THE FIRST 1000 DAYS AND BEYOND: THE PROCESS OF CHILD DEVELOPMENT

By

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January 2026

COWLES FOUNDATION DISCUSSION PAPER NO. 2491

COWLES FOUNDATION FOR RESEARCH IN ECONOMICS

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The first 1000 days and beyond:
The process of child development.*

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June 2025, revised August 2025 and January 2026.

* I would like to thank Helen Baker-Henningham, Theresa Betancourt, Elizabeth Caucutt, Lelys Dinarte, Greg Duncan, Emanuela Galasso, Michele Giannola, Jim Heckman, Lance Lochner, Joe Mullins, Qianyao Ye and, especially, Jere Behrman and Janet Currie for valuable comments on a previous draft of this paper. The editor, David Romer, and 4 anonymous reviewers also gave valuable and useful feedback. My views on these issues have been influenced by the work I have done over the years with Ingvild Almås, Helen Baker-Henningham, Jere Behrman, Raquel Bernal, Bet Caeyers, Lina Cardona-Sosa, Emla Fitzsimons, Pam Jervis, Costas Meghir, Marta Rubio-Codina, Marcos Vera, Qianyao Ye and others. Sally Grantham McGregor has shaped in an important way my work in this field. Diana Perez Lopez was a very effective research assistant. I am grateful to Department of Economics at the Università Federico II in Napoli which has hosted me while I was writing the first draft of this paper. I have used ChatGPT to polish and improve the style of several paragraphs in the text.

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Outline

1. Introduction

2. The process of human development: what we know
    1. How our understanding of human development has evolved.
        i. Developmental psychology
        ii. Economists and human capital.
        iii. Identification of causal links: models and experiments in economics
    2. What is known:
        i. The early years have long run impacts
        ii. Human development has several dimensions
        iii. Child development is driven by many factors
        iv. The drivers of child development

3. Policy interventions and the building of evidence.
    1. Interventions targeting children and parenting practices directly
    2. Interventions targeting children and parenting practices indirectly
    3. Dynamic complementarities of interventions

4. Challenges:
    1. Measurement
    2. Towards a better understanding of the child development process
        i. The process of child development
        ii. Parental behavior
        iii. Nurseries and schools
    3. Child development: the ingredients of a model
    4. Early years interventions: scaling up and complementarities
        i. Scaling up of effective and sustainable interventions
        ii. Static and dynamic complementarities of interventions

5. Conclusions

Abstract

This paper reviews recent developments in the economics of human development, focusing on the early years of life as a critical period for shaping long-term outcomes. Early childhood development is inherently multidimensional: cognitive and socioemotional skills evolve dynamically and interact with health, nutrition, and environmental influences. Economists have contributed to this field by providing a conceptual unifying framework that highlights how key drivers of development reflect the choices of individuals operating under incentives and constraints. Within this framework, the paper emphasizes two central challenges: understanding the interactions among multiple dimensions of development and identifying causal links - particularly the effects of different inputs at different ages. Measurement issues are a recurring theme, given the difficulty of assessing young children and the need for comparability across contexts. The paper also stresses these issues' policy relevance for poverty reduction and social mobility by discussing early childhood interventions in both developed and developing countries.

1. Introduction.

The early years of human development, especially the first thousand days from conception, are now widely recognized as a critical period shaping life-long trajectories. A substantial body of research shows that early experiences have persistent effects and strongly predict adult outcomes relevant for individual well-being. At the same time, early developmental trajectories are not predetermined at conception or birth. They evolve in response to parental behaviors, the environments in which children grow, and, crucially, public policy interventions. Understanding these developmental processes is therefore essential for the study of inequality, intergenerational persistence, and social mobility. Because early development is highly malleable and responsive to intervention, this period represents a particularly powerful window for effective policy.

Recent decades have seen a renewed focus among economists on the study of human development, beginning at birth and even earlier. This work examined developmental processes in far greater detail than before, with growing recognition that development is inherently multifaceted and that the early years play a crucial role. A central theme is the role of diverse and interacting skills in shaping both economic and social outcomes (Cunha et al., 2006). These skills evolve through dynamic, cumulative, and mutually reinforcing processes across the life cycle, with profound implications for adult outcomes. For example, a child's ability to concentrate and their motivation at a given age are likely to foster cognitive development in later periods, which in turn may enhance self-confidence. Furthermore, these developmental dimensions are themselves shaped by parental behavior, the broader environment in which the child lives, including the influence of peers, and other contextual factors. A related literature, with a special focus on nutrition, has analysed whether there is or not 'catch-up growth'.[3] Cunha and Heckman (2007) list a set of stylized of facts that are universally accepted and present a holistic model of human development that can explain them and has strong policy implications, as I discuss below.

At the same time, research on early childhood development has become increasingly interdisciplinary, spanning economics, psychology, child development, and psychometrics. Despite substantial progress, important strands of this literature remain only loosely connected, while key questions remain about how developmental domains interact and respond to different environments over time. These questions are central to policy design, particularly for efforts aimed at promoting social mobility and reducing poverty. This paper reviews recent advances in the economics of human development and situates them within the broader interdisciplinary literature. Rather than offering a comprehensive survey ((Almond and Currie 2011a, 2011b; Currie and Vogl 2013; Almond, Currie, and Duque 2018), the goal is to highlight recent contributions and clarify the distinctive perspective that economics brings to the study of child development. Central to this perspective is a conceptual framework,

[3] Some nutritionist (see, for instance Victor et al , 2010) argue that past age 2, it may be difficult to make up for developmental delays. Other studies, however point to the significant associations of post age 2 growth and late childhood cognition (Crookston et al (2013) and Mani (2012),.

exemplified by Cunha and Heckman (2007), which views child development as a multidimensional and dynamic process. Multiple domains evolve through contemporaneous and intertemporal interactions with one another and with inputs shaped by decisions made by parents, institutions, and policymakers.

Progress in integrating insights across disciplines hinges on clarity along two fundamental dimensions. The first concerns the **multidimensional nature of skill formation**. Development unfolds across several domains - cognitive, linguistic, socio-emotional, physical, and health-related - that interact both contemporaneously and over time. The strength and direction of these interactions may change across developmental stages, underscoring the importance of adopting a life-cycle perspective. While the appropriate level of aggregation of different dimensions depends on the research question, careful conceptual and empirical distinctions among domains are often essential. For example, some analyses may require separating cognitive and language skills, while others may emphasize socio-emotional development or mental health. At the same time, these domains cannot be studied in isolation, given the central role of their dynamic interdependence.

The second issue concerns the **identification of causal mechanisms** linking inputs, such as parental investments, schooling, health, and environmental conditions, to developmental trajectories. Randomized controlled trials provide, under certain conditions, credible estimates of the effects of specific interventions, while longitudinal observational data are key for characterizing developmental dynamics. Yet neither source of evidence is sufficient on its own to uncover underlying mechanisms or to predict the consequences of policies implemented in new contexts. Structural models that integrate behavioral responses with developmental processes are therefore essential for interpreting empirical findings, reconciling evidence across settings, and conducting policy counterfactuals.

To summarize, the main message I wish to convey is that while there is broad agreement in economics and related disciplines on both the importance and the malleability of the early years, much remains to be learned about the nature of the developmental process itself. This is not merely an academic concern: according to some estimates (see, e.g., Richter et al., 2017), as many as 250 million children fail to reach their full potential because they are born into disadvantaged families. Understanding the details of the child development process, and how it evolves with age, is therefore central to the design of policies that can be powerful instruments for reducing poverty and promoting social mobility. These considerations are particularly salient in developing countries, where a much larger share of children are born in disadvantaged environments, but they are also highly relevant in developed contexts.

The process of human development is clearly shaped by cultural contexts, social norms, and other factors that depend on levels of economic development and available resources. At the same time, the importance and malleability of the early years are universal**,** making them relevant across all settings. When designing interventions aimed at improving long run outcomes, reducing poverty and increasing social mobility, the specific factors of different contexts cannot be ignored. However, as pointed out by Cunha and Heckman (2007), early interventions, in many contexts, seem to be more effective than

late interventions. Moreover, many interventions (but not all) report larger impacts on the most disadvantaged children, implying that they do not face the tradeoff between equity and efficiency.

The rest of the paper is organized as follows. In Section 2, I begin with a summary of our current understanding of early childhood development and examine how recent contributions in economics intersect with research in other fields. I first stress the importance of the early years in determining adult outcome. I then discuss the increasingly acknowledged multidimensionality of human development and the complexity of the dynamic processes that development. I then conclude this section with a discussion of the drivers of child development. In section 3, I consider the evidence that has accumulated from the evaluation of policy interventions in both developed and developing countries. Finally, in Section 4, I discuss the main challenges for future research, both in deepening our understanding of child development and its drivers and in improving policy design.

2. The process of human development: what we know

In recent years, economists have devoted renewed attention to the process of child development, reflecting its central role in shaping adult outcomes that matter both for productivity and for the distribution of resources. While substantial progress has been made, many important questions remain open. This section begins by reviewing the historical evolution of economists' interest in early human development. Until the last decades of the twentieth century, economists paid relatively little attention to its dynamics, with much of the foundational progress occurring in other disciplines, most notably developmental psychology and psychometrics. The insights developed in those fields have increasingly informed economic research as the profession's interest in the early years has grown. The section then turns to the main lessons from the economics literature, emphasizing the specific insights that economic models and empirical strategies bring to the study of child development.

2.1 How our understanding of human development has evolved

As mentioned above, for much of the 20th century, economics has not paid considerable attention to the process of child development and to the early years. This focus, or lack thereof, was probably due to the view of labor as a simple input in the process of production, playing one or maybe two roles. The productivity of this input could be represented by schooling or ability acquired in schooling (see, for instance, Becker, 1964 and Tinbergen, 1974). Indeed, the few studies in economics that looked at the process of human capital (or human abilities) focused on the role of schools, such as Hanushek (1971, 1986) or job training program (see, for instance, Lalonde, 1986, and Heckman and Hotz, 1989 and Bloom et al, 1997). Given the increasing attention paid by economists to the early years, it may be worth to try to sketch how our understanding of this process has evolved over the last few decades.

2.1.1 Developmental psychology. While economists paid relatively little attention to early childhood development for much of the twentieth century, other disciplines were actively studying the process

and making substantive progress. In the early decades of the century, a dominant view held that key skills—most notably intelligence—were largely inherited and determined at birth. This perspective, which was widespread in the first decades of the twentieth century, began to be challenged in the 1930s, as vividly documented in Brookwood (2021). Over the following decades, evidence accumulated showing that human development is not predetermined at birth nor driven exclusively by genetic endowments: the environments in which children grow and the adults with whom they interact play a central role in shaping developmental trajectories.

Developmental psychology was at the forefront of this shift. Early attention to the formative years can be traced to the seminal contributions of Piaget (1926, 1952) and Vygotsky (1978)[4], who emphasized the active and socially mediated nature of cognitive development. Subsequent work, particularly from the 1950s onward, increasingly highlighted the role of parents and attachment in early development. The contributions of Bolwby (1951, 1969) and, subsequently, of Ainsworth (1967, 1985) with their focus on attachment were particularly relevant.

The contributions of twentieth-century developmental psychologists were influential not only scientifically but also in shaping major policy initiatives. In the United States, the work of the Cooke Committee during President Johnson's War on Poverty informed the design and implementation of the Head Start program, on which the work of psychologist such as Ziegler and Valentine (1979), Ziegler (1994) and Bronfenbrenner (1967, 1974) was very influential. During the 1960s and 1970s, a series of pioneering early childhood interventions—many evaluated using randomized controlled trials and later analyzed by economists—demonstrated both the malleability of early development and its long-term consequences. Prominent examples include the Abecedarian (ABC) program (Ramey and Campbell, 1979) and its extension, ABC/CARE (Ramey et al., 2004), as well as the Perry Preschool Program (Schweinhart and Weikart, 1980), the Milwaukee Project (Garber and Heber, 1973), among others.

And this type of work was not limited to developed countries. In several developing-country settings, researchers were designing, implementing, and, crucially, evaluating early childhood interventions. The studies by McKay et al. (1990) and Super et al. (1978) offered early evidence on innovative and potentially scalable programs in Colombia aimed at very young, disadvantaged children. Eventually, the celebrated Jamaica study (Grantham-McGregor et al., 1991), which I discuss later, became particularly influential in shaping subsequent research and policy.[5] The fact that pioneering interventions were developed in very different contexts and had an impact on the design of later ones, reflects what I pointed out in the introduction about the importance and malleability of the early years.

2.1.2 Economists and human capital. Economists began to engage seriously with early childhood development—and with policies designed to influence it, only relatively recently, despite the central

[4] Vygotsky (1978) is a collection of works written in the 1920s and 1930s. Piaget (1926) appeared in French in 1923.
[5] Another important intervention was the INCAP Orient study in Guatemala, which I mention below. However, unlike the interventions I mention here, it was a nutrition intervention.

role that the concept of human capital has played in economics since Becker's seminal work (1964). Early exceptions include Leibowitz (1974a, 1974b), who explicitly analyzed human capital accumulation in the early years and emphasized the role of parents. At the time, however, the bulk of research in labor economics focused on schooling and job-training programs aimed at raising adult productivity. The literature examining the effects of education and related factors on earnings and other adult outcomes is vast and cannot be reviewed here. As evidence accumulated casting doubt on the effectiveness of many adult-focused interventions (see, for example, Heckman et al., 1999, and the studies cited above), attention increasingly shifted toward the idea that investments made earlier in the life cycle—prior to adolescence or adulthood—may yield higher returns.[6]

Beginning in the 1990s, economists started to investigate early-life interventions as potential levers to improve the life prospects of children born in poverty and to enhance the efficiency of human capital accumulation more generally. Currie and Cole (1993), for example, examined the effects of cash transfers to poor mothers on birth weights, while Currie and Thomas (1995) studied the impact of Head Start on various child outcomes.[7] These studies highlighted the empirical challenges of identifying causal links between program participation, often non-random, and later outcomes, thereby laying the groundwork for the rich empirical literature that followed.

Around the turn of the century, a more unified theoretical framework for child development and skill formation began to emerge. Seminal contributions by Heckman and Lochner (2000), Carneiro and Heckman (2003), Heckman (2007), and Cunha and Heckman (2007) laid the groundwork—discussed below—for an economic theory of skill formation that highlights the dynamic, cumulative nature of human capital investment. Building on this framework, Heckman and Masterov (2007) made a particularly influential argument for the high returns to early childhood interventions.

While some of the literature focuses on the first three years of life, economists have also modeled child development over the entire childhood and into adolescence. Cunha et al. (2010) study the joint evolution of cognitive and non-cognitive skills using the NLSY, following children across multiple developmental stages. Caucutt et al. (2020), using the Children of the NLSY, distinguish between early (ages 0–12) and late (ages 13–23) periods, while Del Boca et al. (2014, 2016) model development across several stages of childhood to study the effects of transfers on child outcomes and household behavior. A common feature of this work is that human development is embedded—implicitly or explicitly—within broader models of household decisions, including consumption and labor supply.

2.1.3 Identification of causal links: models and experiments.. Given the economists' growing interest in the early years, a natural question is what economics adds beyond the insights of developmental psychology. Its distinctive contribution is in integrating child development's multiple dimensions into a unified framework, in understanding the drivers of individual behavior so to uncover the causal

[6] Kraft (2020) considers many evaluations, carried out both by education economists and psychologists of K-12 interventions over a long period of time.

[7] Currie and Gruber (1996) study the impact of the expansion of public health insurance on children health outcomes.

mechanisms behind the process. This perspective shapes economists' empirical strategies: while randomized experiments can estimate program impacts, interpreting these effects and extrapolating to new contexts typically requires structural models. Estimating such models and conducting mediation analyses, however, depends on assumptions that are often hard to validate empirically.

In the context of child development, this perspective points to a holistic framework that recognizes that many key drivers of development are the result of choices made by individuals, such as parents and teachers, who pursue specific objectives subject to constraints. Identifying the relevant causal links within the broad process of child development requires a clear understanding of individual choices and the factors that shape them. Such an approach can complement and unify the detailed insights provided by developmental psychology, psychometrics, and related fields. In addition, the use of rich and well-identified structural models enables extrapolation beyond the settings directly studied, allowing researchers to predict the likely effects of interventions and policies in new contexts. The prices that is paid for this general approach is the fact that results obtained are only as credible as the assumptions made to identify the parameters of interest.

This perspective recognizes that many key drivers of development arise from choices made by individuals, such as parents and teachers, who pursue specific objectives subject to constraints. Identifying causal relationships within the broader process of child development therefore requires a clear understanding of these decisions and the factors that shape them. Framing development in this way helps integrate and organize insights from developmental psychology, psychometrics, and related fields. At the same time, the use of rich, well-identified structural models allows researchers to extrapolate beyond the settings directly studied and to predict the effects of interventions in new contexts. The cost of this generality, however, is that the credibility of the results ultimately depends on the strength of the assumptions used to identify the parameters of interest.

Important examples of the combined use of structural models and experimental evidence to evaluate some well-known early years interventions which we discuss in Section 3 are Heckman et al (2013) and Garcia et al (2020). Heckman et al (2013) show that the Perry Preschool program's large adult-life benefits were driven primarily by improvements in noncognitive skills such as self-control and social behavior, rather than by persistent gains in IQ, using a structural mediation framework to identify these causal mechanisms. García et al. (2020) provide a comprehensive evaluation of the long-term economic returns to high-quality early childhood education. Using rich longitudinal data from the Carolina Abecedarian and CARE programs, they quantify impacts across the entire life cycle, education, earnings, crime, health, and parental labor supply, and monetize these outcomes within a unified accounting framework grounded in the skill-formation model. In both cases, the data used came from relatively small RCTs designed to evaluate their impacts and subsequent follow ups.

The use of structural models in combination with the variability induced by an experiment is one approach to understand the mechanisms that generate the observed results and, in a way, address the issue of external validity of the results. A recent paper by Mullins (2025) takes a further step in this direction and uses four different data sets from the US, three of which are built around the evaluation

of different interventions, in different states, aimed at female labor supply behavior, including the provision of subsided childcare, while the fourth is a large observational panel. Mullins (2025) argues that an economic model allows the aggregation of these different pieces of evidence and their structural interpretation, which in turn allows the consideration of meaningful counterfactuals and the extrapolation of the accumulated evidence across contexts. Importantly, the identification of the parameters of interests comes both by the structure imposed by the model considered and by the variation induced by the different experiments, although implemented in different contexts.

More generally, most economists are keenly aware of the challenge of identifying causal links and mechanisms, although the approaches used to tackle such challenges are different. Some of them rely exclusively on experiments or 'natural experiments', others make explicit use of models of individual behavior to identify causal links or interpret the available evidence. Examples of this latter approach are Todd and Wolpin (2008) or Attanasio et al. (2012). The former paper estimates a structural model and uses the cluster RCT designed around the expansion of the celebrated CCT PROGRESA in Mexico to validate it and, in turn, interpret the results of the trial. The latter uses the same data from the clustered-RCT and the variation induced by it to estimate a complex model of schooling decisions.

2.2 What is known

Given this background, it is useful to take a stand on what economists have learned and is widely accepted about the process of human development and the role of the early years in it. We divide this discussion into four parts: (i) the long run impacts of the early years; (ii) the multidimensionality of human (and child) development; (iii) the multiplicity of inputs in the process of child development and their drivers; (iv) the dynamics of child development. While this classification of different topics is a useful way to organize the exposition, there are obviously important overlaps among them.

An issue that has been discussed extensively in the literature and that we will refer to in what follows is that of *complementarities* (see, for instance, the discussion in Heckman and Zhou, 2025). When discussing them, one might be referring to *static* complementarities among different inputs or factors in the process of child development or *dynamic complementarities,* that refer to the interactions to different factors (and the level of developmental itself) at different points in time. The former set of issues would be relevant for parts (ii) and (iii), while the latter would concern part (iii) and (iv). Furthermore, as indicated in Del Boca et al (2014) and Attanasio et al. (2020a), the parameters of the process that describes child development and therefore the role of different inputs change over time.

When discussing the contributions that are relevant to each part, we consider several papers that try to estimate the parameters of the relevant models. The identification strategies used in different studies are, at times, very different, although I do not discuss them in detail here.

2.2.1 The early years have long run impacts. While later stages such as adolescence remain important for brain development, the early years - often defined as the first 1,000 days from conception, and

more broadly as all of childhood (Draper et al., 2024) - represent a particularly critical period. These years matter both for their long-term consequences and because they are highly responsive to environmental conditions and interventions. Early evidence from studies of Romanian orphans (e.g., Rutter et al., 1998, 2004) documented the lasting effects of severe deprivation while also revealing the potential for catch-up when conditions improve early. Since then, a vast body of evidence from both developed and developing countries has reinforced this perspective.

Complementing insights from other disciplines discussed above, a substantial economics literature has documented the importance of early health conditions for adult outcomes. Reviews by Almond and Mazumder (2013), Currie (2011), and Currie and Rossin-Slater (2015) emphasize the lasting effects of in utero environments, birth weight, and early-life nutritional status. Almond and Currie (2011), and more recently Almond, Currie, and Duque (2018), examine the fetal origins hypothesis and show that variation in birth weight has significant consequences for adult economic outcomes. Behrman and Rosenzweig (2004) exploit twin data to identify the relationship between birth weight and long-run outcomes while controlling for unobserved genetic and family characteristics, whereas Majid et al. (2019) use exogenous variation generated by Ramadan fasting in Indonesia to estimate similar effects. Synthesizing this evidence, Lambiris et al. (2022) present a meta-analysis showing that, across the studies they examine, a one–standard-deviation increase in birth weight is associated with a 2.75 percent increase in adult annual earnings.

Another study that looks at the long run impacts of the early years is Schoelmann (2016), who relates adult earnings of individuals who entered the US as refugees to the age at which they entered as refugees. He documents that for several ethnic groups, there is no relation up to age 6, and that after that age adult earnings decline, with age of entry. This evidence is also consistent with that from US administrative data presented by Chetty et al (2016).

Similar evidence is also available from developing countries. The COHORTS studies, for instance, that were developed in 5 countries (Brazil, Guatemala, India, Philippines, and South Africa) have been widely used. One of them, the Guatemalan INCAP study, has been following children for about 50 years (and counting) after an early life community randomized nutritional supplement intervention; it finds that early life nutritional status impacts multiple adult health, cognitive and socioeconomic outcomes decades later (Hoddinott et al, 2013). In a recent paper, Lloyd and Yang (2025) look at the long run impacts of early conditions in the Philippines. Another important initiative is the Young Lives project (which also is still collecting information on two cohorts of children born in Ethiopia, India, Peru and Vietnam) as they age through their 20s.

Much of the existing evidence, including some of the studies cited above, examines the effects of early health and nutrition on adult outcomes. By contrast, evidence on the long-run impacts of early cognitive and socio-emotional skills is far more limited, largely due to the scarcity of longitudinal data linking early measures of these dimensions to later-life outcomes. Early contributions from the 1970s provide some of the first evidence on these links. Leibowitz (1974a), extending the Ben-Porath (1967)

model to allow for multiple stages of skill formation and investment, uses data on a cohort of high-IQ children observed from primary school in the early 1920s and shows that early cognitive development predicts educational attainment decades later, even after controlling for family background.

More recent evidence on long-run outcomes comes primarily from evaluations of early childhood interventions. Studies of Head Start, including Currie and Thomas (1995), and Pagés et al. (2020), document persistent effects on educational attainment and adult outcomes, consistent with models in which early skills raise the productivity of later investments and with models in which unobserved genetic and family background endowments have effects over the life cycle. Paxson and Schady (2007), using data from Ecuador, consider how the Socio-Economic Status gradient in children's cognitive development changes with age and analyze different channels that could account for these effects, including health and nutritional status and parenting practices.

One issue that has hampered progress in this respect and has encouraged the use of administrative data set,[8] when they are available, is the scarcity of consistent longitudinal data that follow individuals from the early years to adulthood, both in developed and developing countries. In addition to the Young Lives (2025) data, which have been collecting data for over two decades on two cohorts of children in four countries (Ethiopia, India, Peru and Vietnam), very few longitudinal data exist. An example that looks at the long run evolution of cognitive skills and health status using the Young Lives data from India, is Attanasio et al. (2020e), while Attanasio et al. (2017) use the Young Lives data from Ethiopia and Peru and somewhat different functional forms for a similar exercise.

In the US, the most noticeable exceptions are the two NLSY cohorts. However, these longitudinal data, which I have mentioned above, have limited information on early years development, as they start to follow adolescents. Having said this, it should be mentioned that these two cohort studies have started to measure the children of the cohort members. The CNLSY1979, which was started in 1986, for the children of the 79 cohort, for instance, has been used in several of the studies I have mentioned.

In the UK (or England), there are several cohort studies that have been following individuals born in 1946, 1958, 1970, 2000 and, more recently, a study of children born in 2010-11. Some surveys also follow the children of some cohorts. For instance, in 2004, the children of the 1970 cohort were observed. Several studies have used such data to look at the long run impacts of early years outcomes in different dimensions, including Currie and Hyson (1999), Currie and Thomas (2001), Feinstein (2003), Case and Paxon (2010) and Dearden et al (2011). As with the NLSY data, several of the British Cohort studies contain information on the children (and parents) of the cohort members. In the case of the BCS (individuals born in 1970), for instance, in 2004 the children of the cohort members were observed and their development in different dimensions measured.

[8] East et al (2023) is an example where the expansion of Medicaid is linked to administrative data to study the impact on the next generation of children.

Some studies have used these data to consider the intergenerational persistence of income, including Blanden et al (2107). Similarly, Attanasio et al. (2024a) examine the intergenerational transmission of internalizing and externalizing socio-emotional skills using the BCS data. Bolt et al. (2025) use the British National Child Development Study (1958 cohort) to study the mechanisms underlying intergenerational earnings persistence. They show that higher parental investments among high-income families foster greater cognitive development, which in turn accounts for a substantial share of the intergenerational elasticity of earnings.

2.2.2 Human development has several dimensions. In early economic models of production, labor was often represented by a single scalar input or, at most, two inputs distinguished by education or skill level. Within this framework, inequality could be captured by differences in skill levels or by variations in the relative prices of different inputs, as in Tinbergen (1974) and Katz and Murphy (1992).

More recent work shows that a unidimensional view of human capital is insufficient to capture modern production processes and the dynamics of inequality. Rising specialization, automation, and labor market complexity call for a multidimensional conception of skills (Acemoglu and Autor, 2011; Deming, 2017). A useful distinction might be among cognitive skills, and socio-emotional skills - both internalizing (e.g., motivation and focus) and externalizing (e.g., sociability and teamwork)- as well as health and nutrition. These dimensions play distinct roles in human development and labor market outcomes. Deming (2017) for instance, emphasizes the growing importance of sociability in increasingly specialized production environments.

Research on child development has paralleled this shift. Early studies highlighted the importance of health and nutrition, which remain central, but later work has emphasized the role of cognitive and socioemotional skills. Of note is the increased attention given to socioemotional skills, recognizing the important and distinct effects they have on both personal development and labor market outcomes. These skills interact in the process of development.

The study of the impacts of Head Start by Currie and Thomas (1995), cited above, trying to consider multiple dimensions of development, look at test scores, academic achievement, measles shots and height per age. Cunha et al, (2010) considers both cognitive and socio-emotional skills. Attanasio et al. (2020a) use a similar approach and a longitudinal data set following a sample of (disadvantaged) children annually during the first 6 years of life to model the evolution of cognitive and socio-emotional skills as well as health.

2.2.3 Child development's drivers. The process through which humans develop in many dimensions from birth onwards is not only complex because of its dynamics and the many ways it can express itself but also because many inputs play an important role. Furthermore, these inputs may interact in complex ways, reflecting substitutabilities or complementarities. For instance, the productivity of parental investment might depend on the level of development of their children. Moreover, parental

investment itself may be made of different components which could be complements or substitutes. And the role of these inputs may be changing over time, an issue to which I return in Section 2.2.4. Here I discuss some of the drivers of child development considered in the literature.

2.2.3.a Parental behavior. Parents (and the adults with whom children interact in the very first months and years of life) play key roles in shaping the very important early years of development. It is therefore key to understand what drives parental behaviors (and what may change such behaviors).

In most economic models, as parents maximize an objective function, parental investment depends on parental tastes, resources and, crucially on their perception of the effectiveness of parental investment in affecting child development. Such an objective function may be defined over the distribution of outcomes among the children and therefore affected by the distribution of endowments among children, including innate abilities, gender, and so on. To establish the causal link of parental investment on child development, this issue needs to be considered.

The endogeneity of parental investment is at the center of the evaluation paper by Attanasio et al. (2020b). While they use the randomization of a parenting intervention across villages to evaluate its impacts, in performing a mediation analysis, they do not use that variation as the exclusion restriction that would allow the identification of the impact of parental investment.[9] Their favorite functional form for child development is a Cobb-Douglas specification, therefore implying some degree of complementarity between initial development and parental investment.

Intra familial variances in adult outcomes are sizeable. Therefore, accounting for intrafamilial allocations is important as parents may reinforce or compensate for endowment differences. While some papers have studied the allocation of resources among different children (see Behrman and Taubman, 1988, Behrman (1988b), Behrman et al. (1982) and Giannola (2024).), the evidence on within families' allocations is still scarce.

A growing body of evidence shows that there are important socio-economic gaps in 'parental investment': Guryan et al (2008), for instance show that higher-educated parents spend more time in educational activities with children. Kalil et al (2012) show that there is an increasing SES gaps in time spent with children, with single mothers have especially low time investments. Fitzsimons et al (2017) look at how persistent poverty affects parental investments in cognitive stimulation. Ramey and Ramey (2010) show that, starting in the 1990s, the time investment in children has increased dramatically, with the increase among high SES parents being considerably more pronounced. Ramey and Ramey (2010) hypothesize that this increase is driven by an increase in competition for university places.

If some parents do not spend much time stimulating their children, it may be because they underestimate the usefulness of such activities or misperceive their children ability. The former explanation is consistent with the anthropological and sociological evidence (see Lareau, 2003 and

[9] They use instead price data and violence history referring to the time when the parents where adolescents.

Putnam, 2015) as well as with quantitative evidence using data on parental beliefs in the US (Cunha et al, 2022), Colombia (Attanasio, Cunha and Jervis, 2019). Dizon-Ross (2019) provides convincing evidence about the latter in the context of Malawi while Wang et al (2024) consider data from Guatemala and relate to reference points about height.

Following Cunha et al (2022),[10] Attanasio, Cunha and Jervis (2019) use questions that elicit parental beliefs about the process of child development. Imposing the assumptions that parents' beliefs about the process of child development has a similar functional form as the actual process, they estimate 'subjective production functions' of the process of child development that can be compared to the functions estimated on child development data. The results indicate that in the sample of poor Colombian households, parents systematically and substantially underestimate the productivity of parental investment. Furthermore, when investment productivity is allowed to change with the initial conditions, they find that parents, on average, assume substitutability between children's initial level of development and parental investment, while there is evidence of some complementarity. Therefore, in this sample and on average, parents underestimate investment productivity especially at high level of initial conditions. The use of subjective beliefs data simplifies the estimation of (subjective) production function: as respondents are presented with alternative counterfactual scenarios constructed by the researchers, the endogeneity of parental investment, which must be considered when estimating the 'objective' production function, is not an issue.

Beyond parental beliefs about child development, other factors shape parental behavior, and the inputs children receive. In particular, intra-household bargaining and the relative position of spouses may influence parenting choices. while resource allocation within households has been widely studied (e.g., Chiappori, 1988 and the subsequent literature), the implications of non-unitary models for child development remain largely unexplored, with notable exceptions such as Almås et al. (2024).

Finally, gender and other social norms absorbed during the early years are also likely to be key drivers of parental behavior. Some work exists on the topic, including, for instance, Behrman (1988a), Jayachandra and Kuziemko (2011) and more recently, Ayyar et al (2024).

2.2.3.b Child-care, preschool centers, primary schools, peers. While parental inputs in the first few years of life are obviously important, they are not the only factors that affect individual development. As children age, they start receiving inputs from child-care centers, preschools teachers and, eventually, peers.

The identification of the impacts of these factors on child development is not trivial, however, for the same reasons for which the causal link between parental investment and child development is hard to estimate: these inputs are endogenous and likely to be correlated with many unobserved determinants of child development. A few recent papers, however, have used experiments or some unique data sets to address this identification problem. Araujo et al (2016) use data on two cohorts of kindergarten

[10] The working paper version of Cunha et al (2022) was circulated in 2013.

students who were assigned randomly to different teachers in Ecuador. With this remarkable data, which contains also rich information on children's outcomes and teaching practices, Araujo et al (2016) estimate sizeable impacts of classroom quality on different dimensions of child development.

In the case of peer effects, these issues are compounded by the well-known 'reflection problem', discussed by Manski (1993). Such a link is not easy to identify in a structural fashion, as the determinants of peers are likely to be correlated with several other unobservable factors that affect individual performance. The data used by Araujo et al (2016) gave rise to a longitudinal data set, in which the children in the original study were followed for seven years through elementary school and were randomly allocated to different classrooms in each year. This allocation mechanism induces exogenous variation in the position of a child in classroom ranking, as well as the quality of teachers and peers. In a recent paper, Carneiro et al (2025a) have used these unique data set and show how classroom ranking have a sizeable impact on individual performances.

This exercise in Ecuador echoes a somewhat similar experiment performed in Tennessee, known as project STAR, where children were allocated randomly to classes of different sizes (see, for instance, Schanzenbach, 2006). While the experiment on project STAR's main objective was to study the effect of class size on student achievement, the randomization also induced exogenous variation on teacher and peer quality. Chetty et al (2011) use it to estimate these quantities and document important impacts of these variables on adult outcomes. Incidentally, this is another example where administrative data are linked to the data of an experiment and provide evidence on long run effects that could not be estimated due to do the lack on longitudinal data.

More research is now developing pointing to the fact that the way different interventions affect *the quantity and quality* of childcare and preschools can be extremely important, as shown, for instance, in Currie (2001), Currie and Neidell (2007), Wolf et al (2019), Andrew et al (2024) and Behrman et al (2024).[11] The quality of childcare centers and nurseries is then likely to interact with the quality of the early years inputs children receive at home. The evidence on the impact of these interactions (whether these inputs are substitute or complement) is however, very limited. A big challenge here is that 'centers quality' as 'parental inputs' might be multidimensional and hard to measure.

2.2.4 The nature and dynamics of child development is complex. As emphasized by Cunha et al. (2006), human development is a complex process in which multiple skills interact both contemporaneously and over time. Despite persistent data limitations, particularly in early childhood, empirical evidence increasingly supports rich models of skill formation. A central insight is the presence of *dynamic complementarities*. Cunha and Heckman (2007) formalize the concept of self-productivity, whereby current skills raise future skills, and show that the productivity of later parental investments is higher when preceded by early investments, and vice versa. These complementarities

[11] Attanasio et al. (2022b) look at the impact of the provision of childcare centers in Brazil on caregivers and children. Other studies consider interventions in primary schools, such as Berlinski et al (2023) and Alan and Mumcu (2024).

across childhood stages shape parental behavior and have implications for the design and timing of effective policies.

Building on these ideas, Cunha et al. (2010) estimate a model in which cognitive and socio-emotional skills evolve as functions of past skill levels, parental investments, and family background. Using data spanning eight periods of childhood, grouped into two developmental stages, they allow the key parameters governing these relationships to vary across stages and treat parental investment as endogenous. Their estimates provide strong evidence of dynamic complementarities in skill formation.

Attanasio et al. (2020c) and Attanasio et al. (2017) use a similar econometric approach to estimate the process of child development for two cohorts of children observed between the age of 1 and 15 in three of the four countries that comprise Young Lives. Attanasio et al. (2017) explore both a CES and a nested CES considering two dimensions of development (cognition and health). For each age, they assume a production function with five different inputs: the initial levels of health and cognition, parental investment, and parental background in cognition and health. When considering the nested CES, they allow the initial levels of development to have a different degree of substitutability. The empirical results reject the restrictions that would yield a simple CES, in favor of the more nuanced nested CES, which allows different elasticity of substitutions between different groups of inputs.

This evidence shows that the process of development can be quite complex with different patterns of substitutability across different inputs in the process. Attanasio et al. (2017) show what these estimates imply for the productivity of parental investment at different ages and contexts. It is interesting to note that the flexibility of the nested CES (or more generally of allowing different patterns of substitutability among different inputs) has different implications in different contexts and at different ages.

Attanasio et al. (2020a) study the dynamics of early child development using longitudinal data on disadvantaged Colombian children aged 6 to 72 months measured yearly over a period of 6 years. They model three domains - cognitive, socio-emotional, and health and document increasing dispersion in all dimensions as children age. They also provide novel evidence that, in some domains and at some ages, development is non-Markovian: past developmental levels remain predictive of future outcomes even after conditioning on current status, implying richer dynamics than commonly assumed. The paper shows the parameters of the development process differ sharply across domains and evolve with age. When considering parental investment, accounting for its endogeneity is key, as investment productivity is substantially underestimated when treated as exogenous. For cognition, parental investments are most productive early in life, while self-productivity rises later; for socio-emotional skills, investment productivity peaks later and self-productivity is relatively stable; and for health, self-productivity dominates and multiple developmental lags matter, underscoring the complexity of health dynamics.

These features have important implications for policy design. Using simulations based on their estimates, Attanasio et al. (2020a) show that the timing, duration, and persistence of interventions

critically shape their impacts. Policies that increase parental investments are most effective when implemented at ages at which investment productivity is highest and before developmental persistence becomes strong. Early and sustained interventions generate substantially larger and longer-lasting effects than later or short-lived ones, and allowing for richer developmental dynamics materially alters the predicted returns to policy.

Caucutt et al (2020) present evidence of complementarities in the process of child development. In particular, they focus on complementarities between 'early' and 'late' investment in a two-period model, stressing how their presence accentuates the impact of liquidity constraints and other frictions. And the presence of dynamic complementarities is not the only relevant dimension of interest. Caucutt et al (2025) consider different components of parental investment which are aggregated into the production of child development through a nested CES function. They show the presence of important complementarities between different types of investments. On the other hand, Rossin-Slater and Wüst (2020), which we discuss later, show evidence of strong dynamic substitutability. Bailey et al (2020) and Jenkins et al (2024) analyze the possibility of complementarities of education interventions at different ages presenting a meta-analysis the former paper and a study of North Carolina examples the latter.

Summing up. The papers reviewed in this subsection highlight the inherent complexity of child development. Some of the economic literature approaches this problem using structural models of individual behavior, which provide a unifying framework for organizing and interpreting a growing body of empirical evidence. Combining these models with experimental and quasi-experimental variation has enabled researchers to identify causal links between key inputs and developmental outcomes. The resulting evidence points to both static and dynamic complementarities among inputs, with production relationships that evolve as children age and vary across contexts. Understanding these features is central to a comprehensive account of the child development process.

While much progress has been made, there are still many open issues, ranging from the precise identification of the key windows of opportunities in the process of development to the relevant dimensions to consider, the details of the dynamics of the process. I discuss some of these issues in Section 4. Before doing that, however, I discuss some of the policy interventions that have been studied in the literature and that have offered invaluable evidence on the process of child development.

3. Policy interventions and the building of evidence.

Much of our knowledge about the process of child development, its malleability and the long-run effects of early environments comes from the evaluation of interventions implemented at different ages and in diverse contexts. Long-term follow-ups to landmark programs, such as the Perry Preschool Program and the Abecedarian Project, have been instrumental in demonstrating the lasting influence of early childhood conditions, while the variation generated by these, and other interventions provides valuable leverage for identifying causal mechanisms and developmental pathways.

Reflecting the growing recognition of early development as a driver of long-run outcomes, policymakers have been implementing a wide range of interventions aimed at improving children's developmental trajectories, particularly among disadvantaged populations. This diversity of policies mirrors the multidimensional and dynamic nature of child development: different inputs matter at different stages, and domains such as cognition, socio-emotional skills, and health interact over time. Broadly, interventions can be grouped into three categories. Some target health and nutrition, through in-kind support, cash transfers, or improved access to health services. Others seek to influence early development more directly by promoting parenting practices or expanding access to high-quality childcare and early education. A third set operates indirectly, relaxing economic constraints that limit parents' capacity to invest time and resources in their children. Taken together, these policies highlight the multiple channels through which child development can be shaped and provide a rich empirical basis for studying developmental processes.

In this section, I review a selection of interventions aimed at fostering the development of young children. The objective is not to provide a comprehensive survey, but to highlight a set of well-studied programs that shed light on key mechanisms through which policy can affect developmental trajectories. I first consider interventions that act directly on children and parenting practices, I then examine programs that operate indirectly by alleviating resource constraints faced by disadvantaged families. I conclude with a discussion of dynamic complementarities among interventions implemented at different stages of childhood.

3.1 Interventions targeting children and parenting practices directly

This subsection examines a group of early-years programs whose impacts have been rigorously evaluated and that illustrate how specific inputs, such as parenting practices, stimulation, and childcare quality, shape child development. These interventions, summarized in Table 1, include examples from both high-income and low-income settings. I do not present an exhaustive list of interventions. The emphasis here is on programs that modify children's immediate learning environments, rather than on nutrition or health interventions. I start with interventions in developing countries.

Evidence on early childhood interventions in developing countries is particularly compelling. Seminal studies from Colombia in the 1970s documented large benefits from early stimulation programs (McKay et al., 1978; Super et al., 1990). More recently, parenting interventions targeting the first two to three years of life have since been widely developed and implemented. Two prominent examples are *Care for Child Development* (*CCD*) and *Reach Up*. Developed by WHO and UNICEF (2012), *CCD* provides caregivers with guidance on promoting cognitive, language, and socioemotional development through play and responsive interactions. *Reach Up*, originally designed and evaluated in Jamaica, delivers structured, curriculum-based home visits to strengthen parenting practices and stimulate child development, and has since been replicated in countries including in Bangladesh (Hamadani et al., 2006, 2019, Mehrin et al 2022), China (Sylvia et al., 2020; Zhou et al., 2023, Zhou et al, 2026), Colombia (Attanasio et al., 2020c, 2022a), India (Grantham-McGregor et al., 2020; Meghir et al., 2023),

Zimbabwe, and several other countries.[12] . The evaluation of the original version of *Reach Up* deserves a special mention because it is one of the few cases where the very long impacts of the intervention were examined. Gertler et. al. (2014) finds significant impacts of the treated individuals in adulthood on several labor market and other outcomes.[13]

While the evidence on the long-term effects of early years interventions on adult outcomes remains limited, particularly in developing countries, some emerging studies examine their medium-term effects, a few years after the intervention. In certain cases, the initial impacts fade (e.g., Andrew et al., 2018), whereas in other contexts they persist or even grow. Jervis et al. (2024) analyze the medium-term effects of *Reach Up* in urban India and find substantial improvements in school readiness nearly four years after the intervention ended. Similarly, Meghir et al. (2023) report significant benefits from a comparable program in rural India. This mixed evidence suggests that outcomes are shaped by multiple factors, including the quality of the intervention, its ability to produce sustained changes in parental behavior, and the way early gains interact with children's subsequent environments. Understanding the mechanisms behind these heterogeneous impacts is therefore critical.

Some of the Bangladesh studies (Hamadami et al 2019 and Mehrin et al , 2022) as well as the India trial analyzed in Grantham-McGregor et al. (2020) and the Colombia intervention studied in Attanasio et al. (2022a) are particularly noteworthy because they investigate alternative modes of delivering the *Reach Up* intervention. Whereas the original model, evaluated in Jamaica (e.g., Grantham-McGregor et al., 1991), relied on individual home visits, these studies also assess group-based sessions, either on their own or alongside individual visits. Group visits are especially interesting given their substantially lower costs and their potential to activate different mechanisms, such as fostering interactions among mothers, that may influence parental behavior. Strikingly, several of these studies find that group and individual visits yield similar average impacts. The mechanisms underlying these effects remain insufficiently understood and warrant further investigation.

Many parenting interventions inspired by *Reach Up* and CDD have traditionally focused on the primary caregiver, typically the mother or another female household member. More recent programs, however, have sought to engage fathers and to address additional household challenges, such as intimate partner violence. A notable example is the Sugira Muryango intervention in Rwanda, which has been rigorously evaluated in both the short and medium term. Studies examining its effects (Betancourt et al., 2020; Jensen et al., 2021; Jensen et al., 2025) find significant improvements in parenting practices and reductions in intimate partner violence, though impacts on child development outcomes are more limited.

While early childhood interventions have received substantial attention due to their potentially large impacts, policies targeting older children and adolescents can also yield meaningful benefits. For example, Duflo et al. (2024) show that an intervention providing incentives for girls' continued

[12] A recent meta-analysis synthesizing evidence from various *Reach Up* implementations is provided in Jervis et al. (2023).
[13] Another intervention that had very long follow ups was the INCAP study in Guatemala, which was a nutrition program.

education in Ghana generates long-term gains for both the participants and their children, thereby contributing to improved intergenerational mobility.

In the United States, several early childhood interventions have been extensively evaluated, many of which are reviewed in Heckman and Kutz (2014). A number of these programs have demonstrated substantial long-term benefits, particularly those that act directly on children's early environments and parenting practices. Prominent examples include the Nurse–Family Partnership (NFP) (Olds, 2006; Olds et al., 2010), the Incredible Years program (Webster-Stratton and Reid, 2010), Parents as Teachers (Wagner et al., 2002), the Triple P – Positive Parenting Program (Sanders et al., 2014), the Chicago Child-Parent Center program, Ireland's Learning for Life program (Doyle, 2020), and Early Head Start (Love et al., 2014).

These programs differ in their modes of delivery but share a focus on strengthening early interactions and developmental supports. NFP is a nurse-led home-visiting program for first-time mothers, aimed at improving maternal health and promoting children's early development. Incredible Years provides structured training in positive parenting strategies to improve children's behavior and socio-emotional skills. Parents as Teachers offers home visits beginning in pregnancy and continuing through early childhood, with an emphasis on early learning and school readiness. Triple P is a multi-level system designed to enhance parenting skills, encourage positive child behavior, and reduce maltreatment. EHS, a federally funded U.S. initiative, delivers comprehensive services, including parenting support, to low-income families with infants and toddlers.

A program that deserves particular attention is the Perry Preschool Program (PPP), launched in the late 1960s in Ypsilanti, Michigan, and targeted at disadvantaged children aged three to four. PPP generated immediate improvements in outcomes such as IQ. While the IQ impact faded out by third grade, achievement gains of about 0.2-0.4 SD persisted through the end of adolescence (as documented in Schweinhart (1993), and, importantly, produced substantial long-term effects on adult employment, earnings, and criminal behavior, despite an apparent fading of the impacts on IQ. A distinctive contribution of Heckman et al. (2013), one of the key studies examining PPP's long-term impacts, is its effort to uncover the mechanisms through which the program produced these lasting effects. The emphasis on different dimensions of skills (cognitive and socioemotional) and on the role they play, both in the process of human development and in the labor market, is key here.

Another extensively studied early childhood intervention is the Abecedarian (ABC) program in North Carolina. Unlike the Perry Preschool Program, ABC began earlier in life and lasted longer, combining high-quality, center-based childcare with home visits and other supports. The program produced large and persistent effects across multiple domains, including cognitive development, health, and later-life outcomes. Garcia et al. (2013) show that these benefits substantially exceed the program's costs, with benefit–cost ratios estimated between 7:1 and 10:1 and internal rates of return of 7- 10% per year. [14]

[14] Garcia and Heckman (2023) report evidence on the long run effects and social mobility of both ABC and PPP and show how both these programs had important effects in both dimensions.

More recently, as mentioned above, Garcia et al (2025) have shown that PPP had impacts on its recipients as adults and, importantly, on their offspring, therefore affecting social mobility. Garcia and Heckman (2023) report evidence on the long run effects and social mobility of both ABC and PPP and show how both these programs had important effects in both dimensions.

Another interesting study is that of Duncan and Sojourner (2013), who used an RCT to estimate the impact of the Infant Health and Development Program (IHDP). This intervention, implemented in eight U.S. cities, targeted low-birthweight (LBW) or premature children, but eligibility did not depend on income or socio-economic status. As a result, the RCT sample was quite representative of the US population of LBW children. The intervention delivered a curriculum very similar to that of ABC. The paper focuses on the subsample of children who were close to a normal birth weight and shows that the program's impacts were substantially larger, and almost entirely concentrated among the poorest segment of the sample.

The evidence coming out of relatively small trials (such as those mentioned so far) is obviously important. From a policy perspective, however, an important issue is how to scale interventions that have been shown to achieve important effects in small efficacy trials. Recent evaluations of early years interventions in the developing countries have tried to evaluate interventions that could be, in principle, implemented at scale. This is the case, for instance of the Reach Up versions in Colombia and India (see, e.g. Attanasio et al. 2020b and Meghir et al. , 2013). In developed countries some early childhood programs have also been evaluated at large scale. In the United States, Head Start, a major federal program launched in 1965 and subsequently modified several times, has been the subject of extensive research. A similar program in the UK, Sure Start, has also been studied. [15]

Before the randomized trial conducted in the late 1990s, Head Start had already been evaluated many times. Hundreds of local and regional studies were conducted from the program's inception through the mid-1990s, generally finding short-term gains in cognitive, socio-emotional, and health outcomes. However, most relied on non-experimental designs, were based on small or non-representative samples, and were subject to substantial selection bias and attrition. A comprehensive synthesis of this pre-HSIS evidence is provided by Besharov et al. (2011), who review the broad and heterogeneous set of early evaluations. They conclude that while early findings were broadly encouraging, the evidence base was too weak to support reliable causal inference or to assess long-term impacts, underscoring the need for the more rigorous design later implemented in the HSIS randomized trial.

Head Start received its first large-scale randomized evaluation in 1998 through the Head Start Impact Study (HSIS), which leveraged excess demand for program slots. The study reported modest Intent-

[15] There is a large literature on the evaluation of Head Start. Gibbs (2025) offers a comprehensive overview.Key contributions using quasi-experimental approaches include Currie and Thomas (1995), Deming (2009), and Bailey et al. (2021), among many others. For a comprehensive overview of the broader literature, see Gibbs (2025).

to-Treat (ITT) effects: by the end of the Head Start year, children experienced a small boost in literacy skills (about 0.18 standard deviations) and no detectable gains in math or socioemotional outcomes, with these impacts largely fading over time. Kline and Walters (2016) re-examined the HSIS data and highlighted that, although children were randomly assigned to Head Start or a control group, many control-group children enrolled in alternative childcare arrangements, including other Head Start centers. Accounting for this substitution, they found sizeable program impacts that more than justify the program's cost. Their analysis also revealed substantial heterogeneity in treatment effects, with the largest benefits accruing to children who would otherwise have had limited access to formal childcare.

In recent work, Morris et al. (2018), using the same HSIS data, identify additional sources of heterogeneity, including significant differences across states, centers, and child characteristics. Children with lower baseline scores and Dual Language Learners benefit more, and impacts are generally larger in urban than in rural settings. Morris et al (2018) highlights substantial variation in the quality of Head Start centers, which may help explain the heterogeneity of impacts observed among children in different contexts. These findings underscore the importance of implementation quality in determining the ultimate effects of early childhood interventions, especially when the evaluation of such programs are based on small-scale RCTs.

The evaluations of Head Start in the US are particularly informative because they examine programs implemented at scale, rather than small, tightly controlled RCTs. In the United Kingdom, Carneiro et al. (2025) examine the short- and medium-term effects of the Sure Start, another program that has been implemented at scale, finding sizeable benefits, particularly for the most disadvantaged children. By tracing exposure to local Sure Start centers at ages 5, 7, 11, and 16, they document significant improvements across multiple dimensions, including educational achievement and reductions in hospitalizations.

3.2 Interventions targeting children and parenting practices indirectly

Financial stress can limit the mental and emotional resources parents have available for constructive parenting, suggesting that alleviating economic hardship may support child development. Some programs try to address this challenge by providing low-income families with additional financial resources and by lowering the costs of education, healthcare, and childcare. Conditional cash transfers (CCTs), for example, offer financial support contingent on specific behaviors, such as ensuring young children receive health check-ups and vaccinations or enrolling older children in school. By linking resources to these actions, CCTs both encourage investments in children's development and effectively reduce the cost of key activities, fostering immediate and longer-term benefits for child outcomes. But CCT are not the only type of programs that try to address these issues. Other programs include minimum wage and employment programs. Mani et al (2023), for instance, using Young Lives data, look at the impact on child development of a large employment program India, finding strong positive impacts on a variety of outcomes both in the short and medium run. Majid and Behrman

(2023) look at the effect of Minimum Wages during the first year of a child's life in Indonesia and find positive impacts on height per age at age 5.

Recently, several interventions transferring resources to very poor people have received considerable attention, both in policy circles and in academic journals. For instance, Egger et al (2022) consider the impacts of an intervention that gave a substantial unconditional cash transfer to poor households in Kenya. They found large impacts both among the recipients of the transfers and among the non-recipients *living in the same villages as the recipients;* arguing such impacts might be to general equilibrium effects. Analogously, many papers looked at the impacts of transfers of assets and training to 'ultra-poor' households (see, for instance, Bandiera et al (2013) and Banarjee et al (2021)).

Although many studies evaluate these interventions and find positive average effects, very few examine their impacts on children. These include impacts on the nutritional status of children (Raza et al., 2018, Banarjee et al., 2015) and educational attainment (Sulaiman, 2009). A comprehensive discussion for the US and other developed countries is contained in the recent paper by Page (2024). Even in the case of CCT, which have been studied extensively, the evidence on their long run impact on child development is limited, except for some studies that looked at the impact of the celebrated *PROGRESA* program in Mexico on nutritional outcomes and child and maternal mortality and in Brazil (see, for instance, see, for instance Rivera et al., 2004, Ozer et al., 2009 Ramos et al . 2021, Richterman et al. 2023, 2025).

Some evidence on the effect of this type of programs on child development, however, has been emerging. Paxson and Schady (2007) show that a relatively small cash transfer in Ecuador shows no significant impact on average, but a positive and significant impact on the cognitive development of the children living in the poorest households. Macours et al (2012) look at the impact of *Atención a Crisis*, a CCT intervention in Nicaragua, that was evaluated with a RCT. This paper finds a significant impact on children cognitive development both at the end of the program and 2 years after its end, without much impacts' fading observed.[16] For the US, Bailey et al (2024) have looked at the long run impacts of food-stamps on child developments. The authors find that these transfers do have an impact on a variety of children outcomes, up to age 5, but not at later ages.[17]

The *Baby's First Years* study investigates these issues through a randomized controlled trial in four U.S. cities, providing disadvantaged mothers with substantial, unconditional monthly cash transfers over several years. Preliminary results (Noble et al., 2025; Troller-Renfree et al., 2025) show that after four years of transfers exceeding $300 per month, there are no detectable effects on children's cognitive or

[16] The Nicaraguan CCT was sizeable and some of the conditions in the early years (attendance to health visits, *de facto* were not enforced.

[17] Relatedly, in the US, some papers (see, for instance, Boudreau et al, 2016 and Brown et al, 2019) have looked at the long run impact on children of access to programs such as Medicaid, finding positive long term impacts on various adult outcomes. On the other hand, Hawkins et al (2025), using a Regression Discontinuity Design, find no long-run impacts of Supplemental Security Income program. In developing countries, Kremer and Miguel (2014) has looked at the long run implications of a de-worming program in Kenya on children's outcomes.

socio-emotional development, despite some increases in parental investments. Although these findings are early and context-specific, they suggest that income support alone may be insufficient to improve child development, highlighting the potential need to combine cash transfers with interventions that directly influence and shape parenting practices.

A related issue concerns the design of transfer programs. Should support be delivered in cash or in kind, and should it be tied to specific behaviors? Early work by Currie (1993) emphasized the potential importance of these design choices. However, evidence on how alternative forms of transfers affect household behavior, child outcomes, and local prices remains limited. Some guidance comes from studies of conditional cash transfer programs, such as Attanasio et al. (2015), who show how linking financial support to behaviors like health service use or school attendance can shape parental behavior and, in turn, child outcomes.

The limited evidence on the impact of programs such as cash or asset transfers on child development is unfortunate, especially given their proven effectiveness in lifting very poor households out of poverty. This is particularly relevant because several of these interventions provide assets and training to women, who play a crucial role in raising children. Assessing the potential effects of programs that have been shown to have a positive impact on many economic outcomes, might have on child development is also important because financial stress and economic insecurity may reduce substantially parents' ability to engage with and stimulate their children.

3.3 Dynamic complementarities of interventions and impact heterogeneity

Several pieces of evidence seem to indicate that the largest impact is observed among the most disadvantaged children, possibly allowing some degree of 'catch-up' between the most and least disadvantaged.[18] Such an effect could indicate that some intervention might be *substituting* for other inputs. However, a different story can be told in the presence of *dynamic complementarities,* which have recently received renewed attention. The presence of dynamic complementarities could imply that certain interventions may have an effect not only at the age in which they are implemented, but in subsequent ages, as they might make children more responsive to certain stimula and equip them with skills that can be used in the growth process. For instance, the presence of *static complementarities* during, say, adolescence, might make cognitive interventions more effective in youths with a higher level of certain socioemotional skills. If such skills are formed in the years preceding adolescence, different interventions might be able to exploit these *dynamic complementarities.*

However, partly because of the scarcity of longitudinal data, such complementarities are difficult to identify and quantify. One valuable exception is Johnson and Jackson (2019), who use an ingenious identification strategy the interaction of Head Start in the US and subsequent improvements in the quality of K-12 schools. They find that while both interventions improve adult outcomes for the

[18] Jervis et al. (2024), e.g., find that an ECD intervention in India primarily benefited the most disadvantaged children.

children exposed to them, their combined effect is larger than the sum of the two individual effects, suggesting the presence of important complementarities.

Evidence on dynamic complementarities, however, is mixed. Rossin-Slater and Wüst (2020) examine the long-run and intergenerational effects of a Danish preschool intervention and its interaction with an infant health program. Leveraging high-quality administrative data and staggered program rollouts, they identify causal long-term impacts but find strong substitutability rather than complementarities between the interventions. Similarly, Carneiro et al. (2025b), using a unique dataset from Ecuador, find no evidence of dynamic complementarities in classroom quality across grades.

Meghir et al. (2023) evaluate two ECD interventions in Odisha, India: a parenting program for children aged 9-36 months, and a community nursery program for children aged 36-60 months. In a clustered RCT, villages were assigned to one of four groups - parenting only, nursery only, both interventions, or control - allowing comparisons across early-only, late-only, combined, and no-intervention groups. The study finds that both interventions have positive effects, with the combined program producing an impact slightly larger than the sum of the individual interventions, though this difference is not statistically significant.

Summing up. The discussion in this section is not dissimilar from that presented by Duncan et al (2023) in their Handbook of Education chapter where they synthesize findings from experimental and quasi-experimental studies of preschool programs, home-visiting interventions, parenting programs, and income-support policies. They start from the evidence that looks at the role played by genetic factors and stress that the environment and, therefore, policy intervention can play a crucial role. However, they conclude that "existing research on early childhood education falls short of sufficiently answering fundamental questions about what works for whom and why. A tighter link between theory, econometric methods and data is essential to compare and reconcile the mixed and sometimes conflicting empirical results across studies, and to understand when and why the impacts of home environment and pre-school interventions fadeout." This quote leads us naturally on the next section.

4. Challenges

The studies referenced above, though not exhaustive, highlight the critical role and malleability of early childhood. This evidence explains why early years should be a primary focus for interventions aimed at fostering child development, reducing inequality, and enhancing social mobility. However, despite the well-established importance of early childhood, our understanding of the processes driving child development remains incomplete. We still lack clarity on how these processes evolve as children grow and which specific factors should be prioritized in large-scale interventions, especially when financial and human resources to implement them are limited.

In this section, I discuss what I perceive the main challenges in the academic and policy discussions on the early years and interventions targeted to them. I start, in Section 4.1, with a discussion of

measurement. Measuring child development and its drivers, including the behavior of the main actors in the growth process, such as parents and teachers, is key to achieve a better and more complete understanding of the process. I discuss what I perceive the main challenges in achieving such a goal in Section 4.2. In Section 4.3, I summarize what I see as the ingredients of a theoretical model that could be used in this endeavor. Finally in Section 4.4, I discuss how a better understanding and modeling of the child development process can lead to design better policies and interventions.

4.1 Measurement

Measuring child development across multiple dimensions is challenging. Over the years, specialists and psychometricians have developed a wide range of age-specific tests, some of which are summarized in Table 2. Nonetheless, measurement challenges persist, prompting recent efforts to combine items from existing tests into new instruments that enable comparable, scalable assessments across different contexts (see Cavallera et al. 2023, McCray et al., 2023, van Buren et al., 2024).

Assessing child development across contexts and over time faces several challenges. First, a key issue is the need for a metric that allows meaningful comparisons: measures at different ages or in different environments must be comparable, and ideally cardinal, to quantify intervention impacts. Standard tests, however, capture markers of development whose relevance can vary across settings and life stages. Ideally, one would identify a small set of measurement tools that would retain similar meaning across contexts and adjacent age groups, enabling a coherent metric by linking measures across ages. Additional items without such a property could be added allowing for different roles over different contexts or age, to improve precision. In practice, this approach is difficult to implement, particularly because many widely used test items are binary or discrete.

Second, the recognition that child development is a construct that cannot be observed directly points to the use of *latent factors models,* which are very useful statistical tools for inferring underlying developmental dimensions from observable markers. However, estimates derived from factor models are unavoidably affected by measurement error, which must be considered when these estimates are used in regression analyses. One approach, discussed in Skrondal and Laake (2001), incorporates the statistical properties of item-specific measurement error directly into the measurement system. Variation across interviewers or data-collection techniques can also be controlled when collecting the data and exploited to help justify assumptions about the structure of these errors.

Third, measurement tools should capture multiple domains of child development. The level of detail needed depends on the research questions being pursued. Measures must be flexible enough to represent distinct developmental dimensions while allowing aggregation into broader constructs. For instance, in early childhood, cognitive skills can be distinguished from language abilities, with language further divided into receptive and expressive components. A modular set of items that can be combined in different ways to suit diverse analytical objectives is therefore especially valuable.

Fourth, measurement instruments should be implementable at scale and potentially serve as diagnostic tools. One approach, as in the Global Scales for Early Development (G-SED; van Buuren et al., 2024), is to offer multiple test versions: simple, easy-to-administer versions for diagnostics, alongside more complex versions requiring specialized administration. While such dual approaches exist in practice, it is desirable to integrate them within a coherent, overarching framework.

In addition to measures of child development, to achieve the goal of understanding *the process of child development*, it is also necessary to collect measures of parental behavior. In addition to parents, teachers in nurseries and pre-schools are obviously important actors as they interact with children as they grow and develop; their behavior should also be measured. Several standardized tests (such as the Home Observation for Measurement of the Environment- HOME- , the Family Care Indicator – FCI – or Knowledge of Infant Development Inventory - KIDI) have been developed and are widely used. The first two measure the *actual quality and quantity of stimulation* and learning opportunities available to the child in the home, with HOME being observational while the FCI being a survey. KIDI, instead, measures *parental knowledge about child development*, assessing how well parents understand developmental milestones, typical behaviors, and effective parenting strategies.

Many tools for measuring child development and parenting practices come with pre-built scoring algorithms that aggregate multiple items into domain scores. This approach should be used with caution. These algorithms are typically derived from factor models, such as IRT, calibrated on pilot data from specific contexts and may not be appropriate elsewhere. Items highly relevant in one setting may be less so in another, and applying standard weights can introduce bias or unnecessary noise. A more effective approach is to re-estimate scores using a flexible latent factor model, which accounts for measurement error and explicitly models the relationship between latent traits and observed indicators. Such estimation should be transparent, with clear reporting of assumptions and methods, allowing researchers to summarize test information efficiently and appropriately for their context.

Assessing the impact of parents' and teachers' behavior on child development requires explicit models of their choices, which in turn depend critically on data measuring the determinants of those choices. Beyond standard variables—such as income, prices, socio-economic background, and the policy environment—there is a growing recognition that progress hinges on the availability of direct measures of beliefs, expectations, and attitudes related to child development and child-rearing practices.

In Section 2.2.3, we mentioned evidence highlighted in the sociology and anthropology literature (Lareau, 2003; Putnam, 2015) that parents from disadvantaged backgrounds tend to invest less time and fewer resources in their children than would be optimal for fostering development in certain dimensions, given prevailing preferences and constraints. While this pattern may partly reflect binding time and budget constraints associated with meeting children's basic needs, it does not fully explain why disadvantaged parents engage less in cognitively and emotionally stimulating activities even when they do spend time with their children (Kalil et al., 2012; Guryan et al., 2008; Phillips et al., 1998). Distorted or incomplete beliefs about the process of child development provide a plausible alternative

explanation. Measuring parental beliefs directly is therefore essential both for understanding observed behavior and for designing effective policy interventions. Recent economic studies have begun to collect such data, focusing on parents of very young children (Attanasio et al., 2019; Cunha et al., 2022) as well as on parents of older children (Boneva and Rauh, 2018; Attanasio et al., 2021).[19]

Similar measurement challenges arise in the study of teachers. Teachers form expectations about their students, and these expectations can influence students' behavior, choices, and developmental trajectories. While this phenomenon has long been studied in psychology (Jussim and Harber, 2005), only recently have economists begun to collect and exploit data on teachers' expectations, mostly for older students. Evidence from this emerging literature shows that teachers' beliefs are strongly associated with students' educational attainment (Papageorge et al., 2018) and with the development of non-cognitive skills, particularly when teacher and student backgrounds align (Jackson, 2018). Systematic measurement of teachers' expectations is therefore a necessary step toward understanding how classroom interactions shape child development and how policy can leverage these mechanisms.[20]

The need for better and richer longitudinal data providing information on various aspects of development at different ages is clear. Data on child development should be complemented with data on the likely drivers of the process, including parenting behavior and its determinants as well as data on the environment children live and grow in. Furthermore, when collecting new surveys, consent to link those surveys to administrative could be collected.[21] Such data, especially if linked to the evaluation of specific interventions, could allow not only the estimation of the impacts that such intervention have, but, crucially, could provide a better understanding of mechanisms behind human development and the roles played by different factors in the process. The development of such data should consider the need of measurement tools yielding estimates of child development in different dimensions that are comparable across contexts.

Piloting of different measures and testing what in the literature is labeled as *measurement invariance,* is important. More generally, as in many contexts in economics, it is important to recognize that, as argued by Almås et al (2024), perfect measures of many concepts do not exist; modeling the presence of measurement error and the relationship between the latent factors of interest and observable markers that might be related to them can be useful both for the construction of new measures and for the way certain phenomena are modeled.

[19] A variant of this approach, taken by Wang et al (2024), is one that focuses on reference points on investment in children.
[20] Duflo et al (2011), using data from Kenya study how tracking in schools affects children's development and teacher behavior. However, they do not have data on teachers' beliefs and perceptions. More recently, several studies in psychology and education sciences have been looking at teachers' perceptions of students' abilities, implicit biases and their relationship with student performance (see, for instance Lang and Kahn-Lang Spitzer, 2020, and Peterson et al. 2020).
[21] This is a suggestion made by Greg Duncan. In some contexts, individuals, when filling in administrative forms, are asked consent to further contacts and sharing of those administrative data for research purposes.

4.2 Towards a better understanding of the child development process.

As mentioned in Section 2, recent research underscores that labor's role in the production process is multifaceted and cannot be adequately represented as a simple, one-dimensional input (Acemoglu and Autor, 2011; Deming, 2017). In parallel, substantial progress has been made in understanding human development as a multidimension process and, within it, the pivotal role of early childhood. Evidence from interventions like the Perry Preschool Program illustrates this complexity: while gains in cognitive skills often diminish over time, effects on non-cognitive skills, and ultimately long-term adult outcomes, tend to persist (Garces et al., 2002; Heckman et al., 2013). Therefore, economists have increasingly focused on these issues to better explain inequality and declining social mobility in Western societies, and in response to the recognized limited effectiveness of adult-focused interventions such as job training. This shift toward the early years has generated a rich body of research and important insights.

Despite the substantive progress, several key challenges in early childhood development research remain. To make substantive progress we need:

(i) A better understanding of the child development processes in different dimensions, and how they change in the first 6 years of life.
(ii) A better understanding of parental behavior drivers, and how they change. Such drivers include, in addition to resources, subjective beliefs, the balance of power within households and social norms.
(iii) A better understanding of what teachers in nurseries, childcare centers and kindergartens do, what determines their behaviors and how they interact with parents.

I now discuss these challenges in turn.

4.2.1 The process of child development. As discussed in Section 2.1, economists in recent decades have increasingly adopted complex models of human development, often integrated within broader frameworks of household decision-making. This line of research has evolved to capture the intricate ways in which children develop and parents allocate resources toward their development. And in many of the papers cited below, structural models play an important role in identifying and interpreting the observed process of child development.

Structural models of child development. A good example of this approach is a recent paper by Cunha et al (2025) where the authors estimate the impact of a parenting intervention in Texas, which was designed to be potentially scalable. Importantly, in addition to the intervention's impacts on a variety of outcomes, Cunha et al (2025) use a structural model to isolate the channels that yield the observed impacts and conclude that in addition to the direct effects, the program achieved part of its goals by changing parental preferences. The use of a structural model, in this and other papers, to complement the evidence provided by RCT is key both because it provides the tools to understand the impact of

an intervention and it makes what is the contribution that economists can provide relative to those from different fields.

Multidimensionality. Another key consideration in modeling child development is its multidimensional nature, and the corresponding multidimensionality of parental investments across childhood stages. As children grow, the development process evolves rapidly, changing the relative importance of different inputs. Attanasio et al. (2020a) illustrate this issue by following Colombian children annually from birth to age six, but such rich longitudinal data are rare. As a result, the existing evidence remains fragmented and does not yet yield a coherent characterization of the developmental process.

Some recent work has looked at more nuanced models of child development. Caucutt et al. (2025), for instance, leverage data from the Child Supplement of the PSID Caucutt et al. (2025) estimate a process of child development that depends on for parental time, home goods, and market-based child care investments. They address the issue that these inputs are chosen by parents, by using a *relative demand approach* that also addresses measurement error and does not require direct skill measure. They find moderate complementarity across inputs and little direct role for parental education beyond its effect on resources and preferences. Ye (2025) studies the quality of social support in neighborhoods in Chicago and, using a clever identification strategy, finds that it has an important role.

Dynamics. An area where our understanding remains limited concerns the dynamics of child development. Many studies assume a Markov structure. As discussed in Section 2.2.4, evidence from Attanasio et al. (2020a) already challenges this assumption. More recent evidence from the UK reinforces this conclusion. Using data from the UK Millennium Cohort Study—which follows individuals born in 2000 across seven waves—Attanasio et al. (2025) show that outcomes across multiple domains at age 17 are predicted by cognitive skills and family background measured at age 3. Crucially, early development remains predictive even after controlling for outcomes at ages 5, 7, 11, and 14, rejecting the assumption that current skills fully summarize past development.[22] This evidence underscores the pivotal role of the early years and suggests that interventions before age 3 can have long-lasting effects.

Changing dynamic complementarities. How the effects of parental investments evolve with age remains poorly understood. Furthermore, long-run relationships across developmental dimensions are often nonlinear. Nutritional status provides a clear example: severe early deficits, such as stunting, can have large effects on adult outcomes, while gains beyond a minimum threshold yield much smaller returns. Other important factors - including sibling and peer interactions and the allocation of resources within households - have received relatively little attention in the child development literature.

A unifying issue underlying many of the challenges discussed above is *dynamic complementarities*, which have recently attracted considerable attention. As Heckman effectively puts it, "skills beget skills" (see

[22] The Markov structure is implicitly subsumed in the so called 'value added approach' to the study of education interventions, which is widely used in the literature.

Heckman and Mosso, 2014). Children who enter primary school with stronger skills across multiple domains, not only cognition, but also attention and behavioral regulation, are likely to perform better than their less-prepared peers. Similarly, children who begin school at higher developmental levels may require access to high-quality instruction to remain on a strong trajectory. Yet, despite its central importance, there is limited high-frequency evidence that allows researchers to quantify the dynamic interactions among different skills.

Agostinelli and Wiswall (2025), using the same U.S. dataset (Children of the NLSY 1979) as Cunha et al. (2010), estimate a "production function" of child development at ages 5–6, 7–8, 9–10, and 11–12, employing a different functional form. They model future development as a function of current skill levels and parental investment, finding modest evidence of substitutability between these inputs, particularly at ages 5–6. A key finding is that the production function changes substantially with age: the self-productivity parameter, capturing the impact of current skills on future skills, is highest in the early years, while the effect of parental investment peaks at ages 11–12, the final period analyzed.

These results have important policy implications, as the productivity of certain inputs and the degree of persistence change as children grow. The analysis of how the process of skill formation changes with age allows the identification of *windows of opportunities,* that is period during which the impact of potential interventions that modify, for example, parental investment, might be highest in the long run. Relevant to this discussion is also the evidence that several interventions, in particular those targeting the early years, seem to have larger impacts on the most disadvantaged children.

While these results should be taken with some caution, as the identification of the impact of parental investment might be difficult given the data available, impacts' heterogeneity over the first few years of life might be showing that well-designed and well-timed interventions can move the most disadvantaged children on different *developmental trajectories*. The presence of dynamic complementarities makes then early interventions worth of attention from policy makers. This logic is also relevant for other interventions targeted to adolescents, as discussed in Baliley et al (2017).

A better understanding of the long-term dynamics of human development is crucial for both policy design and for identifying the mechanisms that shape outcomes, including the role of initial conditions and their interaction with environmental factors. From an econometric perspective, as noted in Section 4.1, this requires measuring relevant latent factors in a well-defined and age-comparable metric. A key challenge in latent factor models is that unobservable quantities lack a natural scale, and various normalizations can be applied. When studying developmental dynamics, it is essential that the metrics used to estimate these latent factors are consistent across ages, a point emphasized by Agostinelli and Wiswall (2025).

4.2.2 Parental behavior. Parents play a key role in the process of child development, especially in the first few years of life. It is therefore key to determine the drivers of parental behavior and investment. In Section 2.2.3, I already mentioned the possibility that parents may have a distorted view of the

process of child development that leads to suboptimal choices, such as Attanasio et al. (2019) and Wang et al. (2024). Caucutt et al. (2025) adopt a different approach, estimating child development using components of parental investment rather than direct beliefs data. By analyzing relative demand for these components, they avoid assuming that parents know the "true" production process and can test whether parents correctly perceive complementarities and substitutabilities among inputs, even if misperceptions about overall investment productivity cannot be assessed. They find little evidence of such misperceptions and show via Monte Carlo simulations that estimating substitution elasticities is imprecise given the PSID data, suggesting that tests of cross-equation restrictions may lack power. Differences between studies may reflect age: Attanasio et al. examine children under 3 in Colombia, whereas Caucutt et al. study U.S. children aged 5–12, consistent with the notion that both skill formation and potential parental misperceptions evolve with age.

Doepke and Zilibotti (2017, 2019) focus on parental preferences and develop models showing how parental choices over time, resources and *parenting styles* shape children's skill formation, with trade-offs between current consumption and long-term human capital. They emphasize that differences in parental preferences and resources can contribute to persistent intergenerational inequality. Doepke, Sorrenti, and Zilibotti (2019) extend this framework by considering heterogeneous parental beliefs and skill complementarities, showing how these factors interact with economic conditions and policy to influence developmental outcomes. In contrast, Del Boca et al. (2014) take an empirical approach, estimating how actual household allocations of time and resources affect cognitive and non-cognitive development, highlighting the measurable effects of economic constraints and incentives. Together, these studies highlight the central role of family behavior and economic incentives in shaping the dynamics of skill formation and inequality.

In a recent paper, Bellue (2024) presents a model where potentially distorted about child development beliefs inform parental time and location choices. This contribution is particularly interesting because beliefs change according to a very plausible learning model, in which parents learn from their neighbors. As parents decide, in equilibrium and considering a variety of factors, to move to certain neighborhoods, *distorted beliefs* can become entrenched and emerge as a persistent equilibrium outcome that is not corrected by learning.

Furthermore, while several contributions have considered how household choices are made when more than one decision maker is present, how these choices are determined when different decision makers within a family have different views and beliefs has not been investigated much. And how allocations among different children (with different genders or perceived levels of abilities) are determined, or the role played by social norms and conventions have only been looked at by few studies. Giannola (2024) has looked at this problem with an innovative measurement tool aimed at capturing parental preferences for equality and efficiency with a lab-in the field experiment.

Another angle that has been investigated little in relation to child development is the marriage market and how assortative mating might influence how families are formed and how they raise their children.

Adams and Andrew (2024) look at role of gender norms and build innovative measures of individual beliefs of the returns to education in the marriage and labor market in India. Two other papers that are relevant in this dimension are Moschini (2023), and Calvo (2025).

Rustichini et al. (2023) consider a different angle from which to study parental impacts on child development. They extend a standard parental-investment model of intergenerational mobility by formally incorporating genetic transmission using polygenic scores for educational attainment. They show that including genetic variation changes key model predictions - most notably that the intergenerational income elasticity (IGE) can be larger and depends on the distribution of genotypes. The authors test their extended model using data on twins and their parents with genetic information, estimating how genetic factors and environments interact in shaping educational outcomes. They argue indicate that genetic influences - especially those related to intelligence - play a substantial role in educational attainment and mobility, and that genes and environment jointly affect intergenerational transmission of skills.

Further work in this area is needed: our understanding of behavior within the household is still incomplete. How decisions are made by couple with distinct utility function and even perceptions, how resources are allocated among different children, how this interacts with fertility decision is not completely clear, while having first order consequences for the process of child development.

4.2.3 Nurseries and schools. After the early years, children's experiences extend beyond parental care, as parents make choices about childcare centers, preschools, and schools. The interactions between these institutional inputs and family environments become crucial for development. Pre-primary programs (typically ages 3–5), primary, and secondary schools are all important contributors, yet while some research examines each input individually (e.g., Fort et al., 2020), evidence on how they interact across stages of childhood remains limited. Studies such as Attanasio et al. (2023) highlight the role of quality in center-based care and primary schools, but many inputs are shaped by individual decisions—by parents, teachers, or principals—making it difficult to establish clear causal links between these factors and developmental outcomes.

As mentioned above, the evidence on the interactions between different interventions, targeted to children of different ages is very limited. It is likely, as pointed out by Caucutt et al (2020), that children that enter a high-quality kindergarten at age 2 or 3 after living in a nurturing and stimulating families, maybe because of the impact of a parenting intervention, are more likely to thrive than children arriving from a deprived and unstimulating environment. At the same time, there is much evidence that quality pre-schools have higher impacts on deprived children.[23] Again, to square these pieces of evidence a more complete understanding of the process of child development is necessary.

In a recent study, Agostinelli et al. (2025) model the evolution of cognitive and non-cognitive skills among U.S. children during kindergarten, allowing end-of-year skill levels to depend on initial abilities

[23] For a counter example from Mexico, see Behrman et al (2026).

as well as investments made at home and in the classroom. Using an econometric framework grounded in a measurement system à la Cunha et al. (2010), they estimate a translog production function in which the productivity of each type of investment varies with children's initial skill endowments. Their results indicate that both parental and classroom investments contribute to the development of cognitive and non-cognitive skills. However, parental investments exhibit substantially greater inequality across children than classroom inputs, making them a key driver of observed disparities in early childhood development in the United States.

While these studies mark important advances in the understanding of child development, evidence on the nature of complementarities remains limited, as I discuss in Section 4.4. Before doing that, however, I provide a sketch of what I think could be a useful model of early childhood development.

4.3 Child development: the ingredients of a model

Section 4.2 underscores both the significant progress economics has made in understanding child development and the important gaps that remain. In this section, I outline what I consider the key components of a model that could deepen this understanding and guide the design and large-scale implementation of interventions like those discussed in Section 3. The aim is not to formalize these ideas - many already appear in the literature cited above - but to provide a conceptual overview of a modeling framework that may be useful in this context.

A central component of economic models of early childhood development is specifying the objective functions of key decision-makers, primarily parents, but also teachers and other caregivers. For parents, a key question is whether they act as a unified decision-making unit or whether choices reflect interactions between individuals with distinct preferences and constraints. Equally critical are the arguments that enter these objective functions. Standard models often assume parental utility depends on consumption, leisure, and child development, but several questions remain only partially explored: How many dimensions of child development matter, and which are valued by parents? How does parental time investment factor into utility? In families with multiple children, do parents prioritize equality across siblings or only aggregate outcomes? How do these preferences interact with fertility decisions, and how does relative parental power shape the process?

A second key component of early childhood models is the developmental process itself and the factors that influence it. When examining development from one age to the next, the "production function of human development" typically includes the child's current skills, inputs from parents and other caregivers (e.g., relatives, siblings, teachers, or peers), and broader environmental factors such as neighborhoods, communities, weather, or pollution. These inputs interact in complex ways, with complementarities or substitutabilities shaping final outcomes. Building on earlier work like Cunha et al. (2010), Heckman et al. (2025) provides a precise treatment of these dynamic complementarities.

A potentially important input in the process of child development, which has often been ignored, is that of environmental factors, as considered, for instance by Ye (2025). As for the role of social norms, Ayyar et al. (2024) use the British 1958 birth cohort to examine how early "gender conformity" influences adult outcomes. They input essays written by cohort members at age 11 (in 1969) into a Large Language Model (LLM) trained on texts from 1958–1978 to generate a gender conformity index, which is shown to predicts many adult outcomes for female participants. This study is notable for several reasons: it highlights an additional factor that child development models might consider, underscores the long-term consequences of early development, and demonstrates the potential of using LLM to extract quantitative measures from qualitative data, enabling richer empirical analyses.

The behavior of parents is likely to be determined by the resources available to them and their preferences. In models where parents allocate time between leisure, market work, and child investment, higher-wage parents may face a higher opportunity cost of spending time with their children. Yet evidence shows (e.g. Raikes et al. 2006, Sénéchal and LeFevre, 2002 and Kalil et al. 2012) that more educated mothers often spend more time reading to young children. Explaining this pattern may require accounting for heterogeneity in parental preferences, in the effectiveness of specific investments, or in beliefs about the benefits of certain activities for child development.

A further key determinant of parental behavior is the information parents possess about the process of child development. A growing body of work - including Cunha et al. (2022), Wang et al. (2024), Attanasio et al. (2019), List et al. (2021), and Wang et al. (2022) - shows that parental beliefs are often systematically distorted, particularly among low-income families. Models of child development should therefore allow for misperceptions about the returns to different investments. Frameworks that incorporate learning and belief updating, such as Bellue (2023), are especially promising in capturing how parental behavior may adjust over time in response to new information.

It is also important to recognize that parents are not the only actors influencing children, especially beyond the earliest years. The behavior of teachers, childcare providers, pre-primary and primary schools, play a critical role. Understanding these influences requires considering how markets for childcare services evolve and interact with other sectors, particularly the housing market.

4.4 Early years interventions: scaling up and complementarities

As mentioned above, it is now well established that early year's interventions can be very effective and can have long run effects that benefit individual born in disadvantaged circumstance. Moreover, evidence exists about interventions targeted at different ages during per-school years. It would then seem an obvious policy prescription that such interventions should be implemented on a large scale. However, there are still challenges and unknowns about the scaling and the impacts of interventions. In this subsection, I discuss the issue of scaling up and sustainability and the scarcity of evidence about the complementarities of different interventions.

4.4.1 Scaling up of effective and sustainable interventions. Several early childhood interventions, both in developed and developing countries, have been designed, sometimes rigorously evaluated through randomized controlled trials (RCTs), and, in some cases, scaled up. It is now clear that well-designed and well-implemented interventions can significantly impact the cognitive and socio-emotional development of young children and change their lives. The next step is then the scaling of such interventions. For that, financial and resource constraints are relevant, but they are not necessarily the most significant barriers policymakers face when trying to scale interventions. First, there is the issue of fidelity and quality, programs that are effective on a small scale may not produce the same results when expanded, particularly when human resources are limited and what is actually implemented is a much-watered down version of the original intervention. Second, many interventions seek to change parenting practices and individual behaviors, such as those of parents or teachers, which requires engagement and ownership from the recipients. Third, given financial and human resource limitations, it is crucial to determine which aspects of child development to prioritize. Similarly, there is the question of the appropriate age group to target, should interventions focus on infants as young as nine months or on three-year-olds?

On the first point, the need to design interventions that can be scaled up with minimal resources constitutes a justification for some interventions looking very *prescriptive*. If some interventions need to be implemented by some individuals with limited training and background, they need to be explicit about what needs to be done for the intervention to be effective. On the second point, changing individual behavior and practices requires connection and good communication with the interventions' recipients. Changing behavior and engrained mechanisms is hard and needs ownership and participation from recipients. This in turns implies that the main messages must be conveyed by agents that are recognized and play a useful role in the community. Community participation in the implementation of interventions becomes then critical. To address the third point, it is necessary to get a better understanding of the process of child development in its details, including the timing dynamics and the role of different input. At the same time, there is the risk of designing parenting interventions that might be interpreted as promoting the advice of *parenting experts,* which is probably not desirable. Parents do not need to be lectured or *coached* into parenting. This is probably one of the reasons some successful parenting interventions, such as *Reach Up* stressed *parent engagement with their children,* and participation in real activities and interactions. Again, in this respect, community members can play an important role.

Another important issue when thinking of scaling up intervention, particularly those that aim to increase the availability and quality of childcare, is that of the effects that such interventions might have on several variables, ranging from female labor force participation, to parenting practices to the prices of childcare. Many papers have recently looked at these issues, including Borowsky et al (2022), that calibrate a General Equilibrium (GE) model which includes the demand and supply of childcare, to look at the impact of expanded subsidies. García-Vázquez (2025) also considers a general equilibrium model of the childcare market to consider the impacts of regulations such as minimum staff ratios, finding that such policies affect simultaneously wages in the sector and the distribution of child development. Using data from Chile, Escobar et al (2024) also use a GE model to study the

welfare and distributive consequence of childcare policies, such as mandates for employer-provided childcare. Finally, while Chaparro et al (2020) do not consider a full GE model, they model parental choices (about labor supply and childcare) in a very nuanced way, which allows them to perform several counterfactual exercises. The papers above are only a partial list of contributions that have tackled these issues. What emerges clearly from this growing literature is that the assessment of different policy options needs to consider both direct and indirect effects that they might have.

There is no single answer to the many questions about how interventions shown to be successful in pilots should be scaled up. Addressing them requires a deep understanding of child development and its key drivers. We need better insights into the behaviors of parents, teachers, and all individuals who interact with young children during their most formative years. Only then can we design effective policies that can be successfully implemented at scale. It is interesting to note, however, that in some contexts, *implementation science*, is taken seriously. An example, for instance is the scaling up of the Sugira Muryango intervention in Rwanda, which I have mentioned above. Black et al (2025) published a protocol for the scaling up of that intervention to assess how its implementation works.

4.4.2 Static and dynamic complementarities of interventions. Different interventions focus on distinct aspects of child development. Some are implemented when children are of the same age, while others may target the same children at different, sometimes adjacent, ages. A clear example of the former are nutrition and stimulation interventions. Early Colombian studies from the 1970s (e.g., McKey et al., 1978; Super et al., 1979) included a nutritional component, as did the well-known Jamaican study, the initial Reach Up program (Grantham-McGregor et al., 1991), and the Colombian intervention analyzed by Attanasio et al. (2014, 2020).[24]

The dynamic aspects of child development, discussed in Section 2.2, have recently attracted substantial attention. Evidence on these dynamics remains limited, particularly regarding the complementarity of different policies and interventions that may target children at varying ages. In Section 3.3, I review four studies examining such complementarities: Johnson and Jackson (2019) and Rossin-Slater and Wüst (2020) focus on U.S. children, Meghir et al. (2023) on Indian children, and Carneiro et al. (2025b) on Ecuadorian children. Overall, empirical evidence on dynamic complementarities, whether in child development itself or across interventions, is scarce. Understanding whether these complementarities are significant is crucial both for conceptualizing the developmental process and for designing effective policies. Despite its importance, a well-established narrative on this topic has yet to emerge.

Beuermann et al. (2023) highlight an additional layer of complexity in evaluating education interventions and, more broadly, school quality. They argue that school quality affects not only test scores but also a wider range of outcomes, including formal employment and criminal behavior.

[24] The Jamaican intervention finds some interactions in the short run but not in the long run when only the stimulation intervention (with or without nutrition) has a significant impact. Attanasio et al. (2014, 2020) instead report no impact of the nutrition intervention neither in the short run nor in the medium run.

Developing a methodology to capture these broader impacts, they show—using data from Trinidad and Tobago—that such effects are quantitatively important.

From a policy perspective, it can be said that access to quality schooling might be an important factor for the impacts of early interventions can be sustained. Along these lines, it may be argued that the fading out of early impact which is sometimes documented could be attributed to the lack of education inputs of sufficiently high quality. This argument is the other side of a coin that states that to exploit education services in primary school children must arrive there with a sufficient level of development. Analogous considerations can be made about the complementarities between different types of skills. It may be that school age children with well-developed socio-emotional skills might be better able to develop cognitive skills later on, maybe using more effectively the quality provided by the educational system. The importance of specific domains in the process of development can also inform the design of interventions that could target specific goals.

The limited evidence on this type of factors, despite their importance, might be originated by the objective difficult in estimating rich and well-specified models, especially with observational data. At the same time, evaluating the complementarities between different interventions might require coordination between different institutions that manage those interventions, which can be difficult in most contexts.

5. Conclusions

In this paper, I have discussed the status of the current economic literature on the early years in child development. I looked at how this set of issues, extending from the nature of the process of child development to interventions aimed at fostering it among disadvantaged children, has become important among economists and how they have incorporated insights from other disciplines, ranging from developmental psychology to implementation science and discussed the contributions that economists can bring both to a better understanding the process of child development and to the design of effective and scalable policies.

The main messages I want to convey can be summarized as follows. While it is now clear that the early years are extremely important, both because of their long-run effects and their malleability, there are still several issues that need to be clarified. We still do not fully understand the dynamics of the process of formation of different dimension of child development and how these dynamics change as children grow. We also need to better quantify the contribution of a variety of inputs, from that of parents to that of teachers, peers and other environmental factors. To do so, it is also necessary to model and understand individual behaviors and their drivers.

A cross-cutting and key theme is that measurement: we need to develop better measurement of child development, individual inputs and their drivers, including individual beliefs and attitudes. In doing so, we need to address several outstanding issues, including the design and implementation of

measures that are comparable across context and ages. That is, we need to establish a metric that could be used to measure child development and its drivers consistently.

Economists' contribution consists in providing a holistic approach to the problem, recognizing that different dimensions of child development, while being distinct, interact with each other and that the identification of the causal links among different factors is not a trivial problem but one that could be tackled by modeling individual behavior. Furthermore, the construction of models of individual behavior can guide and inform the construction of measures and experiments that can facilitate the identification and estimation of causal links. For this approach to be fruitful, however, it is necessary to use coherent economic models. Such models should inform and guide the design of new experiments and measurement tools. The evidence from such experiment can then be used effectively to improve our understanding of the relevant processes and to design effective policies.

Table 1. Early childhood interventions discussed in this paper subjected to evaluation						
Intervention	Papers	Country	Period	Evaluation	Children age at baseline	Description
1a Developed countries						
Danish Public Preschool and Nurse Home Visiting Program (NHV)	Rossin-Slater and Wüst (2020)	Denmark	1933-1960	Differential rollout across municipalities	NHV: pregnancy Preschool: 3-7 years	Preschool and home visits
Milwaukee Project	Garber and Heber (1973)	US	1963	RCT	From birth	Psychosocial stimulation and maternal employment preparation
Head Start	Currie and Thomas (1995), Garces et al. (2002), Currie and Neidell (2007), Deming (2009), Love et al. (2014), Kline and Walters (2016), Morris et al. (2018), Johnson and Jackson (2019), Bailey et al. (2021)	US	1965 to date	RCT (HSIS 90s-00s) and expansion roll-out	3-4 years	Center based and some home visiting. Varied across centers
The Chicago Child-Parent Center	Fuerst and Fuerst (1993)	US	1965	Matching	3-5 years	High quality preschool and primary education
Nurse-Family Partnership	Olds (2006), Olds et al. (2010)	US	1966, RCT in 1977	RCT	Pregnancy	Home visits
Perry Preschool Program	Schweinhart and Weikart (1980), Garces et al. (2002), Heckman et al. (2013), Garcia et al (2025).	US	Late 1960s	RCT	3-4 years	High quality preschool
Abecedarian (ABC)	Ramey and Campbell (1979), Garcia et al. (2020)	US	1972 to 1985	RCT	0-5 years	Center based. Intense enhanced preschool and kindergarten
ABC/CARE	Ramey et al (2004)	US	1972-1992		0-5 yrstd	ABC+ 3.5 home visits per month
The Incredible Years (IY)	Webster-Stratton and Reid (2010)	US	1980s	RCTs	0-12 years	Group sessions and teacher training
Parents as Teachers	Wagner et al. (2002)	US	1980s	RCT	Less than 8 months	Home visits and group sessions
Positive Parenting Program	Sanders et al. (2014)	Australia US + 11 countries	1980-2013	RCTs	0-12 years	Individual and group sessions
Student/Teacher Achievement Ratio (STAR)	Schanzenbach (2006), Chetty et al. (2011),	US	1985 to 1989	RCT	In grades K-3	Students and teachers randomized into small or large classrooms
Sure Start	Carneiro et al. (2025a)	UK	1999	Differential rollout	0-4 years	Childcare, home visits, group sessions
Learning for Life program	Doyle (2020)	Ireland	2010-2015	RCT	Pregnancy – 5 years	Home visits, group sessions, and baby massage
Jumpstart	Cunha et al. (2025)	US	2016	RCT	36-47 months	Meetings with a family liaison

1b Developing countries						
INCAP	INCAP (2019)	Guatemala	1969-77 date	RCT	Pregnancy to 7	Nutrition intervention
Cali's Nutritional, Health Care, and Educational Study	McKay et al. (1978)	Colombia	1971-1974	RCT	4	Nutritional supplementation, health care, and psychosocial stimulation
Bogotá Study of Malnutrition, Diarrheal Disease, and Child Development	Super et al. (1990)	Colombia	1973-1976	RCT	Pregnancy – 3 years	Food supplementation and home visits
Reach up	Grantham-McGregor et al. (1991), Gertler et al. (2024), Zhou et al. (2023)	Jamaica	1986-1987	RCT	1-2 years	Home visits for psychosocial stimulation and nutritional supplement
Adapted *Reach up*	Hamadami et al. (2006,2019) Mehrin et al (2022)	Bangladesh	2000	RCT	6-24 months	Group sessions and home visits
	Attanasio et al. (2014, 2020c, 2022a)	Colombia	2010-2011	RCT	1-2 years	Home visits for psychosocial stimulation
	Grantham-McGregor (2020), Meghir et al. (2023)	India	2015 and 2018	2 RCTs	1-5 years	Home visits, group visits and childcare centers quality
	Sylvia et al. (2020), Zhou et al. (2023), Zhou et al. (2026)	China	2015	RCT	6-30 months	Home visits psychosocial stimulation
Educational Mentoring Program	Agostinelli et al. (2025)	Mexico	API 2009-16, API + 2016 to date	RCT and scale up analysis	8-14 years	Mentoring program with (API) and without enhanced training for mentors (API Plus)
Adapted Abecedarian	Attanasio et al. (2020a), Bernal et al. (2022)	Colombia	2010	RCT	0-4 years	High-quality center-based care and nutrit. supp.
Hogares Infantiles Mejorados (HIM)	Andrew et al. (2018, 2024)	Colombia	HIM: 2011 to date, FE: 13 months	RCT	18-60 months	Additional funds for hiring TAs and professional development training for teachers
Classroom Rank	Carneiro et al. (2025b)	Ecuador	2013-2018	RCT	5 years	Students are randomized into classrooms
FAMI	Attanasio et al. (2022a)	Colombia	2014	RCT	0-2 years	Enhanced quality of group visits with a curriculum based on RU & a nutrit. supp.
Quality Preschool for Ghana (QP4G)	Wolf et al (2019)	Ghana	2015-2016	RCT	4-5	Enhanced quality of preschools
Sugira Muryango	Betancourt et al. (2020), Jensen et al. (2021,2025)	Rwanda	2018	RCT	6-36 months	Home visits

Table 2. Measures of child development		
Tests and subscales	Child ages	Administration (test versus parental report)
Denver- II Language, Fine Motor, Gross Motor, Personal-Social	0-72 months	Direct assessment with some parental report
Battelle Developmental Inventory (BDI – 2) Cognitive, Communication, Motor skills, Personal-Social, Adaptive Skills	0-95 months	Direct assessment
Malawi Development Assessment Tool (MDAT) Cognitive, Language, Fine motor, Gross motor Socioemotional	0-5 years	Direct assessment
Griffiths Language and Cognition, Fine motor, Gross motor Socioemotional	0-6 years	Direct assessment
Vineland Adaptive Behavior Scales-II Socioemotional, Motor	0-90 years	Parent and teacher report
Bayley Scales of Infant Development – BSID III Cognition, Receptive and Expressive Language, Fine and Gross Motor skills	1-42 months	Direct assessment
Ages and Stages Questionnaire – ASQIII Problem solving, Communication, Fine and Gross motor skills, Personal-Social, Socioemotional	1-60 months	Parental report
Infant Characteristics Questionnaire (ICQ) Socioemotional: Fussy/Difficult, Unadaptable, Dull, and Unpredictable	4-24 months	Parental report
MacArthur-Bates Communicative Development (CDI) Language	8-37 months	Parental report
Spanish MacArthur-Bates Communicative Development Inventories Language	8-37 months	Parental report
Early Children's Behavior Questionnaire (ECBQ) Socioemotional	18-36 months	Parental report
Strength and Difficulties Questionnaire (SDQ) Socioemotional	2-17 years	Parental report
Woodcock-Johnson Cognition	18-95 months	Direct assessment
International Development and Early Learning Assessment (IDELA)	3.5 – 6 years	Direct assessment
Stanford-Binet Intelligence Score Cognition	2-85+ years	Direct assessment
Peabody Picture Vocabulary Test (PPVT) Receptive language	2.5-90+ years	Direct assessment
Early Literacy Skills Assessment (ELSA) Cognition	3-6 years	Direct assessment
Bracken School Readiness School readiness	3-7 years	Direct assessment
Pencil Tapping Task Executive function	3-7 years	Direct assessment
Daberon-II School-readiness	4-6 years	Direct assessment
Early Grade Reading and Math Assessment	Pre-K to 3rd grade	Direct assessment
Head Toes Knees and Shoulders (HTKS) Executive function	4-8 years	Direct assessment
Pupil Behavior Inventory (PBI) Socioemotional	6-9 years	Teacher report
Wechsler Preschool and Primary Scale of Intelligence (WPPSI) Cognition	6-16 years	Direct assessment

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