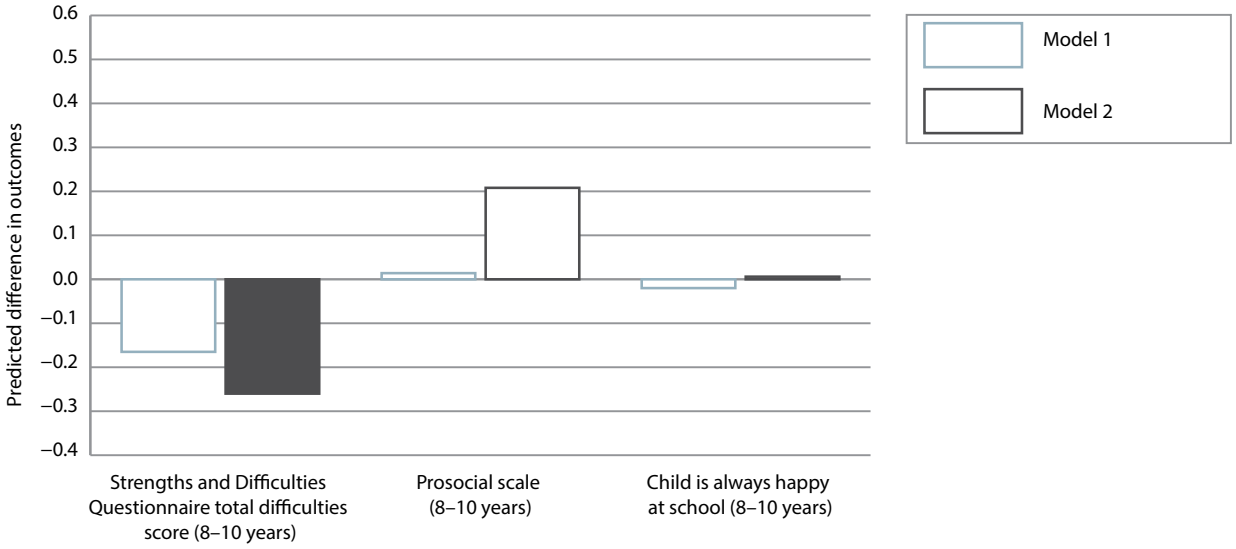
It seems that, in the short term, the strongest effect of preschool attendance is on increasing a child's vocabulary, which in turn has a strong correlation with reading proficiency later in life (Biemiller 2007). While the results of Biemiller (2007) are not specific to Indigenous children, we can expect them to hold for Indigenous children as well, given that the Renfrew vocabulary test is conducted in a child's native language, so there is no bias where Indigenous children with poor English proficiency will be scaled as having a less-developed vocabulary.

Next, we explore the longer term effects of preschool on various developmental and cognitive outcomes to determine whether the short-term positive effect of preschool on vocabulary translates to higher reading and literacy proficiency, as well as whether any effects of preschool attendance on other cognitive and developmental outcomes can be observed in the longer term.

Longer term relationships between preschool attendance and outcomes

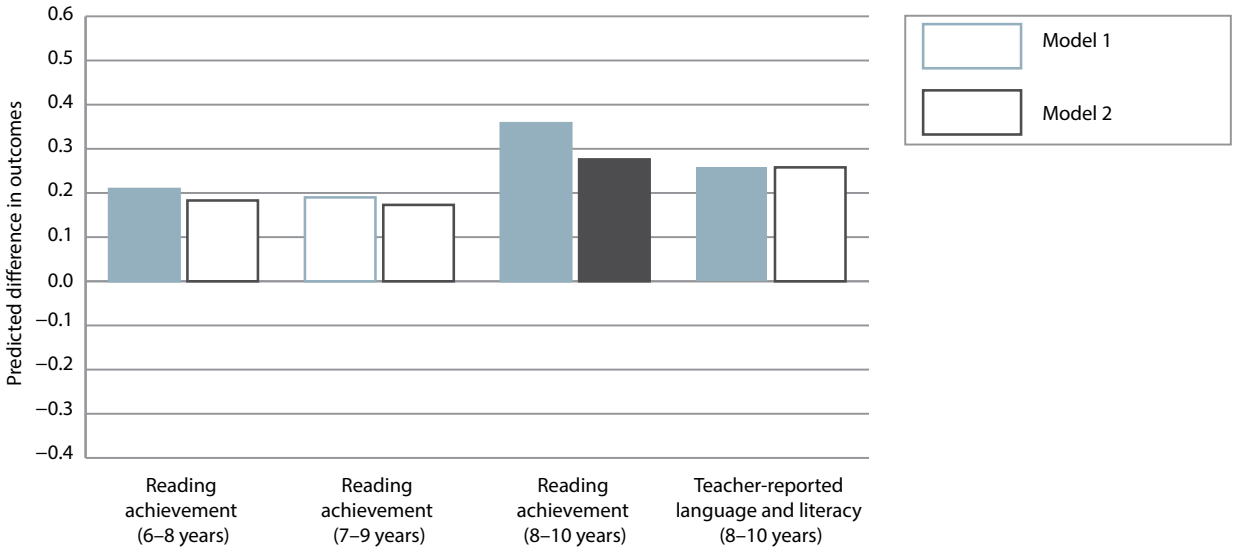
Although we are unable to estimate the longer term effects of preschool for the baby cohort because those data are not yet available, it is possible to estimate longer term effects for children in the kid cohort. These longer term outcomes are measured 3–5 years after preschool enrolment, when children were 6–10 years old, using outcomes from waves 4–6. These recent waves contain new information on students' reading, literacy and maths proficiency that are more relevant to older children. As such, the marginal effects of preschool are presented in three different groups: Fig. 3 presents the relationship between preschool attendance and developmental outcomes, Fig. 4 presents the relationship between preschool attendance, and reading and literacy ability, and Fig. 5 presents the relationship between preschool attendance, and mathematical and abstract reasoning ability. All scores are standardised to permit comparisons of marginal effects across the different outcomes, and statistical significance in the figures is represented with shaded bars.

FIG. 3: Longer term effect of preschool attendance on developmental outcomes



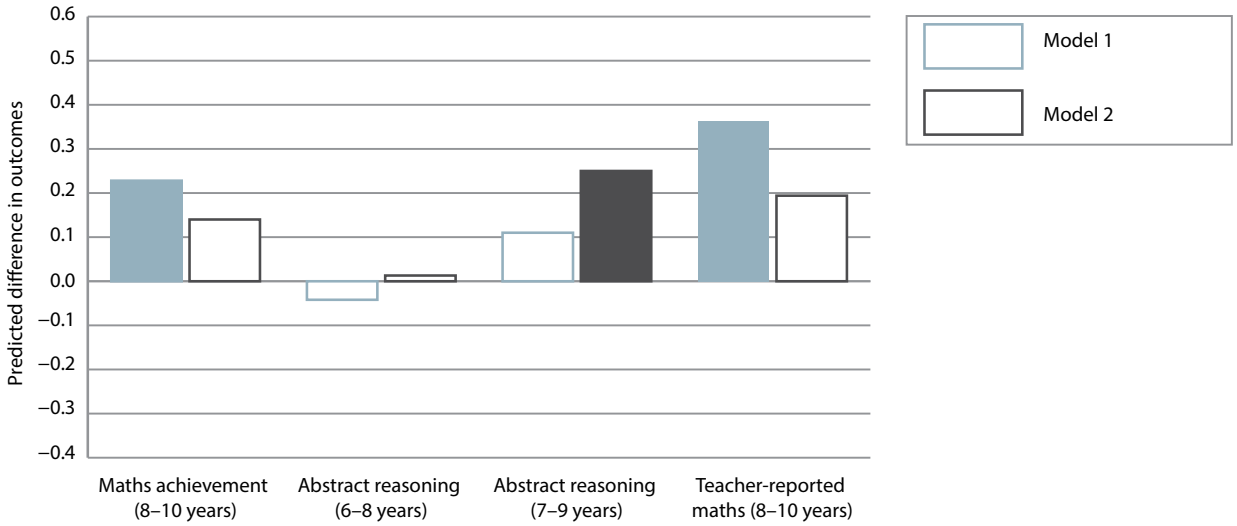
Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

FIG. 4: Longer term effect of preschool on reading and literacy proficiency



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

FIG. 5: Longer term effect of preschool on maths ability and abstract reasoning



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

There is now stronger evidence for the effect of preschool on developmental outcomes: the marginal effect of preschool on the SDQ total difficulties score is large and negative, and is statistically significant after controlling for demographic characteristics (this is a positive outcome, because higher SDQ scores represent more developmental problems). There is also a large weak association between preschool attendance and a child's sociability once we control for other demographic characteristics. One possible explanation for observing a relationship between preschool and developmental outcomes in the longer term and not in the short term is that some developmental problems develop later in childhood, and they would have been difficult to detect or undetectable at the ages of 5–7 years, when short-term outcomes were examined. Given these results, it is important to note that while these development scales have been created outside an Indigenous context, they were assessed by LSIC staff and education experts, and deemed appropriate—and modified where necessary—for Indigenous children. Furthermore, the SDQ responses we analyse are those of primary parents or carers, which removes the possible bias that may be introduced if the child's behaviour were to be analysed solely by teachers or other staff who are not knowledgeable in Indigenous culture and values. This, of course, does not remove the possible bias of a scale that scores sociability according to Western norms. Even in this case, these scores are important indicators of how well a child is coping in formal schooling, and are linked to the likelihood of further educational attainment. Indigenous-specific analysis has also highlighted the importance of educational attainment in improving a range of wellbeing indicators.

There was a large and statistically significant relationship between preschool attendance and a child's Renfrew vocabulary test score at the ages of 5–7 years (see Fig. 2). From the results of the PAT-R for the last three waves of the survey (when children were 6–10 years old), it is clear that there are large and positive marginal effects of preschool attendance. In the latest wave, these results are large and statistically significant, even after controlling for other demographic characteristics. Although the effect of preschool on teacher-reported language and literacy at the ages of 8–10 years is statistically insignificant after controlling for demographic characteristics, the marginal effects are still large and positive.

In the short term, the only measure of numeracy proficiency was teacher-reported maths ability, but for later waves, we can use a range of other outcomes to measure numeracy and abstract reasoning. Analogous to the PAT-R, the PAT-M measures a child's mathematical profiency. The results from the PAT-M at ages 8–10 show a statistically significant effect of preschool that becomes statistically insignificant once the demographic controls of model 2 are added, but this weak relationship is still large and positive. Therefore, demographic characteristics do not fully account for the longer term improvements in PAT-M scores that were originally attributed to preschool attendance in model 1, providing some evidence of the positive impact of preschool attendance on this outcome. Results from the Matrix abstract reasoning tests are available for waves 4–5 when

the children were 6–9 years old. The marginal effect of preschool on the Matrix tests is small and insignificant when the children were 6–8 years old, but larger and statistically significant at ages 7–9 (once demographic characteristics are controlled for). Finally, teacher-reported maths ability and preschool attendance had no relationship in the short term when children were 5–7 years old, but there is weak evidence of a positive relationship between the preschool attendance and teacher-reported maths ability in the longer term after demographic characteristics are controlled for.

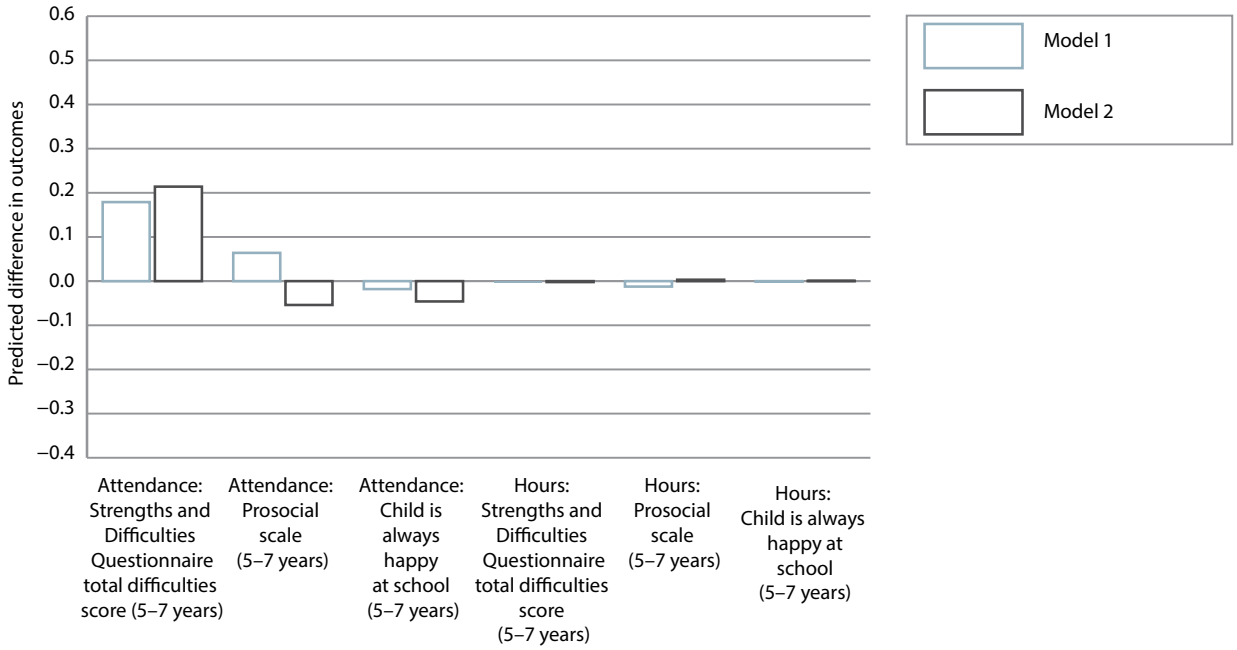
Overall, there is stronger support for the importance of preschool attendance in improving the developmental and cognitive outcomes of Indigenous children in the longer term. Also, the use of outcomes that are not available in earlier waves of the survey permitted testing the effect of preschool across a wider range of cognitive variables. As this longer term analysis uses only observations from the kid cohort, the statistical significance of some of the estimated marginal effects is compromised by a smaller sample size; however, weak relationships between preschool and various outcomes are consistently large and positive.

Effect of preschool hours attended

The analysis so far has used a binary outcome variable to indicate whether a child attended or did not attend preschool. It is possible, however, that the relationship between preschool and the various outcomes that have been considered so far do not just depend on preschool attendance, but rather on the amount of preschool exposure a child experiences. To control for differing hours of preschool attended, we replace the binary attendance variable with a continuous variable that indicates the number of hours per week that a child spends at preschool. The following results are from models that include the binary preschool attendance variable as well as preschool hours (and its squared term); as before, model 2 controls for demographic characteristics.[9] Given that the number of preschool hours attended was only asked of the baby cohort in wave 4, the estimates are of short-term standardised outcomes only, and are thereby less precise due to the smaller sample size.

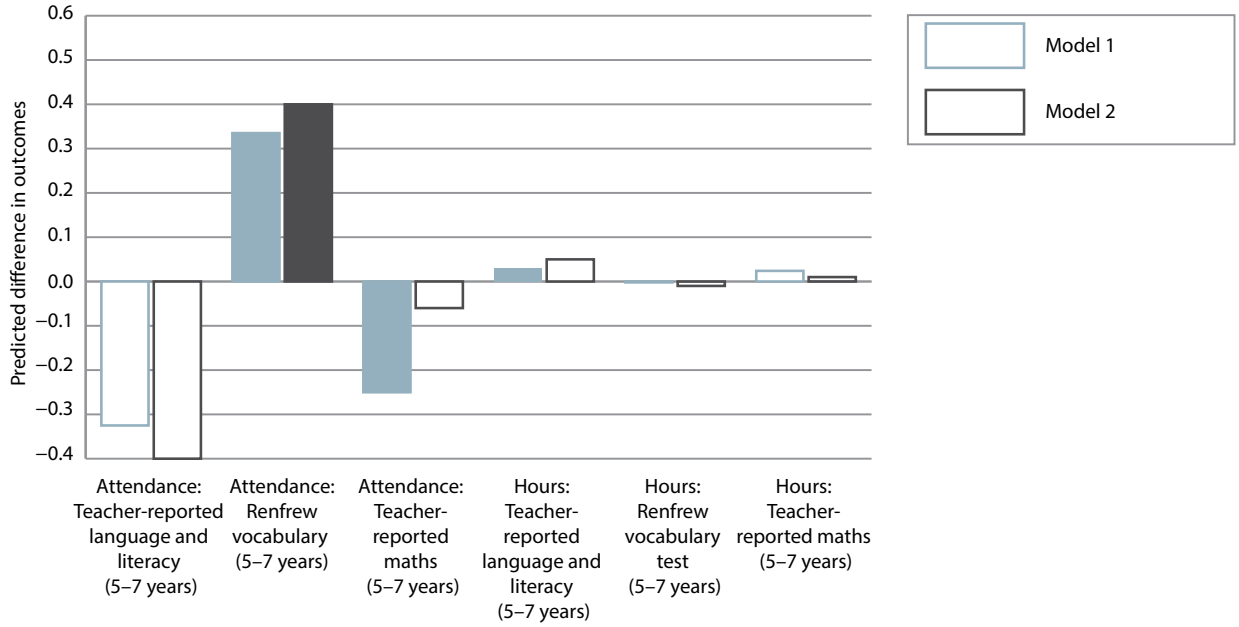
Fig. 6 shows the effects of preschool attendance and preschool hours on the same developmental outcomes previously explored. Given that all outcome measures have been standardised, the vertical axis of all of our marginal effect graphs measure the number of standard deviations above or below the mean, resulting from participating in a particular ECEC type (i.e. preschool or child care), and from being exposed to an additional hour at an ECEC facility. As in previous analysis, there are no statistically significant relationships between preschool attendance and the outcome variables; nonetheless, large weak associations are captured by preschool attendance and not preschool hours. When considering cognitive effects, as in the previous short-term analysis, the Renfrew vocabulary test is the only short-term outcome associated with preschool that is statistically significant after controlling for demographic characteristics (see Fig. 7). Again, the binary preschool attendance variable captures most of the relationship between preschool and cognitive outcomes, whereas the marginal effects of preschool hours are very small and statistically insignificant. There are no available data to test the effect of preschool hours on longer term outcomes, yet these results point to a very small and insignificant effect of hours attended. Indeed, the regression framework we use has the drawback that it does not point to a minimum threshold at which ECEC attendance and hours begin to have a statistically significant impact on cognitive and developmental outcomes. We did, however, analyse various ranges of ECEC hours attended and found that even shorter hours at ECEC (1–15 hours per week) led to significant improvements in cognitive and developmental outcomes.

FIG. 6: Short-term effect of preschool attendance and hours on developmental outcomes



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

FIG. 7: Short-term effect of preschool attendance and hours on cognitive outcomes



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

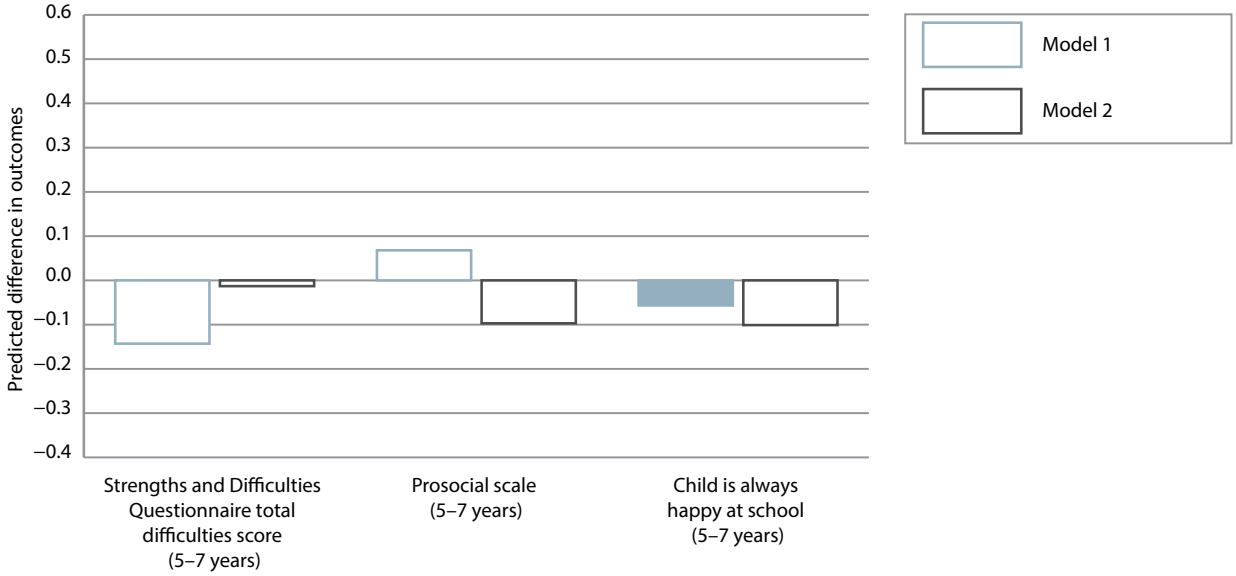
Effects of child-care participation on the short- and longer term developmental and cognitive outcomes of Indigenous children

Preschool and child care often have similar financial structures and curriculums, yet, by law, child-care centres (except child-care centres in New South Wales with more than 29 children) do not have to provide educational services or employ staff who are qualified teachers (Dowling & O'Malley 2009). Given the proposed reforms to expand government subsidies for child-care use, understanding their impact on Indigenous children's developmental and cognitive outcomes is of particular importance. In practice, about 40% of child-care centres are long day–care centres, 55% are centres that operate outside school hours, and about 5% are centres that provide family, in-home or occasional care (Productivity Commission 2014). As families often combine preschool use with child-care use, the previous analysis of preschool includes children who attended preschool and child care. In this section, however, we analyse the effect of child care for children who only attend child care, and compare their outcomes with children who did not attend child care or preschool. We highlight these differences because they show why one should not compare the size of the marginal effects of preschool participation with the size of the marginal effects of child-care participation.

Short-term relationships between child-care attendance and outcomes

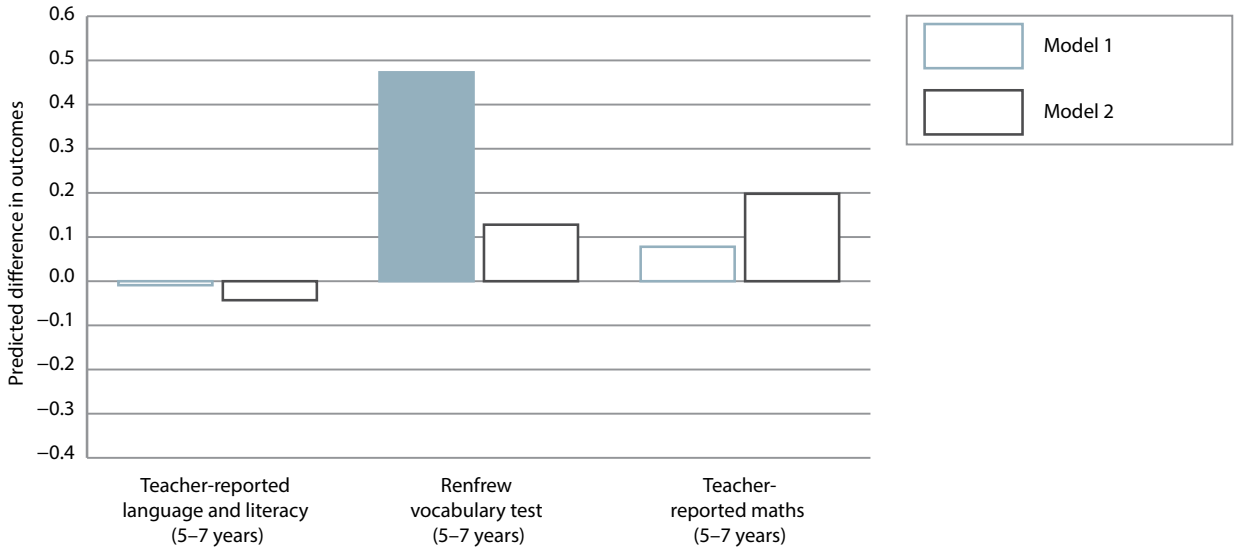
To quantify the effect of child-care attendance, we use the same two models discussed previously, this time using child-care attendance instead of preschool attendance as a control variable. Figs 8 and 9 present the marginal effects of child-care attendance on standardised short-term outcomes using a pooled model of the two cohorts (statistical significance is indicated by solid bars).[10] Together, the results show that, once other demographic characteristics are controlled for in model 2, child care has a small and insignificant effect on most developmental and cognitive outcomes; the marginal effects of child-care attendance on the Renfrew vocabulary test and on teacher-reported maths ability are larger but statistically insignificant. Relative to preschool attendance (see Fig. 2), there is weaker evidence for the short-term effect of child-care attendance on improving cognitive or developmental outcomes for Indigenous children.

FIG. 8: Short-term effect of child-care attendance on developmental outcomes



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

FIG. 9: Short-term effect of child-care attendance on cognitive outcomes



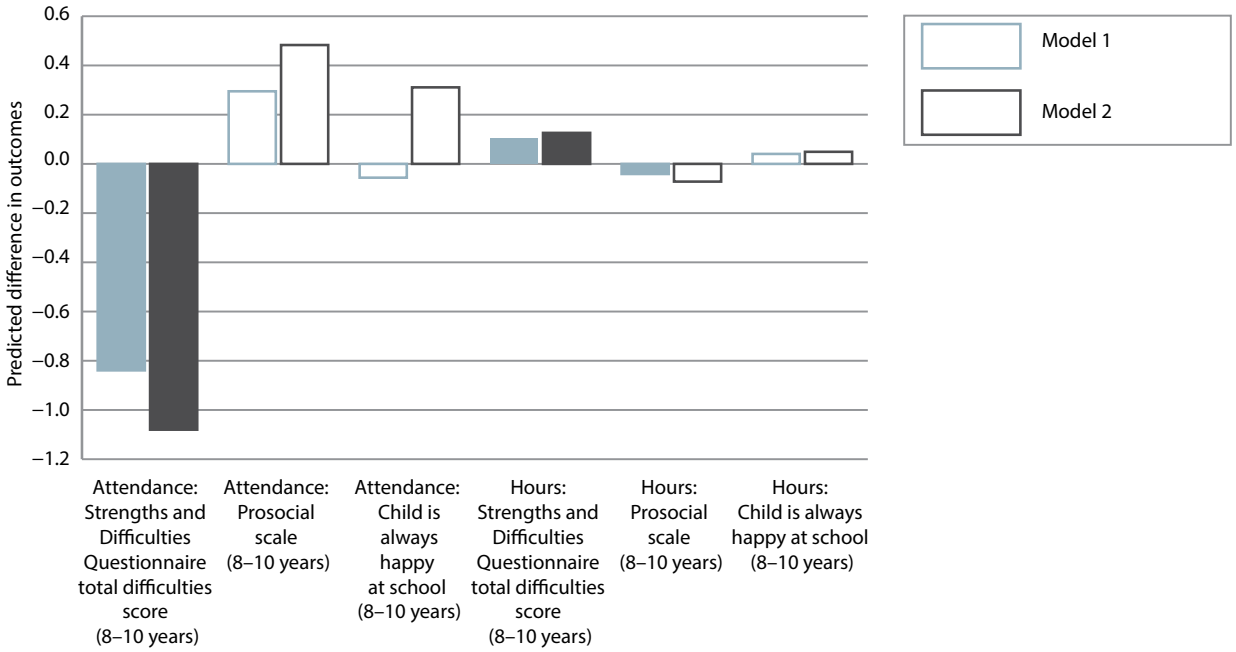
Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

Longer term relationships between child-care attendance, child-care hours and outcomes

As with the preschool analysis, using information from waves 4–6 (when children in the kid cohort were 6–10 years old) it is possible to estimate the longer term effects of child-care attendance on developmental and cognitive outcomes. The existence of longer term effects of the number of hours attended are explored simultaneously with the longer term effects of attendance, because this information was not available in the short term for child care as it was for preschool. Hence, the marginal effects of child-care attendance are estimated using the same two models, but the binary preschool attendance variable is replaced with a binary child-care attendance variable, and both models include a linear and squared term for the continuous 'number of hours per week spent at child-care' variable. All scores are standardised to permit comparison, and solid bars in the figures represent statistical significance.[11]

Fig. 10 presents the marginal effects of child-care participation on longer term developmental outcomes. Child-care attendance leads to statistically significant lower SDQ scores (which is good, because higher scores indicate more developmental problems), and there is also a large positive weak association between child-care attendance, and both a child's prosocial score and their probability of being 'always happy at school', after controlling for demographic characteristics. Unlike preschool, where the effect of hours attended on developmental outcomes was consistently small, there is a positive and statistically significant relationship between the number of hours spent at child care and SDQ scores; this is an unwanted effect, since higher SDQ scores point to more developmental problems. The effect of child-care hours attended is negligible for the other two developmental outcomes considered.

FIG. 10: Longer term effect of child-care attendance and hours on developmental outcomes

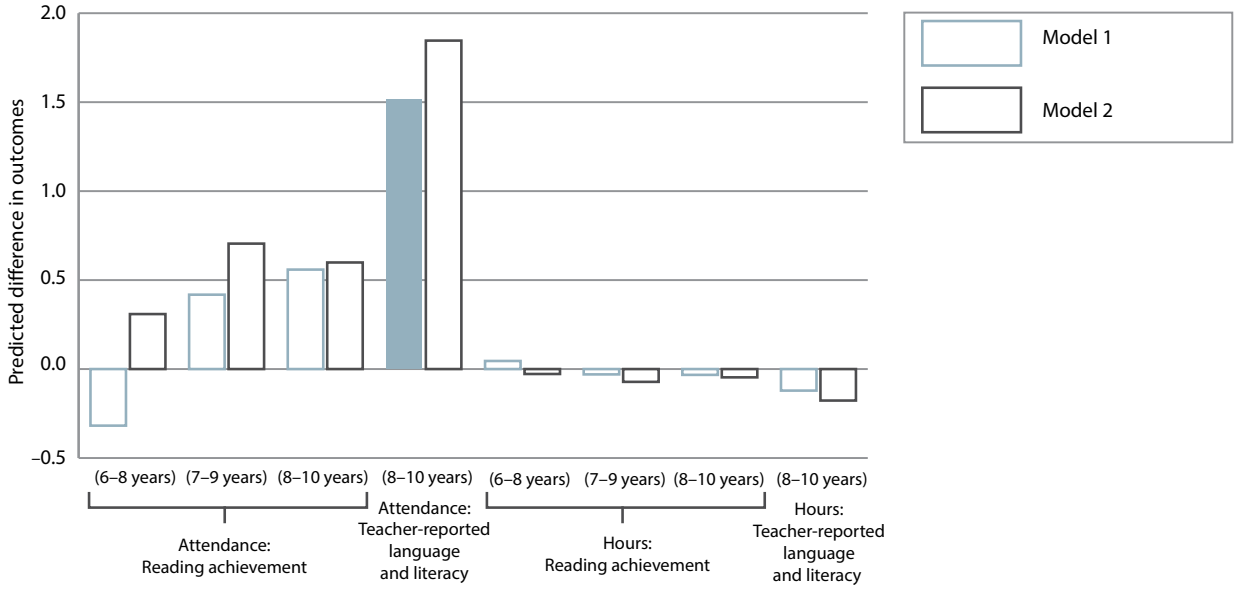


Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

The cognitive effects of child-care participation are of particular importance given the lack of educational curriculums that characterise many child-care centres. Nonetheless, Fig. 11 shows that, for reading and literacy, child-care attendance has a large and positive relationship with all outcome variables, although none of them are statistically significant once background characteristics are controlled for, potentially due to the small sample size.[12] The effect of hours attended is consistently negative, small and statistically insignificant across the outcome variables. The positive and significant marginal effect of child-care hours attended on the SDQ scale (see Fig. 10; this is a detrimental effect since higher SDQ scores point to more behavioural difficulties) provides some weak evidence that, unlike preschools, which have a capped maximum hours of attendance, very long hours at child-care centres can be detrimental to children's development.[13] This was also found for the general Australian population using data from the LSAC (Biddle & Seth-Purdie 2013).

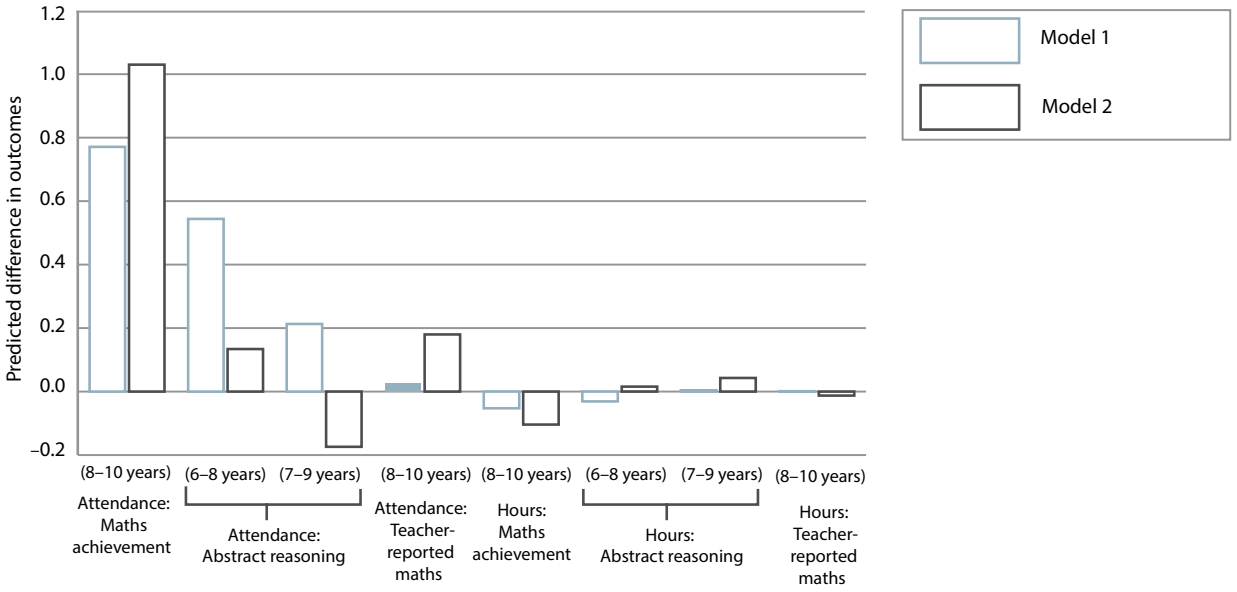
Fig. 12 shows that child-care participation is also linked to improvements in children's abstract reasoning and maths ability: attendance appears to have a positive and large effect across most of the outcome variables, but this effect is only statistically significant for the PAT-M at the ages of 8–10 years. Furthermore, while the effect of child-care hours attended is small across all outcomes, it has a negative and statistically significant effect on the PAT-M scores, reinforcing the claim that spending too many hours at child care can be detrimental. Overall, the positive effect of child-care attendance on children's developmental and cognitive outcomes is most notable in the longer term outcomes, yet there is some weak but consistent evidence of a negative effect of child-care hours attended.

FIG. 11: Longer term effect of child-care attendance and hours on reading and literacy proficiency



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

FIG. 12: Longer term effect of child-care attendance and hours on abstract reasoning and maths ability



Note: Shaded bars are statistically significant at the 10% level (at least). Predicted difference in outcomes is shown as a proportion of one standard deviation from the mean.

Conclusion and policy implications

Improving the cognitive and developmental outcomes of Indigenous children is a key policy goal for all levels of government. Overall, the findings of this study point to the importance of ECEC participation for Indigenous children as a means to improve a range of cognitive and developmental outcomes. The increased policy focus on ECEC access for Indigenous children is justified, as the benefits of participation are not confined to the non-Indigenous population. Nonetheless, the effects of ECEC participation varied significantly across the three groups of outcomes analysed (reading and literacy, maths and abstract reasoning, and developmental) and between the two formal venues of ECEC provision (preschool and child care). In particular, ECEC participation in preschool and child care led to a large improvement across reading and literacy outcomes in the short and longer term, although these effects were statistically insignificant for child care. For maths ability and abstract reasoning, preschool and child care had a positive effect only in the longer term, and although there were no short-term benefits of preschool or child care on developmental outcomes, there is good evidence of preschool and child care having a positive effect on developmental outcomes in the longer term. Finally, the number of preschool hours attended had no significant effect on any of the outcomes in the short term, but there is some evidence of a negative effect of child-care hours attended in the longer term. Overall, the positive effects of preschool participation were more significant than those of child-care participation—this could be explained by preschool-specific characteristics such as structured learning curriculums, capped attendance hours and stricter employment requirements for staff (for the effects of teacher qualifications on student cognitive outcomes, see Warren & Haisken-DeNew 2013). Hence, policies should not only focus on participation in an early education centre, but should also note that an educational, structured ECEC program with capped attendance hours is more likely to boost cognitive and noncognitive outcomes for Indigenous children, and that child-minding centres of poor quality can actually have detrimental impacts on children, especially on their noncognitive formation.

There are several drawbacks to using LSIC data, including a small sample size, which often precludes statistical significance despite consistently large weak associations in the short and longer term. Secondly, extrapolations of these results to specific Indigenous groups must be done carefully, because the LSIC sample is not fully representative of Australia's population of Indigenous children, in the sense that it may not be representative of the children that identify with a particular Indigenous group or of Indigenous children in certain jurisdictions within Australia. These limitations aside, the LSIC is still highly informative to policy makers because it is a community sample that roughly represents the proportion of Australia's Indigenous children living in urban, rural and remote areas, and its longitudinal structure avoids issues of unobserved heterogeneity in drawing causal relationships over time. Although the analysis did not use the entire LSIC sample, we were able to obtain useful information from large subsamples. This is especially true for the preschool analysis; the child-care analysis relied on smaller samples, and some very large associations were often statistically insignificant as a result (e.g. see Fig. 11).

One of the limitations of the analysis in this paper (as opposed to the data) was the focus on outcome variables that were not specific to the Indigenous population. That does not mean they were not relevant—on the contrary, many Indigenous leaders and all levels of government highlight the importance of literacy, numeracy and school adjustment for Indigenous children. Furthermore, there is some evidence that formal education enhances rather than conflicts with Indigenous-specific measures of wellbeing into adulthood (Dockery 2010, Biddle & Cameron 2012b). Nonetheless, there are other measures on the LSIC that are likely to be of particular relevance for Indigenous children and young people. These include whether Indigenous children feel good about being Indigenous or enjoy sharing Indigenous culture while in class, and whether Indigenous children have experienced bullying or discrimination because of being Indigenous. These variables deserve their own specific analysis and are the focus of ongoing work by the authors.

Internationally, the most convincing evidence for the effect of ECEC on long-term outcomes comes from a small set of randomised trials that carefully control for selection into programs (Heckman & Mosso 2014). Using these trials, it is possible to control for observable and unobservable differences between those who do and do not participate in ECEC. By using longitudinal data, we can control for observable characteristics at the time of preschool participation without resorting to recall. This is a step up from the cross-sectional data used in the past and allows us to be reasonably unequivocal that we are not capturing reverse causality. However, there is still a chance that there is a third variable or set of variables that affect both participation and outcomes. We therefore strongly recommend that the results from this analysis are only the second step, and should be used to support careful trials of Indigenous-specific or Indigenous-targeted preschool programs that build

selection into the design. Indigenous-specific factors are not only important determinants of ECEC participation, but fundamental considerations in designing culturally sensitive programs that build on the skills and values that Indigenous children bring to formal schooling. We have previously mentioned the importance of creating an environment where Indigenous families feel that their culture will be respected and embraced—for example, through the inclusion of Indigenous school personnel or programs that incentivise Indigenous parents and communities to engage with educational staff and facilities. Boosting ECEC participation is also just a first step in engaging with Indigenous children in a pedagogical sense: researching and implementing teaching methods that support Indigenous culture and values should be a fundamental part of policies aimed at boosting Indigenous educational achievements.

Despite the limitations of our work, the results consistently show the potential that ECEC participation has in bridging the gap between Indigenous and non-Indigenous children's school achievements. As previously discussed, the choice of ECEC participation is often subjective and not primarily motivated by parents' desires to improve their children's intellectual development or ease their transition to mandatory formal schooling in later years. This supports early, targeted government interventions that incentivise ECEC participation through culturally sensitive curriculums, as many Indigenous parents may not be aware of the longer term benefits that ECEC can have on their children's developmental and cognitive outcomes. Similarly, Indigenous families' willing engagement in ECEC and other forms of formal schooling has complex determinants that are Indigenous-specific, and that need to be well understood by policy makers to deliver the best programs for Indigenous children.

Notes

1. The year before full-time schooling is referred to as kindergarten in some areas and preschool in others, but this study adopts the more commonly used term: preschool.
2. We use the following multivariate method to test for sampling bias in the teacher-reported outcomes, which is better than conducting bivariate comparisons of each control (Cuddeback et al. 2004): we estimate binary probit models where the dependent variable indicates whether an observation was included or not included in the teacher-reported analysis, and where the controls are the same demographic controls used in the corresponding teacher-reported analysis.
3. The sample bias tests were done for the (pooled) short- and longer term teacher-reported maths and reading outcomes. The marginal effects were the same for corresponding reading and maths outcomes since the samples were the same. Hence, Table 4 does not differentiate between maths and reading marginal effects.
4. The purpose of setting the geographic distribution of Indigenous and non-Indigenous children to be equal is to examine the differences in preschool attendance for the two populations that can be attributed to nongeographical factors. This is an important exercise because it shows that Indigenous children do not have lower preschool attendance only because they are more likely to live in more remote areas.
5. By standardised, we mean that the outcomes have been rescaled to have a mean of 0 and a standard deviation of 1. This is done so that the effects become scale-independent and can be compared directly. Furthermore, a marginal effect is one that measures the effect of a change in an independent variable (e.g. ECEC participation) on the change of a dependent variable (e.g. Renfrew vocabulary test score).
6. For a detailed list of the outcome measures used and related information, see Appendix 1. See Appendixes 2–6 for full results of all the regression analyses presented throughout this paper.
7. The specific controls in the pooled model are gender, age of study child, age of primary parent/carer, Indigenous status of primary parent/carer (usually the child's mother), Indigenous status of secondary carer/parent (usually the child's father), whether secondary parent/carer is partnered, whether primary parent/carer liked school as a child, health status of primary parent/carer, the English and Indigenous language fluency of primary parent/carer, the employment status of primary parent/carer, the LORI index of geographical remoteness, whether the household experienced financial shortage or excess, whether the primary parent/carer moved in the previous year, whether the primary parent completed Year 12 or higher qualifications, and a cohort dummy to control for changes across time.
8. A control is defined as statistically significant at the 1–10% levels. Statistical significance lets us know whether the impact of ECEC participation could have occurred by pure chance.
9. Although results from this particular specification were chosen due to better fit, two other specifications of preschool hours were considered that yielded qualitatively similar results. These were (1) preschool hours as a linear term along with the binary preschool attendance variable, and (2) preschool attendance grouped into three categories by the number of hours attended (short, medium or long attendance).
10. See LORI (Level of Relative Isolation) for detailed tables of the regression results.
11. Although results from this particular specification were chosen due to better fit, two other specifications of child-care hours were considered that yielded qualitatively similar results. These were (1) child-care hours as a linear term along with the binary child-care attendance variable, and (2) child-care attendance grouped into three categories by the number of hours attended (short, medium or long attendance).
12. The number of observations for this set of regressions varies between 84 and 194 children.
13. In another specification of the model that yielded qualitatively equivalent results, child-care hours were divided into three categories: short, medium and long periods of attendance. Long periods of attendance (more than 30 hours per week at child care) had a similar detrimental effect on children's developmental outcomes under this specification.

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Appendixes

Appendix 1: Detailed description of the developmental and cognitive outcome measures used in this analysis

Developmental outcomes

- SDQ total difficulties score: The SDQ is a developmental screening questionnaire for children and adolescents. The questions can be grouped into five scales: emotional symptoms, conduct problems, hyperactivity and inattention, peer relationship problems, and prosocial behaviour. The primary parents/carers and teachers answer the SDQ, and the score is made up of the first four scales (Department of Social Services 2015).
- Prosocial scale: This is a subset of the SDQ questionnaire answered by primary parents/carers, and measures prosocial behaviour using a scoring scale (Department of Social Services 2015).
- Child is always happy at school: The study child is asked, 'When you get up in the morning, do you feel happy about going to (preschool/school)?' This binary variable is equal to 1 if the child answers 'always', and is equal to 0 if the child answers 'sometimes' or 'never' (Department of Social Services 2015).

Cognitive outcomes: reading and literacy ability

- Teacher-reported language and literacy: This continuous variable contains ratings of a child's language and literacy, as given by the child's teacher at a particular wave (Department of Social Services 2015).
- Renfrew vocabulary test: A continuous variable containing test results from the Renfrew vocabulary test, which assesses a child's ability to describe pictures of objects. The child can respond in English or another language (Department of Social Services 2015).
- Reading achievement test (PAT-R): Developed by the Australian Council for Educational Research, the PAT-R (4th edition) measures student achievement in reading comprehension, vocabulary and spelling. The tests are modified shortened versions of the general PAT-R, and the scores should not be compared with the scores of children outside the LSIC sample (Department of Social Services 2015).

Cognitive outcomes: abstract reasoning and maths ability

- Teacher-reported maths: This continuous variable contains ratings of a child's mathematical ability, as given by the child's teacher at a particular wave (Department of Social Services 2015).
- Maths achievement test (PAT-M): Analogous to the PAT-R (4th edition), the PAT-M yields scores indicating a child's number, algebra, measurement, geometry, statistics and probability aptitude. LSIC PAT-M scores should not be compared with the results of children not participating in LSIC (Department of Social Services 2015).
- Abstract reasoning (Matrix test): This test indicates a child's abstract reasoning ability using the Wechsler Intelligence Scale for Children. It is a language-independent measure (Department of Social Services 2015).

Appendix 2: Full regression results for the short-term marginal effects of preschool attendance (pooled cohorts)

TABLE 7: Effect of preschool attendance on short-term developmental outcomes

	SDQ total difficulties score (5–7 years)		Prosocial scale (5–7 years)		Child is always happy at school (5–7 years)	
Control variables	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	0.062	0.042	0.018	0.102	–0.207**	–0.124
Study child is female		–0.248***		0.217***		0.132
Age of study child		0.059		0.023		–0.342***
Primary parent/carer is male		–0.073		0.408*		0.904**
Primary parent/carer is non-Indigenous		0.005		–0.121		–0.024
Secondary parent/carer is non-Indigenous		–0.085		–0.029		–0.147
Secondary parent/carer is not partnered		0.105		–0.040		–0.083
Primary parent/carer liked school as a child		–0.114		0.184**		0.262**
Primary parent/carer has good health		0.131		–0.195*		–0.211
Primary parent/carer has fair health		0.353***		–0.193		–0.299
Primary parent/carer speaks English and Indigenous language with similar fluency		0.003		–0.037		0.344
Primary parent/carer speaks Indigenous language best		–0.103		0.023		0.008
Primary parent/carer is not employed		0.114		–0.103		0.369***
LORI index of isolation: 2		0.049		–0.163**		–0.007
LORI index of isolation: 3		0.199		–0.258*		0.034
LORI index of isolation: 4		–0.045		–0.445**		0.018
Household experienced money shortage		0.167		–0.140		–0.094
Household experienced money surplus		–0.001		–0.069		0.111
Primary parent/carer has moved in the past 12 months		0.186**		–0.007		0.005
Primary parent/carer has completed Year 12 or higher education		–0.155**		0.055		–0.128
Study child is part of kid cohort	–0.004	–0.003	–0.166*	–0.177**	–0.096	–0.110
Constant	–0.036	–0.383	0.084	0.108	0.652***	2.453***
Sample size	990	806	990	805	913	744
R-squared/pseudo R-squared	0.001	0.061	0.007	0.065	0.006	0.053

LORI = Level of Relative Isolation; SDQ = Strengths and Difficulties Questionnaire

Notes:

1. The base case child for model 1 did not attend preschool and is part of the baby cohort. For model 2, the base case child is in the baby cohort, did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 from the Longitudinal Study of Indigenous Children.

TABLE 8: Effect of preschool attendance on short-term cognitive outcomes

	Teacher-reported language and literacy (5–7 years)		Renfrew vocabulary test (5–7 years)		Teacher-reported maths (5–7 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	0.063	0.076	0.295***	0.237***	–0.006	–0.001
Study child is female		0.303***		0.094		0.194**
Age of study child		0.040		0.392***		0.153
Primary parent/carer is male		–0.033		0.028		–0.116
Primary parent/carer is non-Indigenous		0.037		0.236***		–0.109
Secondary parent/carer is non-Indigenous		–0.196		0.375***		–0.102
Secondary parent/carer is not partnered		–0.059		–0.015		–0.058
Primary parent/carer liked school as a child		–0.023		–0.018		0.047
Primary parent/carer has good health		0.059		0.067		0.348**
Primary parent/carer has fair health		–0.284		0.241**		–0.161
Primary parent/carer speaks English and Indigenous language with similar fluency		0.009		–0.419**		0.319
Primary parent/carer speaks Indigenous language best		0.150		–0.051		0.451
Primary parent/carer is not employed		–0.174		–0.295***		–0.002
LORI index of isolation: 2		–0.209**		–0.165**		–0.172
LORI index of isolation: 3		–0.556***		–0.784***		–0.382*
LORI index of isolation: 4		0.116		–0.373**		0.231
Household experienced money shortage		0.013		–0.189**		0.089
Household experienced money surplus		–0.010		–0.054		0.057
Primary parent/carer has moved in the past 12 months		–0.172		–0.008		–0.096
Primary parent/carer has completed Year 12 or higher education		0.032		0.213***		0.205*
Study child is part of kid cohort	–0.226**	–0.070	–0.007	0.070	–0.289***	–0.122
Constant	0.062	–0.120	–0.120***	–2.281***	0.127	–1.545**
Sample size	448	365	927	750	448	365
R-squared/pseudo R-squared	0.014	0.104	0.023	0.272	0.019	0.099

LORI = Level of Relative Isolation

Notes:

1. The base case child for model 1 did not attend preschool and is part of the baby cohort. For model 2, the base case child is in the baby cohort, did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 from the Longitudinal Study of Indigenous Children.

Appendix 3: Full regression results for the longer term marginal effects of preschool attendance (kid cohort)

TABLE 9: Effect of preschool attendance on longer term developmental outcomes

	SDQ total difficulties score (8–10 years)		Prosocial scale (8–10 years)		Child is always happy at school (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	–0.165	–0.260**	0.014	0.208	–0.050	0.020
Study child is female		–0.293**		0.329***		0.057
Age of study child		0.132		–0.155		–0.033
Primary parent/carer is male		–0.118		0.234		–0.102
Primary parent/carer is non-Indigenous		0.229		–0.247		–0.219
Secondary parent/carer is non-Indigenous		0.199		–0.130		–0.303
Secondary parent/carer is not partnered		0.054		–0.072		0.273
Primary parent/carer liked school as a child		–0.263*		0.196		0.311*
Primary parent/carer has good health		0.017		–0.098		0.616**
Primary parent/carer has fair health		0.277		–0.216		0.517
Primary parent/carer speaks English and Indigenous language with similar fluency		0.110		–0.370		–0.572
Primary parent/carer speaks Indigenous language best		0.089		–0.257		–0.281
Primary parent/carer is not employed		0.001		0.028		–0.008
LORI index of isolation: 2		0.044		–0.231		0.062
LORI index of isolation: 3		–0.093		–0.073		0.195
LORI index of isolation: 4		0.031		–0.291		0.108
Household experienced money shortage		0.147		–0.200		–0.200
Household experienced money surplus		–0.090		0.051		0.260
Primary parent/carer has moved in the past 12 months		0.135		0.166		–0.207
Primary parent/carer has completed Year 12 or higher education		–0.203		0.079		0.172
Constant	0.036	–0.945	–0.020	1.559	0.059	–0.389
Sample size	340	283	341	283	334	275
R-squared/pseudo R-squared	0.007	0.099	0.000	0.078	0.001	0.064

LORI = Level of Relative Isolation; SDQ = Strengths and Difficulties Questionnaire

Notes:

1. The base case child for model 1 did not attend preschool. For model 2, the base case child did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the kid cohort from the Longitudinal Study of Indigenous Children.

TABLE 10: Effect of preschool attendance on longer term reading and literacy proficiency

	Reading achievement (6–8 years)		Reading achievement (7–9 years)		Reading achievement (8–10 years)		Teacher-reported language and literacy (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	0.209*	0.183	0.190	0.173	0.358***	0.276**	0.258*	0.262
Study child is female		0.381***		0.327**		0.309***		0.323*
Age of study child		0.362**		0.180		0.043		0.142
Primary parent/carer is male		0.564*		0.265		0.194		0.514
Primary parent/carer is non-Indigenous		–0.208		0.211		0.137		0.199
Secondary parent/carer is non-Indigenous		–0.235		–0.196		–0.196		–0.165
Secondary parent/carer is not partnered		0.027		–0.106		–0.106		–0.111
Primary parent/carer liked school as a child		0.022		0.088		0.001		–0.013
Primary parent/carer has good health		–0.215		–0.098		0.127		–0.211
Primary parent/carer has fair health		–0.112		0.121		0.439*		0.183
Primary parent/carer speaks English and Indigenous language with similar fluency		–0.274		–0.573		–0.846**		–2.916***
Primary parent/carer speaks Indigenous language best		–0.178		–0.766*		–0.713**		–1.874*
Primary parent/carer is not employed		–0.234		–0.173		–0.296**		–0.059
LORI index of isolation: 2		–0.175		–0.320**		–0.356***		–0.093
LORI index of isolation: 3		–0.127		–0.629*		–0.543**		–0.488
LORI index of isolation: 4		–0.315		–0.506		–1.090***		–0.361
Household experienced money shortage		–0.046		0.141		0.066		–0.216
Household experienced money surplus		0.164		0.116		–0.016		–0.064
Primary parent/carer has moved in the past 12 months		–0.106		–0.017		0.225		–0.244
Primary parent/carer has completed Year 12 or higher education		0.129		–0.048		0.256**		0.494***
Constant	–0.048	–2.145*	–0.076	–0.547	–0.132*	0.322	–0.098	0.470
Sample size	348	251	283	215	311	261	330	276
R-squared/pseudo R-squared	0.011	0.142	0.009	0.126	0.031	0.178	0.018	0.261

LORI = Level of Relative Isolation

Notes:

1. The base case child for model 1 did not attend preschool. For model 2, the base case child did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the kid cohort from the Longitudinal Study of Indigenous Children.

TABLE 11: Effect of preschool attendance on longer term maths ability and abstract reasoning ability

	Maths achievement (8–10 years)		Abstract reasoning (6–8 years)		Abstract reasoning (7–9 years)		Teacher-reported maths (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	0.228**	0.140	-0.042	0.013	0.110	0.250**	0.363**	0.194
Study child is female		0.258**		0.095		0.263**		0.187
Age of study child		0.149		-0.253*		-0.239*		0.211
Primary parent/carer is male		0.571**		0.432		0.299		0.435
Primary parent/carer is non-Indigenous		0.169		-0.004		-0.084		0.116
Secondary parent/carer is non-Indigenous		-0.016		0.083		-0.100		-0.181
Secondary parent/carer is not partnered		0.074		0.069		0.018		-0.026
Primary parent/carer liked school as a child		-0.064		0.174		0.130		0.164
Primary parent/carer has good health		0.028		0.078		-0.016		-0.393
Primary parent/carer has fair health		0.161		-0.089		0.196		-0.135
Primary parent/carer speaks English and Indigenous language with similar fluency		-0.654*		-0.030		-1.034***		-3.057***
Primary parent/carer speaks Indigenous language best		-0.533*		-0.013		-0.571*		-1.969*
Primary parent/carer is not employed		-0.441***		-0.214		-0.268**		-0.076
LORI index of isolation: 2		-0.212		0.189		-0.238*		-0.137
LORI index of isolation: 3		-0.388		-0.112		-0.661**		-0.481
LORI index of isolation: 4		-1.038***		-0.280		-0.847***		-0.357
Household experienced money shortage		0.025		-0.036		0.033		-0.210
Household experienced money surplus		-0.053		-0.134		-0.049		0.010
Primary parent/carer has moved in the past 12 months		-0.003		-0.353		-0.319		-0.672**
Primary parent/carer has completed Year 12 or higher education		0.274**		0.121		0.250*		0.430**
Constant	-0.085	-0.639	0.072	1.779	-0.008	-0.239*	-0.180*	0.091
Sample size	330	276	346	250	342	251	154	128
R-squared/pseudo R-squared	0.013	0.183	0.001	0.091	0.003	0.163	0.035	0.264

LORI = Level of Relative Isolation

Notes:

1. The base case child for model 1 did not attend preschool. For model 2, the base case child did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the kid cohort from the Longitudinal Study of Indigenous Children.

Appendix 4: Full regression results for the short-term marginal effects of preschool attendance and hours (baby cohort)

TABLE 12: Effect of preschool attendance and preschool hours attended on short-term developmental outcomes

	SDQ total difficulties score (8–10 years)		Prosocial scale (8–10 years)		Child is always happy at school (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	0.179	0.214	0.064	–0.054	–0.060	–0.134
Weekly hours at preschool	–0.004	–0.002	–0.013	0.003	–0.004	0.002
Weekly hours at preschool squared	0.00004	–0.00001	0.00027	0.0001	0.0001	0.00004
Study child is female		–0.210**		0.208**		0.059
Age of study child		0.047		0.039		–0.147***
Primary parent/carer is male		0.542		0.183		0.358
Primary parent/carer is non-Indigenous		–0.078		–0.086		0.037
Secondary parent/carer is non-Indigenous		–0.050		–0.077		–0.005
Secondary parent/carer is not partnered		0.202*		–0.044		–0.042
Primary parent/carer liked school as a child		–0.083		0.269***		0.062
Primary parent/carer has good health		0.188		–0.220*		–0.079
Primary parent/carer has fair health		0.472***		–0.261		–0.057
Primary parent/carer speaks English and Indigenous language with similar fluency		–0.010		0.396		0.331**
Primary parent/carer speaks Indigenous language best		–0.154		0.498*		0.103
Primary parent/carer is not employed		0.168		–0.203*		0.167***
LORI index of isolation: 2		0.023		–0.097		0.051
LORI index of isolation: 3		0.144		0.059		0.120
LORI index of isolation: 4		–0.020		–0.354		–0.111
Household experienced money shortage		0.205		–0.259*		–0.022
Household experienced money surplus		0.056		–0.210**		0.072
Primary parent/carer has moved in the past 12 months		0.252**		–0.130		–0.041
Primary parent/carer has completed Year 12 or higher education		–0.153		–0.010		–0.009
Constant	–0.060	–0.511	0.068	–0.350	0.755***	1.356***
Sample size	537	435	537	435	513	409
R-squared/pseudo R-squared	0.004	0.094	0.003	0.091	0.012	0.109

LORI = Level of Relative Isolation; SDQ = Strengths and Difficulties Questionnaire

Notes:

1. The base case individual for model 1 did not attend preschool. For model 2, the base case individual did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the baby cohort from the Longitudinal Study of Indigenous Children.

TABLE 13: Effect of preschool attendance and preschool hours attended on short-term cognitive outcomes

	Teacher-reported language and literacy (5–7 years)		Renfrew vocabulary test (5–7 years)		Teacher-reported maths (5–7 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Preschool attendance	–0.325	–0.406	0.335	0.403**	–0.663*	–0.589
Weekly hours at preschool	0.031	0.047	–0.002	–0.015	0.063*	0.061
Weekly hours at preschool squared	–0.001	–0.001	0.00002	0.00017	–0.001	–0.001
Study child is female		0.390***		0.117		0.318**
Age of study child		0.178		0.448***		0.222
Primary parent/carer is male		0.019		–0.813**		–0.374
Primary parent/carer is non-Indigenous		–0.144		0.256**		–0.235
Secondary parent/carer is non-Indigenous		–0.253		0.386***		–0.062
Secondary parent/carer is not partnered		–0.138		0.081		–0.088
Primary parent/carer liked school as a child		–0.104		–0.058		–0.056
Primary parent/carer has good health		0.104		0.095		0.400**
Primary parent/carer has fair health		–0.480*		0.292**		–0.021
Primary parent/carer speaks English and Indigenous language with similar fluency		–1.161		–0.686***		0.052
Primary parent/carer speaks Indigenous language best		–0.524		–0.133		0.779
Primary parent/carer is not employed		–0.241		–0.238***		–0.055
LORI index of isolation: 2		–0.081		–0.252***		–0.093
LORI index of isolation: 3		–0.732**		–1.168***		–0.384
LORI index of isolation: 4		0.650		–0.549**		0.328
Household experienced money shortage		–0.098		–0.082		0.243
Household experienced money surplus		0.041		0.036		0.224
Primary parent/carer has moved in the past 12 months		–0.266		–0.053		–0.426**
Primary parent/carer has completed year 12 or higher education		0.257		0.167*		0.345**
Constant	0.029	–0.399	–0.145**	–2.522***	0.052	–2.508**
Sample size	257	212	510	408	257	212
R-squared/pseudo R-squared	0.003	0.189	0.024	0.398	0.012	0.184

LORI = Level of Relative Isolation

Notes:

1. The base case individual for model 1 did not attend preschool. For model 2, the base case individual did not attend preschool, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the baby cohort from the Longitudinal Study of Indigenous Children.

Appendix 5: Full regression results for the short-term marginal effects of child-care attendance (pooled cohorts)

TABLE 14: Effect of preschool attendance and preschool hours attended on short-term developmental outcomes

	SDQ total difficulties score (5–7 years)		Prosocial scale (5–7 years)		Child is always happy at school (5–7 years)	
Control variable	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Child-care attendance	–0.143	–0.013	0.068	–0.097	–0.253*	–0.253
Study child is female		0.108		0.178		0.012
Age of study child		–0.003		0.149		–0.215
Primary parent/carer is male		0.020		0.377		1.067*
Primary parent/carer is non-Indigenous		–0.102		–0.141		0.017
Secondary parent/carer is non-Indigenous		–0.334**		0.145		0.107
Secondary parent/carer is not partnered		0.077		0.031		–0.039
Primary parent/carer liked school as a child		–0.200*		0.182		0.405**
Primary parent/carer has good health		0.059		–0.005		0.057
Primary parent/carer has fair health		0.361*		–0.029		–0.000
Primary parent/carer speaks English and Indigenous language with similar fluency		0.063		0.003		0.455
Primary parent/carer speaks Indigenous language best		–0.014		0.012		0.384
Primary parent/carer is not employed		0.084		–0.103		0.192
LORI index of isolation: 2		0.068		–0.200		–0.043
LORI index of isolation: 3		0.060		–0.470**		0.172
LORI index of isolation: 4		–0.220		–0.257		0.105
Household experienced money shortage		0.096		0.026		–0.271
Household experienced money surplus		–0.021		–0.005		0.239
Primary parent/carer has moved in the past 12 months		0.045		0.070		0.064
Primary parent/carer has completed Year 12 or higher education		–0.093		0.136		–0.040
Study child is part of kid cohort	0.070	0.068	–0.244***	–0.236**	–0.169	–0.236
Constant	–0.034	–0.323	0.106	–0.867	0.768***	1.225
Sample size	477	386	476	385	428	349
R-squared/pseudo R-squared	0.005	0.086	0.015	0.068	0.010	0.065

LORI = Level of Relative Isolation; SDQ = Strengths and Difficulties Questionnaire

Notes:

1. The base case child for model 1 did not attend child care and is part of the baby cohort. For model 2, the base case child is in the baby cohort, did not attend child care, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the Longitudinal Study of Indigenous Children.

TABLE 15: Effect of child-care attendance and hours on short-term cognitive outcomes

	Teacher-reported language and literacy (5–7 years)		Renfrew vocabulary test (5–7 years)		Teacher-reported maths (5–7 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Child-care attendance	–0.009	–0.043	0.473***	0.128	0.078	0.198
Study child is female		0.167		0.117		0.202
Age of study child		–0.043		0.347***		–0.072
Primary parent/carer is male		–0.148		–0.141		0.124
Primary parent/carer is non-Indigenous		0.349		0.329**		0.042
Secondary parent/carer is non-Indigenous		–0.460*		0.412***		–0.198
Secondary parent/carer is not partnered		0.044		0.062		–0.034
Primary parent/carer liked school as a child		–0.094		0.031		0.015
Primary parent/carer has good health		0.141		0.018		0.194
Primary parent/carer has fair health		–0.377		0.111		–0.558*
Primary parent/carer speaks English and Indigenous language with similar fluency		0.155		–0.527*		0.382
Primary parent/carer speaks Indigenous language best		0.183		–0.236		0.368
Primary parent/carer is not employed		–0.071		–0.349***		0.224
LORI index of isolation: 2		–0.402**		–0.292**		–0.259
LORI index of isolation: 3		–0.738**		–0.846***		–0.372
LORI index of isolation: 4		0.181		–0.420*		0.263
Household experienced money shortage		0.075		–0.239*		0.087
Household experienced money surplus		–0.099		–0.087		0.009
Primary parent/carer has moved in the past 12 months		–0.072		0.030		0.013
Primary parent/carer has completed Year 12 or higher education		–0.084		0.128		0.085
Study child is part of kid cohort	–0.285*	–0.120	–0.012	0.049	–0.306*	–0.115
Constant	0.089	0.500	–0.250***	–1.746**	0.101	–0.088
Sample size	206	173	442	357	206	173
R-squared/pseudo R-squared	0.015	0.156	0.044	0.230	0.019	0.121

LORI = Level of Relative Isolation

Notes:

1. The base case child for model 1 did not attend child care and is part of the baby cohort. For model 2, the base case child is in the baby cohort, did not attend child care, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the Longitudinal Study of Indigenous Children.

Appendix 6: Full regression results for the longer term marginal effects of child-care attendance and hours (kid cohort)

TABLE 16: Effect of child-care attendance and hours on longer term developmental outcomes

	SDQ total difficulties score (8–10 years)		Prosocial scale (8–10 years)		Child is always happy at school (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Child-care attendance	–0.839*	–1.080*	0.295	0.483	–0.139	1.013
Weekly hours at child care	0.107**	0.132**	–0.043	–0.076	0.035	–0.015
Weekly hours at child care squared	–0.002**	–0.003**	0.001	0.002	–0.001	–0.001
Study child is female		–0.374**		0.370*		0.075
Age of study child		0.085		–0.038		0.096
Primary parent/carer is male		–0.415		0.427		0.386
Primary parent/carer is non-Indigenous		0.361		–0.636**		–0.412
Secondary parent/carer is non-Indigenous		0.060		–0.329		–0.348
Secondary parent/carer is not partnered		–0.117		0.015		0.160
Primary parent/carer liked school as a child		–0.246		0.210		0.810***
Primary parent/carer has good health		0.026		–0.154		0.645
Primary parent/carer has fair health		0.337		–0.551		0.519
Primary parent/carer speaks English and Indigenous language with similar fluency		0.605		–0.420		–0.554
Primary parent/carer speaks Indigenous language best		0.886**		–0.428		–0.691
Primary parent/carer is not employed		–0.251		0.019		0.158
LORI index of isolation: 2		0.224		–0.553**		0.275
LORI index of isolation: 3		–0.129		–0.304		0.545
LORI index of isolation: 4		0.569		–0.851*		–0.041
Household experienced money shortage		0.085		–0.091		–0.026
Household experienced money surplus		–0.312		–0.022		0.355
Primary parent/carer has moved in the past 12 months		–0.044		0.425		–0.850**
Primary parent/carer has completed Year 12 or higher education		–0.280		0.009		0.401
Constant	0.029	–0.954	–0.020	1.040	0.040	–1.966
Sample size	194	159	194	159	187	152
R-squared/pseudo R-squared	0.035	0.212	0.006	0.142	0.005	0.150

LORI = Level of Relative Isolation; SDQ = Strengths and Difficulties Questionnaire

Notes:

1. The base case child for model 1 did not attend child care. For model 2, the base case child did not attend child care, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the kid cohort from the Longitudinal Study of Indigenous Children.

TABLE 17: Effect of child-care attendance and hours on longer term reading and literacy proficiency

	Reading achievement (6–8 years)		Reading achievement (7–9 years)		Reading achievement (8–10 years)		Teacher-reported language and literacy (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Child-care attendance	–0.318	0.309	0.418	0.705	0.559	0.599	1.515*	1.846
Weekly hours at child care	0.047	–0.029	–0.031	–0.075	–0.034	–0.048	–0.126	–0.184
Weekly hours at child care squared	–0.001	0.00005	0.001	0.002	0.0004	0.001	0.002	0.003
Study child is female		0.169		0.363*		0.398**		0.296
Age of study child		0.408*		–0.016		–0.214		0.053
Primary parent/carer is male		0.799*		–0.211		–0.140		0.230
Primary parent/carer is non-Indigenous		–0.285		0.204		0.027		0.044
Secondary parent/carer is non-Indigenous		–0.398		–0.142		–0.153		–0.092
Secondary parent/carer is not partnered		0.136		–0.069		–0.239		0.192
Primary parent/carer liked school as a child		0.402*		0.252		0.142		0.078
Primary parent/carer has good health		–0.015		0.136		0.174		–0.320
Primary parent/carer has fair health		0.013		0.289		0.618*		0.291
Primary parent/carer speaks English and Indigenous language with similar fluency		–0.193		–1.083		–1.150**		–1.721
Primary parent/carer speaks Indigenous language best		–0.184		–0.567		–0.935*		–0.593
Primary parent/carer is not employed		–0.268		–0.033		–0.153		–0.296
LORI index of isolation: 2		–0.196		–0.411*		–0.429**		0.045
LORI index of isolation: 3		0.002		–0.337		–0.575		–0.503
LORI index of isolation: 4		–0.188		–0.504		–1.182**		0.857
Household experienced money shortage		–0.007		0.016		–0.009		–0.366
Household experienced money surplus		0.202		0.032		–0.192		–0.242
Primary parent/carer has moved in the last 12 months		–0.108		–0.468		–0.077		–0.332
Primary parent/carer has completed Year 12 or higher education		0.003		–0.105		0.343*		0.373
Constant	–0.081	–2.801*	–0.114	0.517	–0.177*	2.735	–0.137	0.126
Sample size	193	141	156	118	176	147	82	68
R-squared/pseudo R-squared	0.008	0.139	0.004	0.158	0.009	0.201	0.041	0.281

LORI = Level of Relative Isolation

Notes:

1. The base case child for model 1 did not attend child care. For model 2, the base case child did not attend child care, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the kid cohort from the Longitudinal Study of Indigenous Children.

TABLE 18: Effect of child-care attendance and hours on longer term maths ability and abstract reasoning ability

	Maths achievement (8–10 years)		Abstract reasoning (6–8 years)		Abstract reasoning (7–9 years)		Teacher-reported maths (8–10 years)	
Control variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Child-care attendance	0.771	1.031*	0.544	0.134	0.213	–0.174	0.027	0.180
Weekly hours at child care	–0.055	–0.108*	–0.032	0.017	0.004	0.045	0.001	–0.013
Weekly hours at child care squared	0.001	0.002	0.001	–0.001	–0.0002	–0.001	–0.0001	0.000
Study child is female		0.284*		–0.186		0.207		0.145
Age of study child		0.033		–0.380*		–0.58***		0.020
Primary parent/carer is male		0.504		0.482		0.288		0.190
Primary parent/carer is non-Indigenous		0.191		0.034		0.050		0.095
Secondary parent/carer is non-Indigenous		0.053		0.161		0.036		0.201
Secondary parent/carer is not partnered		0.253		0.186		–0.009		0.202
Primary parent/carer liked school as a child		0.353*		0.496**		0.452**		0.365
Primary parent/carer has good health		0.172		0.317		0.059		–0.572
Primary parent/carer has fair health		0.297		–0.149		0.103		–0.330
Primary parent/carer speaks English and Indigenous language with similar fluency		–0.834*		–0.152		–0.624		–1.717
Primary parent/carer speaks Indigenous language best		–0.642		–0.282		–0.482		–0.603
Primary parent/carer is not employed		–0.449**		–0.237		–0.248		–0.153
LORI index of isolation: 2		–0.362**		0.163		–0.263		–0.138
LORI index of isolation: 3		–0.452		–0.262		–0.563		–0.634
LORI index of isolation: 4		–1.12***		–0.478		–0.436		0.933
Household experienced money shortage		0.204		0.020		0.164		–0.235
Household experienced money surplus		–0.157		0.145		0.086		–0.013
Primary parent/carer has moved in the past 12 months		–0.164		–0.376		–0.538*		–0.989**
Primary parent/carer has completed Year 12 or higher education		0.220		–0.107		0.215		0.042
Constant	–0.146*	0.106	0.006	2.557	–0.072	4.844**	–0.175	0.591
Sample size	185	153	189	140	191	139	82	68
R-squared/pseudo R-squared	0.015	0.235	0.012	0.181	0.010	0.201	0.0003	0.256

LORI = Level of Relative Isolation

Notes:

1. The base case child for model 1 did not attend child care. For model 2, the base case child did not attend child care, is male, has Indigenous primary and secondary parents/carers, and has a secondary parent/carer who is partnered. He/she has a primary parent/carer who is female, liked school as a child, has poor health, speaks English best, is employed, lives in an area that is not geographically isolated (LORI index of 1), had just enough income to meet obligations, has not moved houses in the past 12 months, and has not completed Year 12.
2. Statistical significance is labelled * at the 10% level, ** at the 5% level and *** at the 1% level.
3. A blank cell indicates that the control variable was not used in model 1.

Source: Customised calculations using waves 1–6 of the kid cohort from the Longitudinal Study of Indigenous Children.

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