# (Mis)perceptions about children

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#### Abstract

I quantify how early childhood education teachers' perceptions of developmental delays are influenced by both a child's own development and the average development level of other children in the neighbourhood, using cognitive (receptive language) and non-cognitive (socio-emotional) objective measures of development from the Longitudinal Study of Australian Children. I find that teachers in neighbourhoods with lower average levels of noncognitive development are less likely to perceive delays in both cognitive and non-cognitive dimensions of child development, conditional on objective development measures. This implies that they are less likely to recognize a developmental delay when such delays are more prevalent in the neighbourhood. Further, mothers' perceptions of their children's noncognitive development are influenced by the information that teachers convey. Teachers' and mothers' beliefs about delays predict investment in remedial services—including children's learning and behavioural therapy and tutoring—as well as the quality of parent-child interactions. I also find that teachers with college degrees are more likely to identify children with low levels of development compared to those with diplomas or certificates.

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## 1 Introduction

Correctly identifying cognitive (e.g., receptive language) and non-cognitive (e.g., socio-emotional) developmental delays in preschool-aged children is critical for educators and families when deciding how to support children's early development — whether by spending extra time reading together or seeking professional help like tutors or psychologists. Developmental delays occur when a child does not reach their developmental milestones within the expected time frame relative to their same-age peers.<sup>3</sup> Addressing these delays in early childhood is is particularly important because skills are self-productive – early delays can compound over time, hindering both learning and socialization in later years (Cunha, Heckman, and Schennach, 2010).<sup>4</sup>

Importantly, teachers' and families' biased perceptions of children's cognitive development have been shown to lead to suboptimal investment decisions — like picking the wrong textbook level — that disrupt the accumulation of human capital (Kinsler and Pavan, 2021; Dizon-Ross, 2019; Bergman, 2021). Recognizing the importance of accurately assessing children's cognitive development, many governments supplement teachers' and parents' subjective perceptions with nationwide standardized tests of cognitive skills.<sup>5</sup> Using objective measures of children's cognitive development available for a representative sample of young children in the United States, two recent papers have provided the first evidence that teachers' perceptions suffer from reference group bias (Kinsler and Pavan, 2021; Elder and Zhou, 2021). This bias arises when teachers in low-achieving schools overestimate, and those in high-achieving schools underestimate, children's cognitive skills.

<sup>&</sup>lt;sup>3</sup>Examples of delays in preschool-aged children include speech or language delays (cognitive) and behavioural disorders that often manifest as severe temper tantrums (non-cognitive).

<sup>&</sup>lt;sup>4</sup>The Centers for Disease Control and Prevention (CDC) emphasizes the importance of acting early on concerns about developmental delays to ensure children receive appropriate support before the start of formal schooling (see CDS, "Developmental Monitoring and Screening"). According to the CDS, "many children with developmental disabilities are not identified until they are in school, by which time significant delays might have occurred and opportunities for treatment might have been missed." Up to 50 percent of preschool behavioural problems can persist into childhood mental health problems, increasing risks of substance misuse, family violence, and crime (Luangrath and Hiscock, 2011).

<sup>&</sup>lt;sup>5</sup>For example, the National Assessment Program – Literacy and Numeracy (NAPLAN) is conducted in Australia, the Education Quality and Accountability Office (EQUAO) provincial assessments are conducted in Canada, and the National Assessment of Educational Progress (NAEP) is conducted in the United States. Despite important limitations such as their strong association with students' effort during testing (Zamarro, Hitt, and Mendez, 2019) and their potential to reinforce unequal opportunities (Reeves and Halikias, 2017), test scores provide an objective measure of children's positions in the distribution of cognitive skills for similar-aged children.

Non-cognitive skills are as important as cognitive skills for a range of life outcomes, including earnings (Deming, 2017), educational attainment and risky behaviours (Heckman, Stixrud, and Urzua, 2006), and health (Conti, Heckman, and Pinto, 2015). While cognitive skills are routinely measured through objective large-scale assessments, comparable measures for noncognitive development are often not available. In the absence of such measures, teacher judgments may serve as the primary source of information on non-cognitive delays for schools, governments, and even families.<sup>6</sup> Due to the lack of objective measures, the influence of the reference group on perceptions of non-cognitive skills has not yet been directly quantified from the data.<sup>7</sup>

I address this challenge by using direct, face-to-face observations from psychologist-trained interviewers who evaluate children's non-cognitive skills in the Longitudinal Study of Australian Children (LSAC), a nationally representative survey of 10,000 children followed biennially since 2004. These observations provide objective measures of non-cognitive skills, alongside cognitive skill measures based on language tests included in the dataset.<sup>8</sup> The survey also collects teachers' private beliefs about whether a child shows signs of cognitive or non-cognitive delays, relative to other similar-aged peers.<sup>9</sup> To examine whether these perceptions vary with the local environment, I follow an approach similar to Kinsler and Pavan (2021) and Elder and Zhou (2021) by estimating a measurement system that models perceived delays as a function of both the child's own development and the average development level of other children in the neighbourhood.

I find that early childhood teachers' perceptions of developmental delays in children ages 4–5 are systematically related to the local environment. Teachers of children living in neighbourhoods with lower average levels of non-cognitive development are less likely to perceive delays

<sup>&</sup>lt;sup>6</sup>For example, in 2024 in Australia, over 12 percent of total government funding for primary and secondary schools was allocated to accommodations for students with disabilities, largely based on teachers' judgments. Nearly a quarter of school-aged students received accommodations, with over 88 percent addressing cognitive and non-cognitive delays. See ACARA's report and the Australian Schooling Resource Standard.

<sup>&</sup>lt;sup>7</sup>Elder and Zhou (2021) estimate the potential impact of reference group bias on racial gaps in non-cognitive skills. However, without objective measures of non-cognitive skills, they rely on strong assumptions about either the unobserved distribution of non-cognitive skills or the size of the bias.

<sup>&</sup>lt;sup>8</sup>While these measures cannot be used to diagnose children with delays, they provide a standardized measure of non-cognitive development for a nationally representative sample of children.

<sup>&</sup>lt;sup>9</sup>Throughout the text, I refer to all early childhood education and care (ECEC) providers as "teachers." This includes staff who, in the Australian context, are commonly classified as early childhood teachers, educators, or assistants, depending on their qualifications.

- both cognitive and non-cognitive – even when controlling for the child's own measured development. This suggests that teachers are less likely to recognize a developmental delay when non-cognitive delays are more common in the local context. Specifically, teachers in neighbourhoods in the top quartile of average non-cognitive development are 1.4 percentage points more likely to report non-cognitive delays compared to those in the bottom quartile. However, when accounting for the role of local reference groups, this relationship reverses: teachers in the top quartile are up to 10 percentage points less likely to report delays than those in the bottom quartile.

My results also indicate that teachers' perceptions of cognitive delays are systematically related to the average level of cognitive development among other children in the neighbourhood, extending the findings of Kinsler and Pavan (2021) and Elder and Zhou (2021) from the U.S. context, which features higher inequality. This parallel pattern for cognitive skills is consistent with the idea that teachers' perceptions may be shaped by both a child's individual development and local reference points. These findings have important implications for governments aiming to identify disadvantaged areas based on nationwide teacher evaluation statistics, such as the Australian Early Development Census. When the local environment shapes teacher beliefs, developmental delays tend to be underestimated in disadvantaged areas — where such delays are more common — and overestimated in advantaged ones.

Having shown that teacher perceptions vary with the local environment, I next examine whether the likelihood of reporting delays in children with low measured development also differs by teacher qualifications or early childhood program characteristics. During the 2000s in Australia, training requirements for early childhood education staff varied widely across jurisdictions. Individuals could generally qualify as early childhood teachers by completing a university degree, or as educators or assistants by obtaining a diploma or certificate through a Registered Training Organisation — typically requiring one to two years of study. I find that teacher education is an important predictor of delay recognition: among children with low objective measures of non-cognitive development, teachers with a university degree are 9 percentage points more likely to perceive delays than those with certificates or diplomas. The pattern is consistent for cognitive development, showing a 6.7 percentage point difference. I further leverage the rich LSAC data to explore the potential implications of teachers' misperceptions. First, I examine whether school-to-parent communication is associated with changes in mothers' beliefs. Using a value-added regression approach — controlling for mothers' prior beliefs about their children's development — I find that contact from the school is linked to a significant shift in parental perception. Among mothers of children ages 8–9, being contacted by the school increases the likelihood that they perceive their child to have non-cognitive delays by 11 percentage points. This suggests that teachers' perceptions are likely to be transmitted to mothers.

Second, I provide evidence that perceptions of developmental delays are significant predictors of the use of community and school services aimed at supporting children's cognitive and non-cognitive development. In the LSAC data, both teachers and mothers report whether children use services such as behavioural therapy, psychological evaluation, speech therapy, or academic support. I estimate value-added regressions of these investment choices on lagged teacher and mother perceptions, controlling for prior service use, child and household characteristics, and neighbourhood context to address potential endogeneity. I find that children whose teachers perceive non-cognitive delays at ages 4–5 are 4 percentage points more likely to use behavioural therapy or undergo psychological evaluation by ages 6–7. Similarly, children whose teachers perceive cognitive delays are 4 percentage points more likely to receive learning or speech therapy. These results imply that misperceptions shaped by local reference groups can be an important source of misallocation of resources across neighbourhoods.

Moreover, I provide suggestive evidence that mothers' perceptions of non-cognitive delays are associated with key aspects of home environment — such as the quality of parent-child interactions, parental attitudes, and family investment decisions — factors known to support non-cognitive development (Fiorini and Keane, 2014; Falk, Kosse, Pinger, Schildberg-Hörisch, and Deckers, 2021). I find that these perceptions are linked to two contrasting patterns in parenting choices. On the one hand, mothers who report delays are more likely to seek professional support: perceived delays are associated with increased use of tutoring services and greater uptake of parenting education resources. This suggests that reference bias in perceptions may contribute to unequal investments across neighbourhoods, potentially reinforcing skill gaps between more

and less advantaged areas. On the other hand, perceived delays are associated with lower-quality parent-child interactions and reduced educational expectations. These patterns imply that overestimating delays may have unintended negative effects on families, and that communication about non-cognitive delays should be accompanied by appropriate parenting support.

A growing literature examines how parents' beliefs about their children's skills relate to the decisions they make about their home environment. Much of this work has focused on cognitive skills, showing that parents who revise their beliefs also adjust their educational investments. For example, in experimental settings, Dizon-Ross (2019), Doss, Fahle, Loeb, and York (2019), and Bergman (2021) find that mothers who update their beliefs about their children's academic progress also change their input choices. Bergman (2021) further shows that correcting misperceptions improves student learning efforts, as rated by teachers. By contrast, I provide evidence on how beliefs about children's non-cognitive skills are formed and how these beliefs relate to key features of the home environment — such as parenting attitudes and expectations — that are critical for non-cognitive development (Fiorini and Keane, 2014; Falk, Kosse, Pinger, Schildberg-Hörisch, and Deckers, 2021).

My work contributes to understanding why children's environments differ across parental socioeconomic status (SES) and neighbourhoods. Prior research has documented several important drivers, including resource constraints, parental preferences, and differences in perceived returns to investment.<sup>10</sup> By contrast, I focus on the role of neighbourhood-related information frictions in shaping parental behaviour.

This paper also contributes to the literature on how educational program characteristics influence student outcomes. For example, Chetty, Friedman, Hilger, Saez, Schanzenbach, and Yagan (2011) find that having a more experienced teacher in kindergarten is associated with higher earnings in adulthood, and Goldhaber and Brewer (2000) show that teacher certification significantly affects student test scores. In contrast to this work, I focus on how early childhood instructors' qualifications and classroom characteristics relate to the identification of developmental delays — an important early-stage outcome that may influence subsequent support for children's development.

<sup>&</sup>lt;sup>10</sup>See Attanasio, Cattan, and Meghir (2022) for a review of research exploring the drivers of SES gaps in children's environments.

The remainder of the paper is structured as follows. Section 2 describes the data, and Section 3 outlines a conceptual framework in which reference group bias in teachers' perceptions may influence home and school environments. Sections 4 and 5 examine how teachers' and mothers' perceptions of child development vary with the local environment. Sections 6 and 7 explore how these perceptions relate to investment decisions at school and within the family. Section 8 concludes.

#### 2 Data

The data for this project come from the LSAC, a national study of children in Australia that tracks childhood environments, development, and life course trajectories. The survey started in 2004 with participating families interviewed biennially. It follows the development of two cohorts of children: the "baby" cohort (B cohort), which includes 5,107 children aged 0–1 in 2003–2004, and the "kindergarten" cohort (K cohort), composed of 4,983 children aged 4–5 in 2004. In this paper, I use the data for children between 4 and 11 years old who attend formal care or education arrangements.<sup>11</sup>

The survey has four features that allow me to investigate variation in teachers' perceptions across local environments. First, it contains a rich set of objective measures of child development obtained during the interview that can be matched to teachers' and parents' perceptions. Second, it is clustered at the neighbourhood level, which allows me to construct a measure of the local environment by matching children from the same neighbourhood. Third, it tracks the dynamics of multiple measures related to children's home and school environments. Finally, the survey collects a comprehensive set of information about family demographic and educational composition, family income, labour market outcomes, and neighbourhood characteristics.

<sup>&</sup>lt;sup>11</sup>This sample restriction allows me to focus on the perceptions of staff with childhood education and care qualifications, who are typically employed in these formal settings. Over 95 percent of children aged 4–5 in the sample attend formal care or educational arrangements, including mainly daycare, preschool, or kindergarten. Over 97 percent of children aged 6 and above—within the compulsory schooling age in most jurisdictions—attend formal educational arrangements.

#### 2.1 Measures of child development

The survey collects information about child development from three sources: trained interviewers observing children during face-to-face interviews, teachers, and parents. The interviewers use tests and direct observations to assess children's cognitive and non-cognitive development, and teachers evaluate child development and the classroom environment. Children's primary caregivers, mainly mothers, are asked to evaluate child development and environment during face-to-face interviews.

I use direct observations of children's non-cognitive skills recorded by interviewers during the in-person household visit to construct an objective measure of non-cognitive development. These observations, available when children are 4–5 and 8–9 years old, are based on 1 to 2.5-hour visits during which interviewers observe the child both with and without their parent present, allowing for assessment across different interactional contexts. The interviewers evaluate the non-cognitive development of children across three dimensions: negative response (e.g., fussing, crying, vocal or physical expression of anger), focus during the cognitive test, and positive response (e.g., smiling or laughing).<sup>12</sup>

These measures have three important advantages for quantifying how the reference group relates to teachers' perceptions. First, interviewers were trained by psychologists and completed practice interviews with parents and children to ensure consistency in evaluations. Second, they used objective rating scales that captured both the frequency and intensity of behaviours. For example, when evaluating children's negative or positive responses, they selected from five options ranging from "none displayed" to "three or more intense, heightened, or prolonged displays."<sup>13</sup> These direct observation methods were originally developed by psychologists to complement the

<sup>&</sup>lt;sup>12</sup>Persistent loss of temper and aggressive behaviour – captured by the negative response measure – are symptoms of behaviour disorders in children (see CDS, "Behavior or conduct problems"). Similarly, difficulty concentrating and sustaining focus during tasks – as reflected in the focus during the cognitive test – is the main symptom of Attention-Deficit/Hyperactivity Disorder (ADHD) in young children, according to the Australian Psychological Society (see Australian Psychological Society, "ADHD in children"). While focus is often treated as a cognitive process in psychology, inattention is a common symptom of behavioural and neurodevelopmental issues. In the education literature, attention and task persistence are frequently used as indicators of non-cognitive skills, such as student effort and self-regulation (Rosen et al., 2010; Lundberg, 2017). In Appendix D, I show that my results are robust to measuring non-cognitive skills using only the degree of the child's negative response.

<sup>&</sup>lt;sup>13</sup>The five options for the degree of children's focus include the following: constantly did not pay attention; typically did not pay attention and attended in one to two instances; did not pay attention half the time; typically paid attention but attention wandered in one to two instances; and constantly paid attention/concentrated.

diagnosis of non-cognitive delays in children (Volpe et al., 2005; Minder et al., 2018), and their use in the survey – combined with interviewer training – helps minimize potential bias in assessments. Third, the assessments were implemented at scale in a nationally representative sample without additional burden on respondents. Because children were not required to complete extra testing, observing non-cognitive development added no time or cost to the interview process. This design enabled large-scale direct evaluations.<sup>14</sup>

Figure 1 shows the distribution of interviewer-recorded observations for children aged 4– 5. While positive responses varied, 62 percent of children were both constantly focused and showed no negative responses during the interview. I construct an objective non-cognitive development score as the first principal component of three interviewer-recorded observational measures. Each measure is first age-standardized, and the resulting principal component is then re-standardized by age to ensure comparability with other skill measures used in the analysis.<sup>15</sup> The resulting score is right-skewed, with many children clustered at the top and a long left tail capturing those who display non-cognitive problems with varying degrees of frequency and intensity (see Figure A.1). This measure allows me to detect children with symptoms of non-cognitive delays in the left tail of the skill distribution but does not differentiate between children at the top who are more likely to be developmentally on track.

In addition to observing non-cognitive skills, interviewers assess children's cognitive development using a short form of the Peabody Picture Vocabulary Test (PPVT), a standard, ageadapted measure of receptive vocabulary and spoken word comprehension. The PPVT is commonly used in the literature as a measure of children's cognitive skills (Fiorini and Keane, 2014, Nicoletti and Tonei, 2020). Another measure of cognitive skills available in the survey is the Who Am I (WAI) assessment, which is administered for children aged 4–5 to evaluate the general cognitive abilities needed for school readiness. This assessment tests receptive and expressive language and numeric abilities, and I use it as an instrument to address measurement error in the PPVT.

A common critique of standardized tests of cognition is that they provide context-dependent

<sup>&</sup>lt;sup>14</sup>By contrast, evaluations of non-cognitive skills by psychologists who directly observe children are less common in large-scale survey datasets, as these types of evaluations are often more resource-intensive and time-consuming.

<sup>&</sup>lt;sup>15</sup>See Table A.1 for the PCA loadings.



Figure 1: Non-cognitive development observed during the interview at ages 4-5

Notes: The figure displays histograms of interviewer-recorded observations evaluating non-cognitive skills of children aged 4–5 attending formal care or education settings. Panel (a) shows the degree of positive response — smiling, laughing, or sounding excited, happy, or pleased. Panel (b) shows the degree of negative response — fussing, pouting, whining, crying, or expressing anger vocally or physically. Panel (c) shows the child's level of focus during the Peabody Picture Vocabulary Test (PPVT).

measures of children's academic abilities, depending on student effort, motivation, test-taking abilities, and a range of other factors (Heckman and Kautz, 2012). Similarly, the interview measure of children's non-cognitive skills used in the LSAC, based on a limited set of interactions between interviewers and children, is likely to have similar limitations. By contrast, teachers' perceptions are informed by interacting with children in multiple environments and learning about their history, family, and community. While the interview-based development scores may not capture all aspects of child development, they provide objective measures of cognitive and non-cognitive skills that meaningfully reflect variation in children's abilities and predict future outcomes.<sup>16</sup>

#### 2.2 Measures of perceived developmental delays

An important advantage of the LSAC survey is that it captures teachers' private perceptions of children's developmental delays. When a child is 4–5 years old, teachers' private beliefs about their development relative to same-age peers are elicited through a self-complete questionnaire.<sup>17</sup>

<sup>&</sup>lt;sup>16</sup>For example, children's cognitive and non-cognitive scores at ages 4–5 are associated with a lower likelihood of grade repetition by ages 12–13 and higher grade 9 national test scores in reading and numeracy (see Appendix C).

<sup>&</sup>lt;sup>17</sup>Teachers were asked to fill in the self-complete questionnaire and mail it in a pre-paid envelope. Therefore, parents did not know about the details of teachers' replies, and teachers had comparable incentives to report their

Teachers are asked to evaluate the child's development level compared to others of similar age in several dimensions, including social/emotional development (e.g., adaptability, cooperation, responsibility, self-control) and receptive language ability (e.g., understanding, interpreting, and listening).<sup>18</sup> These perceptions align with the dimensions of child development assessed by interviewers, enabling a direct comparison between measured development and teachers' perceptions. The results of the interviewers' assessments are unknown to teachers and parents.

To incorporate these teacher assessments into my analysis, I construct binary indicators of perceived developmental delays based on their responses. In the questionnaire, teachers can rank the child as much more competent than others, as competent as others, less competent than others, or much less competent than others. I construct an indicator for perceived non-cognitive delay equal to one when a teacher reports that a child is less or much less competent than other children in non-cognitive development.<sup>19</sup> Similarly, I classify a child as having a perceived cognitive delay when teachers report them as less or much less competent in receptive language development. Around 15 percent of teachers report delays in cognitive development, compared to just over 20 percent for non-cognitive delays (see Appendix Table A.2).

I next assess how perceived delays relate to interviewer-assessed development scores, as shown in Figure 2. Panel (a) plots the average share of teachers reporting non-cognitive delays against children's non-cognitive interview scores. The negative slope suggests that both teacher perceptions and interview-based measures are informed by non-cognitive development: children who received higher non-cognitive scores during the interview are less likely to be perceived as having non-cognitive delays by their teachers.<sup>20</sup> Similarly, panel (b) shows that teachers are less likely to report cognitive delays for children who received higher cognitive interview-based development scores. Since both teacher perceptions and interview-based measures are informed by children's individual development, a similar association might be anticipated at the neighbourhood level—such that teachers in higher-development neighbourhoods would report fewer

beliefs.

<sup>&</sup>lt;sup>18</sup>The exact statement was "Rate how this child was compared with other children of a similar age, over the past few months."

<sup>&</sup>lt;sup>19</sup>Less than 4 percent of teachers indicate that children are much less competent than those in non-cognitive or cognitive dimensions. Therefore, I pool the "much less competent" and "less competent" replies together to indicate delays.

<sup>&</sup>lt;sup>20</sup>Panel (a) also reflects that the distribution of non-cognitive interview-based development scores is skewed to the right, with children clustered at the right tail of the skill distribution.



Figure 2: Children's interview-based development scores and teachers' perceptions at ages 4-5

Notes: Panels (a) and (b) display binned scatterplots showing the share of children perceived by teachers as having non-cognitive and cognitive delays, respectively, plotted against their corresponding non-cognitive and cognitive interview development scores. Both panels report raw regression lines. The sample includes children aged 4–5 attending formal care or education settings, with non-missing interview-based cognitive and non-cognitive development scores, neighbourhood average development scores, and teacher perception measures.

delays. The next subsection describes the construction of the average neighbourhood development score and shows that this pattern does not necessarily hold if teachers evaluate children relative to local reference points.

In addition to teacher assessments, the survey also collects mothers' perceptions of noncognitive delays by asking whether the child is easier, about average, or more difficult than others of similar age. I create a binary indicator equal to one if mothers perceive their children as more difficult compared to others of similar age. Only 7 percent of mothers consider their child to have a non-cognitive delay (see Appendix Table A.2).

Importantly, the perception measures capture the private beliefs of teachers and mothers about a child's development relative to the whole population of similar-aged children. Delay identification should therefore involve comparing a child's skills to age-specific developmental milestones, rather than to peers in their class, grade, school, or neighbourhood. When respondents were asked to compare a child's development to others in the group, class, or grade, the questionnaire explicitly provided the reference group.<sup>21</sup> This distinction matters: Kinsler and Pa-

<sup>&</sup>lt;sup>21</sup>For example, in the same questionnaire, teachers are asked "During organized physical activities for your group,

van (2021) show that when evaluating cognitive skills, mothers respond differently when asked to compare their child to others of similar age and to classmates.

Beyond the role of reference groups, the LSAC also provides an opportunity to examine how mothers update their beliefs in response to new information about their child's non-cognitive development. When children are 8–9 years old, mothers are asked whether the school has contacted them about their child's behaviour within the last 12 months. This measure allows me to examine how external signals from schools relate to changes in mothers' perceptions of noncognitive delays, rather than relying solely on the potentially bidirectional association between teacher and parent beliefs.

#### 2.3 Measures of the local environment

A key feature of the LSAC data that enables measurement of the local environment is the availability of household postcode information, which I use to define neighbourhoods throughout the analysis. Crucially, the sampling design groups children by postcode and ensures geographic representativeness across all Australian territories.<sup>22</sup> Australia has over 2,600 postcodes; the first survey wave includes children from 409 of them, with an average of 37 children per postcode<sup>23</sup> For example, children were selected from 93 postcodes in Sydney and 35 in Perth. This design supports the construction of neighbourhood-level aggregates of child development based on postcode.

I leverage information on the development levels of other children living in the same neighbourhood (postcode) to construct a measure of the local environment. Specifically, I use the average objective cognitive and non-cognitive development scores of similarly aged peers in the same postcode as a reference group.<sup>24</sup> To construct this measure, I follow a two-step leave-one-out procedure. First, I de-mean interviewer-assessed development scores to account for potential

how does this child compare with other children in the group in terms of the level of physical activity?"

<sup>&</sup>lt;sup>22</sup>A sample was selected to be representative of all Australian children in the selected age cohorts. It was drawn using a two-stage stratified sampling procedure, with the first stage selecting postcodes to ensure proportional geographic representation, and the second stage selecting children within those postcodes.

<sup>&</sup>lt;sup>23</sup>Australian Bureau of Statistics defines 2,644 Postal Areas (POAs) as geographic approximations of Australia Post's four-digit postcode system (Australian Bureau of Statistics, 2021). However, the total number of operational postcodes in Australia is substantially higher, though no definitive public count is maintained by Australia Post.

<sup>&</sup>lt;sup>24</sup>For each child, I compare children of similar age (4–5 or 8–9) from both cohorts living in the same postcode.



Figure 3: Average neighbourhood development scores and teachers' perceptions at ages 4-5

Notes: Panels (a) and (b) display binned scatterplots showing the share of children perceived by teachers as having non-cognitive and cognitive delays, respectively, plotted against corresponding average neighbourhood non-cognitive and cognitive interview development scores. Both panels report raw regression lines. The sample includes children aged 4–5 attending formal care or education settings, with non-missing interview-based cognitive and non-cognitive development scores, neighbourhood average development scores, and teacher perception measures.

cohort effects in the skill distribution by regressing the scores on a cohort indicator within each age group and retaining the residuals. Second, I compute the average de-meaned score of all other children in the same postcode, excluding the child in question. To ensure a representative average, I restrict this to neighbourhoods with at least ten other children across both cohorts with non-missing development scores.<sup>25</sup> Finally, I standardize neighbourhood scores within age groups to match the scale of individual development scores used in the analysis.

As teachers' perceptions of developmental delays are informed by the child's development (see Figure 2), it can also be expected that teachers in neighbourhoods with lower average levels of child development will be more likely to report developmental delays. However, Figure 3 shows that this is not necessarily the case. Panels (a) and (b) of Figure 3 plot the average shares of teachers perceiving developmental delays against average neighbourhood development scores. While panel (b) shows that teachers perceive fewer delays in neighbourhoods with higher levels of child development, Kinsler and Pavan (2021) and Elder and Zhou (2021) find that this negative relation-

 $<sup>^{25}</sup>$ The results are robust to alternative methods of constructing the neighbourhood development score – for example, using only children from the same cohort, including children of all ages, or adjusting the minimum number of observations required per postcode to ensure a stable average. See Appendix D.

ship would have been stronger in the absence of reference bias in teachers' perceptions.

In contrast, panel (a) reveals a positive association between neighbourhood-level noncognitive development and the likelihood that teachers report non-cognitive delays: teachers in neighbourhoods where more children score highly on non-cognitive development are actually more likely to perceive delays. This surprising relationship may be driven by teachers having higher expectations about children's developmental milestones in neighbourhoods where most children are developmentally on track.

If teacher perceptions shape how families and schools respond to children's needs, biased perceptions may have important implications for support access. The following subsection introduces the measures of home and school environments used to examine this possibility.

#### 2.4 Measures of school and home environments

Understanding the consequences of perceived delays requires examining how schools and families respond to children's developmental needs. The LSAC collects detailed information on both school- and home-settings, including parenting practices (e.g., time use, parenting style, attitudes) and access to remedial services such as behavioural therapy, speech and learning support, psychological evaluations, and tutoring. These measures allow me to study how perceptions held by teachers and mothers relate to the allocation of inputs shown to matter for child development (Cunha, Heckman, and Schennach, 2010; Caucutt, Lochner, Mullins, and Park, 2020; Del Boca, Flinn, and Wiswall, 2014; Fiorini and Keane, 2014).

The school environment measures include two types of therapy, one targeting cognitive skills and another targeting non-cognitive skills. LSAC asks both teachers and mothers whether children have used additional school or community services aimed at helping those with developmental delays. To capture non-cognitive therapy uptake, I construct a binary variable equal to one if teachers report the child used behaviour management programs or underwent a psychological assessment in their care, or if mothers report using guidance counselling or other psychiatric or behavioural services for the child in the past 12 months. Similarly, I construct a cognitive therapy use indicator, coded as one if teachers report that the child received speech therapy or learning support in their care, or if mothers report using speech therapy in the past year. At ages 4–5, around 5 percent of children are reported to have received non-cognitive therapy and 15 percent received cognitive therapy (see Appendix Table A.5). At ages 6–7, non-cognitive therapy uptake increases to 6 percent, while cognitive therapy uptake decreases to 13 percent.

The home environment is measured by LSAC-constructed scores for maternal parenting styles (e.g., warmth and anger), use of parenting education programs and support groups, and weekly additional tutoring or help sessions. I further use information on parental expectations about children's future educational attainment and measures of quality time, such as total time and reading time spent with the child each week (see Appendix A.4). These measures allow me to examine how the home environment may respond to perceived developmental delays. To interpret these patterns, the next section introduces a conceptual framework in which reference group bias in teacher perceptions may influence both family and school responses to child development.

# 3 Conceptual framework: Reference group bias

This section presents a conceptual framework in which reference group bias in teachers' perceptions may affect children's home and school environments, inspired by the setting in Kinsler and Pavan (2021). Consider a child of age t with development level  $D_t$ . During the interview, this development level is evaluated by a psychologist-trained interviewer who assigns a continuous measure  $D_{it}^I$  given by

$$D_{it}^{I} = D_{it} + \mu_{it}^{I}, \quad \text{s.t.} \quad \mu_{it}^{I} = \Theta_{it}^{I} + \epsilon_{it}^{I}, \tag{1}$$

where  $\mu_{it}^{I}$  summarizes potentially unobserved factors that can affect the objective interviewbased measures,  $\epsilon_{it}^{I}$  is a mean-zero iid measurement error, and  $\Theta_{i,t}^{I}$  is an idiosyncratic interviewday shock that may be correlated across different interview-based development measures. For example, this shock captures potential variation in children's interview effort across neighbourhoods. It may be particularly relevant in settings where interviews are conducted at children's homes, and therefore conditions of the interview—in terms of parental support and interruptions from siblings—may be correlated with neighbourhood advantage.

To identify developmental delays in children ( $T_{it} = \{0, 1\}$ ), teachers compare children's

development to perceived age-specific benchmarks. If these perceived standards of development are affected by the level of development among other children in the neighbourhood, teachers' recognition of delay depends on both a child's own development level and the average development level in the neighbourhood,  $\bar{D}_{it}^N$ . Thus, teachers' perceptions of children's delays relative to same-age peers are

$$T_{it} = F^{T}(D_{it}, \bar{D}_{it}^{N}, X_{it}^{T}) + \mu_{it}^{T}, \text{ s.t. } \mu_{it}^{T} = \Theta_{it}^{T} + \epsilon_{i,t}^{T},$$
(2)

where  $X_{it}^T$  are variables related to children's development and perceptions that are observed by both interviewers and teachers. These variables can affect perceptions conditional on children's true development levels. For example, teachers may perceive children from lower SES families as more prone to non-cognitive delays, and neighbourhoods with low child development may have a higher number of these families. Here,  $\mu_{it}^T$  summarizes factors unobserved by the interviewer that can affect teachers' perceptions,  $\epsilon_i^T$  represents an iid error term, and  $\Theta_{i,t}^T$  represents sources of unobserved heterogeneity not captured by interview-based measures but potentially related to children's or neighbourhood's development levels and perceptions. For example, better-educated and more experienced teachers may select into advantaged neighbourhoods and also be more skilled at recognizing developmental delays. Importantly, if teachers' benchmarks for what constitutes healthy development depend on the local environment  $\overline{D}_{it}^N$  in a systematic way, then their evaluations of children's developmental delays may be biased relative to objective developmental milestones for same-age peers.

Mothers' perceptions about developmental delays  $M_{it}$  depend on true development levels and teachers' perceptions:

$$M_{it} = F^{M}(D_{it}, T_{i,t}, X_{it}^{M}) + \mu_{it}^{M}, \quad \text{s.t.} \ \mu_{it}^{M} = \Theta_{it}^{M} + \epsilon_{it}^{M}, \tag{3}$$

where  $X_{it}^M$  are observed variables potentially correlated with children's development and perceptions. The shifter  $\Theta_{i,t}^M$  can include elements of idiosyncratic perceptions of mothers, such as over-optimism or lack of involvement, which may be correlated with children's development or teachers' perceptions. For example, teachers might communicate differently with uninvolved mothers, who may also be more likely to have children with lower skill levels. If teachers' perceptions are biased and mothers' perceptions are affected by them, then the bias in teachers' judgment will be transmitted to mothers.

Perceptions play a critical role in investment decisions (Dizon-Ross, 2019). Formally, schoolbased investments,  $I_{i,t}^S$ , are determined by teachers' and mothers' perceptions, while family-based investments,  $I_{i,t}^F$ , are determined by mothers' perceptions:

$$I_{i,t}^{S} = F^{S}(M_{it}, T_{it}, X_{it}^{S}) + \mu_{i,t}^{S} \text{ s.t. } \mu_{i,t}^{S} = \Theta_{i,t}^{S} + \epsilon_{i,t}^{S},$$

and

$$I^F_{i,t} = F^F(M_{it}, X^F_{it}) + \mu^F_{i,t} \text{ s.t. } \mu^F_{i,t} = \Theta^F_{i,t} + \epsilon^F_{i,t}$$

where  $\Theta_{i,t}^S$  and  $\Theta_{i,t}^F$  represent sources of unobserved heterogeneity correlated with perceptions and investment by schools and families.  $\Theta_{i,t}^S$  can include idiosyncratic determinants of school investments like available resources, and  $\Theta_{i,t}^F$  may include unobserved determinants of family investment-like habits. These shifters can be correlated with perceptions and investment choices; for example, uninvolved mothers may be less likely to recognize delays and habitually invest less in their children.  $\epsilon_{it}^F$  and  $\epsilon_{it}^S$  are idiosyncratic measurement errors. If family and school investments depend on how teachers and mothers perceive children's developmental delays, then biases in these perceptions may affect children's environment, potentially leading to suboptimal investment strategies. The following sections describe my estimation strategy and elaborate on the results.

# 4 Teachers' perceptions of developmental delays

#### 4.1 The role of the local environment in teachers' perceptions

Subjective perceptions of children's non-cognitive skills are commonly used to compare development levels across groups of children. For example, the Australian Early Development Census surveys early childhood educators nationwide to identify communities and institutions that are struggling to promote non-cognitive development. Subjective perceptions also play a key role in diagnosing non-cognitive delays.<sup>26</sup> In research, they are often used to compare non-cognitive skills across children or over time (Attanasio, De Paula, and Toppeta, 2020; Chaparro, Sojourner, and Wiswall, 2020; Fletcher and Wolfe, 2016; Nghiem, Nguyen, Khanam, and Connelly, 2015). Any reference group bias in these perceptions may distort estimated differences in skills. This section quantifies how teachers' perceptions vary with the reference group, using objective measures of child development and average neighbourhood-level development.

To determine whether teachers in neighbourhoods with lower levels of child development are more or less likely to report developmental delays in children, I estimate a linear probability model based on Equation (2). The dependent variable,  $T_{it}$ , is an indicator equal to one if the teacher perceives a developmental delay in child *i* at age *t*. The key independent variables include  $D_{it}^{I}$ , the interviewer-assessed individual development score, and  $\bar{D}_{it}^{N}$ , the average development level in the child's neighbourhood:

$$T_{i,t} = \beta^{T,N} \bar{D}_{i,t}^{N} + \beta^{T,D} D_{i,t}^{I} + \gamma_{t}^{T,X} X_{i,t}^{T} + \epsilon_{it}^{T}.$$
(4)

In this model,  $\beta^{T,N}$  captures how teachers' perceptions vary with their local reference group. If teachers rely solely on age-specific developmental milestones and compare children to the population of similar-aged peers, then  $\beta^{T,N}$  would be equal to zero. The control vector  $X_{i,t}^{T}$  includes the child's gender, cohort, and age in months, along with a household-level socioeconomic status (SES) index derived by LSAC, based on parental income, education, and occupational prestige (Baker, Sipthorp, and Edwards, 2017).<sup>27</sup>

Table 1 presents the estimates of the linear probability regression specified by Equation (4). Columns (1) and (3) show the results when only the development measures corresponding to the perceived delay are included in the regression — that is, cognitive development measures are used when estimating perceived cognitive delays, and non-cognitive development measures are used when estimating perceived non-cognitive delays. In each case, the regression includes both the

<sup>&</sup>lt;sup>26</sup>The American Academy of Pediatrics recommends that when diagnosing non-cognitive delays, healthcare providers ask parents, teachers, and other adults who care for the child about their behaviour in different settings, like at home, school, or with peers. See Centers for Disease Control and Prevention.

 $<sup>^{27}</sup>$ Results are robust to using individual demographic controls – such as mother's age, marital status, education, employment, number of siblings, family income, and home language – in place of the SES index.

	Non-cog	nitive delay	Cogniti	ve delay
	(1)	(2)	(3)	(4)
Neighbourhood	$0.024^{*}$	$0.021^{*}$		0.014*
non-cognitive score	(0.006)	(0.006)		(0.005)
Non-cognitive score	-0.057*	-0.043*		-0.030*
-	(0.006)	(0.006)		(0.006)
Neighbourhood cognitive		0.008	$0.018^{*}$	$0.015^{*}$
score		(0.006)	(0.005)	(0.005)
Cognitive score		-0.050*	-0.085*	$-0.081^{*}$
-		(0.007)	(0.006)	(0.006)
N	5508	5246	5258	5242
Mean	0.21	0.20	0.14	0.14
R2	0.05	0.05	0.08	0.09

Table 1: Teachers' perceptions and average neighbourhood child development

Notes: The table reports estimates from a linear probability regression using a sample of children aged 4–5 attending formal care or education settings. Controls include children's gender, cohort, and age in months, as well as a household socioeconomic status (SES) index. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

child's interview-based development score and the neighbourhood's average development level. The results confirm that teachers are less likely to perceive delays in children with stronger individual development scores, even though they do not observe these interview-based evaluations. Columns (2) and (4) extend the specification to include both cognitive and non-cognitive development measures. The estimates suggest that teacher perceptions are not entirely domain-specific: children with stronger non-cognitive skills are less likely to be perceived as having cognitive delays, and vice versa.

Most importantly, Table 1 shows that the likelihood of teachers perceiving developmental delays increases with the average level of non-cognitive development in a child's neighbourhood. This pattern holds for both perceived cognitive and non-cognitive delays: teachers are more likely to report delays in neighbourhoods where average non-cognitive development is higher, and less likely to do so where this development is lower — even after conditioning on children's individual development levels.<sup>28</sup> This implies that teachers may be less likely to recognize a delay

<sup>&</sup>lt;sup>28</sup>Excluding the attention measure recorded during the interview from the construction of non-cognitive and neighbourhood non-cognitive scores weakens the relationship between average neighbourhood non-cognitive development and perceptions of cognitive delays, though not in a statistically significant way. See Appendix D.

in neighbourhoods where delays are more prevalent.

In contrast, the average level of cognitive development in the neighbourhood predicts teacher perceptions only for cognitive delays, consistent with the findings of Kinsler and Pavan (2021) and Elder and Zhou (2021). This implies that domain-specific reference points shape teacher judgments differently across developmental dimensions.

Finally, comparing columns (1) and (2), and (3) and (4), shows that the inclusion of additional development measures has only a modest impact on the estimated coefficients. This implies that the role of omitted variable bias from unobserved components of child development (such as  $\Theta_{it}^{T}$  in Equation (2)) may be limited. For instance, compared to column (1), which includes only non-cognitive development, controlling for cognitive development in column (2) slightly attenuates the estimated effect of non-cognitive skills on perceived non-cognitive delays, but the change is not statistically significant.

Next, I explore what the estimated magnitudes imply about the role of reference groups in shaping the gaps in teachers' recognition of delays between less- and more-advantaged areas. First, I predict the probabilities of teachers perceiving delays based on estimates reported in columns (2) and (4) of Table 1. Panels (a) and (b) of Figure 4 plot these predicted probabilities against the average neighbourhood development level. The simple linear probability model replicates the patterns in Figure 3, showing a positive relationship between the predicted probability of perceiving non-cognitive delays and average neighbourhood non-cognitive development, and a weak negative relationship between the predicted probability of perceiving cognitive delays and average neighbourhood cognitive development.

To quantify the contribution of the reference group to the observed inequality in perceived delays, I simulate counterfactual probabilities using the estimates in columns (2) and (4), holding the average neighbourhood development levels fixed at the population mean (zero). This approach removes variation in teachers' perceptions attributable to differences in the reference group. Panels (c) and (d) of Figure 4 plot binned scatterplots of these adjusted probabilities against the average neighbourhood development level. Panel (c) shows that removing the variation in teachers' perceptions associated with the reference group reverses the relationship between perceived non-cognitive delays and neighbourhood non-cognitive development. The relationship becomes negative, reflecting the selection of children with lower measured development and less advantaged family characteristics (as captured by control variables) into lower-development neighbourhoods.

In the data, teachers in neighbourhoods in the top quartile of average non-cognitive development are 1.4 percentage points more likely to perceive non-cognitive delays compared to those in bottom-quartile neighbourhoods. By contrast, the adjusted probability of perceiving non-cognitive delays is 2.7 percentage points lower for teachers in top-quartile neighbourhoods compared to those in bottom-quartile neighbourhoods. A similar pattern holds for cognitive delays. Removing the variation in teachers' perceptions associated with the reference group — using the estimates in column (4) of Table 1 — increases the gap in reported cognitive delays between the top and bottom quartiles of neighbourhood cognitive development from 1.9 to 6.8 percentage points.

The estimates in Table 1 rely on three key assumptions. First, the belief formation process follows a linear functional form, as specified in Equation (4). Second, the relationship between average neighbourhood development and teachers' perceptions is not driven by omitted variable bias. Third, while interview-based development scores may be measured with error, any resulting bias does not account for the observed relationship between neighbourhood-level development and teachers' perceptions. The next subsection assesses the robustness of the results by relaxing each of these assumptions in turn.

#### 4.2 Robustness checks

I begin by relaxing the first assumption from Equation (4) — that teachers' belief formation follows a linear functional form. Columns (1) and (4) of Table 2 report average marginal effects from a logistic probability model. The estimated coefficient on average neighbourhood non-cognitive development remains positive and statistically significant, indicating that the results in Table 1 are not sensitive to the choice of functional form. Teachers' perceptions continue to systematically vary with the average level of non-cognitive development in the neighbourhood.

Next, I assess whether the relationship between average neighbourhood development and teachers' perceptions is driven by confounding factors. For instance, idiosyncratic shocks to

child interview effort correlated with socioeconomic conditions in the neighbourhood ( $\Theta_{it}^{I}$  in Equation (1)) may impact how latent development is measured during the interview. Additionally, unobserved determinants of teachers' perceptions ( $\Theta_{it}^{T}$ ) in Equation (2) like teacher quality may be correlated with neighbourhood development levels.

To control for the potential effect of these confounding factors, I estimate Equation (4) with added controls. To proxy for variation in children's effort during the interview, I add controls that are available for the baby cohort in LSAC, which characterize the behaviour of parents and siblings during the cognitive test. I account for indicators of whether the parent and sibling were not present in the room, were present at a distance, observed the child, encouraged the child, or interfered with the tests. I also include a measure of children's sleeping problems reported by parents. To account for the potential selection of better-qualified teachers in more-advantaged neighbourhoods, I control for a range of characteristics of children's teachers and classrooms.<sup>29</sup>

Additionally, I account for neighbourhood characteristics that proxy for potential differences in resources across neighbourhoods that can affect teachers' incentives to perceive a delay. These characteristics are computed based on Census data and include the percentages of children aged 0-4 and 5-9 in the population, percentages of individuals of Aboriginal origin, who speak English at home, or who were born in Australia. I control for the neighbourhood's SES using the Index of Relative Socioeconomic Advantage and Disadvantage, which is computed by the Australian Bureau of Statistics.<sup>30</sup> The index accounts for a broad range of neighbourhood variables reflecting individuals' access to material and social resources and their ability to participate in society (Statistics, 2011). Finally, I include controls for Australian territories to account for potential regulatory differences across early childhood education institutions. Columns (2) and (5) of Table 2 show that these controls have little effect on the estimated coefficients for both the individual non-cognitive score and the average neighbourhood non-cognitive score.

<sup>&</sup>lt;sup>29</sup>Specifically, I control for whether the teacher has a university degree (versus a diploma or certificate), whether the child is attending daycare (versus preschool or kindergarten), the age range of the children's class reported by the teacher, the ratio of children to qualified staff, and indicators measuring teachers' experience in childcare (0– 5 years and 6–10 years versus more than 10 years). Subsection 4.3 explores the effect of teacher qualifications and classroom characteristics on developmental delay recognition in greater detail. For a summary of additional controls, see Appendix A.5. For a summary of teacher and program characteristics as well as a discussion of potential selection of better-quality teachers and programs into more developed neighbourhoods see Appendix A.7.

<sup>&</sup>lt;sup>30</sup>See Appendix A.3 for a summary of neighbourhood characteristics.



Figure 4: Average neighbourhood development scores and predicted teachers' perceptions at ages 4–5

Notes: Panels (a) and (b) report binned scatterplots of the predicted probabilities that children's teachers perceive developmental delays, conditional on the average neighbourhood development score (based on estimates in columns (2) and (4) of Table 1). Panel (a) shows the predicted probability of perceived non-cognitive delays conditional on the average neighbourhood non-cognitive development score, while panel (b) shows the predicted probability of perceived cognitive delays conditional on the average neighbourhood non-cognitive development score. Panels (c) and (d) report counterfactual predicted probabilities adjusted for the potential effect of the reference group. These adjusted probabilities are constructed by setting the average neighbourhood scores to the sample mean (zero) value. Panel (c) displays the adjusted probability of perceived cognitive delays. All panels plot raw regression lines.

	Non-	cognitive delay		Co	gnitive delay	
	(1)	(2)	(3)	(4)	(5)	(9)
	Logit avg. marg. effect	Extra controls	Meas. error adj.	Logit avg. marg. effect	Extra controls	Meas. error adj.
Neighbourhood	$0.020^{*}$	$0.023^{*}$	$0.049^{*}$	0.013*	$0.018^{*}$	$0.024^{*}$
non-cognitive score	(0.006)	(00.0)	(0.013)	(0.005)	(0.007)	(0.009)
Non-cognitive score	$-0.037^{*}$	$-0.034^{*}$	$-0.382^{*}$	$-0.023^{*}$	$-0.029^{*}$	-0.159
	(0.005)	(0.011)	(0.111)	(0.005)	(0.010)	(0.086)
Neighbourhood cognitive	0.009	-0.004	0.003	$0.016^{*}$	-0.004	$0.029^{*}$
score	(0.006)	(0.012)	(0.017)	(0.005)	(0.010)	(0.012)
Cognitive score	$-0.049^{*}$	-0.072*	-0.041	-0.075*	-0.085*	$-0.151^{*}$
1	(0.006)	(0.011)	(0.067)	(0.005)	(0.011)	(0.051)
Z	5246	1914	5203	5242	1914	5199
R2		0.08			0.12	
Notes: The sample is restrict	ed to children aged 4-5	attending formal	care or education	1 settings. All columns co	ontrol for childre	en's gender, cohort,
and age in months, as well $\varepsilon$	is the household socioed	conomic status (S	ES) index. Colun	nns (1) and (4) report ma	rginal effects of	logistic probability
model estimates. Columns (	(2) and (5) report the lin	ear probability r	egression with a	lded controls for sleepin	g problem inten	isity, the behaviour
of parents and siblings duri	ng the test, teacher and	classroom chara	icteristics, Austra	lian territory dummies,	and neighbourh	ood characteristics
from the Census. Standard (	errors are clustered at th	le postcode level.	Columns (3) and	l (6) report linear probab	ility model two-	-stage least squares
estimates adjusted for meas	urement error in childre	en's developmen	t. Instruments fo	r focus during the cogn	itive test are po	sitive and negative
helonious during the intern	The instant for	DDVT : + + - VIVI	Cignificance law	ol. * E 505005+		

behaviour during the interview. The instrument for PPVT is the WAI. Significance level: \* 5 percent.

Table 2: Robustness checks

Finally, the estimates of Equation (4) reported in Table 1 do not account for potential measurement error in the interview-based development scores, represented by  $(\epsilon_{it}^{I})$  in Equation (1). To assess the impact of the measurement error, I estimate a two-stage least squares version of Equation (4) (Kinsler and Pavan, 2021; Agostinelli and Wiswall, 2025). In this specification, I use children's focus during the cognitive test as the primary measure of non-cognitive skills and instrument it with measures of positive and negative behavioural responses observed during the assessment. Similarly, I use the PPVT score as the main measure of cognitive skills and instrument it with the WAI score, with all measures age-standardized.

Columns (3) and (6) of Table 2 show that measurement error has a substantial effect on the estimates, with the bias distorting estimates of children's individual development and the neighbourhood's average development levels toward zero. Adjusting for measurement error strengthens the estimated effects of both children's own development and average neighbourhood development on teachers' perceptions.<sup>31</sup> As shown in the previous subsection, removing the variation in teachers' perceptions associated with the reference group — based on the baseline estimates — yields a 2.7 percentage point lower counterfactual probability of reported non-cognitive delays in top-quartile neighbourhoods compared to bottom-quartile ones. Using the measurement-error-adjusted estimates (column 3 of Table 2), this gap increases to 10 percentage points. A similar pattern is observed for cognitive delays: the gap increases from 6.8 percentage points to 10.1 percentage points when using the adjusted estimates.

Overall, the robustness analysis confirms that teachers' perceptions systematically vary with neighbourhood development, consistent with the potential presence of the reference group bias in teachers' belief formation process. These findings raise the question of what program or teacher characteristics might support teachers in identifying children with developmental delays. The next subsection examines whether qualifications and classroom settings are associated with teachers' ability to recognize children with low measured levels of development.

 $<sup>^{31}</sup>$ Additional robustness checks— aaccounting for measurement error in the average neighbourhood measure of child development, sensitivity to the chosen method of constructing the child's non-cognitive score and average neighbourhood score, and sensitivity to the choice of the measure of teachers' perceptions of non-cognitive development— do not change the conclusion that the probability of teachers' perceiving delays is positively systematically related to average levels of non-cognitive development in the neighbourhood. See Appendices D, F, and E.

# 4.3 The role of teacher and program characteristics in delay identification

Early childhood education quality is documented to have lasting effects on children's outcomes, with extensive research investigating the role of teacher qualifications and classroom characteristics in shaping student progress (Heckman, Pinto, and Savelyev, 2013).<sup>32</sup> One potential mechanism is teachers' ability to identify developmental delays and provide appropriate support. In this section, I examine whether teacher qualifications — measured by education or experience and classroom characteristics — such as type of childcare setting, class size, or age composition are associated with the identification of children with low measured levels of development.

During the 2000s, early childhood education and care (ECEC) provision in Australia was governed by diverse administrative and legislative arrangements, with limited intergovernmental agreement on policy and little coordinated effort to ensure program quality (Elliott, 2006).<sup>33</sup> School was compulsory from age 6 to at least 15, depending on the jurisdiction, and the first year of full-time schooling — often referred to as kindergarten — was typically preceded by one or more years in preschool or daycare. In the LSAC sample, children aged 4–5 attended a range of ECEC settings, with most enrolled in preschool or kindergarten, and 26 percent attending daycare. Only a few children attended Grade 1 (see Appendix A.6).<sup>34</sup>

These differences in settings were accompanied by variation in staff qualifications. In 2000s, there were no nationally agreed or consistent standards for staffing across the child care and preschool sector (Warren and Haisken-DeNew, 2013). Staff in early childhood settings typically qualified either by completing a university degree in early childhood education or by obtaining a diploma or certificate through a Registered Training Organisation (RTO), usually requiring one to two years. In my sample, around 40 percent of early childhood educators did not hold a university degree.<sup>35</sup> This variation allows me to examine whether differences in training are associated with

<sup>&</sup>lt;sup>32</sup>See Manning, Wong, Fleming, and Garvis (2019) for a review of the literature on instructor qualifications.

 $<sup>^{33}</sup>$ Australia's major reform aimed at standardizing the quality of early childhood education and care – the National Quality Framework – came into effect in 2012, after the period when children in my baseline sample were aged 4–5, and therefore is unlikely to affect the results presented in this section.

<sup>&</sup>lt;sup>34</sup>The use of early childhood education and care in Australia was subsidized during this period through the meanstested Child Care Benefit program. Additional subsidies such as the Child Care Rebate were available to eligible families depending on work, training, and study requirements.

<sup>&</sup>lt;sup>35</sup>See Appendix A.7 for the summary of teacher qualifications.

differences in teachers' perceptions of children's developmental delays.

For each dimension of development, I split the sample into subsamples with low and high measured development based on interview-based development scores. The subsample of children with low measured non-cognitive (or cognitive) development consists of those whose interview-based development score falls within the first quartile of the distribution for children ages 4–5. Similarly, the subsample of children with high measured development includes those with scores in the top quartile. Intuitively, children with the lowest measured development are more likely to have developmental delays.<sup>36</sup>

Next, I estimate the linear probability regression separately for two subsamples,  $J = \{H, L\}$ :

$$T_{i,t} = \beta^{J,V} V_{i,t}^T + \gamma_t^{J,X} X_{i,t}^T + \epsilon_{it}^T,$$

where  $X_i^T$  is a vector of control variables included in all specifications. It includes the child's gender, cohort, and age in months, as well as the household SES index. Here  $V_{i,t}^T$  includes observed teacher and classroom characteristics that may be associated with the quality of early childhood education.<sup>37</sup> In particular, I account for whether the teacher holds a university degree (versus a diploma or certificate), whether the child attends daycare (versus preschool or kindergarten), the ages of the youngest and oldest children in the class as reported by the teacher, the child-to-qualified-staff ratio, and indicators of the teacher's experience in childcare (0–5 years and 6–10 years versus more than 10 years).<sup>38</sup>

The results of this specification are presented in Table 3. Among children with low measured levels of development, teacher education is positively associated with delay recognition. Specifically, teachers with bachelor's or postgraduate university degrees are 9 percentage points

<sup>&</sup>lt;sup>36</sup>For example, in 2023, 24.2 percent of students in Australian schools were offered accommodations due to predominantly cognitive and non-cognitive deficits. The results in this section are robust to dividing children into subsamples with measured development above and below the sample median score.

<sup>&</sup>lt;sup>37</sup>These characteristics include teacher and classroom qualities used as controls for the estimation reported in columns (2) and (5) of Table 2.

<sup>&</sup>lt;sup>38</sup>In the 2000s, naming conventions and starting ages for early childhood programs varied across Australian states and territories. Preschool typically referred to the year before formal schooling, while kindergarten marked the first year of full-time school, though terminology differed by jurisdiction (Australian Bureau of Statistics, 2004). Due to misreporting by parents regarding preschool versus kindergarten attendance (Australian Bureau of Statistics, 2023), I combine these categories in the baseline analysis. The association between teacher education and delay recognition remains robust when distinguishing between children attending preschool and kindergarten (see Table A.12).

	Non-cogr	nitive delay	Cognit	ive delay
	(1)	(2)	(3)	(4)
	Non-cogn. score low	Non-cogn. score high	Cogn. score low	Cogn. score high
Teacher college+	$0.088^{*}$	0.031	$0.072^{*}$	-0.002
	(0.027)	(0.021)	(0.024)	(0.015)
Teaching experience 0-5	-0.105*	0.002	0.003	0.043
years	(0.032)	(0.029)	(0.032)	(0.025)
Teaching experience 6-10	-0.042	-0.027	-0.045	0.029
years	(0.030)	(0.024)	(0.029)	(0.020)
Age of youngest in class	0.002	0.002	0.002	0.002
	(0.002)	(0.001)	(0.002)	(0.001)
Age of oldest in class	0.002	0.001	0.001	0.001
	(0.002)	(0.001)	(0.002)	(0.001)
Children to qualified	-0.001	0.001	0.002	0.000
staff ratio	(0.002)	(0.002)	(0.002)	(0.001)
Child attends daycare	-0.038	0.001	-0.025	-0.004
	(0.032)	(0.027)	(0.027)	(0.018)
N	1414	1339	1359	1132
Mean	0.30	0.16	0.27	0.05
R2	0.07	0.03	0.05	0.03

Table 3: Relationship between teacher and program characteristics and perceived delays in children ages 4–5

Notes: The table reports estimates from a linear probability regression for high-development (measured development top quartile) and low-development (measured development bottom quartile) samples, limited to children aged 4–5 attending formal care or education settings. Controls include children's gender, cohort, and age in months, as well as the household socioeconomic status (SES) index. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

more likely to report non-cognitive delays and 7 percentage points more likely to report cognitive delays than those with diplomas or certificates. As expected, this relationship is not evident among children with high measured development, for whom more extensive training should not increase the likelihood of perceiving delays.<sup>39</sup>

Among children with low measured non-cognitive development, inexperienced teachers (those with less than 5 years of experience) are 10 percentage points less likely to perceive delays compared to those with more than 10 years of experience. A further increase in experience does not appear to improve the probability of delay recognition. This experience-related gap is not apparent for cognitive delays, potentially reflecting the fact that teachers persistently sort into

<sup>&</sup>lt;sup>39</sup>A potential explanation for this advantage in delay identification is that university-trained staff may be better equipped to recognize cognitive developmental trajectories and milestones in young children. Appendix B provides evidence of a stronger association between children's cognitive scores and perceived delays among teachers with university training.

low- or high-development areas, which limits their exposure to varied skill levels over time. In contrast, university training may improve teachers' ability to correctly identify developmental delays even in neighbourhoods with low average child development levels. Other classroom characteristics — such as class size (measured by the children-to-qualified-staff ratio) and age composition — do not exhibit a robust relationship with delay recognition.

Teachers' professional judgment plays a critical role in supporting children's learning. For example, the *Early Years Learning Framework* published by the Australian Government Department of Education highlights the central role that teachers' assessments play in effectively planning children's learning activities, communicating progress, monitoring children's advancement toward learning outcomes, and identifying those who need additional support (Australian Government Department of Education, 2009). Bias in teachers' evaluations can distort all of these processes, creating a cascading effect on parental perceptions and children's learning environments. In the following sections, I examine this potential effect by showing, first, that teachers' perceptions of child development affect mothers' perceptions, and second, that the combined judgment of mothers and teachers predicts children's learning environments.

# 5 The influence of teachers' perceptions on mothers' perceptions

Teachers are often a key source of information for parents seeking to monitor their children's progress. In this subsection, I assess whether potential biases in teachers' perceptions shape parental beliefs through informational channels. To do so, I use repeated measures of mothers' perceptions, along with teachers' perceptions and objective development scores, measured for children at ages 4–5 and 8–9. I limit the sample to households in which the respondent to the face-to-face interview – the parent who knows the child best — is the child's mother, which is the case in over 95 percent of households.

To assess this relationship using observational data, I estimate a linear probability model where the dependent variable is equal to one if the mother has indicated that her child is more difficult than other children of similar age  $(M_{it})$ :

$$M_{it} = \beta^{MD} D_{it}^{I} + \beta^{MT} T_{it} + \gamma^{MX} X_{it}^{M} + \epsilon_{it}^{M},$$
(5)

where  $T_{it}$  is a measure of delays perceived by teachers. I explore several available measures of teachers' perceptions for children at ages 4–5 and 8–9, which are described in detail in the results that follow. Here  $X_i^M$  is a vector of controls including the child's gender, cohort, and age in months; the household SES index; and the mother's depression levels. Some specifications additionally control for the lag of the mother's perceptions and her level of school involvement, as reported by teachers when available.

Table 4 presents the results. Columns (1) and (2) examine the relationship between mothers' and teachers' perceptions for children aged 4–5, using the perceived delay measures introduced in Section 4. In the specification reported in Column (2), I also control for the lag of mothers' perceptions measured when children are ages 2–3.<sup>40</sup> This lag accounts for persistent elements of unobserved heterogeneity in parental perceptions that may be correlated with factors affecting the transmission of teachers' perceptions, as represented by  $\Theta_{it}^{M}$  in Equation (3). Such heterogeneity may be driven by differences in skill valuation, over-optimism, or lack of involvement.

The estimates suggest that mothers whose children are reported by teachers to have noncognitive developmental delays are more likely to perceive such delays themselves, conditional on the child's interview-based development scores. After accounting for mothers' prior beliefs, mothers are 8 percentage points more likely to report non-cognitive delays if their child's teacher does so. However, this association does not necessarily imply that teachers' perceptions influence parental beliefs, as the direction of information flow could also run from parents to teachers. For example, mothers of children diagnosed with Autism Spectrum Disorder (ASD) or ADHD may proactively inform teachers of their child's developmental needs.<sup>41</sup>

To address this reverse causality concern, I use a question from the LSAC survey asked of mothers of 8- to 9-year-olds: whether, in the past 12 months, the school contacted them about

 $<sup>^{40}</sup>$ Since the first age of observations for the kindergarten cohort in LSAC is 4–5, this regression can only be estimated for the baby cohort followed from ages 0–1.

<sup>&</sup>lt;sup>41</sup>From columns (1) and (2), it also follows that mothers with more depressive symptoms are more likely to perceive their child as more difficult than other children, similar to the findings of Del Bono, Kinsler, and Pavan (2020).

	Non-cogn	nitive delay	perceived h	oy mother
	(1)	(2)	(3)	(4)
	Ages 4-5	Ages 4-5	Ages 8-9	Ages 8-9
Teach.: Non-cognitive	0.096*	$0.080^{*}$		
delay	(0.013)	(0.020)		
Teach.: Cognitive delay	$0.041^{*}$	0.019		
	(0.015)	(0.021)		
School contacted about			$0.179^{*}$	0.115*
behavior			(0.015)	(0.015)
Mother depression	$0.028^{*}$	$0.021^{*}$	$0.023^{*}$	0.016*
	(0.004)	(0.006)	(0.003)	(0.003)
Non-cognitive score	-0.021*	-0.020*	-0.023*	-0.014*
	(0.005)	(0.007)	(0.004)	(0.004)
Cognitive score	-0.004	0.002	-0.011*	-0.005
	(0.004)	(0.006)	(0.003)	(0.003)
Lag mother: Non-cognitive		0.309*		0.506*
delay		(0.044)		(0.026)
Mothers'				0.002
interactions with school				(0.003)
N	4730	2222	7258	5549
Mean	0.06	0.06	0.07	0.07
R2	0.06	0.12	0.08	0.29

Table 4: The relationship between mothers' and teachers' perceptions

Notes: The table reports estimates from a linear probability regression using a sample of children observed at ages 4–5 and 8–9 who attend formal care or education settings, with their mother as the respondent to the face-to-face interview. Lagged variables are measured at ages 2–3 and 6–7, respectively. Controls include children's gender, cohort, and age in months; the household socioeconomic status (SES) index; and the mother's depression score. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

their child's behaviour. This variable captures a direct transfer of information from teachers to parents, indicating that the teacher perceives the child to exhibit non-cognitive delays. For children ages 8–9, columns (3) and (4) of Table 4 show how mothers' beliefs respond to such contact. Column (4) adds controls for the lag of the mother's perception, measured at ages 6–7, as well as her level of school involvement, as reported by teachers.<sup>42</sup> These variables proxy for differences in schools' incentives to reach out. For example, schools may feel less need to contact

<sup>&</sup>lt;sup>42</sup>The index of mothers' involvement at school is computed by LSAC based on subquestions measuring parents' interactions with the school. Parents' interactions include contacting the teacher, visiting the child's class, volunteering in class, helping in school, attending parent-school committees, raising funds, and participating in other activities.

highly involved mothers, while teachers may hesitate to engage uninvolved ones.

Taken together, the results indicate that mothers revise their perceptions of their child's non-cognitive development in response to school-initiated contact about behavioral concerns. Column (4) shows that being contacted by the school in the past 12 months increases the probability that a mother perceives her child as more difficult than peers by 11.5 percentage points, conditional on her prior beliefs.

This section shows that teachers' judgments affect parental perceptions of children's noncognitive skills. While it is expected that teachers' evaluations of academic progress inform parents (Dizon-Ross, 2019; Doss, Fahle, Loeb, and York, 2019), the role of teacher input in shaping parental beliefs about non-cognitive development is less understood. The findings suggest that teacher-parent communication, when influenced by biased assessments, can transmit those biases to parental perceptions of children's non-cognitive development, potentially affecting children's environments through the investment decisions made by both teachers and parents. The next section explores this possibility by examining the relationship between perceptions and therapy uptake.

## 6 Perceptions and the uptake of therapy

I examine whether teachers' and mothers' perceptions of developmental delays at ages 4-5 predict the uptake of child therapy by ages 6-7 — an important compensatory investment made by schools and families. The analysis focuses on neighbourhood- and school-level use of two types of therapy services: those targeting cognitive skills (e.g., learning or speech therapy) and those addressing non-cognitive development (e.g., behavioural therapy or psychological evaluation).

I estimate a linear probability model in which the dependent variable equals one if the child receives therapy ( $I_{it}^S = \{0,1\}$ ) at age 6–7. The key independent variables are teachers' and mothers' perceptions of developmental delays measured at ages 4–5 ( $T_{it-1}$  and  $M_{it-1}$ ):

$$I_{it}^{S} = \beta^{ST} T_{it-1} + \beta^{SM} M_{it-1} + \gamma_{t}^{SX} X_{it}^{S} + \epsilon_{it}^{S}.$$
 (6)

	Non-cog	n. therapy at 6-7	Cogn. th	erapy at 6-7
	(1)	(2)	(3)	(4)
Teach.: Non-cognitive	0.049*	0.039*	$0.050^{*}$	0.026
delay at 4-5	(0.013)	(0.013)	(0.016)	(0.015)
Teach.: Cognitive delay	-0.004	0.000	$0.102^{*}$	$0.043^{*}$
at 4-5	(0.015)	(0.016)	(0.021)	(0.021)
Moth.: Non-cognitive	$0.183^{*}$	$0.167^{*}$	$0.108^{*}$	$0.072^{*}$
delay at 4-5	(0.026)	(0.028)	(0.026)	(0.025)
Moth.: Concern cognitive	$0.050^{*}$	$0.048^{*}$	0.139*	$0.062^{*}$
delay at 4-5	(0.022)	(0.022)	(0.026)	(0.025)
Therapy at 4-5		$0.120^{*}$		$0.243^{*}$
		(0.033)		(0.019)
N	4608	4423	4608	4423
Mean	0.06	0.06	0.12	0.12
R2	0.06	0.07	0.09	0.16

Table 5: Perceived delays by teachers and mothers and child therapy

Notes: The table reports estimates from a linear probability regression using a sample of children aged 6–7 who attend formal care or education settings, with their mother as the respondent to the face-to-face interview. Lagged variables are measured at ages 4–5. Controls include children's gender, cohort, and age in months; the household socioeconomic status (SES) index; neighbourhood characteristics from the Census; and Australian territory dummies. Columns (2) and (4) additionally control for cognitive and non-cognitive scores at 4–5 and the lag of therapy uptake. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

I address the potential endogeneity of perceptions in several ways. First, I use *lagged* teacher and mother perceptions at ages 4–5 as independent variables to mitigate reverse causality, where changes in perceptions may be driven by the uptake of therapy. Second, I control for confounding factors by including the vector of controls  $X_{it}^S$ , which contains the child's gender, cohort, and age in months, as well as the household SES index measured when children are ages 6–7. I also control for neighbourhood characteristics computed from Census data and Australian territory indicators to proxy for potential variation in the supply of therapy services. Finally, in some specifications I include lagged cognitive and non-cognitive scores, along with prior therapy uptake at ages 4–5, to account for individual-specific heterogeneity, habits, and the history of past inputs using the value-added approach (Fiorini and Keane, 2014; Todd and Wolpin, 2007).

Columns (1) and (3) of Table 5 report estimates of Equation (6) for therapy targeting noncognitive and cognitive development, respectively. Teachers' perceptions of non-cognitive delays are a strong predictor of children receiving non-cognitive therapy. Similarly, their perceptions of language delays are associated with increased uptake of learning support or speech therapy, but not with non-cognitive interventions. Columns (2) and (4) add controls for lagged therapy uptake and interview-based development scores. Conditional on these controls, children whose teachers report non-cognitive delays are 4 percentage points more likely to receive non-cognitive therapy.

In addition to teachers' perceptions, non-cognitive delays perceived by mothers are also associated with greater use of both therapy types. Among variables considered, mothers' perceptions of non-cognitive delays are the strongest predictor of non-cognitive therapy uptake.<sup>43</sup>

These findings underscore the extent to which therapy use reflects the developmental concerns raised by both teachers and parents. Because teachers in advantaged neighbourhoods are more likely to perceive developmental delays (as shown in Section 4) — and these perceptions influence parental beliefs (as shown in Section 5) — reference bias may reinforce existing inequalities by amplifying gaps in therapy uptake between advantaged and disadvantaged areas.

# 7 Mothers' perceptions and home environment

In addition to the uptake of therapy services, mothers who believe their children are falling behind may engage in different parental investment strategies. In this section, I examine the relationship between mothers' perceptions of non-cognitive delays at ages 8–9 and various aspects of the home environment measured at ages 10–11. These include the use of community parenting resources, parenting style, frequency of development-promoting activities (such as reading to or with the child), parental expectations about child's future, and tutoring.

To assess how family investment decisions vary with maternal perceptions, I estimate a linear regression in which the dependent variable represents various measures of family-based investment at ages 10–11 ( $I_{it}^F$ ), and the key independent variable is the lagged indicator of moth-

<sup>&</sup>lt;sup>43</sup>Appendix G shows no evidence of heterogeneity in the role of teachers' perceptions across more- and lesseducated households. While mothers' perceptions of non-cognitive delays are strong predictors of therapy uptake in both groups, concerns about cognitive delays predict cognitive therapy uptake only among college-educated mothers.

	Mother:	child more			
	difficult	at 8-9			
Dependent variable at 10-11	Coef.	SE	Ν	Mean	$\mathbb{R}^2$
A. Uptake of professional services					
Used parenting education courses or programs	$0.05^{*}$	(0.01)	6578	0.04	0.04
Used parent support groups or helplines	0.05*	(0.01)	6578	0.04	0.06
Used tutor	0.10*	(0.03)	3319	0.16	0.15
B. Parental attitudes and quality of interactions					
Mother Warmth Score [SD]	-0.16*	(0.04)	6577	0.01	0.47
Mother Anger Score [SD]	$0.28^{*}$	(0.04)	6575	-0.01	0.44
Mother expects child coll+	-0.07*	(0.03)	3082	0.68	0.41
C. Weekly quality time investment					
Read to child	0.35*	(0.14)	3264	1.11	0.15
Talk about school	-0.05	(0.06)	6588	6.66	0.11
Mom childcare time	-1.04	(0.95)	3308	21.82	0.11
Dad childcare time	-0.13	(0.76)	1745	10.79	0.21

Table 6: Delays perceived by mothers and family investments for children ages 10-11

Notes: The table reports estimates from a linear probability regression using a sample of children aged 10–11 who attend formal care or education settings, with their mother as the respondent to the face-to-face interview. Lagged variables are measured at ages 8–9. Controls include children's gender, co-hort, and age in months; the household socioeconomic status (SES) index; neighbourhood character-istics from the Census; Australian territory dummy; mother's depression score; lag of cognitive and non-cognitive scores; and lag of the dependent variable. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

ers' perceptions of non-cognitive developmental delays at ages 8–9 ( $M_{i,t-1}$ ):

$$I_{i,t}^{F} = \beta^{F,M} M_{it-1} + \beta_{t}^{F,X} X_{it}^{F} + \beta^{F,I} I_{i,t-1}^{F} + \epsilon_{i,t}^{F}.$$
(7)

Following the estimation approach described in Section 6, I address potential endogeneity in parental perceptions by using lagged maternal perceptions as an independent variable to mitigate reverse causality and adopting a value-added approach with a range of controls for potential confounding factors.  $X_{it}^F$  is a vector of controls that includes the child's gender, cohort, and age in months, as well as the household SES index. Control variables also include the mother's depressive symptoms score, neighbourhood characteristics, Australian territory dummies, prior lagged cognitive and non-cognitive scores, and lagged investment  $I_{i,t-1}^F$ . The standard errors are clustered at the postcode level.

Table 6 presents estimates of Equation (7) for various home environment measures when children are ages 10–11. Delays perceived by mothers at ages 8–9 predict two noticeable types of parental responses. Panel A shows that, on the one hand, mothers who perceive delays are more likely to engage in compensatory investments. They are more likely to use parenting education courses and programs, participate in support groups and helplines, and hire a tutor or extra help for their child, similar to the findings of Kinsler and Pavan (2021). Combined with the increased use of therapy services, this implies that parents who perceive developmental delays are more likely to seek professional support for their children.

On the other hand, Panel B shows that mothers who perceive non-cognitive delays also report different attitudes toward their children. They exhibit lower levels of warmth and higher levels of anger in their parenting practices. They also report lower education expectations: those who believe their children have a non-cognitive delay are 7 percentage points less likely to expect that their children will obtain a university education.<sup>44</sup>

Interventions aimed at alleviating parental misperceptions about child development have been found to be effective in improving parental investment choices and even children's outcomes, at least in the short-run (Dizon-Ross, 2019; Bergman, 2021). My results imply that while parents might respond to updated perceptions about non-cognitive delay in children by increasing compensatory investments like therapy and tutoring, they may also experience a decrease in the quality of parent-child interactions which have been shown to play a key role in children's non-cognitive development (Fiorini and Keane, 2014; Falk, Kosse, Pinger, Schildberg-Hörisch, and Deckers, 2021). Therefore, informing parents about non-cognitive delays in their children may need to be accompanied by additional parenting support to mitigate potential negative effects on parental attitudes.

## 8 Conclusion

In this paper, I explore the role of the local environment in the formation of teachers' and mothers' beliefs about developmental delays in children. Using data from direct observations of non-

<sup>&</sup>lt;sup>44</sup>Analyzing the relationship between the home environment and mothers' perceptions separately by maternal education does not yield consistent evidence of differences across education levels (see Appendix H).

cognitive development collected by LSAC interviewers, I show that teachers in neighbourhoods where non-cognitive delays are more prevalent are less likely to perceive cognitive and noncognitive delays, conditional on objective measures of child development. This implies that inequality in teachers' perceptions significantly underestimates the true gaps in child development.

These misperceptions matter beyond their impact on measurement and statistics. When developmental delays go unrecognized by teachers or parents, children appear less likely to receive professional support such as behavioural or learning therapy or tutoring. Parental attitudes may also be shaped by inaccurate perceptions: overestimating delays is associated with lower educational expectations and poorer parent-child interactions.

These findings have implications for how non-cognitive delays are measured and diagnosed in children. In the presence of substantial policy efforts to alleviate inequalities in developmental opportunities across neighbourhoods, supplementing subjective perceptions with standardized measures — such as asking teachers to base evaluations on direct observations, guided by standardized criteria and objective rating scales — could provide a valuable additional tool for assessing child development.

Furthermore, my findings support the role of teacher qualifications in recognizing delays. In the LSAC study, psychologist-regulated training enabled interviewers to assess children's behaviour consistently across the population. Similarly, providing teachers with clearer information about developmental milestones and skill accumulation at each stage of childhood could help promote more objective assessments.

Finally, my results suggest that while informing mothers about non-cognitive delays in their children may increase demand for professional help, it could also negatively affect the quality of parent-child interactions. As such, informational interventions aimed at addressing misperceptions about non-cognitive skills may need to be paired with additional parenting support.

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# A Additional data description

#### A.1 Measures of child development and perceptions

	Aged 4-5	Aged 8–9
Positive behaviour	0.47	0.60
Negative behaviour	0.63	0.67
Focus during PPVT	0.62	0.45
Eigenvalue (PC1)	1.23	1.12
Number of Obs.	8736	8201

Table A.1: Principal component analysis loadings by age group

Notes: The table displays the loadings from a principal component analysis (PCA) of direct observation measures of children's non-cognitive skills, estimated separately for children aged 4–5 and 8–9 attending formal care or education settings.

Fig	ure A.1:	Distribution	of the inte	erview-based	l non-cognitive o	developmen	t score at ages	4-5.
0					()		()	



Notes: The figure displays the kernel density plot of the interview-based non-cognitive development score for children aged 4-5 attending formal care or education settings.

	1	Ages 4-5		1	Ages 8-9	
	N	Mean	SD	N	Mean	SD
Teacher: Cognitive delay	6588	0.15	0.36			
Teacher: Non-cognitive delay	6594	0.21	0.41			
Mother: Non-cognitive delay	6838	0.07	0.25	7734	0.07	0.26
Mother: Cognitive concern	8892	0.08	0.27			
Cognitive score	8262	0.00	1.00	8229	0.00	1.00
WAI score	8644	0.00	1.00			
Non-cognitive score	8736	0.00	1.00	8201	0.00	1.00
Average postcode cognitive score	7028	0.00	1.00	5769	0.00	1.00
Average postcode non-cognitive score	7485	0.00	1.00	5749	0.00	1.00
School contacted about behavior				8278	0.11	0.31

Table A.2: Measures of teacher and mother perceptions and objective development measures, by child's age

This table displays summary statistics for teacher and mother perception measures, as well as objective development measures, by child's age. The sample is limited to children attending formal care or education settings.

## A.2 Measures of household control variables

	4	c		4	10000		7	150 0-0		1		
	Z	Mean	SD	Z	Mean	SD	Z	Mean	SD	Z	Mean	SD
Share of Kindergarten cohort	8895	0.47	0.50	8645	0.49	0.50	8346	0.49	0.50	7859	0.47	0.50
Female child	8895	0.49	0.50	8645	0.49	0.50	8346	0.49	0.50	7859	0.49	0.50
Age in months	8895	57.31	2.76	8645	81.90	3.23	8346	106.10	3.34	7859	130.21	3.79
Index of SES	8864	0.03	0.99	8595	0.00	1.00	8289	0.00	1.00	7784	0.00	1.00
Mother depression	7554	0.00	1.00	8380	0.00	1.00	7679	0.00	1.00	7705	0.00	1.00
Mothers' interaction with school				3615	0.00	1.00	6945	0.00	1.00	2951	0.00	1.00

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#### A.3 Neighbourhood characteristics

Table A.4 summarizes neighbourhood characteristics computed by the LSAC, based on Census statistics matched to each household's location. The Index of Neighbourhood Relative Advantage and Disadvantage, constructed by the Australian Bureau of Statistics, is a weighted average of indicators related to income, employment, education, and housing (see Statistics, 2011 for details). I normalize this index by age group. In addition, I control for the age composition of the population and for ethnic and language composition characteristics, as these were not included in the index but may influence the availability of child development services and language development opportunities in the neighbourhood.

	Ages	4-5	Ages	6-7	Ages	8-9	Ages 1	0-11
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Share population age 0–4	6.67	1.38	6.54	1.30	5.50	1.67	5.53	1.70
Share population age 5–9	7.10	1.54	6.87	1.37	4.18	3.18	4.34	3.23
Index of Neighbourhood Relative Advantage and Disadvantage	0.02	1.00	0.00	1.00	-0.00	1.00	0.00	1.00
Share population Aboriginal	2.14	3.83	2.44	5.09	2.33	5.08	2.28	5.07
Share population English - first language	87.00	12.90	86.46	13.83	83.93	15.01	84.27	14.60
Share population born in Australia	86.76	12.42	91.64	8.21	86.56	14.03	84.89	12.98
New South Welsh	0.30	0.46	0.31	0.46	0.31	0.46	0.30	0.46
Victoria	0.25	0.44	0.24	0.43	0.24	0.43	0.24	0.43
Queensland	0.20	0.40	0.21	0.41	0.21	0.41	0.22	0.41
South Australia	0.07	0.26	0.07	0.25	0.07	0.25	0.07	0.25
Western Australia	0.11	0.31	0.10	0.31	0.10	0.30	0.10	0.31
Tasmania	0.03	0.16	0.03	0.16	0.03	0.16	0.03	0.17
Northern Territories	0.02	0.12	0.01	0.12	0.01	0.11	0.01	0.11
Australian Capital Territory	0.02	0.15	0.02	0.15	0.02	0.16	0.03	0.16
Ν	889	5	864	<b>1</b> 5	834	ł6	785	69
Notes: This table disclays summary statistics for neighbourhood character	ictics hv c	hild's a	re The c	amnla ic	limited to	ohildro	i ottendi	or formal

Table A.4: Summary of neighbourhood characteristics, by child's age

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#### A.4 School and home environment measures

Table A.5 describes therapy uptake for children aged 4–5 and 6–7. The uptake of non-cognitive therapy increases with age, while cognitive therapy uptake declines as children begin formal schooling at ages 6–7.

	Ages	4-5	Ages	6-7
	Mean	SD	Mean	SD
Child behav. therapy or psych. assessment	0.05	0.21	0.06	0.24
Child speech or learning therapy	0.15	0.36	0.13	0.34
N	858	37	762	23

Table A.5: Summary of therapy uptake measures, by child's age

This table displays summary statistics for therapy uptake measures by child's age. The sample is restricted to children attending formal care or education settings.

Table A.6 summarizes home environment measures when children are aged 8–9 and 10– 11. These include parenting practices, use of community parenting resources and professional services, household members' weekly educational activities with the child, total time spent by mothers and fathers with the child, and mothers' expectations about the child's future educational attainment.

Community resource uptake includes the use of parenting education programs and support groups. Mothers are asked whether anyone in the family has used parenting education courses or programs, or contacted a parent support group or helpline within the past 12 months. Around 4 percent of mothers report using such resources when children are aged 8–9 and 10–11.

Parenting style measures include maternal warmth and maternal anger. Both scores are constructed by LSAC and standardized by age. The maternal warmth score is the average of self-reported responses to a battery of items measuring warm, affectionate behaviour. The anger score averages responses to items reflecting disapproval, anger, and lack of praise in interactions with the child.

The measure of tutoring or additional help frequency is based on mothers' responses to whether the child received any tutoring or help from someone outside the household in the past 12 months. I construct an indicator equal to one if the mother reports any use of tutoring during this period. On average, 15 percent of households report using additional help for children aged 8–9.

Mothers' educational aspirations are captured from the question: "Looking ahead, how far do you think the study child will go in his/her education?" I construct an indicator equal to one if the mother expects the child to complete a university degree or postgraduate qualification. Around 67 percent of mothers expect their child to earn a college degree.

Several additional variables capture the frequency with which household members engage in educational activities with the child. Mothers report whether members of the household engaged in various activities — such as reading — over the past week. I transform categorical responses into weekly frequencies as follows: 0 for "Not in the past week," 1.5 for "1 or 2 days," 4 for "3–5 days," and 6.5 for "6–7 days." On average, household members read to the child 2.17 times per week.

Finally, mothers report spending an average of 26 hours per week in childcare when children are aged 8–9, decreasing to 21.68 hours at ages 10–11. Fathers report a lower time investment, averaging 12 hours per week.<sup>45</sup>

<sup>&</sup>lt;sup>45</sup>The exact question asked was: "How much time per week do you spend actively doing things with your children (for example, playing with them, helping with personal care, teaching, coaching or actively supervising them, getting them to childcare, school or other activities)?"

	7	Ages 8-9		Α	ges 10-1	
	Z	Mean	SD	Z	Mean	SD
Used parenting education courses or programs last 12 months	8319	0.04	0.20	7801	0.04	0.20
Used parent support groups or info from phone/net last 12 months	8319	0.04	0.20	7801	0.04	0.19
Use tutor	4056	0.15	0.36	7652	0.16	0.37
Mother warmth score	7633	-0.00	1.00	7581	0.00	1.00
Mother anger score	7630	-0.00	1.00	7581	0.00	1.00
Mother expects child coll+	8076	0.67	0.47	3557	0.67	0.47
Weekly times talk school	8346	6.60	1.18	7858	6.61	1.17
Weekly times read	8317	2.17	2.32	4128	1.09	1.82
Mother average weekly time with child	8154	26.03	17.58	3613	21.68	15.17
Father average weekly time with child	5128	11.96	9.79	2318	11.38	9.45
Jotes: This table displays summary statistics for home environment measures by child'	айе Тhe	samnle is	restricted	d to child	ren attend	nơ formal

Table A.6: Summary of home environment measures, by child's age

ung tormar Notes: This table displays summary statistics for home environment measures by child's age. The sample is rest care or education settings.

#### A.5 Additional controls

Table A.7 describes the additional controls used in Columns (3) and (4) of Table 2 to account for potential idiosyncratic shocks to children's interview effort at ages 4–5. The sleeping problems score is based on mothers' responses to a Likert-scale question regarding the frequency of their child's sleep difficulties over the past month. Responses are standardized by age.

During the PPVT test, most parents either remained at a distance or observed the child without intervening. Approximately 10 percent either actively encouraged their child or were not present during the assessment. Most children completed the test without siblings present in the room or with siblings remaining at a distance.

	1	Ages 4-5	
	Ν	Mean	SD
Sleeping problems score	7633	0.00	1.00
Parent not present	4091	0.12	0.33
Parent at a distance	4091	0.42	0.49
Parent observed	4091	0.35	0.48
Parent encouraged	4091	0.10	0.30
Parent interfered	4091	0.01	0.11
Sibling not present	4091	0.62	0.49
Sibling at a distance	4091	0.22	0.42
Sibling observed	4091	0.14	0.35
Sibling encouraged	4091	0.01	0.11
Sibling interfered	4091	0.01	0.09

Table A.7: Additional control measures

Notes: This table displays summary statistics for additional control measures for children aged 4–5 attending formal care or education settings. Measures of parent and sibling behaviour during the cognitive test are available only for children in the "Baby" cohort.

#### A.6 Childcare arrangement

Table A.8 summarizes early childhood care and education arrangements for children aged 4–5 in the sample. The majority attend preschool or kindergarten, and 26 percent attend daycare. Only a few children in the sample are enrolled in school at this stage.

	Ages	4-5
	Mean	SD
Child attends daycare	0.26	0.44
Child attends preschool	0.57	0.50
Child attends kindergarten	0.18	0.38
Child attends Grade 1	0.00	0.02
N	889	95

Table A.8: Childcare arrangements for children aged 4-5

Notes: This table displays summary statistics for additional control measures for children aged 4–5 attending formal care or education settings.

Naming conventions and starting ages for early childhood programs vary across Australian states and territories. In the 2000s, *preschool* generally referred to structured, play-based education provided in the year prior to full-time primary school. These programs were delivered in a variety of settings by schools, community organizations, and long-day childcare centers (Australian Bureau of Statistics, 2004). In some jurisdictions, preschool programs are referred to as kindergarten. By contrast, *kindergarten* programs — also known as pre-Year 1, preparatory, reception, transition, or pre-primary — were typically offered in schools during the year before Year 1 and mark the beginning of formal schooling.

During data collection, a substantial number of respondents misreported whether their child attended preschool or kindergarten. This variable was heavily imputed by LSAC using teacher reports and later retrospective reports from caregivers (Australian Bureau of Statistics, 2023). Therefore, in the baseline analysis, I combine these two categories.

Table A.9 reports estimates from the specification with additional controls for potential confounders, as shown in columns (2) and (5) of Table 2, distinguishing between preschool and kindergarten attendance. The coefficient on average neighbourhood non-cognitive development remains positive and statistically significant.

	(1)	(2)
	Non-cognitive delay	Cognitive delay
Neighbourhood	0.021*	0.016*
non-cognitive score	(0.010)	(0.007)
Non-cognitive score	-0.032*	-0.026*
	(0.011)	(0.011)
Neighbourhood cognitive	-0.003	-0.003
score	(0.011)	(0.010)
Cognitive score	$-0.072^{*}$	-0.085*
	(0.011)	(0.011)
N	1914	1914
Mean		
R2	0.09	0.13

Table A.9: Teachers' perceptions and average neighbourhood child development

Notes: Linear probability regression with added controls for sleeping problem intensity, the behaviour of parents and siblings during the test, Australian territory dummies, and neighbourhood characteristics from the Census, teacher and classroom characteristics, distinguishing between children attending preschool and kindergarten. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

#### A.7 Teachers' characteristics

Table A.10 summarizes teachers' characteristics when children are ages 4–5. Sixty percent of teachers hold a college degree, and the majority of teachers have more than 10 years of experience. Only 16 percent of teachers have five or fewer years of experience. The ages of the youngest and oldest children in the classroom are reported in the teacher questionnaire. On average, the youngest child in the group was 47.5 months old, while the oldest was nearly 65 months old.

Table A.11 examines the extent to which more qualified teachers and higher-quality programs are systematically selected into more developed neighbourhoods. I estimate linear probability models where the dependent variables are teacher and program characteristics, and the independent variables include average neighbourhood cognitive and non-cognitive development, child's age and gender, cohort, household SES index, neighbourhood characteristics, and Australian territory dummies.

There is no evidence that more qualified teachers systematically select into neighbourhoods with higher average non-cognitive development. This is plausible given that, unlike academic achievement — which is often measured and publicly reported at the community or school level

		Ages 4-5	5
	N	Mean	SD
Teacher coll+	6644	0.60	0.49
Teaching experience 0-5 years	6329	0.16	0.37
Teaching experience 6-10 years	6329	0.22	0.41
Age of youngest child in class	6188	47.49	10.09
Age of oldest child in class	6181	64.67	8.74
Children to qualified staff ratio	6515	14.39	7.00

Table A.10: Teachers' characteristics for children ages 4-5

Notes: This table displays summary statistics for teacher and program characteristics for children aged 4–5 attending formal care or education settings.

there is generally no available ranking of programs based on children's non-cognitive skills.
Teacher education, which is an important predictor of delay recognition as shown in Subsection
4.3, is not significantly associated with either cognitive or non-cognitive development levels in the neighbourhood.

Table A.12 replicates the analysis in Subsection 4.3, distinguishing between preschool and kindergarten attendance. Among children with low measured development, the coefficient on teacher education remains positive and statistically significant.

Children attending daycare or preschool are less likely to be perceived as having delays than those enrolled in kindergarten programs. Since kindergarten education typically marks the start of formal schooling in Australian territories, this suggests that children entering formal education are more likely to be flagged as having developmental delays. This effect appears even among children with high measured development, suggesting that formal school entry does not necessarily improve identification accuracy. One possible explanation is that school teachers may use older children as a reference group, consistent with the relative age effect in teachers' perceptions of delays documented in Elder (2010).

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	COLL+ III EQUC.	Daycare	reach. exp. u-5	reach. exp. 0-10	Age youngest	Age utuest	CIIIIU/ SLAII I'ALIO
Neighbourhood cognitive	-0.012	-0.025*	-0.011	-0.014	$0.449^{*}$	0.271	-0.278
score	(0.012)	(0.008)	(0.007)	(0.010)	(0.219)	(0.223)	(0.155)
Neighbourhood	0.003	0.001	-0.000	0.006	-0.405	0.133	0.061
non-cognitive score	(0.00)	(0.008)	(0.007)	(0.008)	(0.212)	(0.131)	(0.132)
N	5288	6987	5036	5036	4916	4908	5189

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Table A.12: Relationship between teacher and program characteristics and perceived delays in children ages 4–5

	Non-cogr	nitive delay	Cogniti	ive delay
	(1)	(2)	(3)	(4)
	Non-cogn. score low	Non-cogn. score high	Cogn. score low	Cogn. score high
Teacher college+	$0.088^{*}$	0.029	0.069*	-0.004
	(0.027)	(0.022)	(0.024)	(0.015)
Teaching experience 0-5	-0.111*	-0.011	-0.014	0.034
years	(0.032)	(0.030)	(0.032)	(0.023)
Teaching experience 6-10	-0.044	-0.032	-0.055	0.027
years	(0.030)	(0.025)	(0.029)	(0.020)
Age of youngest in class	0.002	0.001	0.001	0.001
	(0.002)	(0.001)	(0.002)	(0.001)
Age of oldest in class	0.001	-0.000	0.001	0.000
	(0.002)	(0.001)	(0.002)	(0.001)
Children to qualified	-0.002	0.001	0.001	-0.000
staff ratio	(0.002)	(0.002)	(0.002)	(0.001)
Child attends daycare	-0.095	-0.100*	-0.221*	$-0.084^{*}$
	(0.051)	(0.046)	(0.047)	(0.032)
Child attends preschool	-0.062	-0.111*	-0.212*	-0.086*
	(0.043)	(0.039)	(0.043)	(0.026)
N	1414	1339	1359	1132
Mean	0.30	0.16	0.27	0.05
R2	0.07	0.04	0.07	0.04

Notes: Linear probability regression including controls for sleep problem intensity, parent/sibling behavior during testing, Australian territory dummies, neighbourhood characteristics from the Census, and teacher/classroom characteristics. The models distinguish between preschool and kindergarten attendance. The sample is limited to children aged 4–5 attending formal care or education settings. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

#### /

# **B** The role of reference group by teachers' education

This section examines whether the association between the reference group and teachers' perceptions varies with teachers' education levels. Table B.13 reports estimates from Equation (4), including interaction terms between child and neighbourhood development scores and an indicator for whether the teacher holds an undergraduate or postgraduate degree. All regressions control for teacher and classroom characteristics. A notable pattern is that the association between perceived delays and children's measured cognitive development is stronger among universitytrained teachers. One possible interpretation is that these teachers may be better equipped to recognize cognitive developmental milestones.

	(1)	(2)
	Non-cogn. delay	Cogn. delay
Non-cognitive score	-0.038*	-0.031*
	(0.011)	(0.010)
Neighbourhood	0.014	$0.021^{*}$
non-cognitive score	(0.009)	(0.008)
Cognitive score	-0.032*	-0.060*
	(0.011)	(0.009)
Neighbourhood cognitive	0.003	0.009
score	(0.009)	(0.008)
Non-cogn. x Teach. coll+	-0.015	-0.003
	(0.015)	(0.013)
Neighb. non-cogn. x	0.014	-0.007
Teach. coll+	(0.013)	(0.011)
Cogn. x Teach. coll+	-0.030*	-0.035*
	(0.014)	(0.012)
Neighb. cogn. x Teach.	0.002	0.006
coll+	(0.014)	(0.011)
N	4618	4616
R2	0.07	0.10

Table B.13: Teachers' education and the role of the reference group

Notes: Linear probability regression of perceived delays on child and neighbourhood development measures, interacted with an indicator for whether the teacher holds a university degree. Controls include the child's gender, cohort, and age in months; a household socioeconomic status (SES) index; an indicator for daycare attendance (versus kindergarten or preschool); the age range of children in the class (as reported by the teacher); the child-to-qualified-staff ratio; teacher degree; and indicators for teacher experience (0–5 years and 6–10 years, with 10+ years as the reference group). The sample is limited to children aged 4–5 attending formal care or education settings. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

## C Measured development and later outcomes

I examine whether interview-based measures of children's non-cognitive and cognitive development at ages 4–5 predict later outcomes. Table C.14 presents estimates from linear regressions of later child outcomes on interviewer-assessed development measures, controlling for a range of child and household characteristics measured at ages 4–5. The results indicate that higher noncognitive scores at ages 4–5 are associated with a lower probability of grade repetition by ages 12–13 and with higher scores on Grade 9 reading and numeracy assessments from the National Assessment Program – Literacy and Numeracy (NAPLAN).

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Table C.14: Interview development measures at age 4-5 and later child outcomes.

Notes: Linear regressions. Control: children's gender, cohort, and age in months, household socioeconomic status (SES) index. The sample is limited to children aged 4–5 who attended formal care or education settings. Outcomes are measured at ages 12–13 and in Grade 9. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

# D Robustness to the construction of average neighbourhood development

This section examines the sensitivity of the estimates reported in columns (2) and (4) of Table 1 to alternative methods for constructing individual non-cognitive skill scores and average neighbourhood child development scores. Figure D.1 presents estimates of the coefficient on average neighbourhood non-cognitive development ( $\beta^{T,N}$ ) from Equation (4), using various measurement approaches.

- Baseline: Replicates the estimates reported in Columns (2) and (4) of Table 1.
- Negative child and neighbourhood score: Uses only the degree of negative behaviour during the interview as the measure of non-cognitive skills, excluding indicators of focus during cognitive testing and positive behaviours. Neighbourhood averages are computed following the method in Subsection 2.3.
- Bartlett child and neighbourhood score: Constructs non-cognitive skill scores using Bartlett factor scores from three interviewer-assessed items. Neighbourhood averages follow the same approach as above.
- 5+ observations neighbourhood score: Retains the baseline individual score but relaxes the requirement for computing neighbourhood averages to at least five observations of noncognitive skills from children other than the index child, across both cohorts.

- 20+ observations neighbourhood score: Uses the baseline individual score but requires at least 20 observations to compute neighbourhood averages, imposing a stricter data threshold than the baseline (10+).
- Same age/same year neighbourhood score: Uses the baseline individual score but restricts the neighbourhood average to children from the same cohort (i.e., similar age and the same survey wave), requiring at least five observations per postcode. The baseline, by contrast, pools data from both cohorts (similar age, different waves) after demeaning.

Across specifications, the estimated association between average neighbourhood non-cognitive development and teacher perceptions remains stable. Relying solely on negative behavioural responses reduces the estimated effect on perceived cognitive delays, but the difference is not statistically significant relative to the baseline.



Figure D.1: Estimated coefficient of the average neighbourhood non-cognitive development

Notes: This figure shows the estimated coefficient on average neighbourhood non-cognitive development from linear regressions of perceived delays on child and neighbourhood cognitive and non-cognitive development levels based on Equation 4 using alternative methods of constructing non-cognitive scores. All models control for child gender, cohort, age in months, and household socioeconomic status (SES) index. Standard errors are clustered at the postcode level. The sample is limited to children aged 4–5 who attended formal care or education settings. Significance level: \* 5 percent.

#### **E** Robustness to the measurement error

This section examines the sensitivity of the estimates to adjusting for measurement error in both the child's individual development score and the average neighbourhood development score.

Figure E.1 displays estimates of  $\beta^{T,N}$  based on Equation (4), using a range of approaches to address measurement error:

- Baseline: Replicates the estimates reported in Columns (2) and (4) of Table 1.
- TSLS (measurement error in child scores): Corresponds to Columns (3) and (6) of Table
  2. This specification instruments for the child's PPVT score using the WAI score, and for the child's focus during the cognitive test using the degrees of negative and positive behavioural responses.
- GMM (measurement error in child scores): Adjusts for measurement error in children's development scores using GMM estimation. The model jointly estimates the perception equations for cognitive and non-cognitive delays, allowing for correlation in the error terms across equations.
- TSLS (measurement error in child and neighbourhood scores): Extends the previous approach by also instrumenting for measurement error in average neighbourhood development. Specifically, the neighbourhood PPVT average is instrumented with the neighbourhood average WAI score, and neighbourhood focus is instrumented with average negative and positive behavioural responses.
- GMM (measurement error in child and neighbourhood scores): Uses GMM to adjust for measurement error in both the child and neighbourhood scores, estimating the cognitive and non-cognitive perception equations jointly and allowing for correlated errors across outcomes.

Taken together, the estimates reported in Figure E.1 imply that accounting for measurement error increases the magnitude of the estimated effect of average neighbourhood non-cognitive development ( $\beta^{T,N}$ ), although the estimates become noisier.





This figure shows the estimated coefficient on average neighbourhood non-cognitive development from regressions of perceived delays on child and neighbourhood cognitive and noncognitive development levels, adjusting for measurement error in child or (and) neighbourhood development scores. All models control for child gender, cohort, age in months, and household socioeconomic status (SES) index. The sample is restricted to children aged 4–5 who attended formal care or education settings. Standard errors are clustered at the postcode level. Significance level: \* 5 percent.

# F Sensitivity to the selected measure of teachers' perceptions

This section estimates how teachers' perceptions of non-cognitive skills vary with the reference group, using an alternative measure of perceptions. I construct a continuous index of perceived non-cognitive problems based on selected items from the Strength and Difficulty Questionnaire (SDQ) - a widely used instrument for assessing children's non-cognitive development (Fiorini and Keane, 2014, Nicoletti and Tonei, 2020). The selected subquestions capture behaviours that align with those evaluated during the interviewer assessment, such as the frequency of temper outbursts, fidgeting, being distracted, and similar behaviours, as reported by teachers on a Likert scale.

Table F.1 presents results from the regression specified in Equation (4), where the dependent variable is the age-standardized index of non-cognitive problems for children ages 4–5 and 8–9. The coefficient on average neighbourhood non-cognitive development is positive and statistically significant, and its magnitude does not decline with age.

	Ages 4-5	Ages 8-9
	(1)	(2)
Neighbourhood	$0.04^{*}$	$0.04^{*}$
non-cognitive score	(0.02)	(0.02)
Non-cognitive score	-0.07*	-0.06*
	(0.02)	(0.02)
Neighbourhood cognitive	-0.01	-0.00
score	(0.02)	(0.02)
Cognitive score	-0.07*	-0.05*
	(0.01)	(0.01)
N	5050	4648
R2	0.02	0.04

Table F.1: The relationship between reference group and alternative measures of teacher perceptions of non-cognitive development, by child's age

Notes: Linear regression. Control: children's gender, cohort, and age in months, household socioeconomic status (SES) index. The sample is restricted to children aged 4–5 and 8–9 who attended formal care or education settings. Standard errors are clustered at the postcode level. Significance level: \* 5%.

# G Heterogeneity of school environment response by mother's education

This section analyzes the heterogeneity in the relationship between therapy uptake and perceptions, as described in Section 6, across households with more- and less-educated mothers. I estimate the linear value-added regressions outlined in Equation (6), extending the specification to include interaction terms between the perception variables and a university-educated mother indicator. Rather than controlling for a composite SES index, I include controls for the mother's education, age, number of children, family income, marital status, whether English is the household language, and employment status. All regressions additionally control for neighbourhood characteristics, Australian territory, lagged dependent variables, and children's cognitive and non-cognitive development scores.

Table G.1 shows no strong evidence of heterogeneity in the role of teachers' perceptions by maternal education. Non-cognitive delays perceived by mothers remain the strongest predictor of therapy uptake across both education groups. However, concerns about cognitive delays expressed by mothers are a stronger predictor of cognitive therapy uptake when the mother has a university degree.

	(1)	(2)
	Non-cogn. therapy at 6-7	Cogn. therapy at 6-7
Teach.: Non-cognitive	0.030	0.028
delay at 4-5	(0.016)	(0.021)
Teach.: Cognitive delay	0.017	$0.060^{*}$
at 4-5	(0.019)	(0.024)
Moth.: Non-cognitive	$0.167^{*}$	$0.087^{*}$
delay at 4-5	(0.035)	(0.037)
Moth.: Concern cognitive	0.025	0.004
delay at 4-5	(0.024)	(0.029)
Teach.: Non-cogn. delay x	0.022	-0.004
Mom coll.+	(0.027)	(0.033)
Teach.: Cogn. delay x Mom	-0.036	-0.014
coll.+	(0.035)	(0.043)
Moth.: Non-cogn. delay x	-0.024	-0.031
Mom coll.+	(0.055)	(0.051)
Moth.: Cogn. delay x Mom	0.079	$0.201^{*}$
coll.+	(0.052)	(0.058)
Therapy non-cogn. at 4-5	$0.102^{*}$	
	(0.032)	
Therapy cogn. at 4-5		0.233*
		(0.019)
N	4160	4160
R2	0.09	0.16

Table G.1: Delay recognition by teachers and mothers and child therapy, heterogeneity by mother's education

Notes: Linear regression using the sample of children aged 6–7 who attend formal care or education settings, with their mother as the respondent to the face-to-face interview. Lagged variables are measured when children are ages 4–5. Controls: lag dependent variable, lag cognitive and non-cognitive score, children's gender, cohort, age in months, mother's age, number of siblings, family income, mother's marital status, whether English is the household language, mothers' employment status, neighbourhood characteristics from Census, and Australian territory. Standard errors are clustered at the postcode level. Significance level: \* 5%.

# H Heterogeneity of home environment response by mother's education

This section analyzes heterogeneity in the relationship between the home environment and mothers' perceptions, as discussed in Section 7, across households with more- and less-educated mothers. Since lower-SES families may face different resource and informational constraints — and may respond to these constraints in distinct ways — I estimate the linear value-added model described in Equation (7) separately for subsamples of children ages 6–7 and 10–11, stratified by whether the mother holds a college degree. The dependent variables are measures of the home environment at ages 6–7 and 10–11, and the key independent variables are lagged measures of mothers' perceptions of non-cognitive delays, reported two years earlier (at ages 4–5 and 8–9, respectively).

Rather than including a composite SES index, I stratify the sample by maternal education and control for maternal age, number of children, household income, marital status, employment status, and whether English is spoken at home. All regressions also include controls for mothers' depression score, neighbourhood characteristics, Australian territory dummies, lagged dependent variables, and lagged children's cognitive and non-cognitive development scores.

Figures H.1 and H.2 plot the estimated coefficients on lagged perceived non-cognitive delays from Equation (7), along with the mean values of the corresponding home environment outcomes for each subgroup. Overall, there are no statistically significant differences in responsiveness to perceived delays between households with more- versus less-educated mothers. This lack of detectable heterogeneity may reflect limited statistical power. Figure H.1: Parenting style and attitudes: estimated effects of perceptions and summary, by child age



(a) Mother warmth (SD)

Notes: Right panels plot coefficients from linear regressions estimated separately by maternal education for children who attend formal care or education settings, with their mother as the respondent to the face-to-face interview. Left panels show the mean of the dependent variable in each group. The outcome is home environment at ages 6–7 and 10-11; the key predictor is mother-reported non-cognitive delay at ages 4-5 and 8-9, respectively. Controls include lagged dependent variable, lagged child development scores, demographics, household and neighbourhood characteristics, and territory fixed effects. Standard errors clustered at the postcode level.

COIIX

40 coll

0.0

40<sup>c011</sup>

40 coll.

COIIX

COIIX

-0.15

40 coll

COIIX

Figure H.2: Parental use of professional help: estimated effects of perceptions and summary, by child age



(a) Family used parenting education courses last 12 months

(b) Family used parental support groups or helplines last 12 months



Coef. mother perceives delay

Mean

(c) Share of children who used additional help or tutoring last 12 months



Notes: Right panels plot coefficients from linear regressions estimated separately by maternal education for children who attend formal care or education settings, with their mother as the respondent to the face-to-face interview. Left panels show the mean of the dependent variable in each group. The outcome is home environment at ages 6–7 and 10–11; the key predictor is mother-reported non-cognitive delay at ages 4–5 and 8–9, respectively. Controls include lagged dependent variable, lagged child development scores, demographics, household and neighbourhood characteristics, and territory fixed effects. Standard errors clustered at the postcode level.

# I Heterogeneity in mother's belief updating by children's development

This section examines whether mothers respond differently to being contacted by the school about a child's behaviour, depending on the child's objectively measured level of non-cognitive development. I divide the sample based on non-cognitive scores measured at ages 8–9, defining children with low (high) development as those in the bottom (top) quartile of the age-specific distribution on interview-based non-cognitive score.

Table I.1 presents estimates from Equation (5) for the high- and low-skill subsamples, using the same estimation approach and controls as described in Section 5. In both groups, school contact is associated with an increased likelihood that mothers perceive non-cognitive delays. However, the change in maternal perceptions is larger among mothers of children with low measured development.

	Non-cognitive delay perceived by mother at 8-9	
	Low non-cog. at 8-9	High non-cog. at 8-9
School contacted about	0.16*	$0.08^{*}$
behavior	(0.03)	(0.03)
Mother depression	0.03*	0.01
	(0.01)	(0.01)
Cognitive score	-0.02*	0.00
	(0.01)	(0.01)
N	1400	1277
R2		
Share contacted	0.14	0.09
Share perceive delay	0.12	0.05

Table I.1: The relationship between mothers' and teachers' perceptions for children with high/low non-cognitive development

Notes: Linear regressions estimated separately for children aged 8–9 with low/high measured non-cognitive development who attended formal care or education settings, with mothers as the interview respondents. Lagged variables are measured at ages 6–7. Controls include child gender, cohort, age in months, household SES index, mother's depression score, and lagged maternal perceptions. Standard errors are clustered at the postcode level. Significance level: \* 5%