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UNEQUAL STARTS:
THE ROLE OF DIFFERENT LEARNING ENVIRONMENTS IN THE DEVELOPMENT OF INEQUALITIES IN SKILLS DURING EARLY CHILDHOOD

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INTRODUCTION

Mapping inequalities in skills in early childhood: the role of formal and informal learning environments

Educational credentials have a central role in contemporary societies, ensuring positive returns in both the monetary and non-monetary spheres. Each additional year of school shapes, for example, employment opportunities and future earnings once individuals enter the workforce. Education credentials associate also with family formation and marriage and correlate with health conditions and nutrition, deviant behaviours, and participation in political and civic life (Gross et al. 2011). However, contemporary societies are characterized by inequalities in both the amount and distribution of resources (Lareau 2003) and education is no exception. Despite the process of educational expansion that occurred in almost all Western societies over the 20th century has boosted a massive enrolment of men and women in the educational system, thus involving in primary, secondary and tertiary education children from disadvantaged social strata (Jackson 2013), *"*the pattern of association between class origins and the relative chances of children in staying on in education, taking more academic courses or entering higher education has, in most societies, been rather little altered " (Breen and Goldthorpe 1997, 276). As such, although the effect of social class on educational outcomes has on average declined during the last century (Breen et al. 2009), a massive amount of sociological research confirms that, contrary to all expectations, social inheritance, i.e., the economic, social, and cultural resources available to the family of origin, continues to affect individual educational performances and transitions, so that opportunities remain unevenly distributed (Esping-Andersen 2008; Blossfled et al. 2017; Blossfeld et al. 2014, 2016; Blossfeld and Shavit 1993).

How can this be explained, and what can we do to tackle this problem? To address these questions, we need to take a step back and look at when and where these inequalities originate. Much sociological evidence indicates, for example, that inequalities in educational achievements and attainments due to social backgrounds are present already in primary and secondary schools and, at the same time, that family social position matters for crucial educational transitions, such as that towards vocational schools or universities[1]. Yet, despite

[1] The sociological literature converges in claiming that social inequalities in educational outcomes are the result of two separate mechanisms, labelled as primary and secondary effects (Boudon 1974). Hence, inequalities in educational opportunities (IEO hereafter) are a matter of both performances and choice. Primary effects of IEO refer to social inequalities in achievements and they are "the consequence of a complex interaction between educational institutions and the cultural, economic, and social resources of individuals and their

todays' children face, compared to previous generations, divergent destinies in their life paths because of growing disparities in parental resources (McLanahan 2004) already from early ages, "sociological research has neglected social inequalities in early educational experiences of children" for a long time (Blossfled et al. 2017, 3). It is only recently that a growing body of research provides evidence for children from different social backgrounds entering primary schools with already considerable gaps in their reading, language, and numeracy skills (Waldfogel 2012; Weinert, Ebert, and Dubowy 2010; Dämmrich and Triventi 2018). Furthermore, new findings from longitudinal research report that babies whose parents belong to different social groups present, at birth, tiny gaps in their cognitive abilities that tend to rapidly increase during toddlerhood and the pre-school age, resulting in quite substantial differences in early cognitive skills before Kindergarten entrance (see for a review Kulic et al. 2019).

If "early experiences are built into our bodies, with lasting impacts on learning, behaviour, and both physical and mental health" (Center on the Developing Child at Harvard University 2016, 4), a strong start can make the difference. Recently, early childhood has been seen, on the one hand, as a promising and sensitive life period, full of opportunities and rapid changes that are foundational for short and long term success (Cunha and Heckman 2007) and, on the other, as a life-stage with great vulnerability for development. If children fail to build basic skills in various ability domains during the first five years of life, this can bring significant disadvantages that can undermine development, threatening future outcomes as well (OECD 2018). Although unquestionably, part of differences in educational performances is due to hereditable characteristics (de Zeeuw, de Geus, and Boomsma 2015), the process of skill formation is not merely a matter of genes and biology. Brains develop not just as a function of hereditable traits, but also thanks to the network of relationships that children build with relevant others and materials encountered during the process of growth. Recent scientific discoveries highlight that not only genes alone cannot fully explain developmental outcomes, but also that the gradual acquisition of competencies depends on appropriate inputs from the surrounding environments, which chemically modify how certain genes are expressed and come at play. Thus, apparently, "while genetic factors exert certain potent influences on human

families" (Jackson 2013, 12). Secondary effects of IEO describe inequalities in educational choices once abilities have been controlled for. This means that, at the same level of performances, children from different social groups will still differ in terms of their educational preferences since "the costs, benefits, and expected probabilities of success associated with different educational outcomes differ according to socioeconomic background" (Jackson 2013, 14). Taken together, these two effects are claimed at explaining divergences in educational achievements (Volante et al. 2019) and attainments (Barone and Ruggera 2018) for individuals with different social backgrounds in European countries over time.

development, environmental factors have the ability to alter family inheritance" (Center on the Developing Child at Harvard University 2016, 14).

Consequently, the foundations of learning are also embedded in the experiences and interactions that children undertake in various informal and formal environments over the life course. Among the former, the family stands out as one of the most important. Indeed, parents are among children's first educators, and they are, especially during early childhood, relevant decision-making agents for their offspring's first educational transitions, thus highly influencing their educational fortunes from the start. Yet, while parental attachment and support are primary, young children are experiencing more and more close relationships with other nurturing actors in institutional care settings nowadays. The early childhood education system has witnessed an expansion in virtually all Western countries starting from the early 2000s. From being perceived as a tool for enhancing female labour market participation, work-family balance, and integration of vulnerable children, childcare services are more and more linked to children's right to an equitable and promising start in education. As such, previous research suggests that both quantity and quality features of childcare attendance influence children's literacy and have a long-lasting impact on performances. When of high-quality, formal care attendance should be most beneficial for socially disadvantaged students, who cannot count on attentive and stimulating learning environments at home.

This dissertation locates within the literature on child development, early education, and social stratification, aiming at further contributing to the sociological evidence on the mechanisms that lead to inequalities in skills. With the imperative to understanding which factors and conditions may influence early learning, we focus primarily on *inequalities in learning outcomes*, i.e., discrepancies in "children's intellectual capacity at a certain point in time expressed in certain skills, abilities, and competencies" (Skopek et al. 2017, 6), that originate in early childhood. This dissertation aims at being holistic in its approach, thus including diverse types of ability domains. As such, we consider both emerging cognitive and noncognitive skills, being the latter much more overlooked than the former by previous research. The core of this dissertation lies in the analysis of the characteristics of the early institutional and familiar learning environments as growth-promoting or, on the contrary, as unfavourable contexts for development. We believe that grasping better knowledge on what happens during early years is crucial since, as observed by Cuhna and Heckman (2009, 320) "preferences and skills determined early in life explain a substantial part of lifetime inequalities". Since skills are self-productive, a weak and impoverished start at a young age has a detrimental impact on later development, even if restorative interventions are put in place at

later ages (Cunha and Heckman 2007). More broadly, this dissertation covers three main topics: (1) the consequences of formal care attendance on cognitive and noncognitive performances in both the short and long term; (2) the factors at play during the care selection process and their dynamics, and (3) the joint role of quality dimensions of both formal and informal learning environments on early skill development. All these topics were addressed with sociological lenses by examining consequences for children from different social backgrounds.

In the first stance, we question *whether and how much early childhood education matters* in the lives of children around Europe, detecting whether participation, the timing of entry, and intensity of exposure influence cognitive and noncognitive abilities once children are adolescents. In Chapter 2, we are interested in examining the enduring benefits of early childhood education, and its eventual compensatory role by asking the following questions: are the effects of early childcare education long-lasting? can early childhood education be an equalizer of opportunities for children from socially disadvantaged social backgrounds? are these patterns similar across countries or is there any specificity? We expand previous findings by analysing the effect of formal care on later skills by providing a better measure of childcare and preschool attendance and more robust estimates. By adopting recent cross-national survey data from the OECD's Programme for International Student Assessment, we find that if preschool has enduring beneficial effects on cognitive and non-cognitive skills in all countries under analysis, especially in contexts where preschool is of high quality and for children from less socially advantaged families. On the contrary, participation in nonparental care when younger than three years has a detrimental impact on later skills, which is stronger for children from less socially advantaged families.

In the second stance, since in most Western countries early childhood education has become a steppingstone in the educational career of many children, we are interested in examining the pattern of choices for formal care during the first three years of children's lives. In Chapter 3, we ask *whether* and *how much parental social position, beliefs, and other family and child characteristics are interrelated with early childhood educational choices*. We claim that examining the circumstances under which parents select childcare is relevant for at least two reasons. First, without information on the selection of care researchers may casually attribute children's developmental outcomes to the type of childcare when at least part of the variation in skills may be due to selection factors that operate in advance. Second, if we assume, as research reports, that early childhood education is beneficial for human capital accumulation, selectivity in early educational decisions may lead to the exacerbation of the achievements' gap, favouring, on average, children who come from an already privileged social background.

We adopt data from a large-scale, recent newborn panel study for examining the determinants and the dynamics of parental decisions towards early childhood education in Germany. By using a comprehensive theoretical framework, we (i) add new evidence on an understudied educational transition, i.e., that towards formal childcare settings, while we (ii) consider that factors affecting selection into childcare may dynamically change accordingly to children's developmental ages. Our findings suggest that, despite a decade of institutional reforms, equity in accessing formal childcare remains a pipe dream in Germany, with inequalities being most pronounced at two years old. Moreover, access to childcare can be seen as a function of both rational choices and parental beliefs towards child-rearing practices and work, indicating how institutional care is more and more perceived as a skills-enhancer for both children's and mothers' human capital.

In the third stance, Chapter 4 focuses on the influence of quality features in both formal and informal learning environments, asking whether these two settings can be relevant for explaining differences in skills before entering primary school. Although the better quality in formal and informal learning settings is beneficial for developmental outcomes, few are the studies that simultaneously investigate their role. Because of the scarcity of data providing adequate information on both family and preschool learning environments, previous empirical studies have mostly focused on returns of either formal care or familiar inputs on early cognitive development. We extend the literature, by providing evidence on the complex relationship between these two main sources of care with early skills by focusing on a rather overlooked context, i.e., Ireland. By relying on a rich and representative infant panel study, our findings highlight that, together with children's social origins, other features of the home learning environments, such as parenting behaviours, practices, and adequate learning materials at home, are pivotal for early skills development. Moreover, high-quality childcare in Ireland is an enhancer of noncognitive skills, while being not adapted for boosting literacy abilities. We also find evidence for the fact that parents with a poor social position should be made aware that, by showing a more responsive and age-appropriate behaviour, they can positively affect their offspring's early emotional and behavioural skills. Moreover, there are hints for the substitution role of high-quality ECE on emotional skills for children whose parents are rather hostile and unresponsive in their parenting behaviours. At the same time, for obtaining the highest gains on early cognitive skills from high-quality ECE participation, parents should engage their children in literacy stimulating activities at home, supporting their motivation to learn also with adequate educational materials.

To sum up, this PhD dissertation focuses on three main topics, each developed through core research questions. First, Chapter 2 examines the consequences of early childhood education on later educational outcomes by asking: are the effects of early childhood education long lasting until secondary school? Do they vary across countries? Second, Chapter 3 looks at patterns and choices of early childhood education by means of the following questions: which factors lie behind care selection process? Does the relevance of these factors change over children's first three years of life? Third, Chapter 4 analyses the complex interlacement for early skill development between care experienced in the family and in formal settings by querying: to what extent does quality of both the home learning environment and childcare influence children's early skill development? what about their interactive influence? Preliminary to these analyses, Chapter 1 provides a review of the theoretical literature on skill development by introducing and describing the main concepts and issues covered in this PhD dissertation, i.e.: skill development, learning environments, care regimes, and social inequalities. Moreover, Chapter 1 struggles to furnish the reader with a concise summary of the relevant dimensions attached to each concept: a preparatory effort to the empirical analyses and contextualization of the results within country-specific care regimes (Chapters from 2 to 4). Finally, we summarize the lessons learnt, conclude, and explore limits and future research avenues in the last chapter of this PhD dissertation.

1. CHAPTER 1. SKILL DEVELOPMENT AND LEARNING IN CONTEXTS: A THEORETICAL FRAMEWORK

1.1. On skills definitions and measurement

While growing up, individual knowledge is built upon, on the one hand, personal traits that are rather stable and defined by hereditability and, on the other, by a set of different types of abilities (i.e., skills) that individuals acquire, collect, learn, and shape constantly throughout the whole life course within diverse environments, including families, schools, and peers (Kautz et al. 2014). Skills are multiple and enable individuals to participate actively and successfully in society, determining a relevant array of different social and economic outcomes (Heckman, Stixrud, and Urzua 2006).

1.1.1. What do we talk about when referring to skills?

Both cognitive and non-cognitive abilities have been found to determine a relevant array of different social and economic outcomes, from the acquisition of skills to productivity in the labour market (Heckman, Stixrud, and Urzua 2006). Although an analytical distinction between the two is helpful, these dimensions are cross-feeding. This means that, for instance, few human activities are performed without the use of cognition while, at the same time, emotional states and personality affect human reasoning (Cunha and Heckman 2009; Kautz et al. 2014). Both cognitive and non-cognitive abilities can be defined as *skills*, in the sense that, in particular during the first five years of age, they are changeable and shaped by the surrounding environments and conditions (Kautz et al. 2014).

1.1.1.1. Cognitive skills

The literature divides cognitive skills into two dimensions, i.e., domain-general, and domain-specific cognitive abilities. Domain-general cognitive abilities are those abilities that are relatively independent of the context and the culture in which individuals grow up[2]. These competencies are basic individual abilities that have been extensively explored within intelligence theories since they lay at the basis of intelligence thinking and action. Domain-general cognitive abilities are sometimes called 'fluid intelligence' or 'cognitive mechanic' and they capture, for instance, "performance differences in the speed of elementary cognitive processes, the capacity of working memory, or in the ability to apply deductive or analogous

[2] As independent from the context, domain-general abilities will not be considered as an outcome of interest for this Ph.D. thesis.

thinking in new situations" (Weinert et al. 2011, 71). Domain-general cognitive abilities are often captured through IQ tests that, for instance, result to be malleable to changes up until the tenth year of age (Cunha and Heckman 2007; Kautz et al. 2014). As deduced by recent findings from an intervention study aimed at enriching the environment of socially deprived children through preschool participation in the United States, by age ten the mean IQs of children who participated in the Perry Preschool Program (treated) and that of those who were not exposed to the program (the control group) were the same (Figure 1.1). Nevertheless, preschool attendance abruptly boosts IQs of the treated group shortly after the program's entry and these benefits last up to seven years of age.

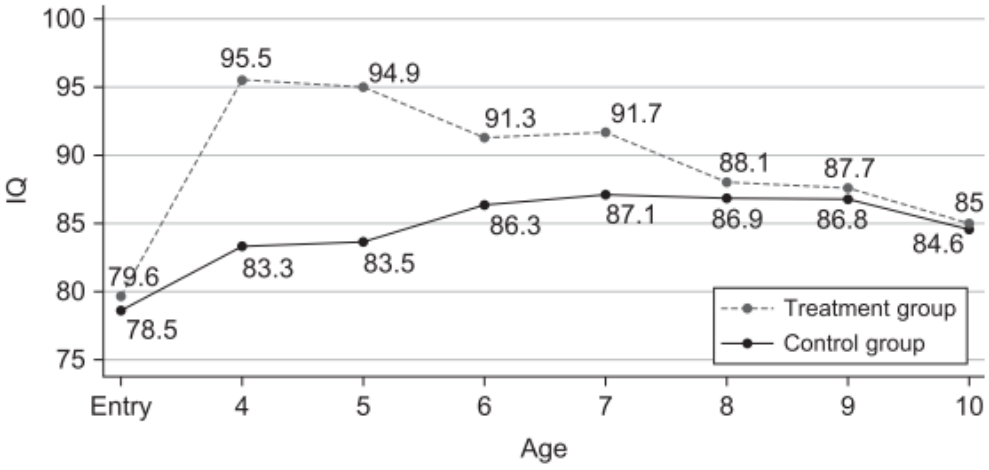

Figure 1.1 Perry Preschool Program: IQ, by age and treatment group
Source: (Almlund et al. 2011, 5)

Domain-specific abilities are those competencies that have, instead, a subject-specific focus. Here, the dimension under examination refers to acquired knowledge, which is often captured by teacher-assigned grades or standardised achievement tests. International large-scale surveys of students' and adults' performances, such as the Programme for International Student Assessment (PISA) or the Adult Literacy and Life Skills (ALL), has largely influenced the measurement of domain-specific abilities. More generally, scholars agree in claiming that both native and foreign language competencies, as well as mathematical and scientific literacy, are important domain-specific competencies since they enable individuals to successfully deal with everyday problems and situations (Weinert et al. 2011).

1.1.1.2. Non-cognitive skills

Despite being extensively studied by personality psychologists since the past century, non-cognitive skills, i.e., an heterogenous set of abilities beyond intelligence, reasoning, and acquired knowledge, have been recently recognized as crucial for later success in the field of economics of education (Almlund et al. 2011). Although varied in their nature, these skills are normally grouped together with the umbrella term 'non-cognitive' and previous findings show that non-cognitive abilities such as attention, self-regulation and perseverance strongly relate with academic achievement (e.g., writing and numeracy); psychosocial outcomes (e.g., mental health problems); social skills and school readiness; cognitive and language outcomes (e.g., overall intelligence, verbal and performance intelligence, expressive and receptive vocabulary) (Smithers et al. 2018). Moreover, achievement motivation, personal goals, the development of interests both inside and outside school, self-concept and self-regulation, personality and social-behaviour are additional non-cognitive skills that research indicate as pivotal for educational performances, processes, and competence development (Wohlkinger et al. 2011).

However, although research highlights the relevance of these 'non-traditional' abilities, the literature lacks a clear and univocal definition of non-cognitive skills. The latter have been variedly named, with most recurrent synonyms being soft skills, personality traits[3], character skills or socio-emotional skills. Therefore, the term encompasses a varied set of attributes that includes different characteristics, such as "perseverance, motivation, self-esteem, self-control, conscientiousness, and forward-looking behaviour" (Cunha and Heckman 2009, 323). Recent classifications distinguish three relevant dimensions: (1) achieving goals; (2) working with others; and (3) managing emotions. The first dimension relates to engagement, i.e., students' commitment at school and passions for goals; effort (i.e., the mental energy devoted to learning); and perseverance (i.e., students' endurance and self-control to concentrate in tests). The second dimension links to social communication and team-working abilities, while the third one focuses on dimensions such as emotional stability, self-esteem, and impulse control (OECD 2015; Azzolini et al. 2019). Table 1.1 briefly summarizes the set of learning outcomes, both in the cognitive and in the noncognitive sphere that children form and develop during the first years of life.

[3] Personality traits are generally represented by the well-accepted Big Five taxonomy (i.e., openness to experience, conscientiousness, extraversion, agreeableness, neuroticism) and are rather stable individual characteristics, hard to change (Azzolini et al. 2019). Since we are interested in aspects that may change according to the social settings and external stimulation, we decide to not consider those traits in this dissertation.

Table 1.1 Main early learning outcomes of interest

Cognitive skills	*Domain-general*	e.g., pattern recognition, process speed, memory…
	Domain-specific	
	Emergent reasoning	e.g., non-verbal problem solving, visual perception and analysis…
	Emergent literacy	e.g., preverbal communication, vocabulary, listening comprehension, phonological awareness, reading…
	Emergent numeracy	e.g., working with/knowledge of numbers, counting …
Noncognitive skills	*Achieving goals*	e.g., engagement, effort, perseverance…
	Working with others	e.g., communication, teamwork, empathy, trust…
	Managing emotions	e.g., emotional stability, self-esteem, impulse control, social behaviour…

Source) Own elaboration, adapted from OECD, 2015.

1.1.2. If skills are changeable, how do they develop over time?

Even though the process of skills acquisition is a *dynamic* one, thus occurring throughout the entire life from childhood to adulthood, some periods are more *critical* than others. Early childhood represents a fascinating period since (a) learning occurs at a fast pace, and (b) it sets the conditions for further development. For what concerns the first statement, recent psychological research demonstrated that cognitive development begins already in the womb, with foetuses that exhibit different movement patterns, such as yawning, stretching, thumb-sucking, and rotating, already by the fifteenth gestational week. Foetuses have been found to have, in addition, a rudimentary form of memory (e.g., they can remember the maternal voice and learn some specific piece of music), attention (e.g., their heart rate has been found to decelerate to certain sound), and learning (e.g., their hearts are found to habituate to vibroacoustic stimuli) (Goswami 2008).

After birth, the subsequent years of life are of fundamental relevance for children's cognitive, linguistic, motor, social and emotional development: it is specifically during infancy and early childhood that the brain has a high degree of plasticity and develops at a fast speed. Shortly after birth most of the 1,000 trillion connections present in the adult brain are formed. Children's brain doubles in size, new synapses (i.e., connections between neurons) are formed, while old ones are pruning away for adapting to the surroundings. Brain's circuits become more and more specialized and efficient and, by the age of three, children's brains are more active than those of an adult (Goswami 2004; Center on the Developing Child at Harvard University 2016). Moreover, during the first five years of life basic skills are rapidly and simultaneously formed in diverse domains, from the sensory-motor area to the cognitive one, from the development of social to emotional skills (OECD 2018). Therefore, despite knowledge is built over time, early years are a fertile period where children's learning capacities are at their

maximum while, with the passing of years, the process of learning new skills becomes more problematic, since it needs more effort to be accomplished (Figure 1.2) (OECD 2018).

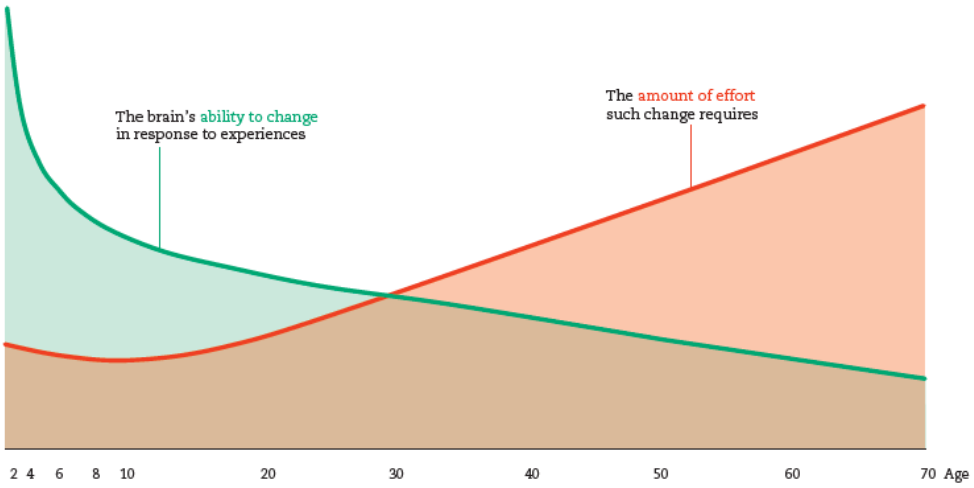

Figure 1.2 The brain ability to change as a function of age.
Source: (OECD 2018, 6)

Examining skills at early ages is relevant because skills are *self-productive*, meaning that skills acquired in a specific period are self-reinforcing for those acquired later (Cunha and Heckman 2007). According to the economic literature, the highest returns of investments in individuals' human capital occur when individuals are at their initial stage in life, i.e., well before the beginning of primary school (Figure 1.3). Therefore, the higher the number of abilities obtained during childhood, the higher the number of abilities at a later period. The 'skills beget skill' requirement applies to both the same skill and to skill coming from diverse ability realms. For example, learning to speak a foreign language before turning 12 years old corresponds to speaking it without an accent than it would have been if children start to learn than idiom at older ages. At the same time, in a process of cross-productivity ok skills, strong emotional security feeling at a given point in life promotes, for instance, successive acquirement of maths abilities) (Cunha and Heckman 2007). Moreover, despite early years matter tremendously for the development of skills, later age points are important too: because of the *dynamic-complementarity* of skills early investments facilitates the productivity of later investments but, for being effective, to early investments should follow other investments at later age points (Cunha and Heckman 2007).

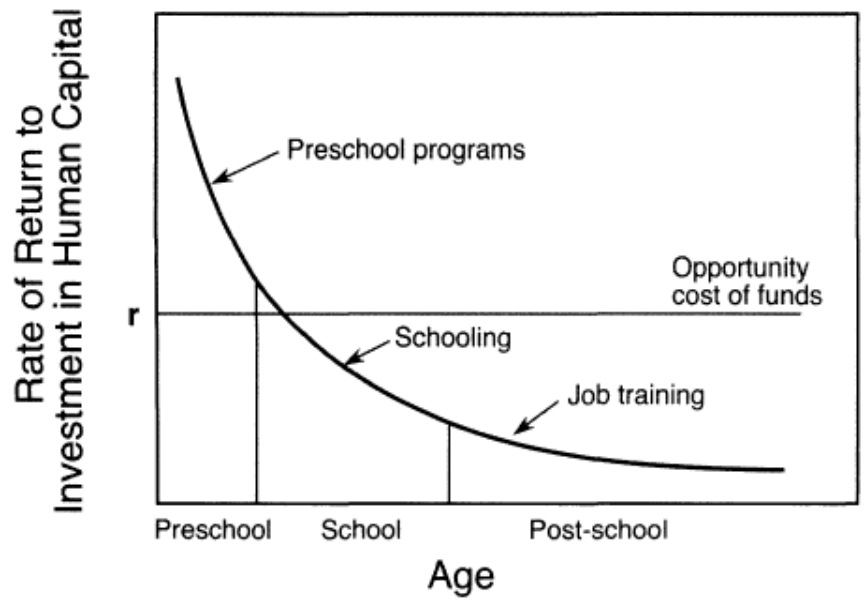

Figure 1.3 Rates of return to investment in human capital as a function of age
Source: (Knudsen et al. 2006, 10157).

1.2. Learning in contexts

Hereditability alone cannot explain the onset of individual differences in skills, educational achievements, and attainments that find a complete description only once environmental influences and conditions are considered in the picture. Findings from research on the social and emotional growth of children report how in fact that "even when there is a gene (or a set of genes) that places individuals at risk of poor health or development, the environment can play a decisive role in determining how that gene (or set of genes) is expressed" (Waldfogel 2006, 17). Thus, the process of skill formation is not only a matter of genes and brain plasticity, but learning is a socially mediated process where diverse actors relate in their surrounding social contexts (Bäumer et al. 2011a). Learning is life-long nourished by and occurs via the interactions that children have with their proximal and more distant environments, in terms of the social exchanges they can have with, for instance, their parents, kins, peers, teachers, in their neighbourhoods, schools and other learning places (Shonkoff and Phillips 2000).

Therefore, learning does not occur in a vacuum, but it is the product of complex synchronic and dynamic interactions between an active, developing child with his/her surrounding environments. The Bronfenbrennerian *bio-ecological model* (Figure 1.4) well depicts the complex interplay of relationships and exchanges in diverse settings that can affect the process of children growth. The contexts, where children are reared from their infancy

onwards, are multiple and nested one in the other. They include networks of children's proximal family and extended family; childcare, preschool, and school settings; friendships and neighbourhood networks; the broader social structure of a society, with specific cultural norms, societal values, and institutions. All these interactions and reciprocal influences between different systems occur over time, within a c*hronosystem*, that accounts, for instance, for major life transitions as well as for environmental and historical events (Bronfenbrenner and Morris 2006; Shonkoff and Phillips 2000; Linberg 2017). Of great relevance is the emphasis given to the role of children, who are not considered passive and incapable actors anymore, but active individuals able to affect, with their peculiar personal endowments and traits, the environments in which they grow. For making an example, both parents and children bring into action their characteristics, multiple and specialized skills, and both change because of their mutual interaction (i.e., Sameroff's *transactional model*). If these are the premises, the core of the transactional-bio-ecological model lies in the so-called proximal processes, i.e., "particular forms of interaction between organism and environment (…) that operate over time and are posited as the primary mechanisms producing human development" (Bronfenbrenner and Morris 2006, 795). To be effective, these interactions "must occur on a fairly regular basis over extended periods of time" (Bronfenbrenner and Morris 2006, 789). These enduring interactions are not just a reciprocal interplay between individuals (e.g., between children with parents, educators, and peers) but they can also involve symbols and objects (e.g., group or solitary play, reading) (Linberg 2017).

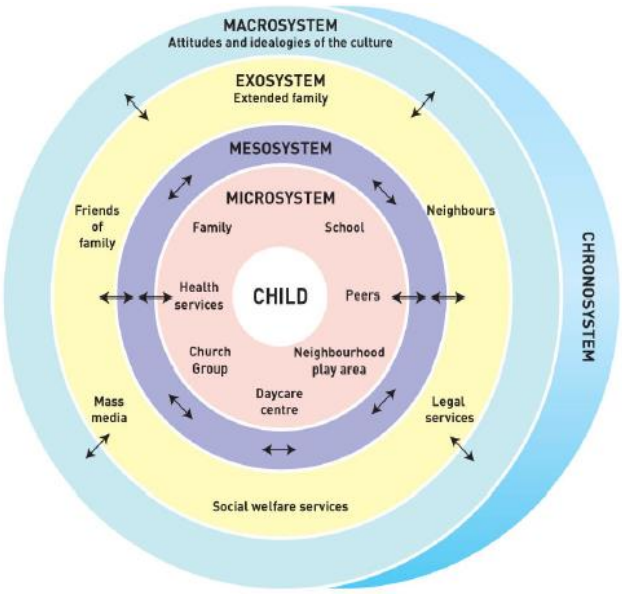

Figure 1.4 The Bronfenbrenner's ecological perspective on child development

Source: (Greene et al. 2014, 6)

1.2.1. Which learning contexts?

The contexts in which individuals acquire and develop their skills are multiple and multidimensional, usually denoted with the adjectives formal, nonformal, or informal.

Formal learning environments are the institutions of the educational system where education is normally carried out. In these settings, learners are qualified, based on their age, with the terms pupils or students and are taught by qualified personnel, who offer specific curriculum-based learning. In these settings, learning is usually compulsory up to a certain age point and it is highly structured in its content, timing, and subjects. Within the formal environments of schools, universities, and apprenticeships, individuals receive certificates that prove their competencies; learning follows a more or less ordered trajectory that, from early childhood education settings to primary schools, lower and upper secondary schools, finally culminating with tertiary education (Rauschenbach et al. 2004; Bäumer et al. 2011a).

Research interests have been mostly devoted to examining the standardized, carefully arranged and programmed learning offered by formal environments leaving rather understudied the influence on child development of other complementary environments. More specifically, learning in informal environments is rather self-imposed, since it is based on an individual choice, slow-going, and flexible. In these settings, for the vast majority of cases, learning is unscheduled, incidental, and implicit. The learning process is described, indeed, as "active, voluntary, self-discovering, self-determined, open-ended, non-threatening, enjoyable, and explorative" (Boekaerts and Minnaert 1999, 536). Informal learning environments are, for instance, those provided by family members, peers, and significant others. Non-formal learning environments are less clearly located within the structure of the educational system, being somewhat in-between between formal and informal learning. These settings (e.g., child and youth services, religious communities, museums, sports associations, or music schools), despite being structured and intentional, are neither regulated nor formally supported (Boekaerts and Minnaert 1999; Rauschenbach et al. 2004; Bäumer et al. 2011a; OECD 2015). Because the interest of this dissertation lies in educational inequalities and the relevance of early years for skill development, we focus on two learning environments where, we claim, children spend most of their time while in infancy and early childhood. These are the home learning environment (HLE hereafter) and the early childhood education system (ECE hereafter).

Among the informal learning context of special interest is the HLE. It is particularly during childhood and adolescence that parents set the conditions for children's development and future learning and, this influence is even stronger during a child's first two years of life,

when constant care, time and stimulating interaction are needed (OECD 2018). The set of familiar resources and the various conditions that parents create at home contribute to shaping children's development. This peculiar setting accompanies children towards all their processes of development, having a long-lasting impact on not just their educational processes but on many other life realms (Cunha and Heckman 2007). Among the formal learning environments, in many industrialized countries young children spend a large amount of time in non-parental care settings nowadays. The ECE has grown in its importance for facing problems of, for instance, (a) work-family reconciliation, because of high participation of women in the labour market and an increase in single-parent households, (b) low fertility rates, and (c) risks of poverty and social inclusion. Moreover, more recently, the formative years before entering compulsory primary school are increasingly acknowledged as foundational for further development and, consequently, (d) early childhood education is largely perceived as an investment in children's learning, which produce a much consistent return in human capital than similar investments at older ages (Gambaro, Stewart, and Waldfogel 2014; European Commission 2013).

1.2.2. Home Learning Environment

Among different environments, family represents the first proximate context in which children are raised, socialized, where they first acquire basic skills and start to form their behaviour (Masten and Schaffer 2006). Even if education is normally associated with formal settings, studies have found that family influence on children's development is always stronger than any institutional educational influence (Sylva et al. 2004; Melhuish et al. 2008). Therefore, it seems that "the care that young children receive from their parents (…) lays the foundation not just for their physical growth and health but also for their cognitive and emotional growth and development" (Waldfogel 2006, 38). This occurs since parents are among the first actors who are responsible for children's process of skills formation long before they enter compulsory school. It is particularly during childhood that parents set the conditions for children's development and future learning, having a pervasive impact on their offspring's attitudes towards learning, school readiness, and academic achievements (Sammons et al. 2015).

1.2.2.1. Understanding the multidimensional nature of HLE

As a demonstration of warm, supportive feelings and interest in children's growth and learning, empirical findings show how a genuine and active parental involvement significantly and positively relates with school readiness and educational outcomes (Baizán, Domínguez-

Folgueras, and González 2010; OECD 2011a; Gracia 2012). It stimulates the development of skills while, at the same time, it keeps alive two important precursors of children's school success, i.e.: curiosity and motivation for learning (Pomerantz, Moorman, and Litwack 2007; Melhuish et al. 2008). However, parental involvement is a difficult concept to define because it encompasses several strategies that contribute to improving children's learning process. In the literature, three are the dimensions that conceptualize this concept: parenting goals and beliefs, styles, and practices.

Parental beliefs refer to "what parents expect the course of development to look like and what parents see as their own role in children's development" (Hoff, Laursen, and Tardif 2002, 235), while parental goals are the outcomes towards which parents direct their effort. Research extensively indicates that parental belief system and aspirations for their offspring's educational attainment is positively linked with many educational outcomes, such as children's setting of academic goals, effective achievements, persistence in school, course enrolment, intellectual abilities, and attendance of college (e.g., Bronstein, Ginsburg, and Herrera 2005). Parenting styles measure the attitudes parents have towards their offspring; the emotional climate through which these attitudes are communicated; the atmosphere in which children are raised, thus including measures of sensitivity and responsiveness (Baumrind 1966; Spera 2005). Parenting styles have been further divided into three types within the well-known taxonomy offered by the clinical and developmental psychologist Diana Baumrind: authoritative, authoritarian, and permissive[4]. Authoritative parents are those who most beneficially influence child development thanks to their appropriate behaviours. Finally, parenting practices encompass a large domain of behaviours that parents have during their interactions with their offspring. These practices help children to reach different socialization goals. If the aim is to enhance school proficiency, parental practices at home may involve, for instance, doing homework together or providing an environment that is supportive to literacy goals through the presence of books or with the engagement in cognitively stimulating literacy activities on a routine basis (Darling and Steinberg 1993; Hoff, Laursen, and Tardif 2002; Pomerantz, Moorman, and Litwack 2007). For instance, beneficial parenting practices for skill development during early childhood are singing songs, reading, and telling stories. These activities help children learn, encourage imagination

[4] Permissive parents behave in a nonpunitive, acceptant, and affirmative way. Permissive parents allow children to regulate their activities, without exercising control. Authoritarian parents shape and control children's behaviours according to a set of standard imperatives. Authoritative parents supervise children's activities in a rational manner, they encourage verbal communication for children giving reasons for their behaviour. Authoritative parents recognize and enforce children's expressions of their individual interests (Baumrind 1966, 1978).

and phonological awareness, improve children's vocabulary and love for language (Rodriguez and Tamis-Lemonda 2011; Waldfogel 2012). Of course, these 'developmental' practices are changeable, since they strictly relate to the specific life-stage children are living. For balanced growth, children need both *physical care* (e.g. feeding, bathing, putting children to bed, watching over…) and *interactive care* (e.g. playing, reading, verbal interaction, and teaching) (Gracia 2014). Parents of infants and toddlers are highly involved in physical care (Waldfogel 2006), which is devoted to accomplishing children's basic needs, security, and well-being. For these reasons, physical care is highly demanding, being both physical- and time-intensive (Cano 2019). Instead, interactive care depicts activities that are devoted to children's cognitive and social needs (Gracia 2014). Despite interactive care being more present during the preschool phase (i.e., when children aged 3 to 5 years old) (Gracia 2015), it may be that parents spend developmental time with their offspring also at older ages since they aim at ameliorating their offspring's skills through appropriate stimuli.

1.2.2.2. Evidence for the influence of early years HLE on skills

Previous studies have mainly examined the short-term impact of various HLE dimensions on achievements. For England, Melhuish and colleagues (2008) find that children's activities at home, such as the frequency of reading, going to the library, playing with numbers, painting and drawing, being taught letters, numbers, songs/poems/rhymes, has a significant positive effect on literacy and numeracy achievements at age 5 and 7. More recent longitudinal associational papers for the whole population find robust evidence for the beneficial influence of different dimensions of early HLE on cognitive development mostly during childhood and, in a few cases, lasting also in adolescence. In Australia, for instance, children with a low-increasing parental involvement over time (the observation period goes from when children are 2 to 6 years old) score below the national minimum standards on reading, writing, and numeracy literacy once compared to children whose parents have been stably involved in shared book-reading practices during early childhood (Hayes and Berthelsen 2020). Dimosthenous, Kyriakides, and Panayiotou (2020) report that, in Cyprus, HLE has significant, albeit low, short- and long-term benefits on students' achievements in mathematics (i.e., during the first school year and after two consecutive school years) especially when looking at measures linked to learning materials[5] rather than that those linked to joint parent-child activities. Silinskas and colleagues (2020) offer additional evidence of the long-term effect of early years HLE on

[5] Such as books, musical instruments, computer, access to the internet and encyclopaedias.

language and literacy skills in primary school in Finland, while Lehrl and colleagues (2020) confirm the beneficial influence of both early and secondary school HLE on reading and maths competencies in Germany. Going beyond primary school years, Sammons and colleagues reinforce the claim that early HLE[6], along with some specific dimensions of HLE at later ages, is associated with academic achievements in English and maths at 14 and 16 years old in England. Finally, by looking at the HLE characteristics of a sample of low-income children in the US, Rodriguez and Tamis-LeMonda (2011) reveal a strong association between HLE, vocabulary and emergent literacy skills across children's first 5 years of life, highlighting the advantage of children who have been constantly experienced stimulating HLE against those who lived in less supportive environments. To the best of our knowledge, evidence for an enduring influence of early HLE on socio-emotional skill development is much overlooked.

1.2.3. Early Childhood Education

Since the 1960s a rising number of children has been enrolled in ECE (Melhuish et al. 2015). In 2014, almost nine out of ten four-years-old (87%), 78% of the three-year-old children and about 40% of those aged two years old were enrolled in early childhood education7 in the OECD countries (OECD 2017a). Over the years, childcare has been conferred with two main functions: on the one hand, it supports mothers' employment and work-family balance, on the other, it is a way for investing in children's human capital. First, in recent years, female labour force participation has rapidly increased in most countries, but mothers still struggle to achieve a satisfactory work−life balance. Childcare facilities are important measures that help the primary caregiver, usually mothers, to take time away from childrearing for employment. Indeed, research has found that labour market participation, particularly of mothers, is relevant for pushing demand for childcare services and, in turn, the availability of these settings increases especially female labour market participation (Del Boca 2015). Being able to come back to work is important since, in this way, mothers can avoid risks of poverty for their families through income gains. Childcare has been recently seen also as an investment in children's human capital, being a tool for homogenizing children's school readiness and equalizing life

[6] i.e., frequency of parent-child learning activities and routines during preschool years.

[7] With the term early childhood education, OECD considers both early childhood educational development programmes (ISCED01) and pre-primary education (ISCED02). The former targets especially children under 3 years old, providing a visually stimulating and language rich environment, where children can especially foster their language acquisition and communication and motor skills. The latter refers to programs aimed at children in the years prior to primary school enrolment, i.e., between 3 and 5 years old. Children improves here their language and social skills, starting to develop logical and reasoning abilities, with the introduction of alphabetical and mathematical concepts as well (OECD 2017a).

chances from the very beginning (Esping-Andersen 2009). ECE has become, therefore, an educational right for every child, regardless of their ages and socio-economic backgrounds.

1.2.3.1. Features of ECE in Europe

"The availability of high-quality, affordable childcare facilities for young children from birth to compulsory school age is a priority" (European Commission 2013, 4) for the European Union, confirming the relevance that these services have gained in the public international debate over the years. In 2017, the European Commission further states that high-quality affordable early childhood education and care is a right for all children, but in particular for those who come from disadvantaged backgrounds, who "have the right to specific measures to enhance equal opportunities" (European Commission 2017, 19). However, in exploring the role of the early childhood education system for inequalities in early educational opportunities and outcomes, we should consider the characteristics of the care regime. In fact, the ECE system efficacy in reducing inequalities varies, in Europe, according to four specific features: availability, accessibility, acceptability, and adaptability[8].

Availability refers to the governmental commitment to provide ECE (van Belle 2016) as a children's right to education. Certainly, ECE provision varies greatly across Europe. The vast majority of countries deliver childcare in centre-based settings separately, depending on children's age. Young children, from infancy to toddlerhood (i.e., between 0 and 2 years old) are cared for in the so-called early childhood care and education (ECEC hereafter) system, while children from three years to school age are enrolled in preschools[9]. This general division reflects the fact that services, in the first age phase, are perceived more as care settings while, at older ages, they start to be more directed also towards the provision of early education for supporting school entry. In some countries, there are unitary single integrated ECE settings, in which children from different ages attend the same environment until they reach school age. Goals are here explicitly devoted to fostering their cognitive, social, and emotional development. The authorities in charge of ECE reflect whether the pedagogical approach is more or less devoted to either educational aims or the care dimension. In some countries, the ministry of education is in charge of the ECE phase. This suggests that the pedagogical approach is interested in boosting school readiness rather than just focusing on children's care.

[8] The 4-A (Availability, Accessibility, Acceptability, and Adaptability) framework has been developed by the United Nations to describe obligations governments have about the human right to education (Tomaševski 2001).

[9] In this PhD dissertation, we refer to ECEC when indicating childcare services for the under-threes, while with the term preschool we specify setting devoted to caring for the above-three years old children.

The latter perspective is, instead, more relevant when the ministry of family and social affairs is responsible for the ECE phase, as it happens in other countries especially for children younger than three years old. Not only the public sector (i.e., the government with its ministries) is responsible for regulating and supporting childcare but, in most European countries, centre-based ECE provision exists together with private and home-based childcare provision (European Commission/EACEA/Eurydice 2019). Although European countries are more and more converging around liberal and market-centred norms (Mahon et al. 2012), they differ in their level of decommodification, i.e., the level to which childcare provision is reliant on the market sector. In highly decommodified countries the state is the main provider of formal childcare services, while the market sector just accounts for a little slice of the supply. When the level of government investment and intervention in ECE is low, childcare services are rather expensive, especially if they are of high quality. Childcare coordinators need to rely mostly on family fees for coping with high production costs, such as adequate payment for their highly educated and trained staff, provision of better learning materials and so on. Moreover, apart from issues in accessing institutional care, the quality of private childcare may be lower than that offered in public childcare. This is because private childcare settings have different levels of adherence to and fewer oversights on pedagogical guidelines and curricula, safety and hygiene standards, staff-child ratios and so on than public subsidized settings (OECD 2011c).

The more accessible services are for all those in need or who ask for them, the higher their level of universalism (Van Lancker and Ghysels 2016). *Accessibility* refers, therefore, to the governmental commitment to provide all children with access to ECE services (van Belle 2016), thus enabling their right to education. Two are the principal ways through which governments guarantee ECE access: (1) via legal entitlement or (2) by making its participation compulsory. In the first case, children are, up to a certain age, entitled to a place in ECE if their parents request for it regardless of their parents' employment, socioeconomic and family status. However, attendance is not compulsory. In the second case, children are guaranteed a place in ECE but, reaching a certain age, they are obliged to attend formal childcare[10]. In the case of legal entitlement, there is a defined maximum amount of free-of-charge hours that children can

[10] In the school year 2018/2019, only Norway together with seven European countries (Denmark, Germany, Estonia, Latvia, Slovenia, Finland, and Sweden) offered a guaranteed place in ECE to children aged between 6 to 18 months. Afterwards, i.e., at age three or older, more countries offered a legal entitlement to ECE instead, with around a quarter of European education systems provide guaranteed places in preschools. ECE is compulsory from the age of three in Hungary and for the last year of ECE, and therefore, depending on the context, for children aged 4, 5 or 6 years old, in Serbia, Switzerland, Bosnia-Herzegovina, Sweden, Finland, Poland, Austria, Cyprus, Croatia, Greece, Czechia, Bulgaria, Netherlands, Luxemburg, Lithuania, and Latvia. At these ages, some European countries do not offer any guarantee, such as Italy and Ireland (European Commission/EACEA/Eurydice 2019).

attend in ECE while, in the case of compulsory attendance, regulations specify also the minimum number of hours that children are required to attend. In both cases, anyway, families may ask for additional hours that are publicly guaranteed (European Commission/EACEA/Eurydice 2019). The time spent in ECE is a relevant issues both from parents' perspective and for enabling children's talents and aptitudes. Therfore, childcare flexibility, measured in terms of opening hours, is another relevant issue, since it determines "the extent to which childcare services can be used and cope with contraints of time and distance" (Yerkes and Javornik 2019, 535), with childcare services that offer standard work hours and timetables being more accessible, since able to reconcile parents' work and care schedules, than services with limited or non-standard provision. In general, the number of subsidized weekly hours varies between (a) part-time frequency (i.e., up to 20 hours); (b) full-time frequency (i.e., 30 or more hours); and (c) school time-frequency (from 20 to 29 hours). Part-time ECE frequency permits both preparing children for school and containing costs for families. Full-time ECE frequency focuses much more on enabling working parents to balance their work-family duties while school time-frequency shifts the focus towards educational goals (European Commission/EACEA/Eurydice 2019).

Hence, we expect that in more universalistic countries formal care use is more equally distributed across different social groups while, where childcare services are rationed, socially deprived and vulnerable groups are more likely to opt for other care sources with (high-quality) childcare settings being disproportionally used by offspring from socially privileged families (Henly and Lyons 2000; Vandenbroeck et al. 2008). Finally, drawing on welfare regime theory, it is important to consider the level of availability of other policies that push families to opt for institutional childcare settings rather than other forms of care, i.e., the level of defamilization. For example, the length and generosity of parental leave may accelerate or, on the contrary, postpone access in the early childhood education system. Through parental leave, parents are allowed to take care of their young children while, at the same time, maintaining their contractual position once returning to work. As suggested by Van Lancker and Ghysel (2016), we might expect that, in countries where the demand of care highly exceed the supply, long periods of parental leave can disincentivize return in the labour market of especially low-skilled mothers, who are typically employed in less remunerative jobs (Hegewisch and Gornick 2011). This, in turn, may favor the (male) breadwinner family model or it can stimulate the reliance on other types of care arrangements, such as care provided by grandparents or close relatives. On the contrary, allowing children to early enroll in free public childcare as well as flexible, standard-work opening hours may have a clear defamilizing effect, reducing children's reliance

on their parents and parental dependencies on their families and acquaintances for care (Lohmann and Zagel 2016)

Acceptability, labelled as quality in other framework (e.g., see Yerkes and Javornik 2019), refers to the governmental commitment to provide services of good quality (van Belle 2016), thus enforcing children's right to education. As stated above, the literature on child development agrees in suggesting that two dimensions are mostly relevant for child development, i.e., structural and process quality. The first dimension relates, for instance, to the level of professionalism of the educators who are "those professionals who have daily, direct contact with children and whose duties involve education and/or care" (European Commission/EACEA/Eurydice 2019). Staff educational requirements have increased in many European countries and different competencies, e.g., in early childhood pedagogy and psychology, are mandatory for working in ECE. In most European countries, and especially where there is a split system, educators need to hold at least a Bachelor degree. Apart from staff qualifications, other important criteria of structural quality are the child-staff ratios and appropriate group sizes. Low ratios and small group sizes help ensure a balanced workload and a one-to-one interaction, which is important for harmonious social, emotional, and cognitive development[11] (European Commission/EACEA/Eurydice 2019). Process quality relates as above said, to the interactions that children can have with their educators, in the first place, but also with their peers and surrounding materials (Kluczniok and Rossbach 2014). Caregivers sensitive and warm responsiveness to children's needs and literacy stimulation are beneficial for developmental outcomes in preschool years (Burchinal et al. 2008). Finally, educational guidelines are of great importance when aiming at improving children's learning. However, these guidelines, which set the focus for the daily activities of children in formal care settings, are more common for services in charge of children older than three years rather than for those involved with the care of younger children. Moreover, pedagogical plans differ between ECE settings (European Commission/EACEA/Eurydice 2019) and, despite all governments have the pressure of providing high-quality care services (European Commission 2014), the policies underpinning them vary substantially, with countries that have already achieved a good level of quality care provision, such as the Nordic countries, and others where, due to the marginal role of the state in providing care, quality remains an issue, as it is the case of English-speaking

[11] In general, in Europe, the maximum number of children per group increases from 12 to 16 at age 2, from 23 to 25 at age 4, with large variation between countries (e.g., at age two the maximum is set to 9 in Romania, 24 in Czechia; at age 4 to 19 in Malta, 30 in the United Kingdom) (European Commission/EACEA/Eurydice 2019).

countries. Despite this, what is understood by quality vary greatly between (and within) countries and it was just recently that the European Commission proposed a quality framework for empowering the quality of the formal care services of its Member States (European Commission 2014).

Adaptability refers to the governmental commitment to provide an inclusive service towards, for instance, children's of minority groups, refugee children, children at risk of poverty and social exclusion, children with disabilities. As such, adaptability strongly relates to issues of *affordability*: promoting fee reductions and priority access through eligibility criteria should, for instance, allow higher inclusiveness. However, most parents have to pay childcare fees, especially for children younger than three years, while, once children get older, ECE access become almost universal and free of charge. Several countries have targeted measures that facilitate ECE accessibility for children with disabilities, migration backgrounds, or that come from regional/ethnic minorities. Another important set of priority admission criteria are: (i) having both parents who work (full-time or part-time) or study; (ii) having parents with turns at work or commuting; and (iii having other siblings, especially if aged 0 to 3 years. Another group of criteria relates to family socio-economic conditions, such as parental unemployment, living in a single-headed household, being children in extreme needs (e.g., orphans or fostered children, children referred by social services or homeless, abused children), the proximity to ECE setting (European Commission/EACEA/Eurydice 2019). Thus, in this vein, ECE services can be seen as a tool for, on the one hand, reconciling parental, and in most cases maternal, work-family life and, on the other, for avoiding issues of poverty and social exclusion and favouring social integration (Brilli, Del Boca, and Pronzato 2011). Interestingly, none of these priority admission rules facilitates ECE take-up for single-earner families, thus forcing parents (i.e., mothers) who aspire to re-enter the labour market after childbirth to either stay home for taking care of their children or relying on some other forms of informal care, e.g., relatives or grandparents, when ECE costs are excessive.

1.2.3.2. Evidence for the influence of ECE attendance and quality on skills

In recent years, educational research and policies have been particularly interested in examining the effect of early childhood education and care (ECEC hereafter) programs and preschools on child development. Initially, research has focused on the comparison between children cared for in non-parental settings and those at home, examining the role and consequences of early separations from mothers, parenting, and attachment security. Later, scholars have been interested in analysing the influence of non-parental education for diverse

subgroups of children and, finally, research has started to apply Bronfenbrenner's approach to linking features of the familiar context with characteristics' of children and interactions they live in other educational settings (Melhuish et al. 2015). Empirical evidence across OECD economies reports that 15-years old students who participated in pre-primary education[12] are better performers than those who have not attended ECE, once their socio-economic background is controlled for. The consequences of daycare attendance for children younger than three years old is much more controversial, depicting a rather unclear and inconclusive picture (Gambaro, Stewart, and Waldfogel 2014).

The field of childhood development widely recognizes the importance of attending high-quality ECE and experts in various fields, e.g., in the economy, neurology, psychiatry, and sociology, claim that those who benefit the most from high-quality childcare are children from disadvantaged social groups (Knudsen et al. 2006; Gambaro, Stewart, and Waldfogel 2014). Much of the available research that measures ECE quality through a global construct, i.e., a proxy that includes within a wide spectrum of dimensions linked to both process and structural quality a single measure, relates to children aged three years old or older. Much less research is devoted to explaining, instead, the influence of ECE quality in the 0-2 phase. In Germany, Beckh and colleagues (2015) report little evidence for a positive association of childcare quality on receptive vocabulary skills and socio-emotional development for children with a migration background. In Portugual, Pinto, Pessanha and Aguilar (2013) find that literacy and language skills at 5 years old are better for children who went to high-quality preschool, while no link is detectable for ECEC. Overall, for children older than three years, the general conclusion is that a good ECE quality is beneficial for cognitive outcomes, even from a long-term perspective. In Germany, Anders and colleagues (2013) report, for instance, that the influence of preschool quality on numeracy skills is confirmed up to 7 years old. Evidence from the English EPPSE study shows that preschool quality consistently predicts academic attainments in English and maths up to 16 years old (Sammons et al. 2014). Vandell and colleagues (2010) report a beneficial relation of high-quality preschool attendance at 4 years on pre-academic and language skills at 15 years old. Regarding socio-emotional and behavioural skills, high-quality ECE, particularly in terms of process quality, lessens behavioural problems and improves social

[12] With the term pre-primary education is intended "all forms of organised and sustained centre-based activities- such as pre-schools, kindergarten, and day-care centres- designed to foster learning and emotional and social development in children. These programmes are generally offered to children from the age of three"(OECD 2017a, 3).

competencies at the end of kindergarten (Burchinal et al. 2008), and it is also linked to fewer conduct issues[13] at 15 years old (Vandell et al. 2010)[14].

1.3. Quantity and quality effects

As described above, from birth onwards "a child's growth and development are intimately tied up with both the proximate and distal context in which they live" (Greene et al. 2014, 4) and the complex network of relationships in which they are embedded shapes their acts, choices, thoughts, and ways of feeling. According to Bäumer and colleagues (2011a), further attention to understanding the emergence of inequalities in skills should be devoted to examining features linked to both the quantity and quality of learning environments.

Quantitative effects of learning opportunities refer to the frequency (i.e., attendance), duration, and intensity of the care provided in either HLE or ECE contexts (Becker and Schulze 2013). More specifically, children's frequency of learning environments may vary greatly according to the age at which children first attend childcare services (i.e., timing), the length of experience (i.e., duration), and the number of hours spent in a specific learning environment (i.e., intensity) (Melhuish et al. 2015) *Qualitative effects* of learning opportunities are of strong significance and they are defined, generally, by two dimensions, i.e.: structural and process quality (Becker and Schulze 2013). Structural quality is defined by a single indicator, i.e.: (i) structure. The latter links to "the arrangement of the educational processes taking place in the learning environment, thus providing, for example, safeness, stability, or clarity of rules to the learner" (Bäumer et al. 2011a, 93). Process quality is more complicated to evaluate than structural quality. Three dimensions capture the concept. i.e.: (i) support, that reflects "positive emotional relations to peer and adults in the learning environment, understanding, feedback, support for autonomy and competence, and social embedding"; (ii) challenge, that relates to "tasks that are not too demanding but also not too simple to be solved by the learner (…) such tasks will also be cognitively activating"; and (iii) orientation, that can be seen, for example, in "shared values and norms, coherence among members of the group/organization, and clear expectations" (Bäumer et al. 2011a, 93). However, although these three dimensions are

[13] Measured through 30 items, which stem from the Youth Self-Report (YSR) scale, i.e., an adolescent self-reported battery of 119 items that reflect a broad range of behavioural and emotional problems, and 16 items linked to socially desirable items.

[14] The above presented review of the literature shows just some of the main findings on the relationship between ECE attendance and child development. More details are covered in the empirical chapters (i.e., Chapters 2 to 4) accordingly to the specific topic covered.

theoretically diverse, it is not always easy to empirically measure them separately. Table 1.2 below examines the main quantitative and qualitative characteristics of HLE and ECE settings.

Table 1.2 Main quantitative and qualitative characteristics of the informal and formal learning environments

Context	Quantity	Quality	
		Structural	Process
HLE	Duration Intensity	*Structure*: Family social, economic, and cultural resources Family composition, size	*Support*: Parenting styles *Challenge*: Parenting practices, learning resources. *Orientation*: Parenting goals
ECE	Frequency Timing Duration Intensity	*Structure*: Child-group size Child-adult ratio Staff training	*Support*: Adult-child interactions *Challenge*: Adult-child interactions, learning resources/facilities *Orientation*: Educators' beliefs

Source) Own elaboration.

1.4. Socioeconomic aspects of learning environments' characteristics and skill development

The sociological research on achievement gaps in preschool and school-age consistently points out that children's social origins exert a powerful influence on educational performances. More recently, longitudinal studies on mainly cognitive outcomes (e.g., literacy and maths skills) underline that this relation is rooted in early years, dramatically emerging already before entering formal schooling. Depending on the context under analysis, social gaps in skills tend to remain fairly stable (or little diminishing) during primary schooling, for increasing once children enter and move along secondary school (Bradbury et al. 2015; Passaretta, Skopek, and van Huizen 2020; Dämmrich and Triventi 2018; Passaretta and Skopek 2018; Skopek and Passaretta 2018). Four are the main theories that have been used in the sociological literature of child development for exploring the relationship between family socio-economic status (SES hereafter) and the emergence of early social inequalities in skills. These are: (1) the family investment model; (2) the family stress model, (3) cultural accounts of SES, and (4) stratification of schooling opportunities (Kulic et al. 2019). Of these models, the last two have been predominantly used for explaining the SES effect on early achievements (Linberg 2017; Skopek and Passaretta 2018).

The *family investment* model stems from the educational economic literature and it stresses the role of available family resources for sustaining children in their process of growing up. In particular, the theory indicates that the chances of supporting child development are linked with parental social positions, captured by family economic resources, education, and social class. According to this theoretical approach, affluent families are thought to have more

chances to provide their offspring with better learning materials and activities, more beneficial parenting practise, and high-quality care than less well-off parents, because of their higher level of financial and knowledge resources (Kulic et al. 2019; Skopek and Passaretta 2018). Empirical results confirm that low-income families are less able to support their children's literacy development compared to high-income parents (Duursma, Augustyn, and Zuckerman 2008); findings also confirm that parents with limited reading abilities are less able to read with their children than their well-educated counterpart and this, in turn, may impede to furnishing children with adequate learning support (Sullivan, Ketende, and Joshi 2013). Additionally, high-SES parents are found to be more prone to enrol their offspring in (high-quality) ECE settings (Pavolini and Van Lancker 2018), since they are more aware of the possible skill-boosting role of these formal learning environments than their less socially advantaged counterparts.

The second model, the so-called *stress model*, provides a psychological explanation for the association of family social position with educational performances. The model underlies the role of economic hardship in creating pressure and distress for parents, thus negatively influencing family everyday functioning and parenting. Economic downturns, such as job loss, long unemployment, poverty and deprivation, may lead to marital conflicts, to a discouraging and hostile family atmosphere, and they can impede parents to devote quality time to their offspring, thus undermining child development and trouble-free growth (Kulic et al. 2019; Skopek and Passaretta 2018). Hence, according to this model, families with low levels of income may suffer from psychological distress that, in turn, will impede their parenting, having determinantal effects on children's early educational performances. The latter claim is supported by recent work on Irish cohort data of Mari and Keiser (2021), who suggest that parental income differences associated with job loss harm young children vocabulary development and problem behaviour.

The third perspective accounts for differences in the *cultural capital and cultural identity* of parents from different social positions. According to Bourdieu (1986), socially dominant privileged groups can count on a greater quantity of cultural resources as their less advantaged counterpart, which better support their offspring in their scholastic path and which are better rewarded and highly appreciated at school since, as the theory assumes, school pedagogical practices and assessments are related to the culture of the upper class (Barone 2006). Cultural capital can exist in three forms: the *embodied* cultural capital (i.e., long-lasting dispositions of the mind and body, such as cultural communication, which are transmitted and

converted into an integral part of a person, into a *habitus*[15]), the *objectified* cultural capital (i.e., the material dimension of cultural capital, such as books, pictures, dictionaries, instruments, etc.), and the *institutionalized* cultural capital (i.e., educational qualifications) (Bourdieu 1986; Dika and Singh 2002). Hence, according to their cultural capital, parents from diverse social classes differ in their systems of beliefs and attitudes, information and knowledge, linguistic styles and behavioural codes, social skills, and activities and this, in turn, influence their parental behaviour, i.e., the "groups of beliefs, values, and norms that guide parents in raising their children" (Kulic et al. 2019, 560). In her influential ethnographic study, Lareau (2003) provides a recognized taxonomy of class-specific parenting practices that are either successful (the so-called *concerted cultivation*) or ineffective (the so-called *natural growth approach*) strategies in promoting children's learning. The theory assumes that families differ according to their cultural capital possession and that parents socialize their children accordingly. This means that parents transmit their cultural dispositions and habitus both intentionally and unintentionally to their offspring, with activities and parental involvement on the one hand, and via their interactional styles, language, and attitudes on the other. Working-class parents (or those with a low social position) tend to conform with the natural growth approach, which assumes that "parenting and family activities (…) do should not conflict with children's free time" (Gracia 2014, 139) while, on the contrary, middle- and upper-class parents pursue the concerted cultivation approach, thus frequently encouraging their offspring in activities that feed their talents and stimulate their human capital accumulation from early ages. In practice, the former should expose their offspring to television watching and free playing, while the latter should promote highbrow and formalized activities that are more conductive for educational success in educational institutions, both in terms of achievements and attainments.

Finally, the fourth perspective for explaining differentials in children's skills looks at the stratification of schooling opportunities by social origins. This perspective highlights that those educational inequalities are not just a result of different school performances of children from diverse social groups (i.e., *primary effects*), but they reflect also discrepancies in the educational choices of children from diverse social groups, despite their same ability levels (i.e., secondary effects) (Jackson 2013). Hence, social background influences occur also because of disparities in students' participation and access to formal learning environments, such as early childhood education, secondary school tracks etc. Based on a counterfactual

[15] The habitus is a socially constituted cognitive capacity, a set of dispositions, which guide the styles of social interactions and which is distinctive to each social class (Bourdieu 1986; Barone 2006; De Graaf, De Graaf, and Kraaykamp 2000).

model of school attendance, Raudenbush and Eschmann (2015) avail the hypothesis according to which school works as an equalizer of opportunities between children from diverse social origins. Since formal learning environments are less heterogeneous in terms of quality than home environments and since schools are assumed to provide all children with better instruction than that offered in other environments, children born in less favourable social circumstances should gain the most from learning in institutional contexts. According to the substitution hypothesis, therefore, children of less socially privileged parents are those who should profit the most from the educational stimuli, resources, and materials of high-quality ECE. As such, universal access to (high-quality) preschool should favour children from low social strata, thus diminishing social inequalities in educational opportunities. However, selection into ECE is the norm and not an exception in most European countries (Pavolini and Van Lancker 2018) and are children from well-off families that disproportionally opt and are early enrolled in institutional care settings (Blossfled et al. 2017). Hence, according to the complementarity hypothesis, offspring from middle- and upper-class families should maximize their human capital development by attending high-quality ECE settings. As such, ECE may act as a potential opportunity de-equalizer, favouring from early years the already privileged and serving as a foundation for later educational inequalities (Domina, Penner, and Penner 2017).

2. CHAPTER 2: THE AMBIVALENT EFFECTS OF EARLY CHILDHOOD EDUCATION ON CHILDREN'S COGNITIVE AND SOCIAL SKILLS: A CROSS-COUNTRY STUDY BASED ON AN ENDOGENOUS TREATMENT MODEL

Abstract

This chapter investigates the consequences of attending early childhood education on cognitive and noncognitive skills at 15 years old. We use a counterfactual theoretical framework to examine (1) whether attending ECE affect later outcomes; (2) to what extent social backgrounds influence participation in ECE. By using PISA 2015 data from six countries, we find that preschool is beneficial for later educational outcomes, contrary to ECEC attendance. Early ECEC entry is not riskier than a late ECEC uptake while, in countries where ECE is of high quality and highly accessible, the longer the time passed in preschool, the better the performances in secondary school tests. The effect of ECEC attendance on later skills complements children's social origins while preschool acts as an equalizer of opportunities, especially in countries where it is of high quality and highly accessible. In this case, children from low-SES families gain the most from preschool participation.

Keywords: early childhood education, skill development, social inequalities, endogenous treatment model

2.1. Introduction

Cognitive and noncognitive skills are pivotal for a 'successful' life in the modern world since they strictly relate to educational achievements, labour market returns (e.g., employment and wages) and a variety of desirable behaviours and life outcomes (e.g., engagement in the civil society, health) (Heckman, Stixrud, and Urzua 2006). The process of skills formation is complex since skills are acquired and developed in a variety of formal and informal learning settings throughout the entire life. Moreover, skills develop cumulatively: what individuals learnt in the past works as steppingstones for present and later acquirements (DiPrete and Eirich 2006). Consequently, learning in the earliest years is of great relevance not only because in this life period children acquire knowledge at a fast pace in various domains (e.g., in motor, linguistic, numeric, socio-emotional area), but also because present children's well-being and their future development are strictly linked to the solidity of these basic acquirements (OECD 2018; Heckman 1999). Indeed, if children have not fully developed core skills by the age of seven years old, they will then struggle more to progress, showing, most likely, also social, and behavioural problems once adolescent (OECD 2020). Hence, since skills attained at one point in life persists at later one (i.e., self-productivity), a good start supports following learning and, as such, although not vain, later investments alone could be less effective if not preceded by interventions at crucial life stages, such as early infancy and childhood (Heckman 2006).

It is in these veins that countries have increasingly invested in "early years policies" not only as a tool to increase mothers' participation in the labour market but also for providing all children with a strong start in inclusive and high-quality formal learning environments, regardless to their characteristics and backgrounds (Gambaro, Stewart, and Waldfogel 2014; Blossfled et al. 2017) With the expansion of their early childhood education system (ECE, hereafter) from the early 2000s onwards, many European countries witnessed, therefore, a growth in ECE participation rates (OECD 2001). Given this context, key questions to answer from a sociological perspective are: to what extent does ECE attendance affect children's development of cognitive and social skills? Are these effects durable or tend to vanish over time? Do entry age and intensity of exposure matter for enduring effects?

Two main streams of research have been trying to provide answers to these fundamental questions. The first one investigates the effect of participating in specific early childcare

programs on the learning outcomes of specifically ad-hoc targeted disadvantaged groups[16]. Evidence of this sort stems largely from randomized controlled trials, mostly from the United States, with some further contributions in selected European countries. Overall, results show that high-quality early childhood education and care (ECEC, hereafter) and preschool (PS, hereafter) provision are beneficial for the cognitive, language, and social development[17] of the program attendees in the short run and, in some cases, positive returns last even during adolescence and early adulthood[18] (e.g., see Barnett, 2011 for US studies; Jensen *et al.*, 2011 for short-term effects of preschools on children's socio-emotional skills in Denmark). A key finding often remarked by this literature is that well-targeted and high-quality interventions have strong potentials of improving the life opportunities of children from socio-economically disadvantaged and minority groups (Melhuish et al. 2015). The strength of these studies lies in the estimation strategy that provides robust estimates of the causal effect of ECE attendance. However, these programs restrict eligibility to specific target groups and are mostly focused on programs with specially designed features. As such, their results can not be generalized to the whole population (Duncan 2008) and the overall actual public offer of ECE services in many countries. Additionally, context-specific factors can also contribute to the outcomes of these evaluation exercises, making it hard to generalize research results from selected countries such as the United States or the United Kingdom to other Western economically developed societies (Kulic et al. 2019). These limitations suggest the need to complement knowledge from context-specific experimental research with observational studies that investigate the effects of ECE participation based on representative samples for larger populations of children and that also take into account the real-world patterns of access to ECEC and PS (Blossfled et al. 2017). Studying ECE effects in 'real-world' settings imposes important challenges to causal inference, stemming from the complex selection processes into formal childcare and education. Yet, as

[16] Disadvantaged is intended in broad terms referring to the impacts of poverty and inadequate learning environments on child development, e.g., children living in impoverished communities, in poor African American families, children born premature or with low birth weight.

[17] For children aged less than three years old, this is especially true if centre-based care is accompanied by home visits while, for children aged three years onwards, if they are placed in socially mixed groups in PS.

[18] Concerning children aged three years old or below, those who participated in Infant Health and Development Program have better cognitive, linguistic, and math abilities at 18 years old (Barnett 2008) while, at 21 years old, the African-American children who took part in the Abecedarian Program gained benefits in various areas: they have better cognitive functioning and academic achievement, lower chances of repeating a grade or of being placed in special schools (Ramey et al. 2000), they show lower rate of delinquent and criminal behaviours, while having improved their social participation (Manning, Homel, and Smith 2010). With reference to children age three or above, similar overall beneficial long-lasting effects are detected, for example, for participants to the Perry Preschool Project, (Schweinhart et al. 1993; Barnett 2008) and to the Early Training Project (Karoly, Kilburn, and Cannon 2006).

suggested by various scholars (Duncan 2008; Kulic et al. 2019), by adopting appropriate identification strategies, population-based designs might also provide credible estimates of the causal effects of attending ECE services and at the same time can yield generalizable estimates to the whole population.

In this work, we will follow this second line of research to investigate patterns of selection into ECEC and PS, as well as the timing and intensity of exposure to these educational environments in selected countries. A key contribution of this work is the adoption of a cross-national perspective and counterfactual approach to investigate the longer-term consequences of ECE attendance on children's competencies. To our knowledge, this is the first study that attempts to apply a formal causal inference approach to address these issues by adopting comparative lenses. Indeed, as we will show later, while several observational studies have implemented solid methodological strategies to identify the causal effect of ECE attendance, they use data from specific local contexts or countries. On the other hand, very few studies tried to scrutinize the consequences of ECEC and PS participation adopting a comparative perspective. These studies, however, admittedly report associational measures and are not able to distinguish different timings of entry and exposure intensities (Cebolla-Boado, Radl, and Salazar 2017; Dämmrich and Esping-Andersen 2017). Yet, these aspects can be important for children's outcomes, according to existing literature reviews (Melhuish 2004; Melhuish et al. 2015; Burger 2010).

With these premises, we aim at answering the following questions: What is the impact of having attended ECE[19] on later learning outcomes? Are the learning benefits of ECE participation greater for children from less advantaged social backgrounds compared to those from high SES families? Our contribution to the literature is fourfold. First, we improve the measurement of ECE experience since we clearly distinguish between early childhood education for 0-2 years old children (ECEC) and preschool institutions for 3-6 years old children (PS). Moreover, we include in our definition key elements related to exposure duration and intensity in both ECEC and PS. Indeed, ECE attendance patterns vary not only according to the institutional context of reference, but also according to the timing, duration, and intensity of ECE exposure, which could mitigate or exacerbate the impact that ECE may have on children's outcomes. Second, we focus on ECE effects on both cognitive and social skills in the

[19] Under the term ECE we include all centre-based learning environments, which provide care and education for children under the compulsory schooling age in Europe. The analysed countries have all a split ECE with children who cared for in different settings accordingly to their ages: in early childhood education and development settings (ECEC) if they are aged less than three years old, in preschools (PS) from three years to compulsory school age.

medium-long run, that is when children are already 15 years old. This allows us to contribute to the debate on whether the short-term effects detected in many studies last until early adolescence, and whether ECE attendance is not only related to cognitive skills but also social competencies. Third, we develop a counterfactual framework that can credibly take into account processes of selection into ECE within a cross-country design. Fourth, inspecting these issues in a comparative perspective also enables us to provide qualitative insights about whether the ECE effects are homogeneous or vary across contexts characterized by heterogeneous institutional features.

The remainder of this chapter is the following: section 2 presents a brief discussion on the definition of cognitive and noncognitive skills, focusing on how the impact of ECE on skill development vary according to family and context characteristics. In this section, we also draw our conceptual model and provide the hypotheses that will guide the analysis. Section three describes our data, analytical sample, variables, and the applied method. We present the results of our analysis in section four. Section five concludes and discusses our main findings.

2.2. Theoretical framework and hypotheses

2.2.1. Skills, social inequalities, and the role of ECE

Cognitive abilities can be distinguished in fluid intelligence (i.e., 'the rate at which people learn") and crystallized knowledge (i.e., "acquired skills") (Kautz et al. 2014, 13). The former is measured, for instance, by IQ tests, while the latter by various indicators of academic performance such as standardized tests scores, teachers' grades, and final educational attainment. If it is not an easy task defining cognition, more complex is attributing a definition to the broad area of the so-called non-cognitive skills, also called soft skills, personality traits, character skills, or socio-emotional skills. Albeit psychologists suggest that elements of cognition are present also in these competencies, economists tend to think of non-cognitive skills as the set of abilities that remain once we get rid of intelligence and achievements, such as motivation, perseverance, self-control, resilience, and creativity (Kautz et al. 2014; Brunello and Schlotter 2011). Economic models suggest that the formation of skills is a dynamic (i.e., thus occurring towards the entire individual lives) and self-productive process (Heckman 1999; Carneiro and Heckman 2003). On the one hand, this means that some age points are more crucial than others and, on the other, that later skills are built upon previous ones. Having a solid basis is dramatically important for reinforcing and enhancing later development since "early learning begets later learning and early success breeds later success just as early failure

breeds later failure" (Heckman 1999, 2). Discourses about the relevance of early years brought parents to increasingly conceive formal childcare services as learning environments with the potential to stimulate their offspring's cognitive and relational competencies and policymakers as a tool for fostering equality of opportunity from the start (Bradbury et al. 2015; Waldfogel 2006).

To better understand theoretically whether and at which conditions ECE can meet such expectations, we adopt the counterfactual instructional regime approach proposed by Raudenbush and Eschmann (2015) and adapted to ECE by Kulic and colleagues (2019). According to this model, each child experiences a unique learning environment (or instructional regime) when attending ECE, which contrasts with the learning environment the child would experience if not attending ECE. The causal effect of attending school on a given skill is then the child-specific difference between two potential outcomes: the skills the child would develop if exposed to the ECE instructional regime and the skills acquired if only experiencing the home learning environment and family-related activities. A child may or may not be attending formal childcare and thus experiencing a given instructional regime at a particular time. Attending ECE can affect skills only through putting in place an instructional regime that departs from the one the child would have received at home. Consequently, according to this framework, ECE affects only indirectly skills by inducing a child-specific change in instructional quality which, in turn, provokes a child-specific increment (or decrement) in cognitive and non-cognitive skills.

In theory, the causal effect of ECE attendance on a given skill for a specific child can be measured as the difference between two potential outcomes associated with the instructional quality experienced either in formal care settings or at home.[20] The population-average impact of attending ECE (versus staying at home) will be higher when attending ECE induces, on average, a significant increase in the exposure to improved instruction and the average impact of instruction on skill is large. This could occur, for instance, in contexts in which families have on average low levels of educational attainment and few educational resources at home and, at the same time, where ECE centres are characterized by high educational quality, such as well-trained instructors and staff, adequate learning materials and structures (Table 2.1). Furthermore, the average impact of ECE attendance on skills will be large when those who stand to benefit most from high-quality instruction (that is, those for whom ECE attendance brings a stronger improvement in the learning regime experienced compared to stay at home) are those who are more likely to attend ECE. This immediately suggests that to better

[20] Practically, as we will see in the empirical part, for each child we can observe only the realized participation to one learning environment, and we should find an appropriate way to reconstruct its counterfactual outcomes.

understand the potential equalizer role of early childcare and education, it is important to jointly consider its overall effects on skills, its possibly heterogeneous effects by children's social background, and who are the children who are most likely to access these services. In the next section, we elaborate on the role of parents' social position in childcare and early education choices.

Table 2.1 Population educational attainment, home educational resources and ECE quality, by country.

	Family educational attainment [21]	Home educational resources[22]	ECE quality: Staff educational level	
			ECEC	Preschool
Germany	Low	Medium	Low	Low
United Kingdom	Medium	High	Low	High
Belgium	High	High	Medium	High
France	High	Low	Medium	High
Italy	Low	High	Low	High
Spain	Low	Medium	Low	High

Source) Own elaboration based on PISA 2015 for what concerns family educational attainment and home educational resources. For staff education, we rely on the information provided by Dämmrich and Esping Andersen (2017), Eurydice (2009). Low: non-tertiary education; Medium: Mixed; High: Tertiary education (for more details on this, see Tab.2.3). By ECEC we meant 0-2 years, Preschool 3 to compulsory school years.

2.2.2. The role of SES: differential participation in ECE and heterogeneous returns

Shortly after birth, parents consider whether to opt for ECE attendance, the timing, and the intensity of exposure. These choices do not occur at random but rather relate to family socioeconomic characteristics and parental values. In many countries, for instance, maternal education primarily and, to less extent, family social class and material resources affect ECE take-up and age of entry, with children from more well-off families who experience more and earlier care in formal care settings (Kathy Sylva et al. 2007 for the United Kingdom; Brilli, Kulic, and Triventi 2017 for Italy; Pavolini and Van Lancker 2018 for a comparative perspective).

[21] From PISA 2015, we recode the original variable that accounts for maternal and paternal highest educational level by combining the original categories "None", "ISCED 1", and "ISCED 2" in (1) Low; ISCED 3 and 4 in (2) Medium; and ISCED 5 and 6 in (3) High. Then, we grouped together these two ordinal variables by creating variable for the highest educational attainment of the family. This variable takes values (1) Low, when either the mother or the father holds a low level of education; (2) if when either the mother or the father holds a medium level of education, (3) if both the mother and the father hold a high level of education. When a variable is missing, the family educational level took the value of the available information. After having weighted the data, we use the modal category for indicating, in each country, the highest familiar educational attainment.

[22] We use the standardized index of home educational resources of PISA 2015, which captures home educational possessions by four items based on answers of 15-years old students. The four items are: availability of (i) a desk to study at; (ii) a quiet place to study; (iii) a computer you can use for schoolwork; (iv) educational software; (v) books to help with your schoolwork; (vi) technical books; (vii) a dictionary. We divide the original metric scale in terciles by creating an ordinal variable of home educational resources with values (1) Low (Q1); (2) Medium (Q2); and (3) High (Q3). We use the modal category for indicating the "average" level of home educational possessions in each country.

As the sociological perspective pointed out, to guarantee social equity, childcare services should serve also as 'social elevator' for the offspring of the most disadvantaged social groups who, by sending their children in (high-quality) formal care institutions, have the chance to ameliorate their offspring later educational achievements and attainments. As such, accessible and high-quality ECE permits, in principle, to furnish every child with the chance to develop[23], but are those coming from socially disadvantaged backgrounds who should have the highest returns. Indeed, enrolling low-SES children in childcare permit them to be exposed to a wider array of learning opportunities than they might not have at home, thus counterbalancing the poor educational stimuli that they receive from their parents. According to this scenario, children whose skill development may be hindered by socio-economic disadvantage should benefit more from high-quality ECE programs than their socially advantaged peers. Thus, ECE *substitutes*, rather than complements, for poor social conditions and impoverished learning environments at home, being a tool for mitigating -if not even equalizing- social inequalities from early ages.

However, an opposite scenario is likely possible. Despite a process of ECE expansion that has occurred in most European countries from the early 2000s onwards, the demand for ECE places exceeds the supply and this means, in practice, that not all families can enter or afford their preferred care arrangement (Plantenga and Remery 2009). As a result, socio-economic discrepancies in accessing (high-quality) ECE is the norm, with children from socially affluent families that have higher rates of early enrolment in high-quality ECE settings than their low-SES peers (Van Lancker and Ghysels 2016). Indeed, socially well-off parents may have sufficient economic resources for paying for (high-quality) care fees being, at the same time, also more aware of the 'skill beget skill' process judging, therefore, (high-quality) ECE as a relevant opportunity for boosting their offspring's skills and school readiness. Moreover, even in the absence of socio-economic selection during the care selection process, children from high-SES families may benefit more from (high-quality) ECE attendance than their socially disadvantaged counterparts. Indeed, socially well-off children may possess both a more promising genetic inheritance and richer linguistic abilities that permit them to better and more frequently interact with ECE educators, thus learning at a faster pace when exposed

[23] Critics to social investment perspective (SI) highlights, however, that this approach is much centred in the future, thus putting aside children's well-being and rights in the here and now. According to the detractors, SI just perceives children as "tomorrow's responsible and productive adults" (Casalini 2014, 85), favouring, from a pedagogical point of view, the 'school-oriented curriculum' approach, which, instead of privileging a child-centred education (see Rosseau, Frobel, Montessori, and Pestalozzi), focuses on fostering cognitive skills claimed to be useful in the long term future, such as maths, sciences, and linguistic abilities.

to high-quality ECE settings than their disadvantaged peers. In this *complementarity* scenario, therefore, the large benefits of (high-quality) ECE attendance on skill development are gained by the already socially privileged children, exacerbating from early ages the ability gap by social backgrounds. From a lifelong perspective, this can be a worrying risk, with this early discrepancy becoming larger and larger, once children grow up and navigate through the educational system.

2.2.3. The role of ECE institutional features in six European countries

Apart from family characteristics and preferences, parental decisions about ECE are embedded within a country-specific context and, therefore, distinct institutional features are relevant in explaining whether and how much formal care settings influence later learning outcomes. The literature on welfare state regimes (Esping-Andersen 1990) has been applied to understanding inequalities in *accessing* childcare (e.g., Van Lancker and Ghysels 2016) but, apart from *whether* children attend formal care settings, what is relevant for detecting the ECE impact on skills, is *how* care was provided in these settings. Yet, till now, a clear and univocal conceptualization of care systems is missing. We decide to base our conceptualization on the work of Yerkes and Javornik (2019), who underlie five relevant dimensions of childcare systems: availability, accessibility, affordability, quality, and flexibility. The first three dimensions relate strongly to equity in accessing formal care settings; the last two are proxy for capturing what can happen within these settings, thus boosting, or hindering, skill development.

Availability refers to the type of ECE provision. Multiple sources of childcare are present across countries, ranging from a mixture of predominantly state provision (e.g., in the Nordic countries) to a market/private provision in liberal welfare states, such as the United Kingdom. In countries where private providers represent a large part of the care supply, the state-market mix can increase competition for care places resulting, on the one hand, in an improved capacity of meeting the demand for care (with childcare that is cheaper, more efficient, and responsive to parental needs) but, on the other, with issues linked to equal accessibility. Indeed, socially disadvantaged families may suffer from this heterogeneity, disproportionally opting for either using other forms of care, such as grandparental care, or registering their offspring in low-quality ECE settings. *Accessibility* refers to ECE admission criteria. Some countries set an admission age at which children are legally entitled[24] to a place

[24] By legal entitlement we meant that "every child has the enforceable right to benefit from ECEC provision. Enforceable right means that public authorities guarantee a place for each child whose parents demand it (in the age-range covered by legal entitlement), regardless of their employment, socio-economic of family

in childcare, while in other contexts compulsory ECE assures participation in these formal settings. Both strategies strive for improving ECE accessibility for all children, regardless of their backgrounds and characteristics. *Affordability* is a key factor in assuring inclusive access to institutional care. The number of childcare fees covered by families may represent an excessive financial burden for some social groups that, consequently, tend to rely on other forms of care when fees for institutional care are high. Moreover, social security systems that rely on market mechanisms to deliver care services (e.g., vouchers, means-tested taxation) may exacerbate care gaps between social groups: in fact, these benefits may encourage low SES parents to either stay home for caring their children or register them in low-quality care services.

Quality and flexibility are the two dimensions that matter when considering the impact that ECE has on skill development. Although researchers lack a standard definition of childcare *quality*, the concept is typically divided into two macro dimensions: structural and process quality. The former relates to regulable and more distal aspects of ECE, such as child-staff ratio, maximum group size, staff educational level, while the latter refers to children's daily experiences in the settings, such as interactions with teachers, peers, and materials as well as pedagogical approach and curricula[25]. The higher the ECE quality, the higher the learning gains obtained from ECE attendees. Finally, the length of exposure to formal care services may matter for child development as well. Measuring *flexibility* in terms of opening hours help to understand the duration effect of ECE on skills being, however, this indicator is also linked to access since, without flexible opening times, parents may rely on informal care (Yerkes and Javornik 2019; Ünver, Bircan, and Nicaise 2018).

status" (Eurydice 2015, 9). This does not necessary imply that provision is free of charge, but only that it is publicly subsidised and affordable.

[25] In general, most European countries follow educational programmes based on the child-centred approach (CCA) rather than on the teacher-directed approach (TDA). The latter is a pedagogical approach more directly focussed on knowledge transmission than the CCA. In the TDA educators favour the acquisition of linguistic and other skills in view of primary school access. The schedule is highly structured and planned. The CCA, instead, gives to children a central position as active agents of their own development process by favouring interactions with peers and adults, cooperative work, spontaneous exploration, symbolic or pretended play. Overall, educational approaches are clearly defined for children over 2 years, while for the youngest there are either any central recommendations or not clearly defined approaches

Table 2.2 Dimensions of ECE access, by country

Country	Availability	Accessibility	Affordability
	Public spending in ECE as % GDP	Legal entitlement	Fees (%)
BG	0.79	No for ECEC (*), yes for preschool	4.0
DE	0.47	No for ECEC (*), yes for preschool	8.0
FR	0.68	No for ECEC, yes for preschools	11.0
ES	0.48	No for ECEC, no for preschools	:
IT	0.45	No for ECEC, yes for preschools	:
UK	0.35	No for ECEC, yes for preschools	33.0

Notes) Fees: Net childcare costs for a dual-earner family with two children aged 2 and 3 in full-time care, earning 167 % of average income. ECEC: children under-three years, preschool: 3-5 years old. (*) Only for children aged 2 1/2 years and older.
Source) Multilink Database (reference year: 2004)[26]; Eurydice 2009 for public spending (reference year: 2004).

Table 2.3 Dimensions of ECE effect on development, by country

Country	Quality				Flexibility
	Staff-child ratio		Staff education		Weekly opening hours
	ECEC	Preschool	ECEC	Preschool	ECE
BG	7:1 or 9:1	19:1	Medium	High	10.5
DE	12:1	12:1	Low	Low	:
FR	5:1 or 8:1	8:1	Medium	High	9.5
ES	*	25:1	Medium	High	7
IT	*	14:1	Low	High	8
UK	(x)	8:1 or 13:1	Low	High	6.5

Notes) * standards not set centrally; (x) limited or no subsidised provision; missing.
For the staff-child ratios, we rely on information provided by Delhaxhe and colleagues in an Eurydice report (2009) By ECEC they meant accredited and subsidised provision for children under 2-3 years; by preschool they meant accredited and subsidised provision for children over 2-3 years in year 2006/07 For indicators on staff education we relied on Dämmrich and Esping Andersen (2017). 'Low' stands for non-tertiary educational level; 'medium' that the staff educational level is mixed;' high' that staff are required to hold a tertiary degree.
Belgium: In the French areas of Belgium, the staff-child ratio is 7:1 or 9:1 in ECEC. In the Dutch areas of Belgium, the ratio for children in private care under 18 months is 7:1, 1.10 for those aged over 18 months. The opening hours report only hours from 8:30 am to 3:30 pm.
Germany: It was not possible to assess a general opening time of ECE settings, due to the great regional variability. Yet overall, part-time provision is available.
France: there are no standards for class sizes for preschools, but the average class size is 26.
Spain: There are no standards concerning the adult-child ratio for ECEC phase that, however, generally increases with children's age (for example, in some communities, 8 children per class/group for 0–1-year-olds; 13 for 1- to 2-year-olds and 20 for 2–3-year-olds).
United Kingdom: Most ECEC provision is subsidised by private or voluntary sectors. For preschools, 2:26 applies to public sector settings (which must employ a qualified teacher and a nursery assistant with a relevant qualification). 1:8 applies to private and voluntary sector settings (which are not required to employ a qualified teacher).
Italy: ECEC standards on the adult-child ratio are set regionally but, in practice, the ratio varies between 1 adult for5 or 10 children, depending on children's age. No PS standards exist, classes with 28 children have 2 teachers, who work in relay over the 8 hour working days when the class works full time.
Source) Multilink Database, 2004; OECD 2005 for public spending, Eurydice 2009 in the case of quality indicators.

[26] Multilinks (2011). Multilinks Database on Intergenerational Policy Indicators. Version 2.0, Multilinks Project and Wissenschaftszentrum Berlin für Sozialforschung (WZB). Data obtained through the Generations and Gender Contextual Database. Netherlands Interdisciplinary Demographic Institute (distributor). Retrieved from: https://px.web.ined.fr/GGP on 15/11/2021.

Tables 2.2 and 2.3 reveal notable country variation in terms of access, quality, and flexibility dimensions of the ECE systems. Countries where ECE is highly accessible and of high quality, especially for children above three years old, are Belgium (BG) and France (FR). As regards access dimensions, Belgium allows for a legal place in ECE from 2 years and a half; the state invests comparatively more than in other countries in early childhood education. This is also true for France where, despite fees are higher compared to Belgium, public spending in the ECE sector is notable when compared to other contexts. In both countries, moreover, ECE opening times are flexible, providing care for children for longer weekly hours than in other contexts. Experiences in ECE, therefore, can influence more children's learning and, at the same time, their opening hours allow for a better work-family balance. Additionally, in Belgium and France educators hold a tertiary degree in both preschool and ECEC, while staff-child ratios are balanced and appropriate for children's age.

Italy (IT) and Spain (ES) can be grouped within a single cluster as well. Both countries show low levels of accessibility and quality for what concerns the 0-2 phase, with the absence of a legal entitlement to a place in ECEC, medium or low levels of staff education and inadequate staff-child ratios, especially in Spain. When looking at preschools, the situation improves, since children are legally entitled to a place in kindergarten in Italy and, although the number of children a single educator need to take care of is still too large, especially in Spain, educators hold a tertiary degree.

Finally, Germany (DE) and the United Kingdom (UK) represent the countries that score worse in terms of access and quality dimensions. The commodisation of care provision in the United Kingdom provokes difficulties in accessing public childcare (e.g., low levels of public spending in the ECE sector and high fees) and low levels of quality, especially for children under three years old. In Germany, although preschool-age children are legally entitled to a place in kindergarten, quality is low, especially in terms of staff educational credentials.

2.2.4. Hypotheses

Previous evidence for the impact of ECEC attendance on socio-emotional development is mixed, with results that range from detrimental effects (Yamauchi and Leigh 2011; Van Beijsterveldt, Hudziak, and Boomsma 2005) to no effects (Barnes et al. 2010) or positive effects, especially for socially disadvantaged children (Watamura et al. 2011)). Few studies look at the long-lasting impacts of ECEC attendance on non-cognitive skills, rather highlighting negative impact. In the United States, children who went longer in childcare are reported as having more behavioural problems, teacher-child conflict, and low self-control in early primary

school grades, even if cared for in good quality formal settings (Huston, Bobbitt, and Bentley 2015; Bradley and Vandell 2007). Full-time childcare participation has been found to be associated with higher levels of teacher-rated antisocial behaviour at seven years old but this relation is absent two years later (Melhuish 2010). By adopting causal identification strategies,

Fort and colleagues (2020) report that in Bologna, one of the most educated and richest Italian cities where childcare is reported to be of high-quality, an additional month spent in childcare at age 0-2 provokes a loss in some non-cognitive traits (i.e., personality traits). As regards cognitive skills, previous findings report a rather positive influence of ECEC attendance in the short run. In the United States, ECEC attendance positively influence language development and early school achievements (Loeb et al. 2007), especially for offspring of low-SES families (Bradley and Vandell 2007). Felfe and Lalive (2010) find a positive effect of ECEC attendance on language and social skills in the short run and on school grades in the medium-run in Germany. Yet, about the long-term impact of ECEC attendance some studies show rather detrimental effects. In Italy, one additional day care month at age 0–2 reduces intelligence quotient and at age 8–14 and that, additionally, the magnitude of this negative effect increases with family income, indicating a stronger detrimental impact for children from relatively affluent families (Fort, Ichino, and Zanella 2020). Corazzini and colleagues (2021) similarly highlight that, while the effect of early childcare attendance is positively associated with language test scores of immigrant children attending fifth grade of primary schools, native students are negatively impacted by early childcare attendance. This was especially true for math test scores of children with highly educated mothers and who lived in Italian municipalities with a relatively low public supply of early childcare.

As regards children older than three years, PS attendance is consistently related to better educational and social skills. For instance, students who attend pre-primary education are found to outperform those who had not in reading assessments at 15 years old, in practically all OECD countries (OECD 2011b). Other studies adopting a comparative perspective reinforce this result, indicating that PS attendance is beneficial for reading competencies in both primary (i.e., 10 years old) and secondary schools (i.e., 11 and 15 years old) and that PS attendance is most effective for the skill development of low-SES children (Cebolla-Boado, Radl, and Salazar 2017) and if of high-quality and intense (Dämmrich and Esping-Andersen 2017). In the United Kingdom, previous evidence indicates that PS attendance ameliorates children's linguistic, mathematical, and cognitive skills (Kathy Sylva et al. 2004b), with associations that are sustained even after the elementary school period if formal care settings were of high quality (Kathy Sylva et al. 2011). In France, quasi-experimental designs show that children from lower

and middle social classes are those who profit the most from PS attendance, with significant and long-lasting positive effects on later school achievements and wages in the labour market. In Denmark, Datta Gupta and Simonsen (2010) find that having attended high-quality pre-school at age three has a positive impact on language and problem solving tests scores, while it decreases the probability of grade retention at age 11. Moreover, children who enter early PS, i.e., at 2 years old, show better schooling outcomes compared to those who enter PS one year later, further indicating that early enrolment has positive long-lasting effects on test scores in the 6th grade, probability of graduating from high school, and the number of grade repetitions at 11 and 16 years old (Dumas and Lefranc 2010). In Germany, PS education has been found to have a positive relationship with several educational outcomes (Büchner and Spiess 2007; Spiess, Büchel, and Wagner 2003). A recent meta-analysis that focuses on studies applying quasi-experimental or randomized designs supported the claim that, outside the American context, cognitive skills and socio-emotional outcomes are boosted by PS participation and that these benefits are sustained over time (Nores and Barnett 2010). Hence, overall, PS attendance appears to be beneficial for behavioural outcomes, particularly if formal care settings are of high quality.

Based on these insights, we draw the following hypotheses, separately for ECEC and preschool. As regards ECEC, we expect mixed results. Overall, we believe that ECEC attendance has either no or detrimental effects on later skills. In the presence of an influence, we believe that this should be more detrimental for children who attend ECEC when younger than one-year-old and for those who come from socially advantaged families, as previous research found. Concerning country patterns, we expect to find that the negative influence of ECEC on skills is lower in countries where care quality is fostered and access is promoted, such as in Belgium and France, rather than in those where ECEC is difficult to access and of low quality, as in Italy and Germany.

As regards PS, we expect an overall beneficial impact on both cognitive and noncognitive skills, especially for children from disadvantaged social backgrounds and for those who experienced full-time PS attendance. As concerns to country patterns, we hypothesize that the highest returns of preschool attendance should be visible in Belgium and France, where PS access is fostered, and formal care settings are of high quality. We expect the lowest returns of PS attendance in Germany and the United Kingdom. In the former case, although access is promoted through a legal entitlement, PS is of low quality; in the latter case, access to high-quality PS is restricted to those parents who can afford it. Finally, in Italy and Spain, where the overall family educational level and learning stimulation at home is low on

average, but PS access is fostered and of moderate quality, we expect a positive long-lasting influence of PS attendance on skills.

2.3. Analytical strategy

2.3.1. Theoretical estimand and identification strategy

The objective of this paper is to assess the causal effect of ECE attendance on cognitive and social skills once adolescent. We ask: How would the average skills level at 15 years old differ if we enrolled a randomly chosen child in ECE/PS or not? Using potential outcomes notation (Imbens and Rubin 2015) as the difference in the potential skills level each person would realize if enrolled in ECE/PS, denoted $Y_i\,(1)$, versus if they did not, denoted $Y_i(0)$:

$$\frac{1}{n}\sum_{i=1}^{n}(Y_i(1) - Y_i(0))$$

As described below, this can be easily extended by substituting the simple participation to ECE/PS with the intensity/duration of exposure. In the second step of the analysis, we consider a conditional average treatment effect as the theoretical estimand of interest (Lundberg, Johnson, and Stewart 2021) to investigate whether the effect of attending ECE/PS differs by parents' socio-economic status.

$$\frac{1}{n_x}\sum_{i:\,X_i=x}^{n}(Y_i(d') - Y_i(d))$$

Figure 2.1 below presents a graphical representation of our identification strategy using Directed Acyclic Graphs (DAG). This figure incorporates our theoretical knowledge related to ECE access and its consequences for children's skills.

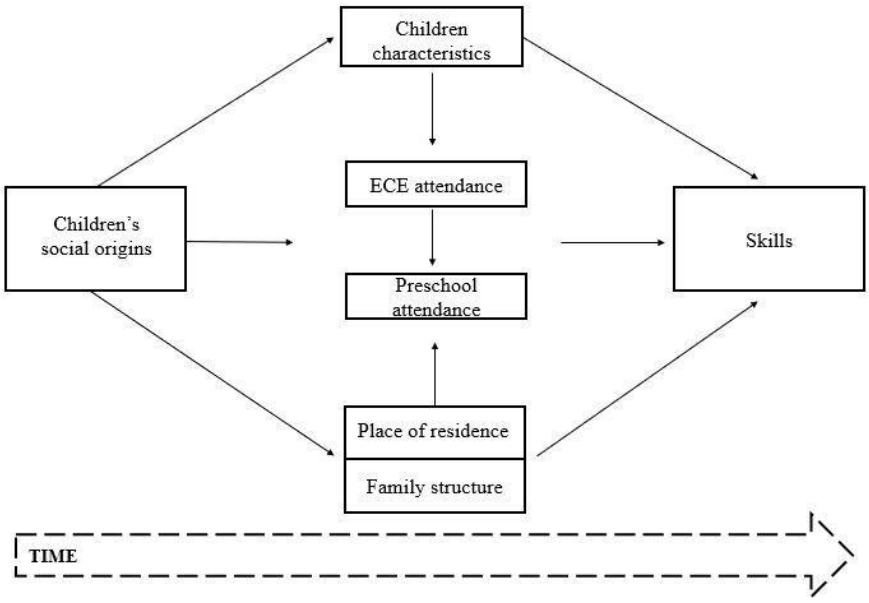

Figure 2.1 ECE model guiding the empirical analysis

Source) Own elaboration based on PKC model

In particular, the Pungello and Kurtz-Costes (1999) model suggests that ECE participation is affected by multiple dimensions, such as the characteristics of the child, the family of origin, and the place of living. While we are in the position to measure basic children and parents' characteristics, several other features are not observed, including parents' values and children's innate cognitive ability potential. Omitting to adjust for these characteristics might be problematic because they are not only possibly related to ECE attendance, but they also influence children's educational outcomes.

Identifying the causal effect of ECE attendance on proficiency scores at 15 years old from observational data is thus clearly challenged by issues of endogeneity of the treatment variable. A possible solution is to find one or more variables that affect ECE participation but not later children's skills, commonly known as instrumental variables, and take advantage of this feature to estimate the effect of interest (Muller, Winship, and Morgan 2014). We rely on self-reported information from the children's parents about whether respectively ECE and PS attendance was considered mandatory in the area where they live when their child was at the appropriate age to attend formal childcare or early education. We believe this information satisfies, at a theoretical level, the needed properties to provide a valid identification strategy for the effect of ECE/PS. Indeed, on the one hand, the existence of formal regulations related to ECE participation is a powerful predictor of enrolment in these services. Even if parents were wrong and such obligation was not in place, the subjective belief in its existence can be still considered as an important thruster of child enrolment. On the other hand, it is hard to envisage

why the parents' belief about the mandatory nature of ECEC participation when their children were 1-5 years old should have any substantial direct effect on their children's skills level at the age of 15. In the next section, we define our target population and describe the sample, while in the Methods section we describe the empirical estimand and the estimation strategy.

2.4. Data and sample selection

Our empirical analysis draws on data from the 2015 Programme of International Student Assessment (PISA hereafter), which collects information on 15-years old students' competencies across OECD countries and partner economies. PISA 2015 employed a two-stage random sample procedure, with schools as primary sampling units and students as secondary sampling units. Overall, an average response rate of 80% was set for both schools and students, being 50% the minimum for considering a school as a participant in the survey. Approximately 540,000 15-years-old students within schools in 72 countries[27] participated in the 2015 survey round. To account for the complex PISA sampling structure, which involves multi-stage random draws from sampling frames collected at both the school and students' levels, we incorporated both final and replicate weights when performing the statistical analysis. More specifically, we apply Fay's variant of the Balanced Repeated Replication (BRR) method[28] to calculate the sampling variance, as recommended by OECD (2017c)[29].

We rely on this specific edition of the survey because it has specific valuable features for the object of interest. First, differently from previous rounds, in PISA 2015 parents – and not students – are asked to provide information on their children's experiences with ECEC and preschool participation. In this way, the risks of recalling errors are reduced, and the answers are more reliable since they refer to an event not too far in time and salient in the lives of many families. However, a parental questionnaire was optional and, consequently, it was administrated in only 18 countries, which were: 9 European OECD countries; (i.e., Belgium, France, Germany, Ireland, Italy, Luxembourg, Portugal, Spain, and the United Kingdom) 3 extra-European OECD countries (Chile, Korea, and Mexico); and 7 partner economies (i.e., Croatia, Dominican Republic, Georgia, Hong Kong, Kosovo, Macao, and Malta) (OECD

[27] More specifically, 35 OECD countries and 37 partner countries.

[28] The Fay variant permits to obtain from the BRR procedure stable variance estimator even in the presence of sparse population subgroups (OECD 2017c; Judkins 1990)

[29] This method accounts for the two-stage stratified sampling strategy and each regression is repeated over the 80 replicate weights provided in the PISA dataset. The sampling variance is then obtained by the average square deviation between the replicated estimates and the estimate obtained with the final weight, with the Fay correction sets to 0.5. In simplest words, each of these replicate weights simulates an alternative sample and the comparison of these alternatives with the final weight yields to the correct estimation of sampling errors.

2017c, 2017b). Among countries that administered the parental questionnaire, we selected those which have valid information on ECE attendance and restrict the sample to European countries, to make the countries more comparable. We further decide to restrict our analysis to students who have valid answers on all the variables of interest for enabling comparisons[30]. Applying these criteria led to a final analytical sample that includes a total of 41,676 students over six European countries: 9,367 in Belgium (BG); 5,592 in Germany (DE); 6,611 in Spain (ES); 5,911 in France (FR); 2,952 in the United Kingdom (UK); and 11,243 in Italy (IT). It should be clear that given the limited number of countries, we cannot examine how macro-level mechanisms affect the ECE-skill link. We are forced, therefore, to limit our comparative interest to the study of the ECE influence on skills in multiple national contexts. This perspective, however, seems still profitable since it permits to shift the focus from a single country study, as it has been for most previous studies, to a cross-country study. This has the advantage of, first, enlarging the population coverage and (2) allowing to examine whether the main discovered pattern of ECE effects on skills is specific to some countries or generalizable to most of them. The first case suggests that countries specificities are pivotal in explaining variation in the ECE-skill link while the second case may imply that, despite contextual differences, the mechanisms behind the ECE-skill relation are general.

2.5. Variables

2.5.1. Outcomes

Before presenting how the outcomes of interest are measured, it is worth mentioning that PISA monitors what students can do with the knowledge they acquired at school. Hence, skills do not strictly relate to school curricula, but instead, they examine "how well students can extrapolate from what they have learned and can apply that knowledge in unfamiliar settings, both in and outside of school" (OECD 2017b, 12). We choose three outcomes, each linked to three distinct domains.

1) Reading literacy is defined as "students' ability to understand, use and reflect on written text to achieve their purposes" (OECD 2017b, 15). Therefore, what is assessed are not basic reading skills, but rather the ability to access and retrieve information, getting the general scope of the text, interpreting, and reflecting on it.

[30] We lose 4.62% of cases over the six European countries of analysis, i.e., 2,017 out of 43,693. This corresponds to 14.02% of deleted observation in Germany, 2.94% in Belgium; 1.86% in Spain; 3.23% in France; 5.11% in the United Kingdom; 2.94 in Italy.

2) Mathematical literacy is the "students' ability to analyse, reason and communicate ideas effectively as they pose, formulate, solve and interpret solutions to mathematical problems in a variety of situations" (OECD 2017b, 16). Hence, PISA checks students' ability to translate, interpret, and solve ordinary life issues using mathematical concepts, facts, procedures, tools, and reasoning.

3) The third outcome is students' collaborative problem solving, which was assessed for the first time in the 2015 PISA edition. It is defined as "the capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills and effort to reach that solution" (OECD 2017b, 134). Thus, students are expected to be able to (i) communicate ideas and opinions; (ii) establish and sustain a team with its internal roles and organization; (iii) handle conflict and disagreement, and (iv) manage the progress towards the achievement of shared goals.

Proficiency level in each domain is a latent concept that is not easy to measure because of various sources of measurement error, including students' mental and physical fatigue or other contextual events. Furthermore, due to time limitations, in large-scale assessment surveys, students usually receive just a subset of the total assessment pool of questions. Consequently, by answering to only a fraction of items, scores for each subject are characterized by a certain degree of uncertainty (OECD 2017c). To overcome the problem, PISA relies on so-called plausible values (PVs). PVs are multiple imputations of proficiency scores generated using both the students' partial set of responses to the test items and available background data that stem from the students' background context questionnaire. Therefore, they represent the "unbiased estimation of the plausible range and the location of proficiency for groups of students" (von Davier, Gonzalez, and Mislevy 2008, 11), rather than individual scores. PVs are a posterior distribution of scores computed for all students participating in the assessment, regardless of whether they effectively took the test in a specific domain, based on information obtained from other students who show similar performances in other domains and have comparable background characteristics. This approach is grounded on Rubin's (1987) multiple imputation technique that Mislevy (1991) adapted to latent variables. To account for uncertainty due to measurement error, ten values are then randomly drawn from these posterior distributions. The analysis is computed ten times, one for each PV, and then estimates are combined using the so-

called “Rubin’s rule” for computing parameters and variances of interest[31] (von Davier, Gonzalez, and Mislevy 2008; OECD 2017c).

2.5.2. Treatment variables

The treatment variable of interest is ECE attendance. As above mentioned, students who took the PISA tests in 2015, were born in 1999. Consequently, their ECE attendance (if any) occurred between 2000 and 2005. The two main treatment variables are two dummy variables indicating whether the child attended respectively 1) early childhood education and care centres (ECEC hereafter) or not; 2) preschool (PS hereafter) or not.

To develop a more nuanced picture of the impact of ECE we look not just at participation, but also the duration/intensity of participation, thereby considering also possible heterogeneity in the effects due to different quantitative exposure. The third and fourth treatment variables are dummy variables contrasting 1) early attendance (one-year-old or younger) vs no attendance, 2) late attendance (older than one year) vs no attendance. The threshold of one year was chosen based on previous literature (Bowlby 1951) and empirical research (Varin et al. 1996) rising concerns that an early starting age (i.e., under the age of one especially) would impact negatively on children’s development, of noncognitive skills especially. This threshold, therefore, highlights this period as critical for the development of children and their relationship with the significant adults around them.

The fifth and sixth treatment variables contrast 1) attendance of PS between 1 and 30 weekly hours vs no attendance of PS, 2) attendance of PS between 31 and more weekly hours vs no attendance[32]. The latter division follows as closely as possible the one provided by EU-SILC indicator on childcare arrangements and duration, that differentiate childcare settings by children’s age and duration (less than 30 hours a usual week; 30 hours or more a usual week). Moreover, this classification is in line also with that provided by Eurydice, which defines full-time frequency as 30 or more weekly hours (European Commission/EACEA/Eurydice 2019).

2.5.3. Moderator variable

Students’ socio-economic status is treated as a control variable in the first set of analyses and a moderator variable in the second set of analyses focused on heterogeneous effects of ECE.

[31] If the mean of PVs can be used, the average over ten calculations will lead to severe underestimation of the variance for group-level calculations. The same bias appears when using only one PV (von Davier, Gonzalez, and Mislevy 2008; Laukaityte and Wiberg 2017).

[32] Reference year for measuring duration is when children are three years old.

Students' SES is measured through the PISA index of economic, social, and cultural status (ESCS). It is a continuous composite index, which derives from indicators capturing parental education, highest parental occupation, and home possession (including books at home). The index was standardized to have a mean of 0 and a standard deviation of 1. Given that we are not interested in the specific effects of various parents' resources, the use of the ESCS index allows us to capture the latent concept of socio-economic advantage at home and guarantees parsimony in the moderation analysis.

2.5.4. Exclusionary restrictions

Two dummy variables represent the main exclusionary restrictions, one referred to the ECEC experience, the other to the eventual PS participation. These variables measure whether ECE attendance was mandatory[33] and they take the value of (1) Yes -if parents declared that either attendance in ECEC/PS was mandatory or most other children attended ECEC/PS-, and (0) No – when parents said that the most important reason why children attended ECEC/PS was that they could not care for the child themselves (e.g., due to work, illness) or because they wanted additional learning stimulation for the child (e.g., social, academic).

2.5.5. Control variables

Controls refer to basic students' socio-demographic characteristics: gender, which takes value 1 for girls and 0 for boys; and migration background, which takes the value of 1 for students with migratory backgrounds, 0 for natives[34]. Moreover, in the PS models, we control additionally for previous ECEC attendance, taking valuer 0 No, 1 Yes.

2.6. Methods

Relying on estimators, such as propensity score or matching, to quantify the effect of ECE/PS is not feasible in our setting since the number of covariates available retrospectively is limited and the estimation would anyway suffer from omitted variables problem. To overcome these issues, we relied on an endogenous treatment model, where we insert an exclusionary restriction, which captures whether ECE attendance was mandatory or not in the country under

[33] The question states, which relates to ECEC participation: "What was the most important reason why your child attended an <early childhood educational development arrangement>"? The question states, which relates to PS participation: "What was the most important reason why your child attended a <pre-primary education arrangement>?"

[34] Natives, i.e., students without a migratory background, include those who are born in the country of assessment or those who have at least one parent who was born in that country.

analysis. Moreover, we control for common causes of both the treatment and the outcome, i.e., students' immigration backgrounds and socio-economic status. We then add relevant controls, such as students' sex and eventual ECEC participation when interested in the effect of PS on later skills. We rely on a set of linear regressions with endogenous treatment effects (LRETE hereafter) to estimate the impact of attending ECE, solving issues of unobserved confounding and endogeneity. LRETE permits to jointly estimate two equations: (1) the outcome equation; and (2) the selection equation or treatment model.

$$\begin{cases} y_{ij} = \alpha + \beta t_{(ECE)ij} + \gamma_{(ECE*SES)ij} + Z_{ij} + \varepsilon_{ij} & (1) \\ t_{(ECE)ij} = \alpha + \zeta_{(MANDATORY)ij} + W_{ij} + \upsilon_{ij} & (2) \end{cases}$$

The outcome equation expresses y_{ij} (i.e., the average expected score in reading, mathematics, and collaborative problem-solving for a given 15-years old student *i* in a specific country *j)* as a function of an intercept α and two main effects of interest, i.e., β and γ. The former depicts the average ECE effects on skills, while the latter captures the interaction effects between ECE attendance and children's socioeconomic backgrounds. These effects are calculated net of a vector of covariates, Z_{ij}. For the outcome models, this set of controls includes students' socio-demographic traits (i.e., sex, social origins, and migration backgrounds) and ECEC attendance, in the case of the preschool equation.

Since access to ECE may suffer from selection effects and issues of unobserved heterogeneity, estimating β, i.e., the effect of ECE on skill development based uniquely on the outcome equation (1), can lead to biased results. Therefore, as a second step, we simultaneously estimate the selection equation (2), which outcome is our endogenous treatment variable, i.e., ECE attendance. In this equation $t_{(ECE)ij}$ is our dependent variable, measuring whether children attend or not ECE. We impose here our exclusionary restriction, thus controlling whether ECE attendance was mandatory or not in the country of interest, ζ. We claim that the latter variable is appropriate since it correlates with our treatment, i.e., ECE attendance, but not with our dependent variables, i.e., educational outcomes at 15 years old. We further estimate our selection equation net of a vector of variables that may determine selection into ECE, W_{ij}. These are: students' social origins and migration backgrounds. Finally, we constrained LRETE models to have constant variances and correlation parameters between the treatment (ECE attendees) and the control group (not ECE attendees). Moreover, in LRETE the errors of the primary and the selection equation (ε and υ) are allowed to correlate. If their correlation is

statistically significant then this means that we do have a problem of unobserved endogeneity in our model that, however, we can address namely thanks to the adoption of LRETE.

2.7. Empirical results

2.7.1. Descriptive statistics

We begin by looking at the distribution of performances of 15 years old students in the three domains of interest across countries (Table A.1 in Appendix A, Chapter 2). We see that Germany, on average, outperform other countries in all cognitive literacy domains as well as in collaborative problem-solving skills (CPS), with students who score, on average, 518, 511, and 533 points, respectively. On the contrary, students in Italy score the worst in reading and CPS (486 and 480 points, respectively), while Spain shows the worst performances in mathematics (487 points).

When looking at ECE participation, we see that most students were not enrolled in ECEC. Spain is a notable exception since one student out of two (51%) participated in ECEC. Moreover, among those who attend, the majority was older than one year old when enrolled in ECEC. The only exception is Italy where, among the ECEC attendees, most parents (18%) in our sample declared to have enrolled their children in ECEC when they were one year old or younger (Table A.2, Appendix A Chapter 2). About PS, we see that in three countries out of six parents did not opt for enrolling their offspring in formal institutions at three years old (79% in Germany, 61% in the United Kingdom, 60% in Belgium), while just one child out of three was not registered in preschools in Spain (36%), Italy (30%), and France (33%). Concerning the intensity of exposure, we note that most students participated in PS for a maximum of 30 weekly hours, but in Italy and Belgium. In these latter contexts, the percentage of students who attended PS for a maximum of 30 weekly hours is almost equivalent to the number of students who were enrolled full-time in PS (Table A.3, Appendix A Chapter 2). Finally, ECE attendance and duration appear to vary according to children's social backgrounds. More specifically, in all countries, high-SES children are more likely than their socially disadvantaged peers to attend both ECEC (Tables A.7, Appendix A Chapter 2) and PS (Table A.9, Appendix A Chapter 2). Moreover, children from high-SES families are more likely than low-SES peers of having experienced ECEC when one-year old or younger (Table A.8, Appendix A Chapter 2) and PS for longer weekly hours (Table A.10, Appendix A Chapter 2). All in all, these first descriptive findings confirm the fact that high-SES parents are (i) disproportionally enrolling their children

in ECE settings, and that (ii) their ECEC enrolment occurs early in life, while for them preschool participation lasts for long hours.

2.7.2. The impact of ECE on achievements in secondary school

In this section, we try to answer first the question about whether and how much ECE affects later students' achievements. Figures below graphically show the average partial effects (APE) on cognitive and noncognitive skills at 15 years old of ECEC and PS attendance. APE report the main effects of either ECEC or PS attendance on later skills and the calculation stems from linear endogenous regression models that, for each skill, include, in the outcome equation, the main independent variable (i.e., ECEC or PS attendance), control variables, and the interaction term between ECE attendance and children's social origins. We present results first for ECEC and preschool attendance. Then, we consider the influence of ECE duration on later skills, for the countries where this calculation was possible.

2.7.3. ECEC and preschool attendance

Figure 2.2 summarizes the main effects of ECEC (left panel) and PS attendance (right panel) on reading, maths, and collaborative problem-solving skills at 15 years old by country. The graphs in the left panel of Figure 2.2 show that, as hypothesised and as previous studies show, the effect on later noncognitive skills of ECEC attendance is, if present, negative (e.g., in Belgium, France, and Spain). The same pattern is visible for cognitive skills, thus corroborating our expectations and previous results. Students who attended ECEC are those who score the worst in secondary school reading tests in all countries but in Germany and in the United Kingdom, where ECEC influence, although negative, is not significant. Moreover, ECEC-attendees perform worse compared to students who did not experience ECEC in maths tests as well, with statistically significant detrimental effects in France, Italy, and Spain.

What can be said about country patterns? Although, as mentioned above, the effect is negative overall, the least beneficial influences of ECEC attendance are detectable, contrary to our expectations, in France. Moreover, in Belgium students who attended ECEC perform badly in later collaborative and reading skills. Why is that? We believe that the results in these two contexts can be explained by the fact that formal care services for children younger than two years and a half (i.e., age at which a legal entitlement to childcare is guaranteed in both countries) tend to promote the care aspect rather than the educational one, thus giving less emphasis to developmental objectives (Delhaxhe et al. 2009). Students who attended ECEC in Italy and Spain scored significantly fewer in reading and maths tests compared to students who

were not enrolled in childcare. The negative effect of ECEC attendance in Spain, however, is less detrimental than that observed in Italy. This may be because, in Spain, the educational focus of pre-primary education is much more highlighted than in Italy for children younger than three years old.

On the contrary, PS attendance (graphs in the right panel of Figure 2.2) has a long-lasting positive effect on later abilities. This finding is in line with our hypothesis, and it corroborates previous results further demonstrating, however, that not just cognitive skills but also noncognitive abilities relate to educational experiences in preschools. However, some country differences are worth mentioning since results are significant where preschool access is publicly guaranteed, and educational goals are promoted. Indeed, an enduring, beneficial influence of PS on all three analysed skills is visible in just two countries, i.e., in Belgium and France as expected, with PS attendees who live in the United Kingdom scoring significantly better than non-attendees in reading tests once in secondary school. This can be explained by looking at the context-specific characteristics of the ECE system. For instance, access to high-quality PS is guaranteed in both France and Belgium. On the one hand, the right to a place in PS may have encouraged parents to send their offspring to PS and, on the other, the pedagogical curricula, which focused on the development of children's social, linguistic, and rudimentary mathematical skills assured a good basis for later skill development. In the United Kingdom, since 2004 children aged three years old were entitled to a place in part-time formal care, which followed national guidelines with programmes that included recommendations on the development and learning of early literacy and numeracy skills (Delhaxhe et al. 2009).

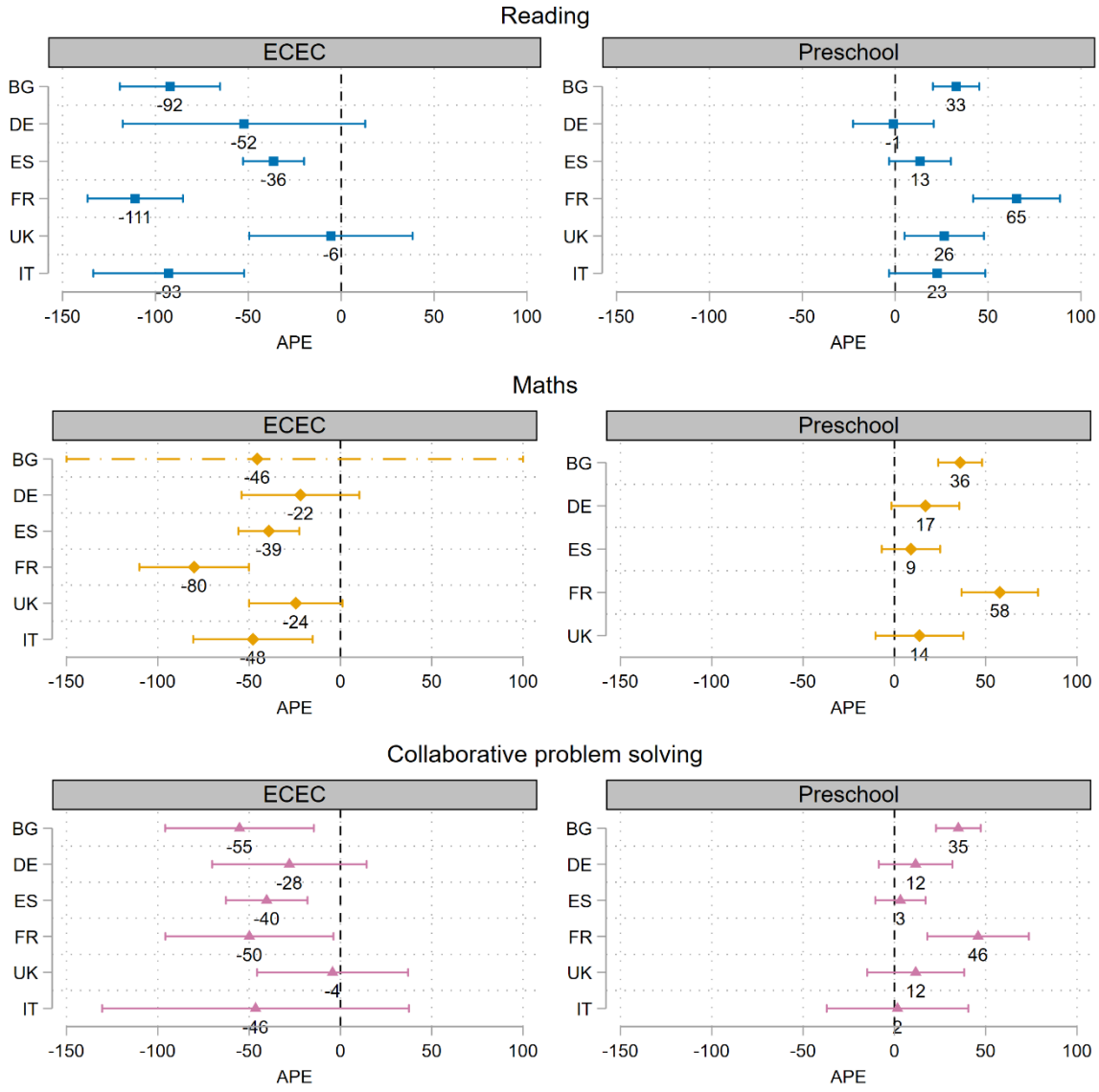

Figure 2.2 Average partial effects (APE) on cognitive and noncognitive skills at 15 years old of ECEC and preschool attendance with 95% confidence intervals, by country.

Note) Reference category for ECEC: No ECEC attendance; reference category for PS: No PS attendance.
In Belgium, the APE effect on maths skills of ECEC attendance is, on average, -45, with lower bound amounting to -219 and higher bound +128 (dash-dotted orange line).
Source) Own calculations on PISA 2015.

2.7.4. ECEC and preschool duration

What does it happen when considering ECEC entry age and intensity of PS exposure? Does our evidence confirm that entering too early in ECEC is more detrimental while staying longer in PS is more beneficial for later skill development? Figure 2.3 gives information about the effects on skills in secondary school tests of early and late ECEC attendance. Overall, we notice that, when significant, the effect of ECEC duration on later skills is negative. This confirms the fact that, regardless of the age of entry, those students who did not attend ECEC during their infancy are better performers than those who were enrolled in these environments. Only in Spain, late ECEC entrance corresponds to slightly less detrimental influences on later competencies compared to early ECEC enrolment. Figure 2.4 depicts the influence of preschool intensity on later skills. The pattern of an overall positive impact of PS attendance on later abilities is confirmed overall but in France and, although less prominently, in Belgium. Here, the longer the time passed in formal care settings the better students' performances in reading, maths, and collaborative problem-solving at 15 years old. Therefore, where PS attendance is guaranteed and quality is promoted, enduring effects of PS intensity on later skills are detectable.

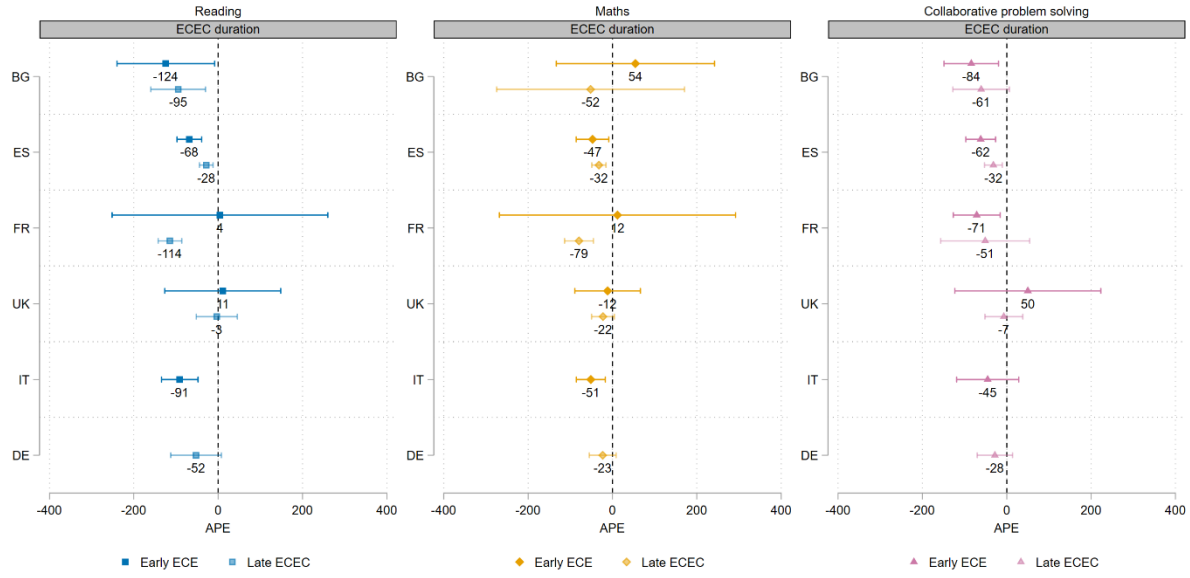

Figure 2.3 Average partial effect of ECEC duration on later skills with 95% confidence intervals, by country

Notes) Reference category: No ECEC attendance.

Source) Own calculations on PISA 2015.

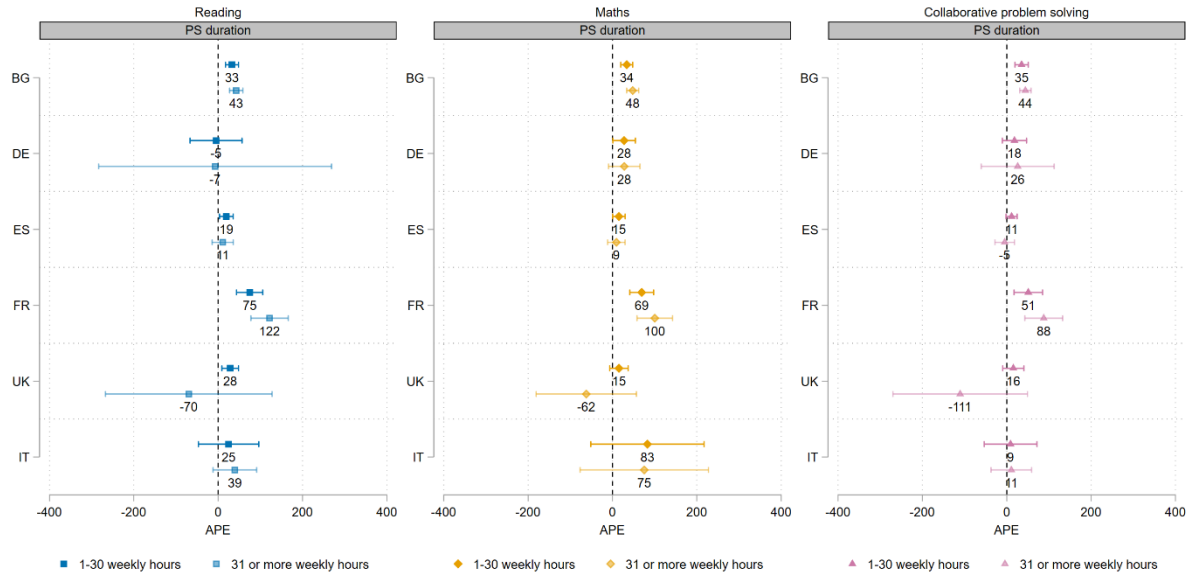

Figure 2.4 Average partial effect of preschool (PS) duration on later skills with 95% confidence intervals, by country.

Notes) Reference category: No preschool attendance.
Source) Own calculations on PISA 2015.

2.7.5. ECE as the great equalizer?

In the following, we show evidence for answering our second research question about whether ECE can be considered an equalizer of opportunities, thus contributing to diminishing social inequalities in later achievements. The moderating role of SES on the relation between ECE duration and later skills yields to more inconsistent results (see Figures A.1 to A.4 in Appendix A Chapter 2). Hence, we decide to focus on ECE attendance. The graphs below show results for the impact of ECEC or PS on reading (blue-shaded graphs), math (orange-shaded graphs), and collaborative problem solving (purple-shaded graphs) across the SES range. Each graph shows the average partial effect (APE) of having attended ECE compared to not having experienced it. Confidence intervals are set at 95%.

Figure 2.5 indicates that the negative impact of attending ECEC on later skills is stronger for students of less advantaged social origins than for those who come from socially privileged backgrounds. Hence, parents with high social status can compensate for the detrimental impact of formal care settings on later abilities more than their socially worse-off counterparts. Contrary to our expectations, this result is in line with the complementarity hypothesis. Only in Spain the impact of ECE attendance on skills seem to not vary across SES levels while statistically significant differences are detectable for reading skills in Belgium, France, and Italy, in France and, to some extent, in Italy for mathematics. As concerns

noncognitive skills, although the direction of the effect confirms the complementarity hypothesis in most countries, differences across the SES range rather not significant, but in Belgium where children from low-SES are those who score the worst in collaborative problem-solving tests in secondary school.

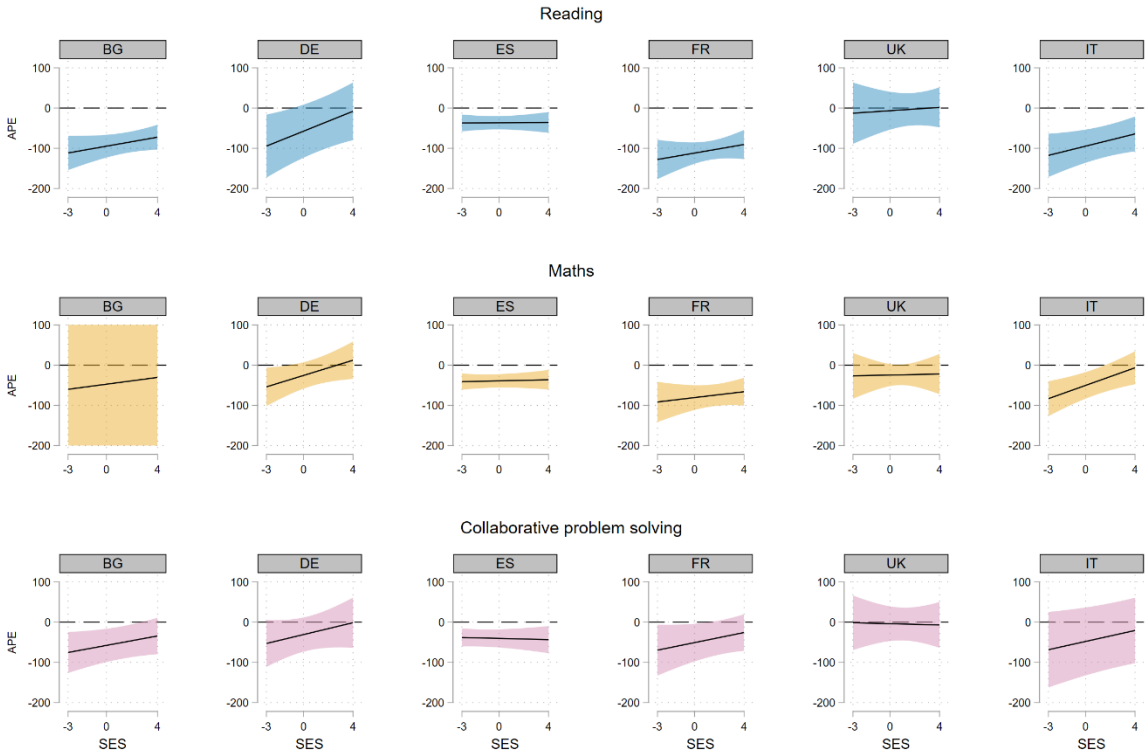

Figure 2.5 Average partial effects (APE) of ECEC attendance on later skills with 95% confidence intervals, by SES

Note) Reference category: No ECEC; Confidence intervals for the interactive effect of ECEC attendance and SES on maths are capped.
Source) Own calculations on PISA 2015.

Figure 2.6 refers to PS attendance. Contrary to ECEC, our findings are in line with the substitution hypothesis: low-SES children are those who benefit the most from preschool attendance, performing better in later cognitive tests, especially. Yet, despite this general pattern, statistically significant interactive effects of PS attendance and SES on cognitive and noncognitive skills are detectable in Belgium. France represents an exception since PS attendance complements, rather than substitutes, to social backgrounds on all the analysed competencies' domains. Therefore, in France, children from socially privileged families are those who gain the most from early learning in preschools.

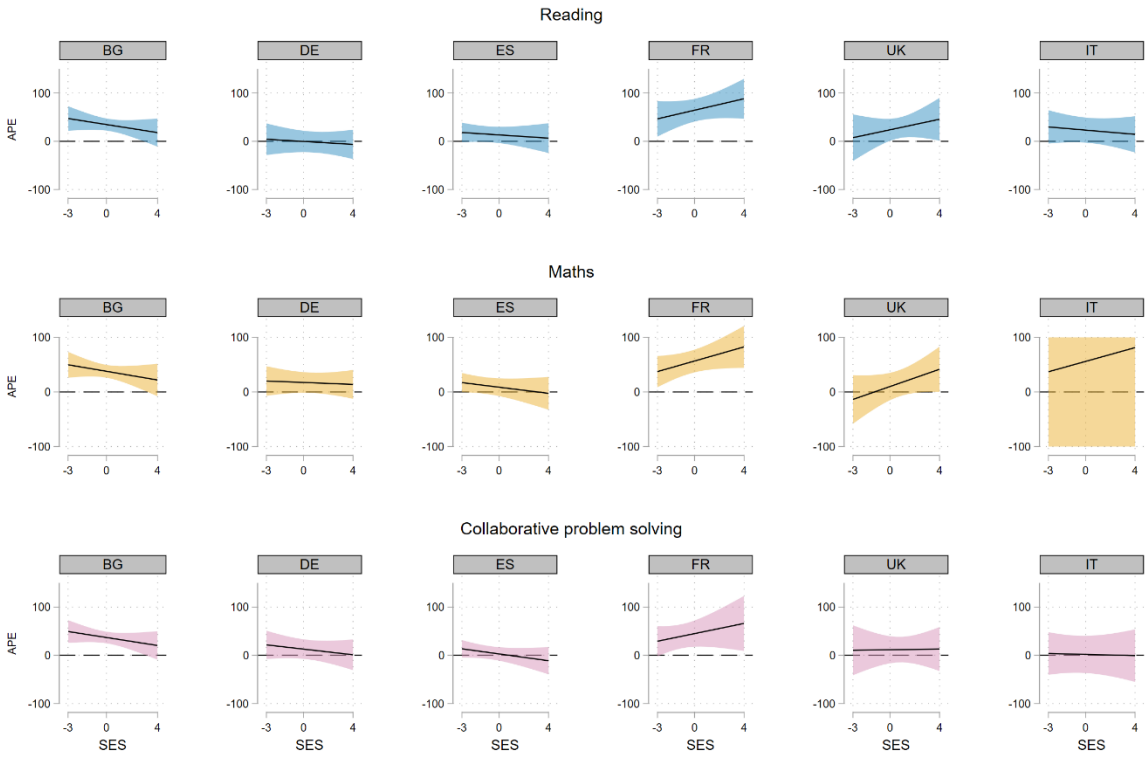

Figure 2.6 Average partial effects (APE) of preschool attendance on later skills with 95% confidence intervals, by SES.

Note) Reference category: Not in preschool; confidence intervals of the interactive effects of preschool attendance and SES on maths in Italy are capped.
Source) Own calculations on PISA 2015.

2.8. Conclusion and Discussion

This chapter aims at investigating whether ECE has an impact on cognitive and noncognitive skills at 15 years old with a comparative perspective. By applying an analytical strategy that permits us to solve possible issues of selection in ECE, we reached four main conclusions. First, we demonstrate that ECE has a long-lasting impact on both cognitive and noncognitive skills with, however, differences in the direction of the effect depending on whether students attended ECEC or preschools. Corroborating previous results, we discover that ECEC has either no effect or a detrimental impact on later skills. Conversely, preschool attendance affects positively later cognitive and noncognitive skills, but only where PS is accessible and of high-quality.

Second, we can conclude that ECEC attendance is more detrimental for low-SES children than for their affluent peers, corroborating the complementarity hypothesis. Socially well-off parents may possess adequate educational resources and networks for counteracting the detrimental impact of ECEC attendance, contrary to low-SES children who are exposed,

from early years to not nurturing and stimulating learning environments, both at home and in childcare. On the contrary, preschool is an equalizer of opportunities, since the learning benefits of attending such a formal learning environment are greater for low-SES children. However, for these effects being present, preschool should be accessible and of high quality, as in the case of Belgium. France represents an exception to this patter since are socially well-off children who gain the most from formal care settings, thus corroborating the complementary hypothesis especially for cognitive skills. We can speculate that, despite French preschools foster quality, constituting a decisive stage in building early linguistic and social competences, access is not legally guaranteed, and fees are high. Moreover, it could be that, despite the aim of giving a place in preschool to all children, those from low-SES families are likely to enrol with fewer entry-level skills compared to their affluent peers and this may impede them to take full advantage of the learning opportunities offered in formal care settings, such as preschool classroom quality and learning-related teachers' behaviours.

Third, we cannot conclude, as suggested by psychologists, that early ECEC attendance is riskier than late ECEC uptake for skill development, while in countries where preschools are available, affordable, and of high-quality, such as in Belgium and France, the longer the time passed in preschool the better the performances in secondary school tests.

Fourth, we find more similarities than differences in cross-national comparison in the direction of the effects, while they were differently pronounced according to the context under analysis. The United Kingdom and Germany show to fit poorly with our expectations since they cannot be considered as being part of a single cluster. In Germany, neither ECEC nor PS attendance has an enduring impact on later skills, while in the United Kingdom having attended PS is beneficial for reading skills. This can be explained by the fact that the German ECE system, especially for the under-threes, started its expansion in the early 2000s, having formal care settings that were of low quality regardless of children's age. In the United Kingdom, instead, although ECEC was mainly provided by the private sector, preschools are of high quality, ensuring positive returns at least on literacy outcomes. Concerning Belgium and France, our hypotheses are partially confirmed. On the one hand, a highly accessible and quality preschool system correspond, in both countries, a beneficial impact on later cognitive and noncognitive skills but, on the other, students from both countries perform badly in secondary school tests if enrolled in childcare. Yet, these results can be explained by the fact that pedagogical curricula for the under-threes were not directed yet to educational goals, but rather they promote care and family life balance. Italy and Spain represent our third group of countries, where the effect of ECEC attendance is negative on cognitive skills and that of PS attendance

is not enduring. These findings, again, call for verifying the ECE quality in the country under analysis since, if not fully implemented, formal care settings are not efficient in enhancing skills beyond primary school.

But why ECEC has a detrimental impact on skills? And in which sense preschool quality is not efficient enough in boosting children's skills? Would does this mean that incentivizing the use of institutional care services is not the right way for assuring all children with a good start? A clarification is here relevant for correctly interpreting the results. We need to keep in mind the period of reference for attending ECEC, i.e., 2000-2002, and preschool, i.e., 2003-2005. It was during the early 2000s that most European countries witnessed an expansion of their ECE system, debating on the role of ECE and its quality, focusing on defining pedagogical curricula and teaching requirements, access criteria and the number of places. Therefore, countries were just about to start to implement formal care services' quality. This can partly explain the negative effects of ECEC on later skills. As such, future studies should look at the long-lasting impact of ECE on skills with more recent data, which can capture the effects of formal care settings shortly after or while in the middle of a period of relevant institutional changes. Moreover, future studies should strive for working with comparative data that provide measures that capture the quality of the settings, enlarging the number of countries involved.

All in all, this chapter suggests that steps towards an improvement of ECE settings are in the right direction since the educational experiences that children collect during their early infancy, toddlerhood, and childhood in formal care settings matter for their later learning. If highly accessible and of high quality ECE has (i) long-lasting effects on both cognitive and noncognitive abilities. Moreover, by improving ECE accessibility and quality, (ii) countries can support the learning of socially disadvantaged children, who gain the most from interactions with teachers, peers, and educational materials in literacy supportive and nourishing. Only in this way, it seems that ECE can act as an equalizer of opportunities, favouring the later academic and social abilities of all children, but especially of those who are more at risk of poor educational outcomes.

3. CHAPTER 3: WHAT DRIVES EARLY CHILDHOOD EDUCATION ATTENDANCE? THE ROLE OF STRUCTURAL FACTORS AND PERSONAL BELIEFS IN GERMANY

Abstract

The chapter investigates whether and how structural factors linked to familiar and contextual characteristics, children attributes, and maternal beliefs relate with early childhood education (ECE) attendance in Germany. We contribute to the literature on selection into ECE by both (i) adapting an adapted version of the theoretical model developed by Pungello and Kurtz-Costes to early educational choices, and (ii) dynamically examining the influences on ECE uptake of different factors. We run binomial logistic regression models, applied to multiply imputed data from the National Educational Panel Study, to show that attendance to the German ECE system remains unequal even after a period of intense reforms. Inequalities in ECE participation begin at one year old, being the largest when children are two years, and then decreasing at age three. Despite the remarkable expansion of formal childcare services, findings confirm the importance of structural divides linked to children's social origins and residential area as main drivers of ECE inequalities, especially at two years old. Beliefs are relevant too: mothers who perceive ECE as a tool to support both their offspring's cognitive development and their own occupational careers are more prone to opt for formal childcare enrolment.

Keywords: childcare; inequalities; childcare selection process; costs and benefits; personal beliefs

3.1. Introduction

From the 1960s, participation of children to early childhood education[35] (ECE) has internationally grown (Melhuish et al. 2015), mirroring a changing perspective around childhood and care since, "after centuries of being a predominantly private, family affair, the care of very young children is now becoming, in significant degree, an out-of-home activity in which governments and private enterprise are increasingly involved" (UNICEF 2008, 3). In many Western countries, the expansion of the childcare provision relates to two important, mutually linked arguments: the ECE relevance in (a) caring for and (b) investing in children. Prompted by increased female participation in the workforce, the first perspective points at childcare services as tools for reconciling work and family duties (Del Boca and Wetzels 2008), tackling child poverty and social exclusion (Gambaro, Stewart, and Waldfogel 2014). Inscribed in the so-called social investment perspective (Esping-Andersen 2002), the second stand conceives childcare as a channel for enhancing children's human capital (Heckman 2011). According to this second perspective, ECE provides all children, but particularly those coming from vulnerable backgrounds, with an externalized, highly-stimulating environment corresponds that supports children's skill development (Van Lancker and Ghysels 2016; Hemerijck 2018). Because of this renewed interest around early life stages, European countries witnessed a lively debate around the ECE system. Primarily focusing on issues of care availability and accessibility (van Belle 2016), the European Commission sets in 2002 the following targets: "childcare by 2010 to at last 90% of children between 3 years old and the mandatory school age and at least 33% of the children under 3 years of age" (European Commission 2013, 4). However, although all member states reached these objectives[36], inequalities in ECE access are the norm rather than the exception (Van Lancker and Ghysels 2016). Who are the elected? Why examining the care selection process is relevant? If ECE is beneficial for human capital accumulation in the short term and, with somewhat smaller effects, even in the long run (see for a review Kulic et al. 2019; Burger 2010), inequalities in early educational decisions can favour, on average, the already privileged, thereby contributing to the later exacerbation the skills gap.

[35] With the term early childhood education, OECD considers both early childhood educational development programmes (ISCED01) targeted at the under-threes, and pre-primary education (ISCED02) devoted to care for children from three years to compulsory school age.

[36] ECE participation rate in 2017 amounts to 34.2% for the under-threes and 95.4% for children aged 4 and over (European Commission/EACEA/Eurydice 2019).

Focusing mainly on demand-side features, previous research on unequal use of formal care services in industrialized countries found support to this concern, showing that children from socio-economically advantaged families start earlier and spend more hours in non-parental care settings compared to their less advantaged counterparts (e.g., Kathy Sylva et al. 2007; Early and Burchinal 2011; Brilli, Kulic, and Triventi 2017). Additional family characteristics, such as lone parenthood and migratory background, are also relevant for childcare choices (e.g., Schober and Spiess 2012), while just some studies have focused on the role played by parents' cultural values and work-care ideals as possible explanations for different use of extra-familiar childcare (e.g., Kathy Sylva et al. 2007).

Yet, although there is rich evidence on "which kind of children experience early child care and which kind of parents select it*"* (Kathy Sylva et al. 2007, 118), less is known about the relevance that each factor has in predicting ECE use. Research that simultaneously investigates the multiple factors within a unique framework is rather scarce. Filling this gap is the first contribution of this article. Secondly, by taking advantage of prospective longitudinal data, this study extends previous ones because it sheds more light on the dynamics of inequality, by analysing whether and how the importance of these drivers changes according to three crucial age points. Thirdly, the article explores recent data for Germany as an exemplary case study, analysing ECE inequalities shortly after a decade of institutional reforms. Indeed, Germany has experienced a rapid expansion of public care services from the early 2000s onwards, recently providing its citizens with *"*a virtually universal, strongly state-subsidized system*"* (Stahl, Schober, and Spieß 2018, 306). Yet, although the participation rate in formal care settings has been continuously growing over the last years (Linberg, Bäumer, and Rossbach 2013), equality in its use remains a challenge rather than a conquest (Jessen et al. 2018). Recent evidence shows that both social and geographical divides remain related to ECE attendance, with higher access rates by children from high-income families, with tertiary-educated mothers, and residing in Eastern areas (e.g., Büchner and Spiess 2007; Kreyenfeld and Krapf 2016), especially during their first three years of life (Skopek 2017). A few studies also showed the association of family features with childcare uptake, such as the number of siblings, marital status, and migrant background (Kreyenfeld and Krapf 2016) while, although not neglected, the role of children's characteristics and parental views on formal care has been less studied (Geier and Riedel 2008; Burghardt and Kluczniok 2016; Burghardt 2018).

The chapter is organized as follows. Section 3.2 describes the German system and its recent changes, both in terms of institutional features and childcare policies. In the section 3.3, we outline the theoretical framework and our expectations. The research design is described in

section 3.4, while section 3.5 is devoted to presenting the research results. In section 3.6 we discuss the main findings and conclusions.

3.2. Germany between reforms and changing work-care cultures

In Germany, the aims of preschool services are in line with both the care and the investment foci. Since 1990, a federal regulation[37] declared as priorities (a) the promotion of young people individual and social development, and (b) the commitment to support families in their duty of children's upbringing (Linberg, Bäumer, and Rossbach 2013). Childcare centres are expected to be as extensive and inclusive as possible, enabling access to all children aged from one-year-old up to school age regardless of their socio-economic, cultural and ethnic background, sex and status (BMFSFJ, Bundesministerium für Familie, Senioren, Frauen 2016).

Childcare expansion took place from the mid-2000s, as a result of both the need of meeting the European childcare policy targets that emphasize the 'good start' rhetoric and because of the so-called PISA shock, which warned about an alarming situation of poor school performances and persisting between-groups achievement disparities (Oberhuemer 2012; Schober 2014; Stahl and Schober 2018). Although since 1996 children aged three years were legally entitled to a place in Kindergarten (Schober and Spieß 2013), in 2005 the Day-Care Expansion Act extended this right to children aged under three years, yet with some limitations (i.e., parents should be employed, in education or employment-integration programmes. Welfare cannot be guaranteed to children otherwise). In 2008, the Child and Youth Welfare Act further enlarged the eligible recipients, entitling all children older than one-year-old starting from 2013 to a place in a care setting regardless of their parents' employment status[38] (Stahl and Schober 2018). As a result, ECE attendance increases tremendously in Germany[39], incentivizing mothers to (re)enter the labour market, especially during the first three years after giving birth (Müller and Wrohlich 2016). Yet some structural differences remain noticeable: the availability of (full-time) ECE places varies significantly between and within Länder[40], and the use of the ECE system remains, in general, more common in East Germany and for children of the oldest age group[41] (Schober and Spieß 2013; Linberg, Bäumer, and Rossbach

[37] Child and Youth Welfare Act (Kinder- und Jugendhilfegesetz - §22 Abs. 2 SGB VIII) of 1990, see https://www.gesetze-im-internet.de/sgb_8/BJNR111630990.html [retrieved on 07 Nov. 19].

[38] A legal entitlement of about 4 to 5 hours a day for children aged one or older from August 2013.

[39] From 2006 to 2019 the number of children cared in formal care settings has been rising from about 2,6 to 3,3 million (Maaz et al. 2020).

[40] The 16 German states are responsible for education and social services, but the municipalities are accorded great autonomy in providing childcare. This, in turn, made the German ECE system highly decentralized.

[41] For the under-three, the enrolment rate has increased from 13.6% in 2006 (39.3% in East Germany, 7.9% in West Germany) to 33.6% in 2017 (51.3% in East Germany, 28.8% in West Germany) while, for the oldest

2013; BMFSFJ, Bundesministerium für Familie, Senioren 2019). In the same period as the legal claim to a place in childcare was introduced, the government launched the so-called 'Betreuungsgeld. The latter is a direct cash transfer benefit (i.e., 100 € and 150 € per month with August 2014) for parents with children aged 15-36 months. The only prerequisite for obtaining the benefit is not having the child enrolled in any form of public or publicly subsidized childcare. Within a counterfactual scenario, a recent study finds that the combined effect of both reforms led to a small increase in maternal labour market participation and formal childcare use, which would have been greater in the absence of the Betreuungsgeld. Hence, the latter schema off-sets the positive impact of the legal claim on both childcare use and mothers' workforce participation (Müller and Wrohlich 2016)

Care unaffordability can be a barrier for ECE use, yet not in Germany where care is highly state-subsidized[42]. To promote inclusive access to public care, German states, municipalities, and childcare providers take over the majority of ECE expenses. Overall, municipal funding contributes, on average, 47 per cent to childcare costs; state funding to, approximately, 32 per cent, the providers themselves to an estimated 5 per cent and, finally, parents bear an average of 14 per cent of the overall cost. (Spiess, Berger, and Groh-Samberg 2008). The latter fee is income-dependent and low once compared with other OECD countries, amounting to an average of 144 euros per month in 2012 (Stahl, Schober, and Spieß 2018). Moreover, low-income or at-risk of poverty families that are exempted from paying childcare contributions (Schmitz, Spiess, and Stahl 2017). Recent estimates indicate that 9% of children have parents who are exempted from contributing to childcare fees due to hardship (Schober 2014).

Moreover, changes in parental leave schemas accompanied reforms in childcare settings (Stahl and Schober 2018). By mirroring the Swedish example, in 2007 the German government incentivized both a rapid maternal return in the labour market and paternal involvement in child-rearing practices (Gangl and Ziefle 2015). Thus, from the typical male breadwinner/female carer model (Stahl and Schober 2018) Germany moved towards a "one-an-a-half-dual-earner-model" (Spiess and Wrohlich 2006, 4), where mothers usually work part-time and fathers full-

age group, the participation rate reaches 93.6% in 2017 (94.3% in East Germany, 93.1% in West Germany) from an initial 87.3% in 2006 (91.6% in East Germany, 86.5% in West Germany) (BMFSFJ, Bundesministerium für Familie, Senioren 2019). In 2019, 66% of one-year old children living in East Germany were enrolled in institutional care against 31% of those who reside in West Germany. One year later, at two years old, this gap is still wide: four children out of five (85%) and three children out of five (58%) attend ECE in East and West Germany, respectively (Maaz et al. 2020).

[42] Moreover, although a private-public mix is present in the provision of childcare services, private providers represent just a small part. In 2017, for example, only 2.6% of institutions were private and non-charitable (Jessen, Schmitz, and Waights 2019).

time. In practice, the new parental leave scheme allowed for a shorter leave for the primary caregiver, lasting 12 months after childbirth. Moreover, it guaranteed a replacement quota amounting to 67% of the previous net earnings. Finally, two additional months were reserved for fathers (or, more in general, for the secondary caregiver), the so-called 'daddy-quota' (Spiess and Wrohlich 2006; Geisler, Kreyenfeld, and Geisler 2010; Stahl and Schober 2018; Spiess, Berger, and Groh-Samberg 2008). Recent longitudinal findings on maternal return-to-work behaviour confirm the positive linkage between maternal employment and childcare take-up, suggesting that an increased supply of state-guaranteed, low-cost childcare places for the under-threes associates moderately with shorter maternal employment interruptions during the ECE expansion period from 2006 to 2014. This holds particularly for West German mothers after second childbirth. Moreover, also the likelihood of returning to work when parental leave expires, i.e., when children are two years old, is accentuated (Zoch and Hondralis 2017). Yet, discrepancies remain when looking at maternal educational levels. Indeed, although the general positive relation between childcare and maternal employment is confirmed, Zoch (2020) corroborates recent trends (Stahl and Schober 2018), indicating the existence of an educational gradient in the association between childcare and maternal employment, being the relation more pronounced for mothers who hold at least a vocational degree, have a second child, or have access to ECE services[43]. Moreover, long-lasting parental leave together with deteriorating labour market opportunities especially for low-skilled individuals has encouraged poorly educated mothers to not (return to) work, particularly in West Germany (Konietzka and Kreyenfeld 2010).

Together with family policy reforms, a cultural shift in the individual-level gender ideologies occurred in the same period as well (Zoch and Schober 2018). After the post-war division, the Western and the Eastern areas developed two opposite visions on norms regarding children's care and female employment (Scholz et al. 2019). The former German Democratic Republic supported female employment with a well-developed system of full-day, public-funded Kindergarten and day-nurseries while in the former Federal Republic areas women were encouraged to mind for their children at home, with their partner being the main providers of family income (Oberhuemer 2012). After the fall of the Berlin wall in 1989, Germany experienced "convergence in occupational and industrial structures as well as the adoption of the West German institutions in all policy areas" (Gangl and Ziefle 2015, 521) that may suggest,

[43] Since having both parents in employment is one of the priority criteria for accessing ECE when the demand exceeds the supply, highly educated families are found to be more likely to benefit from these access rules, thus increasing the educational divide in ECE take-up over time in Germany (Stahl and Schober 2018).

as some recent research confirms, a convergence in attitudes too. West German mothers – especially if poorly educated- shifted towards less-traditional attitudes on maternal employment while, at the same time, in East Germany the change occurs in the opposite direction, thus towards more traditional views (Zoch and Schober 2018).

3.3. Theoretical framework and hypotheses

To understand the aetiology of ECE participation, we conceive parental decisions as to the result of a process of rational reasoning that occurs within a social structure. The latter provides heterogeneous sets of opportunities and constraints, and systems of beliefs and normative values, which delimit the space of desirable options and the importance attributed to different choice criteria. Parents decisions are, therefore, "neither entirely individual (…) nor fully informed and reflective*"* (Meyers and Jordan 2006, 60) and they are rather accommodations, influenced by rational choice evaluations but also socially constructed norms, values, beliefs and networks.

To the best of our knowledge, the research on the mechanisms driving educational choices in early years is scarce compared to that devoted to subsequent educational transitions towards, for example, secondary schools or universities. A recent study addresses the issue in Germany analysing the timing of early care take-up[44] (Steinberg and Kleinert 2019), but mainly focused on the role of rational choice motives, without an attempt to put this decision in a broader context. As such, we draw upon the socio-ecological 'person-process-context' model of development (Bronfenbrenner and Morris 2006; Bronfenbrenner and Ceci 1994) and we adapted the Pungello and Kurtz-Costes (PKC) (1999) model for better framing this complexity, by outlining the interwoven network of mutual relationships that lies behind childcare selection. According to this framework, depicted in an adjusted form in Figure 3.1[45], the decision to enrol children in ECE service is affected by four main sets of factors, including parents' socio-economic resources, family structure, the place of living and child characteristics. Additionally, parents' work-care beliefs and their considerations on costs and benefits associated with alternative childcare arrangements contribute to explaining heterogeneous patterns of ECE access, but also exert independent effects on ECE participation.

[44] Their take home message is clear: although costs and benefits evaluations matter, they do not help in explaining social differences in formal childcare usage when children are under three years old.

[45] The PCK was originally meant at explaining childcare decisions for working mothers in the US. We decide to expand this model by focusing also on care choices of non-working mothers, for grasping a better understanding of the care arrangements of parents and the resulting inequalities, regardless of employment status. Although adapted, this model still suits our research questions, enabling us to jointly analyse possible influences on maternal care search and selection behaviour within a dynamic perspective.

Parents' employment conditions (e.g., being employed, household income, social class) and family structure (e.g., number of children, grandparents' availability) define the set of socio-economic resources and time available for caring for children. Children's characteristics, such as temperament and early cognitive skills, might also enter parents' decisions related to childcare arrangements. Moreover, the choice about ECE enrolment takes place in a specific social context characterized by a specific childcare availability, affordability and quality: few childcare places, higher costs, and lower (perceived) care quality decrease the likelihood of using formal care settings (Meyers and Jordan 2006; Geier and Riedel 2008). It is important to bear in mind that the perception of the costs is relative to the available financial resources in the household: the same absolute costs would imply different economic stress for richer and poorer families. The availability of ECE services is affected by the public (and private) offer in the municipality and the surroundings, but also by the specific criteria of access. Different areas could provide more or fewer services and an offer of different quality, in terms of structure, teachers' qualifications and prevalent caring approach. The PKC model stresses, along with the role of perceived costs and benefits, the importance of parents' – especially mothers' – work-care beliefs, which are affected by cultural aspects, such as systems of values and normative schemas related to motherhood, which make the various childcare alternatives more or less desirable.

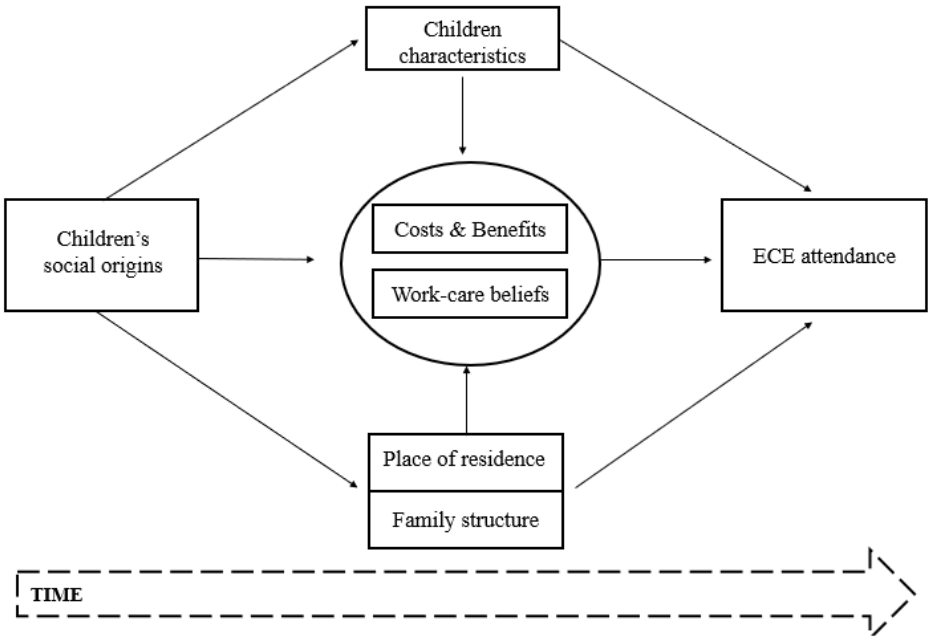

Figure 3.1 Conceptual model of childcare selection (adapted from Pungello and Kurtz-Costes 1999)

By following the insights from the PKC model and previous research, we now formulate some expectations on the role of the selected factors for the German context. First, since disparities in child development due to social origins are present already before the entrance in Kindergarten (Weinert, Ebert, and Dubowy 2010; Kulic et al. 2019) and they tend to increase over the next years (Halle et al. 2009; Skopek and Passaretta 2018), we hypothesize that parents with high social positions disproportionally opt for ECE. Moreover, the availability and the legal regulations of a specific geographical area are important constraints for explaining gaps in ECE enrolment (Pavolini and Van Lancker 2018). We hypothesize that children's place of residence matter in the care selection process, with parents who reside in East Germany disproportionally opting for ECE. Moreover, we expect that, because of the features of the leave system, social and geographical inequalities are more prominent during the Kinderkrippe phase, and more specifically at 2 years old, than at Kindergarten entry.

Given the central position of process variables in the PKC model, we further claim that parental expectations and views around childrearing and childcare are highly predictive for ECE uptake, particularly when children are under three years old. Due to the intense national and international debate around early childhood, we expect that motives linked to both the care and investment foci have been absorbed in parental discourses around care alternatives. As regard to calculation of ECE costs, we expect that childcare affordability is no longer perceived as an issue thanks to the recent reforms put at place in Germany.

About factors related to the family side, we claim that maternal employment status is possibly the most important determinant of ECE take-up, as confirmed by previous studies, yet especially when children are young. Because the well-known interdependence of childcare and employment, working mothers are indeed more likely to enrol their pre-school aged children in ECE services (e.g. Kreyenfeld and Krapf 2016). Research has also found that at a higher number of children at home corresponds a higher probability of choosing home-based or informal care settings while, at the same time, children from single-headed families are more likely to be enrolled in formal centre-based care, thus permitting to their parent to work (Pungello and Kurtz-Costes 1999; Kreyenfeld and Krapf 2016). Finally, the working schedules of fathers as well as the availability of other forms of informal care (e.g., grandparents) may influence the choice for regulated care outside home (Pungello and Kurtz-Costes 1999).

As regard children's characteristics, we base our claims on previous results for other countries that, although scarce, show either any or unclear effects of children's characteristics on ECE participation (see Kathy Sylva et al. 2007). Accordingly, we suppose that, in general, children's attributes matter only modestly for ECE attendance. More specifically, concerning

the influence of children's sex on ECE attendance results are rather inconclusive reporting, for example, no effect (e.g., Kathy Sylva et al. 2007) or a girls' advantage (e.g., Hiedemann, Joesch, and Rose 2004). Children with a migration background are found to have a lower probability of attending ECE compared to natives, particularly in the first two years of life (e.g., Miller, Votruba-drzal, and Levine 2013; Schober and Spieß 2013). Findings on early child temperament are scarce and, when available, rather inconclusive suggesting either no effect (e.g., Melhuish et al. 1991) or that children with a difficult temperament spend more hours in ECE than their counterparts (e.g., Kathy Sylva et al. 2007). Children's individual developmental skills are also important for parents to evaluate ECE attendance. Some studies found that parents who rated their children as more competent in certain area (e.g., early numeracy or early literacy) are more likely to choose centre-based care (e.g., Grogan 2012), thus aiming at optimising their offspring school readiness. Finally, although children's health may influence childcare utilization, research of children with special needs is limited. A study conducted by Brandon (2000) suggests, nevertheless, a negative association between multiple disabilities and childcare attendance[46].

3.4. Data, variables, and methods

3.4.1. Data and sample

We use data from the National Educational Panel Study (NEPS) that reconstructs the educational trajectories of individuals who live in Germany (Blossfeld, Roßbach, and von Maurice 2011). More specifically, our empirical analysis uses the first cohort of the study (hereafter, SC1), which aims to measure the development of competencies and early educational paths of all infants born in Germany between February and July 2012. NEPS data are particularly suitable for our purposes since, beyond providing information on a nationally representative sample of the German population, they contain information on all the theoretical concepts we are interested in, with questions that, in most cases, are consistent across waves, but that also specific according to children's ages. Our research design accounts for the longitudinal nature of the dataset by identifying the temporal dimension of each group of factors (see Table B.1 in Appendix B Chapter 3 for more detailed information on when each item under analysis was measured). Moreover, thanks to their longitudinal nature, our data permit us to detect possible changes of inequality in access to ECE and its drivers.

[46] The study has focused on only working mothers raising children with disabilities, excluding parents who were not in the workforce or who were studying.

The survey adopts a two-stage disproportional stratified sample strategy. In the first stage, German municipalities were proportionally stratified according to a classification of urbanization (i.e., BIK scale[47]). In the second stage, a register-based sample of addresses of newborns[48] was used to achieve the planned sampling size[49] from the 84 municipalities selected. With a response rate of 41%, the final sample size amounts to 3,481 six-to-eight months old infants and their families (FDZ-LIfBi 2019). In the second wave, infants are 12 to 17 months old and all parents who gave consent to be contacted again were interviewed. Yet, for reducing financial and administrative burdens linked to the home-testing of early competencies, only a random subsample of children was chosen from the initial one (n.: 1,417)[50]. From the third wave onwards (n.: 2,609), all panel respondents – i.e., children with their parents – were followed up yearly up to 2017, when target children were about 5 years of age. Because of these specificities, the analysis needs to consider both design and nonresponse weights.

The analytical sample includes only those children whose respondent parent is the mother[51]. In our view, mothers are the focal decision agent since despite many Western countries have witnessed over the past decades a closing gender gap in the time spent with children, they are still those who devote more time to childcare (Gauthier, Smeeding, and Furstenberg 2004). Moreover, because of (a) an increasing number of women involved in the workforce and (b) an agreement around an ideology that reinforces beliefs on the importance of maternal time and nurturing behaviours for child development (Hays 1996), the choice for institutional care can be more controversial and delicate for mothers than for fathers. Furthermore, since household characteristics and related considerations may affect family decisions concerning care already before ECE effective uptake, we further exclude from the analytical sample those children who, at about 7 months of age, were already attending formal care settings[52]. Missing values on the variables of interest were imputed adopting a multiple imputation strategy, which we describe below. With these amendments and corrections, the final size of the analytical sample amounts to 3,184 mothers and their children. Our observation

[47]The BIK scale provides a classification of urbanization in three levels: (a) less than 50,000 inhabitants; (b) 50,000 to 500,000 inhabitants, and (c) 500,000 or more inhabitants (Würbach, Zinn, and Aßmann 2016).

[48] Children living in institutions (e.g., children's home or parent-child home) and their legal guardians were not included in the survey (FDZ-LIfBi 2019).

[49] In the first stage of the sampling procedures, 84 municipalities across the 16 German federal states were selected as primary sampling units. In the second stage addresses were randomly selected by using a systematic interval sampling (FDZ-LIfBi 2019; Würbach, Zinn, and Aßmann 2016).

[50] Here, a random subsample of 34 municipalities have been drawn from the initially 84 selected.

[51] The label mother refers to either biological, adoptive, foster or stepmothers of the target children. Out of six waves (n: 15,087, we exclude from the analysis 321 cases, corresponding to 2,13% of the sample).

[52] We further remove from the analysis 61 children who, in the first wave of the study, were already enrolled in childcare.

period goes from 2012 to 2015, embracing children lives from when they are about 7 months to 3 years. Children of this cohort could take advantage of both recent family reforms described above.

3.5. Variables

Our dependent variable measures ECE attendance, taking value 1 if children are enrolled in formal care, 0 otherwise. Two are the items that measure children's socioeconomic backgrounds. First, parental highest educational level, i.e., a three-categories ordinal variable obtained by the combination of the highest educational level of the mother and her partner measured through ISCED in the first wave of the study. The three categories are (1) low -if at least one member of the couple is poorly[53] educated-; (2) medium -when at least one member in the couple hold no more than a maturity certificate-, (3) high -when both members hold a tertiary degree. Second, family net income, which was standardized to have a mean of 0 and a standard deviation of 1.

The availability of centre-based care services is captured by a variable, which identifies where children reside. The latter takes values of 1 if children reside in East Germany (including Berlin), 0 if children live in West Germany. Although children's residential area is a rough measure for the service supply, it is the only proxy available in the data version we were able to obtain.

Family structure refers to a group of variables that accounts for family characteristics (i.e., marital status and the number of siblings), economic (i.e., maternal employment 12 months before childbirth[54]), and networking resources (i.e., partner's working hours, availability of care offered by either grandparents or other relatives)[55].

Children's attributes include standard socio-demographic information, such as sex and migration background, additionally considering health, early temperament, and cognitive skills.

Personal beliefs capture mothers' perceived costs and benefits linked to ECE attendance, as well as work-care beliefs. The cost dimension measures the likelihood of encountering financial difficulties when attending formal care. The benefit dimension considers formal childcare as a tool for both (a) enabling mothers' labour market return and (b) enhancing children's school readiness. Finally, work-care attitudes are measured by three items:

[53] Holding maximum an ISCED 2 certificate.
[54] Controlling for maternal employment at the time of interview was not possible since most mothers declared to be unemployed (86.8%), while just 14,8% declared to be employed (either full or part-time) or occupied in side-jobs positions.
[55] See Tables 3 and 4 in Appendix Chapter 3 for a summary of the descriptive statistics.

attachment to the job sphere, social costs linked to Kinderkrippe use, and importance given to social competencies Originally, each dimension linked to personal beliefs was captured by a one-item question measured via a quasi-metric scale ranging from 1 to 5. Yet, both the left-skewed distribution (Steinberg and Hoenig 2018) and the non-linear bivariate association with children's social background prompted for a recodification of the items in a three-categories variable, with low values corresponding to negative statements to the question. Table 3.1 below provides more details on the measurement level and question wording of each item under analysis.

Table 3.1 Description of the variables

Theoretical construct	Variables Description
ECE attendance	
Enrolment in ECE[56]	[0] No [1] Yes
SES	
Parental education	[1] Low [2] Medium [3] High
Family net income	Standardized
Place of residence	
Living in East DE (incl. Berlin)	[0] No [1] Yes
Family structure	
Working mother[57]	[0] No [1] Yes
Marital status	[1] Single [2] Married [3] Separated/Divorced
Number of siblings	Standardized
Partner working hours	Standardized
Informal care: grandparents	[0] Yes [1] No
Informal care: other relatives	[0] Yes [1] No
Children's characteristics	
Sex	[0] Male [1] Female
Immigration background	[0] Yes[58] [1] No
Low birth at birth	[0] Yes[59] [1] No
Sensorimotor skills	Standardized
Temperament: negative affectivity	Standardized
Costs and benefits	
Perceived financial costs[60]	[1] A Lot [2] Some [3] Very Little
Prospects of being employed[61]	[1] Very Little [2] Some [3] A Lot
Prospects of cognitive enrichment[62]	[1] Very Little [2] Some [3] A Lot
Prospects of social skills development[63]	[1] Very Little [2] Some [3] A Lot
Work-care beliefs	
Importance of being employed[64]	[1] Very Little [2] Some [3] A Lot
Social costs[65]	[1] A Lot [2] Some [3] Very Little
Importance of social skills[66]	[1] Very Little [2] Some [3] A Lot

Source) Own elaboration on NEPS, SC1.

[56] Is <target child's name> currently cared for in day care, day nursery or Kindergarten? This includes all types of day and/or care facilities for children, as well as parent / child initiatives, i.e., care facilities independently managed by parents and/or youth / childcare workers.

[57] Maternal employment 12 months before childbirth.

[58] Natives are those children who are born in Germany and whose both parents are born in Germany (coded with value 1). First and second-generation migrant are coded 0.

[59] All new-borns weighting less than 2500 grams (excluded).

[60] Attendance of a day-care incurs a variety of costs, such as fees, money for materials and travel costs. How difficult would you find it to pay the costs incurred as a result of <target child's name> attending day-care/Kindergarten?

[61] For the following questions, imagine that <target child's name> was attending day care. How good are the prospects of you being employed if <target child's name> attended day care? /How good are the chances that you would be able to work if <target child's name> attended a Kindergarten?

[62] How good are the prospects of <target child's name> developing if he / she attended day care? / How good are the chances that attending a Kindergarten would have a positive effect on <target child's name>'s development?

[63] For the following questions, please imagine that <target child's name> is three years old or above and is attending a Kindergarten. How good are the chances that <target child's name> would learn how to get along with children his/her own age in Kindergarten?

[64] Parents/Mothers of toddlers have different desires for their occupation. How important is it for you to be employed?

[65] To what extent does the following statement apply to you? If I were to send <target child's name> to a day care, my friends and relatives would look down on me

[66] Parents/Mothers have different wishes for their child when it comes to getting along with other children. How important is it for you that <target child's name> gets on well with other children of the same age?

3.6. Analytical strategy

Because of the sampling design implemented for the SC1, data presents a high amount of missingness (see Table B.4 in Appendix B Chapter 3). A complete case analysis based on the commonly adopted list-wise deletion would lead to a rather small sample size of 1,196 cases (37.6% of the sample). This wide reduction of the sample could lead to both low statistical power and potential biases in the estimates of the quantities of interest. Therefore, we decided to replace missing values through multiple imputations (Rubin 1987; Schafer 1997) by chained equations. This technique allows us to tackle statistical uncertainty in the process of imputing missing values and handling variables of various types at the same time (Azur et al. 2011). We performed 50 imputations, including in the list of covariates all the variables used in the analysis (Tables B.2 and B.3 in Appendix B Chapter 3 show descriptive statistics with either imputed dataset or list-wise deletion method).

After having obtained the suited imputed dataset, we applied binomial logistic regression to model the probability of children being enrolled in formal care at different ages as a function of a set of covariates described in the previous section. Design and longitudinal weights provided by NEPS are used in the regression models, thus accounting for the survey sampling strategy (Würbach, Zinn, and Aßmann 2016).

We estimated several model specifications that allowed us to retrieve specifically the total effect of each item on ECE attendance, by adjusting our estimates for all the potential confounders and excluding variables that may act as mediators or common effects of the relationship of interest (Elwert 2013; Vander Weele and Shpitser 2013). In other words, the effect of each factor on ECE attendance is cleaned up by the possible influence of all those variables that both affect the distribution of the independent variable of interest and access to ECE, but not the possible mediators. In this way we avoid the common pitfalls of interpreting all coefficients from the same model specification, mixing up different types of effect for the independent variables of interest (Westreich and Greenland 2013)[67].

[67] To define which confounders to include in each model, we relied on Directed Acyclic Graphs (DAGs), normally used in counterfactual models for deriving causal inference. By means of these graphical models, we displayed theoretical (causal) relations between our variables of interest that we then tested empirically. In practice, DAGs allowed us to define, for each X-Y relationship, the relevant covariates to control for. We avoided to condition for mediators, thus preventing issues of model over-specification, and common effects, i.e., colliders, thus preventing issues of model miss-specification.

3.7. Empirical findings

In this section, we aim to assess which are the most relevant factors associated with childcare uptake at different critical age points. To make the results from logistic regression more clearly interpretable, we express the conditional association of specific items with the expected probability of ECE attendance using average partial effects (APE) with their 95 per cent confidence intervals.

3.7.1. Descriptive results

We start with a descriptive overview of the transition to formal care across children's ages. In Germany, the older the children are, the highest their ECE attendance is. Indeed, if at one year old only 17% of children attend Kinderkrippe, at four years participation becomes almost universal (98%). However, still, 16% of the three-years-old do not attend Kindergarten (see Appendix B Chapter 3, Figure B.1). Furthermore, systematic differences in childcare uptake are present according to both social and geographical lines. The left panel of Figure 3.2 reveals that offspring of university graduated parents are those with the highest participation rate to institutional care already at one year old[68]. The right panel of Figure 3.2 shows that the regional divide supplements social stratification patterns, with Eastern German children being more likely to attend ECE than West German ones.

[68] The sudden jump at 2 years old is likely due to the end of a paid parental leave, while the educational gradient may reflect the joint introduction of the legal claim to a childcare place and the introduction of the 'Betreuungsgeld'.

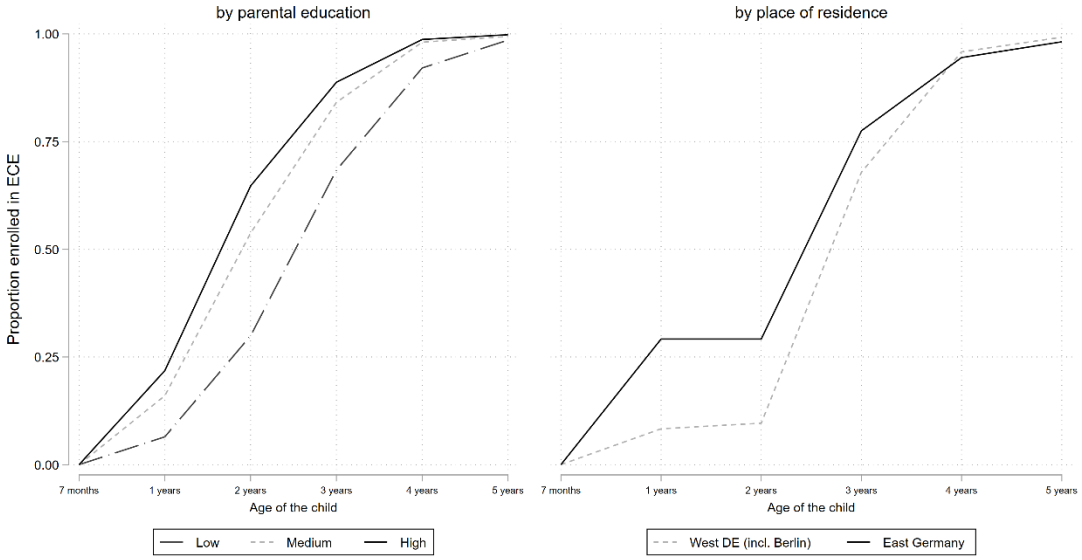

Figure 3.2 ECE participation across children's ages, by parental education and place of residence (Kaplan-Meier estimates)

Source) Own calculations based on NEPS, SC1.

All in all, by providing first empirical support on the importance of structural factors, these descriptive hints suggest looking at the first three years of children's lives, when discrepancies in ECE attendance appear to be remarkably pronounced. We move further, therefore, by analysing what can be the underlying drivers of such discrepancies in ECE take-up, analysing them from a dynamic perspective.

3.7.2. Children's socio-economic backgrounds

Results from the logistic regressions are in line with the descriptive patterns, confirming that, despite years of reforms, structural inequalities in Germany strongly determine ECE take up from early years. More specifically, tertiary-educated parents are 14 percentage points more likely to enrol their children in ECE when they are one year old (Figure 3.3). This advantage doubles one year later (i.e., 29 percentage points), while it reduces to 14 percentage points at Kindergarten entry (Figure 3.3). This result is in line with previous studies for Germany, reporting a divergence in care use over time along educational lines, with children with medium and especially high educated mothers being increasingly enrolled in Kinderkrippe across the period 1997-2013 (Stahl and Schober 2018), and in Kindergarten between 1995 and 2008 (Konietzka and Kreyenfeld 2010).

Conversely, family income is just partially relevant: one standard deviation difference on the income variable is associated with a 2-percentage points difference in the probability of

attending Kinderkrippe at one year old. If we compare families at the extreme of the income distribution, the difference amounts to around 5.6 percentage points (Figure 3.3). Although modest in comparison with the role of education, this result is interesting since, at that age stage, children should have been guaranteed a place in Kinderkrippe, regardless of their families economic standing. This difference can be explained by how parental fees are calculated and their concrete implementation is the responsibility of the federal state and the municipalities and, in some cases, even of the providers of the centre (Scholz et al. 2019; Schmitz, Spiess, and Stahl 2017). As such, although after the introduction of the legal claim differences in care expenses for households at different poverty levels have been gradually decreased, the financial burdens for families in the lowest income quartile are not considerably below those of families in the highest quartile (Schmitz, Spiess, and Stahl 2017).

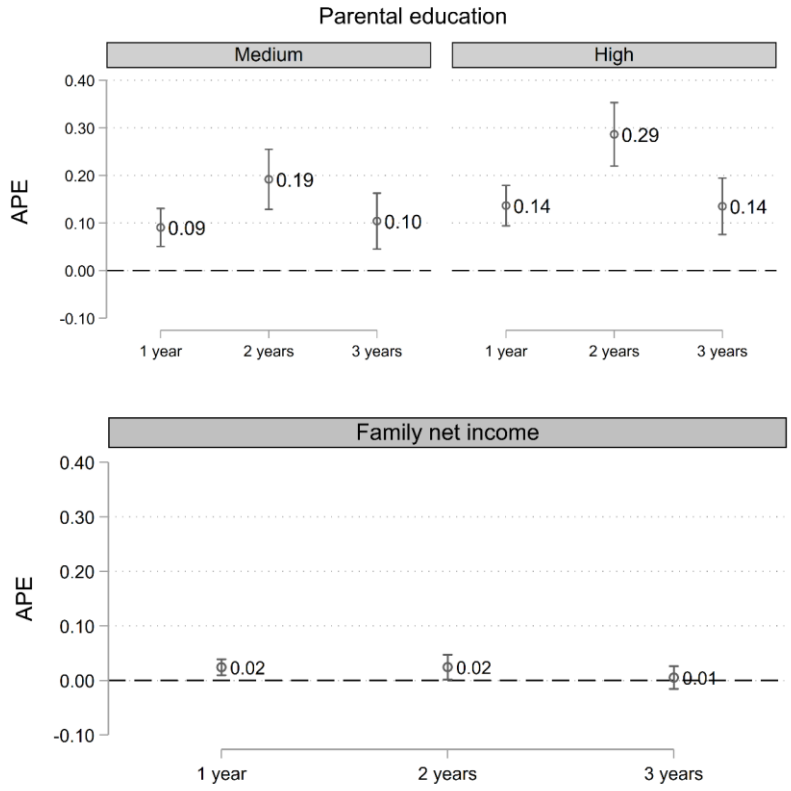

Figure 3.3 The relationship between ECE attendance with children's socio-economic background: average partial effects and 95% confidence intervals (N.: 3,184)

Notes: The estimate of APE for parental education is adjusted for children's sex, migratory background, place of residence. The estimate of APE for family income is adjusted for children's characteristics, marital status, number of siblings, maternal employment, partner's working hours, parental education, place of residence.
Source) Own calculations based on NEPS, SC1.

3.7.3. Place of residence

As depicted in Figure 3.4, Germany suffers from a West-East gap, with children residing in the former German Democratic Republic being more likely to experience care in institutional settings at all ages, yet most evidently at two years old (23 percentage points). Resembling previous ones reported for Germany, this finding could reflect the fact that differences across German areas in childcare services supply and diversities in women's participation in the labour market and attitudes towards care are still present, despite legal changes. Indeed, despite the number of children in day-care has increased significantly from 2005 onwards, it is still in the Eastern German areas where, historically, women had been working part-time or full-time work and where full-day care for young children is widely accepted, that children are disproportionally enrolled in ECE.

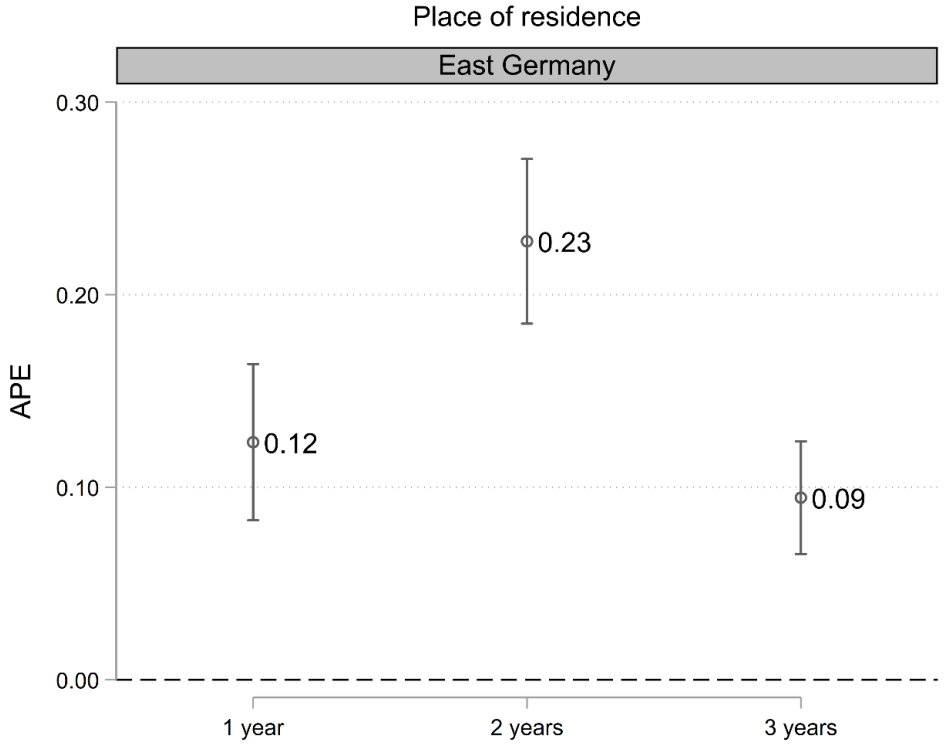

Figure 3.4 The relationship between ECE attendance with the place of residence: average partial effects and 95% confidence intervals (N.: 3,184).

Notes: The estimate of APE for the place of residence is adjusted for children's sex, migratory background, parental education.
Source) Own calculations based on NEPS, SC1.

3.7.4. Family structure and children's characteristics

In general, items linked to the family structure are associated modestly with ECE take-up, with some exceptions. Being a working or a single mother is considerably associated with ECE attendance (Figure 3.5). Being a working mother increases the probability of enrolling children in childcare at already one-year-old by 6 percentage points. This (conditional) difference between working and non-working mothers doubles when children are two years old (12 percentage points) and, although reduced, it is still present at Kindergarten entry (6 percentage points). Being a single mother is associated with a 5 percentage points higher probability than married mothers of ECE participation at age one; the latter increases to 8 percentage points at age two, vanishing afterwards. Other items are, instead, just moderately associated with ECE participation: the higher the number of siblings in the household, the lower the chances (3 percentage points) to be enrolled in Kinderkrippe, but only at two years old. Then, for what concerns the informal care networks at family disposal, those mothers who cannot account for grandparental support are little more prone than their counterparts to enrol their one-year-old children in Kinderkrippe (5 percentage points). Yet, this advantage lasts shortly, disappearing already one year later. Interestingly, the availability of neither mothers' partners nor close relatives matters for childcare uptake (see Figure B.2, Appendix B Chapter 3).

Turning to the role played by the characteristics of children themselves, our results confirm previous ones (e.g., Kathy Sylva et al. 2007; Burghardt 2018) by showing how, across crucial developmental ages, children's characteristics do not matter in the care selection process. Most coefficients linked to this group of factors turn out to be either not statistically significant (see Figure B.2, Appendix B Chapter 3) or very modest in size (see the second and third graph in the lower panel of Figure 3.5). For instance, being native represents a small advantage in terms of ECE participation but only at Kindergarten entry (i.e., 4 percentage points), while having a difficult temperament increases the chances of entering Kindergarten, yet by only 2 percentage points. If we compare families at the extreme of the temperament distribution, the difference amounts to around 6.7 percentage points.

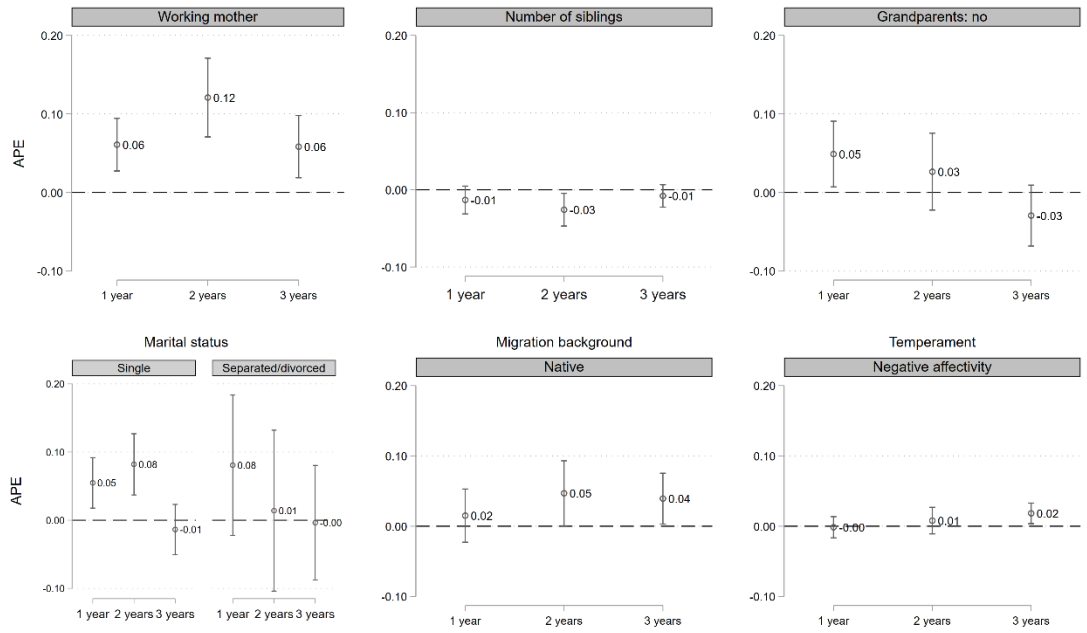

Figure 3.5 The relationship between ECE attendance with family structure and children's characteristics: average partial effects and 95% confidence intervals (N.: 3,184).

Notes: The estimate of APE for maternal employment is adjusted for marital status, number of siblings, income, partner working hours, parental education, place of residence. The estimate of APE for marital status is adjusted for children's characteristics, the number of siblings, family income, maternal employment, partner's working hours, parental education, place of residence. The estimate of APE for the number of siblings is adjusted for children's characteristics, marital status, family income, maternal employment, partner's working hours, parental education, place of residence. The estimate of APE for grandparental availability to care is adjusted for children's characteristics, family structure, parental education, place of residence. The estimate of APE for migration background is adjusted for children's sex, parental education, place of residence. The estimate of APE for temperament is adjusted for other children's attributes, family structure, parental education, place of residence.
Source: Own calculations based on NEPS, SC1.

3.7.5. Personal beliefs: perception of costs and benefits

Overall, the results on the role of personal beliefs suggest that what bears intensively on the care selection process, although with different intensities, are maternal perceived benefits and work-care beliefs. Perceived financial costs are irrelevant for the ECE take-up and, what strongly predicts ECE attendance is rather the prospects of boosting both children's and mothers' human capital development: the former in terms of improvement in cognitive skills, the latter in terms of occupational careers. Moreover, not only considerations about the expected benefits but also more values-related attitudes, such as maternal job attachment, drive the choice towards formal care settings.

More specifically, the first graph in the lower panel of Figure 3.6 shows the role of perception of financial costs and job importance for enrolling children in formal care. We see that costs perception does not affect the probability of enrolling children in Kinderkrippe. The

fact that families do not perceive ECE participation as a financial burden is in line with the relatively modest childcare expenses in Germany. When it comes to Kindergarten, the perception of financial costs is quite surprisingly negatively related to participation, among comparable families. It is possible that at Kindergarten families in need could benefit from additional support, thus being more prone to enrol their children in these environments. Perceptions of benefits associated with ECE attendance are instead strongly related to the choice of formal care since early years (Figure 3.6). Mothers who believe that their return in the labour force is highly probable are, at all ages, more likely to enrol their offspring into daycare settings compared to mothers with lower perceived chances of being employed. The greatest divide is again observed when children are two years old. Moreover, mothers who believe that ECE is helpful for children's cognitive development are more likely to enrol their offspring on formal childcare at all ages. Although the major influence is found at two years old (i.e.: 23 percentage points), the gap is considerable already at one-year-old, amounting to 18 percentage points. Interestingly, perceiving Kindergarten as meaningful for the enhancement of children's social skills does not significantly translate into greater participation.

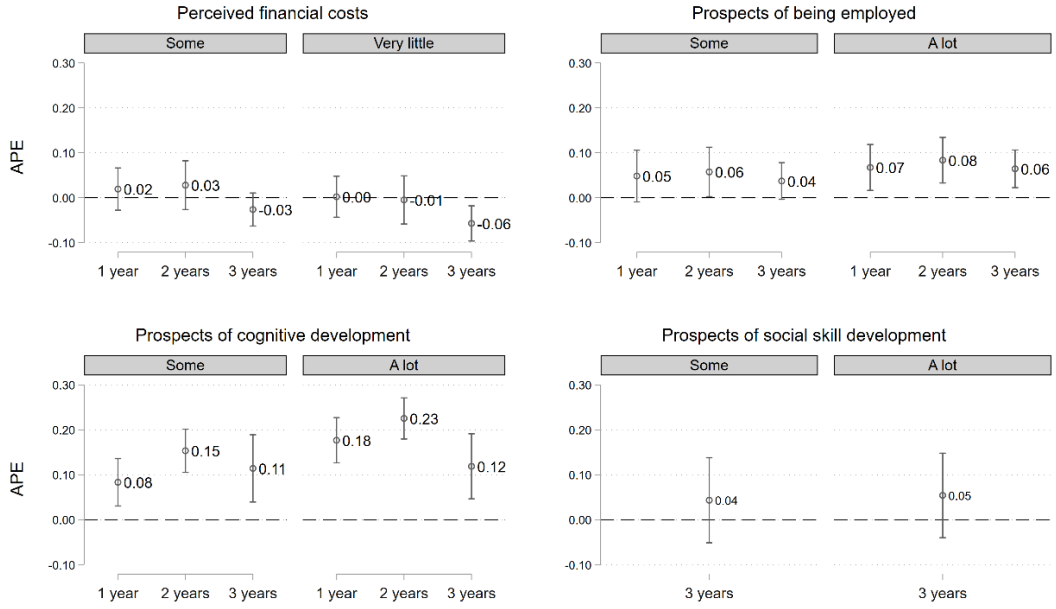

Figure 3.6 The relationship between ECE attendance with costs and benefits perceptions: average partial effects and 95% confidence intervals (N.: 3,184).

Notes: The estimate of APE for perceived costs, employment prospects, and cognitive enrichment is adjusted for children's characteristics, family structure, other costs and benefits perceptions, work-care beliefs, parental education, place of residence. The estimate of APE for social skills enrichment is adjusted for children's characteristics, family structure, other costs and benefits perceptions, work-care beliefs parental education, place of residence.
Source) Own calculations based on NEPS, SC1.

3.7.6. Work-care beliefs

Finally, Figure 3.7 shows the relevance of work-care beliefs in the process of care selection. Results reveal that mothers tend to disproportionally enrol their offspring in Kinderkrippe if their attachment to work is strong. This relation tends to strengthen when children become two years old, reaching 15 percentage points. On the contrary, neither the level of social pressure from near relatives or friends (i.e., what we called social costs) nor the importance attached to social competencies in terms of getting along with others matter for the choice towards formal care settings.

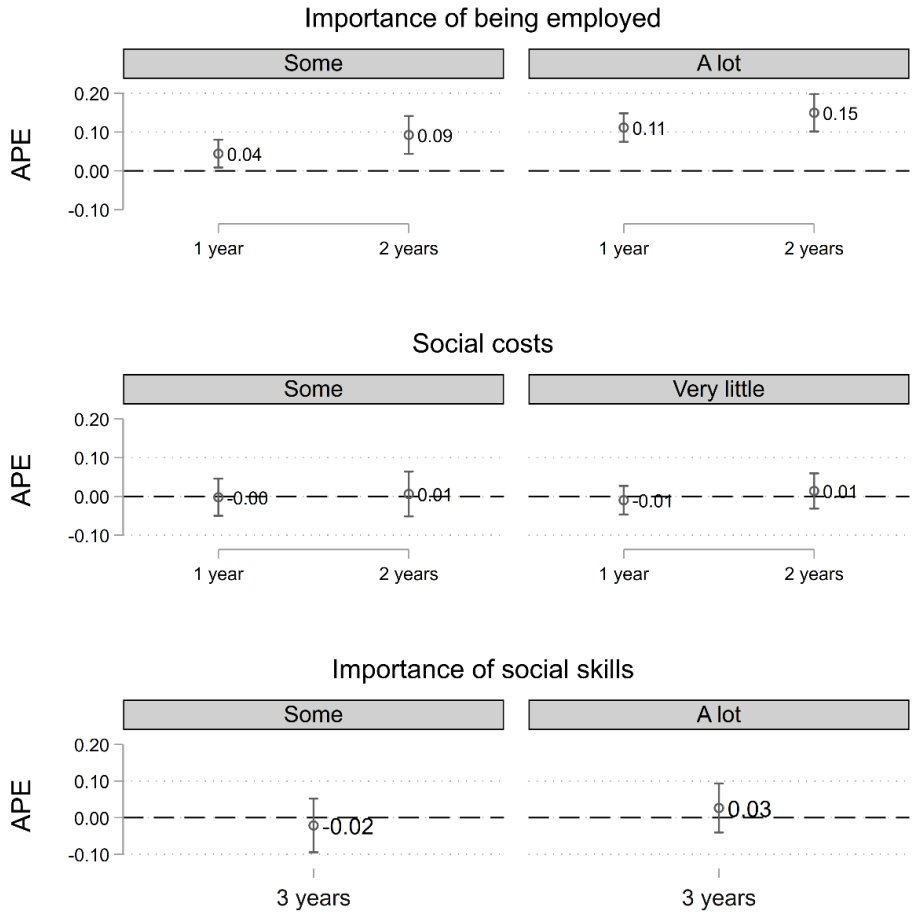

Figure 3.7 The relationship between ECE attendance with work-care beliefs: average partial effects and 95% confidence intervals (N.: 3,184).

Notes: The estimate of APE for the importance of being employed, for social costs, and for the importance of getting along with others is adjusted for children's characteristics, family structure, costs and benefits perceptions, other work-care beliefs, parental education, place of residence.
Source) Own calculations based on NEPS, SC1.

3.8. Discussion and Conclusions

This chapter contributes to the literature on childcare participation, aiming at understanding the role of various factors and, particularly of structural characteristics and personal beliefs, in influencing access to ECE in Germany at different children's ages. Compared to previous studies, we root our analysis into the PKC theoretical model, which allows us to adopt a comprehensive view of the possible drivers of formal care usage and to develop an empirical test of the validity of such theoretical model for a key European country, which experienced important reforms in the ECE organization. While the PKC model emphasizes that care choices are the result of a multifaceted process, it does not clarify which factors are the leading drivers of ECE attendance and how their role eventually change along child ages, which was the aim of our empirical analysis. Indeed, by relying on prospective panel data derived from the NEPS, we incorporated a longitudinal dimension in the analysis that allowed us to inspect the relative importance of various factors at different children's ages.

All in all, we can draw the following main conclusions. First, inequalities in ECE participation are still present in Germany, despite the recent reforms directed toward improving the inclusiveness of services of formal childcare. Structural factors such as mother's educational level and area of residence still play an important role in driving access patterns, corroborating previous results that highlight long term educational gradient and East-West differences in the uptake of formal day-care for children, especially if under three years of age (Schober and Stahl 2014). Our analytical strategy allows us to highlight how, after a period of great reforms, the social gap is slightly broader than the regional one at all the analysed ages in Germany. Second, inequalities are dynamic, since they change according to both the developmental phase children are living in, and the policies put at play. Indeed, the shape of these social and regional inequalities is similar: being present at already one year of age, they sharply increase when children are two years old for then diminishing at Kindergarten entry. This pattern suggests that the Kinderkrippe phase remains the most delicate period despite the expansion of childcare services. This confirms previous hints offered by Skopek (2017) on the critical role of the second year of life in the increase of both social and regional discrepancies. Explanations can relate to recent family policies, and more specifically to two aspects. First, a reduced length of parental leave which, expires with children's second birthday, urges parents to come back to work, especially if from high social classes. Second, the introduction of the 'Betreuungsgeld', which is argued to prevent, especially children from low social backgrounds, to attend ECE (Boll and Reich 2012).

Third, not only structural factors but also perceived benefits for ECE attendance stand out as pivotal for the uptake of formal childcare. In this vein, our analysis provides empirical support to the relevance of the intertwined double function of ECE: access to formal care is fostered by the maternal claim according to which centre-based services both provide cognitive enrichment for children (investment focus) and favour their labour market return and occupational career (care perspective). Moreover, not just maternal prospects of (re)entering the labour market but also mother's attachment to the job sphere is pivotal for enrolment in Kinderkrippe. Fourth, our analyses suggest that, with the virtual universal access to Kinderkrippe, costs are no longer a critical issue in explaining differences across families in ECE participation. Fifth, although primary recipients of ECE, children themselves are rather passive than active actors in the process of childcare selection. Indeed, not only sociodemographic characteristics but also children's early abilities and temperament seem to play a negligible or very modest role in shaping families' decisions about care options.

This study does not come without limitations. Unfortunately, we were not able to find adequate supply indicators, such as regional, or even municipal, childcare coverage, criteria for accessing ECE, quality of childcare. All these factors are relevant structural constraints to childcare uptake, which have been found to tremendously matter everywhere in Europe, especially for disadvantaged children (Pavolini and Van Lancker 2018). Our results offer just a hint for the relevance of supply-side indicators for ECE access, further suggesting that their influences on childcare take-up also change dynamically across children's developmental age. Further research should work in the direction of identifying better these aspects and disentangling their role in childcare uptake over time from that of demand-side factors.

Taking into consideration our findings, we can speculate that the care selection process in Germany appears to be a function of rational decisions that are embedded in a context of opportunities and constraints: indeed, ECE participation occurs considering the characteristics of the broad social context surrounding families and the maternal beliefs on the role of formal care. We can further conclude that this institution is then seen as a potential skills-enhancer for children development, but also as an instrument that allows mothers to reach financial independence, professional realization, and family-work reconciliation.

Acknowledgements

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4. CHAPTER 4: QUALITY OF EARLY LEARNING ENVIRONMENTS AND THEIR INFLUENCE ON EARLY COGNITIVE AND NONCOGNITIVE SKILL DEVELOPMENT: EVIDENCE FROM IRELAND

Abstract

We apply the structure-process model of quality to examine how characteristics of the home learning environment (HLE) and the early childhood education system (ECE) associate with early cognitive and noncognitive abilities in Ireland. Random-effects linear models indicate that both structural features, i.e., social origins, and process quality indicators, i.e., parenting styles, parental involvement, and learning materials at home, influence positively early skills. Attending high-quality ECE fosters noncognitive skills while it is irrelevant for cognitive abilities. Additionally, we examine complementarity or substitution mechanisms of HLE and ECE quality. Highly responsive and demanding parenting styles compensate for being born in low-SES families on noncognitive skills. Attending high-quality ECE substitutes for low-SES on early emotional skills. Children need to receive literacy support and stimulation at home to gain returns from high-quality ECE attendance on their early cognitive skills. At the same time, high-quality ECE compensates for hostile parenting behaviours on early emotional skills

Keywords: home learning environments, early childhood education, compensatory advantage, early cognitive and noncognitive skills.

4.1. Introduction

Early childhood is a crucial period for skill development. During the first five years of life, children acquire, at a fast pace, numerous and diversified skills that are stepping stones for further learning (Cunha and Heckman 2007; OECD 2018). Yet, although the relevance of early educational experiences for later success is out of the question, early inequalities in academic skills are detectable in almost all Western countries before children's entrance into compulsory school (Bradbury et al. 2015; Blossfled et al. 2017). Moreover, novel longitudinal findings suggest that gaps in language, maths, and basic cognitive skills remain stable -or diminish- during primary school, for then re-emerging in secondary schools (Passaretta, Skopek, and van Huizen 2020; Skopek and Passaretta 2018). Although much more overlooked than cognitive skills, gaps in socio-emotional skills also appear early, i.e., before starting primary schools, and then persist over the life course (Heckman and Rubinstein 2001; Moroni, Nicoletti, and Tominey 2019). Failing in acquiring basic levels of cognitive and noncognitive skills can progressively undermine individuals' effective participation in the modern knowledge-based society, with severe consequences on later life outcomes (Kautz et al. 2014).

Which are the determinants of poor early educational outcomes? Do quality features of formal and informal learning environments influence early skill development? Skills are not unmalleable traits determined only by genetics and biology. On the contrary, they can be acquired and promoted, especially during early childhood when brains are highly receptive and ductile (OECD 2018). Minimum standards for the process of skill formation are a learner, a teacher, and an adequate educational space where actors can develop nourishing interactions that can facilitate the acquisition of competencies. Over the life course, individuals encounter plenty of instructors and environments that contribute to the acquisition of abilities. Among the first settings in which children are socialized and acquire basic competencies, there are, on the one hand, the home learning environment (hereafter HLE) and, on the other, the early childhood education system (hereafter ECE). During infancy and childhood, the family can be considered as a relevant informal learning environment. Parents are children's first teachers since they contribute, intentionally or unintentionally, to the skill development of their offspring with interactions, materials, and various educational opportunities. The HLE is highly relevant since it precedes, accompanies and sometimes even outlasts the learning that individuals acquire in other contexts (Bäumer et al. 2011b). Empirical research consistently indicates that HLE is decisive in predicting discrepancies in children's academic and social development (e.g., Rose et al. 2018), especially for offspring of socially disadvantaged groups (e.g., Tamis-LeMonda et

al. 2017). Although it is generally claimed that education starts with compulsory school, children enter primary education with an already rich amount of knowledge acquired in previous formal settings, such as crèches and preschools. During the late 2000s, the ECE participation rate has risen dramatically in the OECD area, especially for children under two years old (Delhaxhe et al. 2009; Commission/EACEA/Eurydice/Eurostat 2014; European Commission/EACEA/Eurydice 2019). Despite ECE being, especially for the under-threes, typically less structured than schools in terms of educational contents, pedagogical curricula, timing, and teachers' profile, there is a growing interest in providing formal care settings with clear educational intentionality. In these veins, ECE shifts its role from being 'just' a reconciling tool for allowing work-family balance to being an educational right for all children (European Commission 2014). This changing perspective is supported by a growing amount of empirical evidence, which highlights the learning benefits of preschool education on child development, especially if of high quality and for children coming from socially deprived and vulnerable families (Gambaro, Stewart, and Waldfogel 2014; Melhuish et al. 2015). However, if previous research extensively shows that part of individual differences in emerging skills can be traced back to different learning experiences at home (Lehrl 2018; Sénéchal and LeFevre 2002) and in childcare (Melhuish et al. 2015; Ulferts, Wolf, and Anders 2019), few studies analyse the simultaneous impact of these two learning environments on skill development (Melhuish et al. 2008; Anders et al. 2012). Yet, for gaining an understanding of the factors that may influence children's school preparedness and for evaluating the potential benefits of preschool education, interrelations between these two environments should be analysed and debated further.

This study aims at filling this gap, examining the reciprocal role of HLE and ECE quality in the transmission of early educational inequalities. More specifically, we ask (1) whether and to what extent structural and process features of HLE relate to emergent cognitive and socio-emotional skills; (2) whether and to what extent attendance of high-quality ECE is associated with early skill development; (3) whether the influence of HLE and ECE quality on skills varies according to children's social origins; and (4) whether the impact of high-quality ECE on skills is the same among children who experience HLE of different qualities.

We choose Ireland as our case study. The latter country is a rather understudied context compared to other English-speaking countries, but its ECE system has interesting peculiarities. First, it is expensive and highly commoditised. The literature indicates that a liberal demand-led care system, such as the Irish one, may contribute to undermining ECE quality since common pedagogical curricula and rules are absent and, at the same time, social inequalities in accessing high-quality formal care settings are in place. Yet, to the best of our knowledge, there

is a strong need for evaluating the influence of ECE quality on skills in Ireland (McGinnity, Russell, and Murray 2015), especially for what concerns non-cognitive skills. One of the few studies that analyses this issue raises concerns about the efficacy of Irish childcare settings, revealing that there is a minimum standard in providing adequate stimuli for literacy and maths development[69] (Neylon 2014).

The paper is structured as follows: the next sections (4.2 and 4.3) introduce the state of research on the role of HLE and ECE dimensions on skills development; section 4.4 furnishes information on the early childhood education system in Ireland; section 4.5 describes our data, sample, variables, and methodology; section 4.6 presents the results and, finally, section 4.7 concludes.

4.2. Conceptualizing the early years learning environments

Who are at risk of poor educational outcomes, and why? As briefly mentioned above, we look at two specific contexts, which children encounter before entering schools, i.e.: the informal learning provided by parents and the formal one, linked to the ECE system. To examine the influence of these two environments on skills, we use a common theoretical framework of educational quality, the so-called *structure-process-model*, which has been used to describe quality in either HLE (Kluczniok et al. 2013) or ECE (Kluczniok and Rossbach 2014). This framework assumes that quality is a quantifiable and measurable concept, which multidimensionality can be summarized in four components: structural characteristics, educational beliefs, educational processes, and networking with families. We adopt this framework for jointly examining quality aspects stemming from the two learning environments.

Structural characteristics include all that proxies that strictly link to children near surroundings and that tend to be stable and long-lasting. These are all personal, social, spatial, and material characteristics such as ECE educators' highest level of education, number of children, child-teacher ratio, educational materials, and space at children's disposal and, in the case of HLE, family social positions, poverty level, and lack of household resources. *Educational beliefs and orientations* relate to claims that actors have around education. In ECE, these are, for example, teaching goals and assertions about the role of care and schooling, which can influence educators' working routines. Similarly, what parents think about care and

[69] Literacy rates the following areas: environmental print letters and words, book and literacy areas, adult reading with the children, sounds in words, emergent writing/mark making, talking, and listening. Maths rates the following areas: counting and its application, reading and writing simple numbers, mathematical activities, shape and space, mathematical activities in matching, sorting, and comparing.

education can impact the way they normally behave with their children at home. *Process quality* is associated with "the nature of interactions between the child and his or her parents and between the child and other children, as well as the child's orientation to his or her spatial-material surroundings*"* (Kluczniok et al. 2013, 422). The literature further divides this concept into two dimensions: global/general and domain-specific educational processes. The former indicates aspects that favour child development in general and that, therefore, cannot be assigned to a precise developmental area, such as language or numeracy. Ordinary non-developmental family activities and the family climate are examples of factors associated with this dimension. The latter encompasses all the educational processes that are linked to the development and stimulation of specific ability domains. Hence, material aspects of HLE and ECE (e.g., the availability of children's books) and parental or educators' engagement in jointly activities are aspects included in this category. Finally, the last dimension links specifically to ECE and describes *networking with families*. This aspect measures the cooperation that ECE services may have with families or with other educational services for enhancing the skills development of the pupils enrolled in their facilities. Counselling and support services for parents are examples of such networking (Kluczniok and Rossbach 2014; Burghardt et al. 2020).

Studies reveal that structural and process quality are the dimensions that mostly predict child development, with the latter mediating the direct link between structural features and educational outcomes (Slot, Lerkkanen, and Leseman 2015; Ulferts, Wolf, and Anders 2019). Hence, what follows focuses mainly on these two aspects. Accordingly, Figure 4.1 graphically summarizes the concepts and their interconnections.

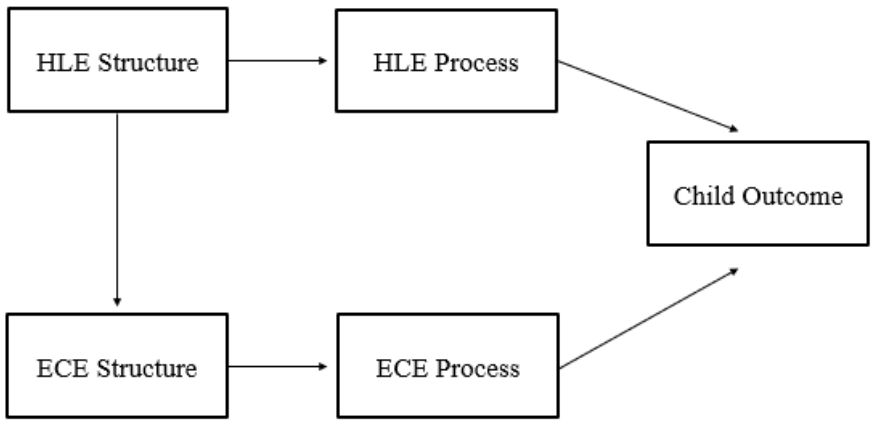

Figure 4.1 A generalized structure-process model of educational quality

Note) Adapted from Kluczniok and Roßbach (2014), Kluczniok et al. (2013), NICHD (2002)

4.2.1. HLE and early educational development

Learning and school preparedness start at home with parents that, either intentionally or unintentionally, are among the first actors who are responsible for children's process of skill formation. Parental economic resources and investments in education as well as adequate support and materials provide children with the opportunities and necessary motivation for acquiring knowledge and developing competencies (Bäumer et al. 2011a).

Children's social origins are one of the most important structural HLE dimensions. Research worldwide consistently recognises how parental socioeconomic backgrounds (hereafter SES), often measured in terms of parental education, social class, and income, are positively associated with children's skills from preschool age onwards (Duncan and Magnuson 2011; Kulic et al. 2019; Moullin 2017; Azzolini et al. 2019; Bradbury et al. 2015). The sociological literature on child development relies mainly on two theoretical perspectives, taken singularly or in interaction, for explaining why social origins exert such a powerful influence on child development. According to the first perspective, i.e., the *family investment model*, social inequalities in skills originate because families with different SES offer, for their offspring's educational goals, diverse types of opportunities and they face different constraints. More precisely, the model claims that, because of a larger set of material, cultural, and social opportunities, high-SES parents tend to provide better resources and learning support than their less socially advantaged counterparts (Conger and Donnellan 2007; Ermisch 2008; Domina 2005). The second perspective, i.e., the *family stress model*, focuses on the emotional and psychological pressure that can derive from economic hardship that can depress parenting and family functioning and, therefore, hamper children's development. Children from low-SES families are more likely exposed to such family stress compared to high-SES children, thus damaging their skill development (Skopek and Passaretta 2018). Based on these insights, we expect that net of other factors, *children from socially well-off families perform better in early cognitive and noncognitive skills compared to their socially disadvantaged counterparts* (H1).

Apart from the structural dimension, features of HLE process quality shape children's cognitive and noncognitive development. These characteristics are more difficult to capture than structural aspects since they change dynamically according to the life phase children are living. Despite the definition and measurement of HLE process quality varying greatly between studies, three components powerfully relate to skill development: children's participation in learning activities, quality of parent-child interactions, and the availability of learning materials (Lehrl, Evangelou, and Sammons 2020).

Interactive care (also called developmental care in the time use literature) is defined as the joint parent-child activities that "have the direct potential to enrich children's intellectual development" (Gracia 2012, 10). These activities stimulate children's curiosity and motivation for learning, which are precursors of school success (Melhuish et al. 2008; Pomerantz, Moorman, and Litwack 2007). Activities such as singing songs, reading and telling stories help children to learn, encouraging their imagination and phonological awareness, and improve their vocabulary and love for language (Rodriguez and Tamis-Lemonda 2011; Waldfogel 2012; Luo et al. 2014; Leseman et al. 2007). Previous studies find that developmental care is associated positively with children's educational performances (Thomsen 2015) and cognitive skill development (Fiorini and Keane 2014). Among the various parent-child activities, oral book reading stands out as a relatively simple interaction that supports the activation of children's brains and the stimulation of children's imagination in associating words to pictures (Klass 2015). Reading aloud to children has shown to be beneficial for (i) developing linguistic skills that are relevant for communicating and interpreting the world; for (ii) fostering children's motivation and interest towards reading; and for (iii) providing children with competencies for managing school tasks and assimilating formal language (Hartas 2012; OECD 2012; Reach Out & Read, n.d.; Price and Kalil 2019). Hence, we expect that *children who are more frequently engaged in literacy activities with their parents and have adequate educational materials at home perform better in early cognitive and noncognitive skills than children who receive few parental inputs of this kind* (H2).

Apart from parental engagement and home educational materials, parenting styles are the third component of HLE process quality that is relevant for educational outcomes. This dimension relates to the emotional climate in which children are raised and where parent-child interactions take place, including measures of parental responsiveness and demandingness (Baumrind 1966; Spera 2005)[70]. Based on the combination of these two aspects, researchers distinguish up to four parenting styles (Baumrind 1991; Darling and Steinberg 1993; Baumrind 1978): (i) authoritative, where parents show high levels of both support and control; (ii) permissive/indulgent, where parents are highly supportive but have low levels of parental control; (iii) authoritarian, where parents are unsupportive but highly rigid in settings rules and discipline; (iv) unengaged or rejecting-neglecting, where there is a lack of both responsiveness and demandingness. Among the four parenting styles, the first one is the most conducive for fostering children's skill formation and school readiness. Indeed, authoritative parents have a

[70] Responsiveness (or support) links to the level of parental emotional warmth, demandingness relates to the amount of parental control over children's behaviours.

"warm and responsive" relation with their offspring and provide them with "affection and support in their explorations and pursuits of interests" (Spera 2005, 134). Moreover, when it comes to setting rules, authoritative parents do not expect strict obedience, but they rather foster discipline through communication and encouragement of independence. Previous studies find that authoritative parenting has a substantially large association with a range of young adults outcomes, such as teenagers' subjective well-being, self-esteem, and risk behaviours (Chan and Koo 2011). To a more authoritative parental behaviour correspond a positive influence on a range of academic and social outcomes, such as the likelihood of graduating from high school, a higher university entrance score, a more internal locus of control, and less risky behaviours (Cobb-Clark, Salamanca, and Zhu 2019). Following these insights, we expect that *children whose parents are more supportive and consistent in settings age-appropriate rules have better performances in early cognitive and noncognitive skills than children whose parents display low levels of responsiveness and demandingness* (H3).

However, parental child-rearing practices vary according to parental social positions (Lareau 2003). On the one hand, socially well-off parents, thanks to the large set of material, cultural, and social resources at their disposal, may tend to provide better learning support through everyday literacy interactions and stimulating materials than their less socially advantaged counterparts (family investments model). Moreover, high-SES parents may be less likely to suffer from the emotional and psychological pressure that derives from economic hardship and, consequently, they may be less likely to behave in a harsh and hostile manner towards their children (family stress model), contrary to low-SES parents. Such inconsistent parenting has been found to severely damage children's behavioural development and school grades of, especially, low-SES children (Kaiser, Li, and Pollmann-Schult 2019). Hence, in this first scenario, parents from more privileged backgrounds are expected to adopt care behaviours that promote their offspring's educational success. Recent results for Ireland indicate that, although controlling for HLE[71] halved the difference in vocabulary scores between children of mothers in the lowest educational category and those in the highest, children with lower educated mothers make less progress in early vocabulary skills between ages three and five, pointing out a widening of class differences before entering compulsory school (McGinnity et al. 2017). Consequently, we expect that *the learning benefits of being exposed to high-quality HLE are greater for high-SES children than for low-SES children* (H3B). We hypothesize, therefore, that high-quality HLE complements children's social origins.

[71] i.e., a composite measure of home learning activities, number of children's books at home, and long hours of TV viewing (three or more hours per day).

On the other hand, children from low-SES families are those who should have the highest returns from exposure to high-quality HLE. Indeed, children who live in a less stimulating HLE and experience more stress at home are expected to profit the most from more responsive and consistent parenting and an extra dose of parental literacy stimulation. Previous studies indicate, for example, that informing parents on the cognitive-enhancing potential of shared book reading has a positive impact on the early vocabulary skills of low-SES children while being trivial for children of high-educated families (Barone, Fougère, and Pin 2021). Moreover, children from poor families or with low levels of family resources whose parents have positive parenting styles have been found to score better in their developmental achievements during the first year in primary school (Kiernan and Mensah 2011). In this second scenario, therefore, we expect that *the learning benefits of being exposed to high-quality HLE are greater for low-SES children than for high-SES children* (H3A). We hypothesize, therefore, that high-quality HLE substitutes for children's social origins.

4.2.2. ECE and early educational development

Over the past decades, an expansion of formal care settings has occurred, also thanks to the so-called Barcelona objectives set by the European Union in 2002. The latter aimed at reaching an ECE participation rate of 90% for children older than three years old and of 33% for the under-threes by 2010 (European Commission 2013). If participation is important, ECE quality is complementary for investing in children's human capital (Council of European Union 2019). Evidence reports that attendance of high-quality ECE is associated positively with children's cognitive, language and social development in both the short- and long run (Yoshikawa, Weiland, and Brooks-Gunn 2016; Melhuish et al. 2015). On the contrary, the enrolment in low-quality childcare could represent, especially for the under-threes and for children from socially vulnerable backgrounds, a risk for development, leading to possible deficits in language or cognitive skills (Melhuish et al. 2015; Gambaro, Stewart, and Waldfogel 2014). However, studies assessing the influence of ECE quality are still scarce compared to those interested in the effect of ECE attendance and, when present, they lead to inconsistent results since they "differ in the components of quality being considered and in how these components are being assessed" (Kluczniok and Rossbach 2014, 146). Yet, although the multidimensionality of ECE quality has been operationalized in many ways, the literature converges in claiming that, generally, two features are relevant for child development, i.e., structure and process quality. The latter relates to broad range of every-day interactions that children have with their surroundings (e.g., materials, peers, and staff) while involved in play,

activities, or routines in ECE settings. The former refers to regulable characteristics of the formal care environments that are partially determined by legislation, such as child-staff ratios, group size and staff education and in-service training (Slot 2018). Hence, core elements that define high-quality in ECE settings since they provide for children's developmental needs are: safe and healthy care settings, appropriate stimulation and opportunities for learning, positive interactions with adults, and positive relationships with other children (Cryer, Tietze, and Wessels 2002; Vermeer et al. 2016). Based on these considerations, we expect that net of other factors, *children who attended high-quality ECE perform better in early cognitive tests and show fewer socio-emotional problems than their peers who never went to ECE or attend low-quality childcare settings* (H4).

What about a possible moderating role of SES? On the one hand, we may expect that parents with a high social position are more likely to invest early in formal educational opportunities for their offspring than low-SES parents, as many studies confirm (Skopek 2017; Brilli, Kulic, and Triventi 2017; Van Lancker and Ghysels 2016). Additionally, high-SES children may enter ECE with an already rich set of abilities that enables them to profit the most from interactions with their teachers and peers. This condition is made even worse by the fact that high-SES children tend to be more frequently enrolled in high-quality ECE compared to their low-SES counterpart, thus exacerbating the achievement gap between different social groups. As such, we expect that *the association of high-quality ECE attendance with skill development is more beneficial for children from high-SES than low-SES* (H4B, complementarity hypothesis). However, a contrasting scenario is possible as well: due to the deprived social conditions in which they live, low-SES children should learn at a faster pace when exposed to high-quality ECE settings than high-SES children, who should be more accustomed to learning stimulation. Therefore, we expect that *the learning benefits of high-quality ECE attendance are greater for low-SES children than for high-SES ones* (H4A, substitution hypothesis).

4.2.3. Cross-fertilizing influence of ECE and HLE on skills

Although both HLE and ECE may influence development, "little is known about their cumulative effects as well as their potential reciprocal, oppositional, or diminishing effects" (Bäumer et al. 2011a, 92). To the best of our knowledge, few studies explicitly address the reciprocal role of both HLE and ECE quality. Previous research in the United Kingdom indicates that aspects of both HLE and ECE matter for literacy scores at school entry (Melhuish et al. 2008). In Germany the effects of the two learning environments on skills appear to not be

simply additive, with children needing some sort of support at home for effectively benefiting from high-quality ECE attendance (Anders et al. 2012). Despite examining ECE attendance rather than its quality, Cebolla-Boado and colleagues (2017) further suggest that, in a comparative perspective, preschool works as an equalizer of opportunities for the learning outcomes of children whose parents are less involved in their education before starting elementary school. In Ireland, McGinnity and colleagues (2017) found evidence for a compensatory effect on vocabulary scores at age five, since those children who are cared in less literacy stimulating HLE, measured in terms of home learning activities, such as read to children, helping children with alphabets or in learning numbers, are those who obtain the highest gains from ECE attendance.

Hence, do children with different levels of stimulation and parental responsiveness at home differ from high-quality ECE participation? To answer this question, two contrasting scenarios are possible. On the one hand, it is plausible that *the learning benefits of high-quality ECE attendance are greater for children who are exposed to poor quality HLE rather than high-quality HLE* (H5A). ECE quality, therefore, substitutes for inadequate support and stimulation at home, thus lessening the achievement gap. On the other hand, however, *the learning benefits of high-quality ECE attendance are greater for children who are exposed to high-quality HLE rather than low-quality HLE* (H5B). ECE quality, in this scenario, complements HLE quality in influencing child development, thus reinforcing the achievement gap.

4.3. The context: Ireland

Available, affordable, and high-quality ECE services are crucial for promoting children's learning and for fighting social inequalities from the start (Gambaro, Stewart, and Waldfogel 2014). However, countries differ in the characteristics of their childcare provision, thus shaping children's early care and education experiences (Van Lancker and Ghysels 2016).

As regards availability and similarly to other European countries, the Irish ECE system has witnessed an expansion between 2000 and 2010. However, Ireland is one of the few European countries that, together with the United Kingdom and the Netherlands, has responded to a growing demand for childcare support by increasing income-related subsidies to families, such as cash-based child benefits. Therefore, by allowing parents to buy early childhood provisions, the Irish government has indirectly boosted the childcare provision of the private and the community sector that, consequently, has increased substantially over the same period (Lloyd and Penn 2014; Mahon and Bailey 2015). State financial support in early childhood

education is very low in Ireland, amounting to less than 0.2% in 2015, against an OECD average of 0.8% (McGinnity et al. 2017). Despite this, some state-subsidised interventions were recently introduced[72], being the Free Preschool Year (FPSY)[73] scheme one of the most important actions. Established in September 2010, the FPSY is a legal guarantee to universal childcare that allows children to enjoy one year of free preschool before starting compulsory school[74]. Eligible children are all those aged between 3 years and 2 months and 4 years and 7 months on the 1st of September each year. The government assures subsidized ECE places on a part-time basis, i.e., for 15 weekly hours. Given the diminished number of families who could afford care costs after the 2009 recession, also private creches decide to offer places under this schema, thus favouring the effective start of the program (Mahon and Bailey 2015). This contributes to making ECE enrolment more and more common for Irish children (McGinnity, Russell, and Murray 2015), with 94% of children and 95% of preschool services taking part in the program in 2010-2011[75].

As regards affordability, most parents in Ireland cover the full cost of childcare up to when children are three years old (McGinnity et al. 2017). Ireland is one of the countries with the highest childcare costs, amounting to over 27% of a dual-earners family net income against 12% of the OECD average. For a single-parent family, the situation is even worse since childcare cost amounts to 40% of net family income (McGinnity, Russell, and Murray 2015). In 2012, the fee for attending childcare in Dublin during five-week days ranges from 730€ to 1,100€ per month (Mahon and Bailey 2015). Consequently, families highly rely on other forms of care, such as grandparents and relatives, especially when children are young (McGinnity, Murray, and McNally 2013).

As regards ECE quality, the regulations in place regarding child-staff ratios and the characteristic of the care environment (Child Care (Pre-School Services) Regulations 1996 and 1997) were criticized for not addressing the nurturing aspect of childcare. Yet, it was just in 2006 and 2009 that two organisations, i.e., the Center Early Childhood Development Education

[72] For example, the National Early Year Access Initiative Programme (NEYAI) is a program devoted to the empowerment of early childhood education and literacy in disadvantaged areas (McGinnity, Russell, and Murray 2015).

[73] The latter is also called Early Childhood Care and Education (ECCE) scheme.

[74] In Ireland, parents are legally obliged to send their 6 years old children to formal education, but primary education may start prior to the beginning of compulsory school. As from the age of 4, however, children can participate to infant classes. The Irish Department of Education and Skills calculates that about 40% of the 4 years old and nearly all 5 years old children were enrolled infant classes (McGinnity et al. 2017). The schema has been extended in 2016.

[75] Nearly all children in the GUI Infant Cohort (96%) take advantage of FPSY between 3 and 5 years old (McGinnity, Russell, and Murray 2015).

and the National Council for Curriculum Assessment, promoted two different quality agendas[76] which aimed at defining a standardised national ECE curriculum. It was only in 2011 that, concurrently with the creation of the new Department of Children and Youth Affairs, a national ECE framework was introduced (Neylon 2014)[77]. This guideline sets specific standards, defining, for instance, staff-child ratios according to children's age and staff educational requirements (Commission/EACEA/Eurydice/Eurostat 2014).

To sum up, in this mainly market based ECE system, we expect to find relevant social inequalities in childcare use. Moreover, the dynamics of competition in market-based ECE systems may lead to inequalities that discourage socially-in-need families from enrolling their offspring in nonparental care settings. Despite disadvantaged social groups may profit from guaranteed ECE access thanks to target-group subsidies, these incentives could be not sufficient for paying parental fees, thus discouraging ECE uptake. Moreover, if the commodisation of care has the advantage of increasing care supply, thus meeting the demand, the latter may disproportionally come from families with high purchasing power. Consequently, private care providers may target firstly wealthy urbanised areas for example, where they can offer their services at higher costs. In turn, this leaves uncovered rural and low-income areas, forcing the residents to rely on other types of care, as happened in the Netherlands (Noailly and Visser 2009). Additionally, in market based ECE systems issues of quality may arise. Research shows that ECE quality of private provision tends to be worse than quality offered in public settings. This occurs because governments are not able to properly intervene in regulating private childcare provision in consistently promoting quality standards and criteria settings (e.g., Mathers and Sylva 2007 for the UK; Sosinsky 2007 for the US). Hence, socially disadvantaged children may pay the highest costs since, because of the lower purchasing power of their parents, they can be systematically assigned to low-quality settings. Indeed, "without strong state investment […], the result will be an insufficient supply of services for those who need those most, leading to increased numbers of children with special needs and learning

[76] In 2006 the Síolta (i.e., seeds); the Early Childhood Quality Framework was published, followed in 2009 by the Aistear (i.e., journey); the Early Childhood Curriculum Framework.

[77] Steering documents for ECE recommended the obtainment of the following objectives for all children, regardless of their age group: (i) personal, emotional, and social development; (ii) language development and communication skills; (iii) physical development and health education; (iv) reading literacy; (v) numerical and logical reasoning; (vi) understanding the world; (vii) expressive arts and development of creativity; (viii) adaptation to school life. The approaches to adopt for these objectives to be gained are, according to the guidelines: (i) alternating between adult-led and child-initiated activities/play; (ii) alternating between (small) group activities and individual activities; (ii) project-based learning relating to children's real life experience; (iv) specific support material. (Commission/EACEA/Eurydice/Eurostat 2014)

difficulties; a lack of equity for poorer families; and overall poor quality of provision" (OECD 2006, 256).

4.4. Analytical strategy

4.4.1. Theoretical estimand and identification strategy

In the first step of the analysis, our objective is to assess the association of heterogeneous dimensions of HLE and ECE quality with children's cognitive and noncognitive skills before entry into primary school. We ask: what are the average skill performances of children who experience different qualities in early familiar and formal care settings? Thus, we are primarily interested in assessing the mean performance in cognitive and noncognitive skills among children (i) who come from households with different SES; (ii) whose parents differ in their parenting styles, involvement, and educational materials at home; (iii) who attended high-quality ECE.

$$\frac{1}{n}\sum_{i=1}^{n} Yi$$

In the second step of the analysis, we ask whether the influence of HLE and ECE quality on skills varies according to children's social origins. More precisely, the solid and dashed lines in Figure 4.2 both indicate the comparison between children who experiences high-quality HLE/ECE versus those who live in poor quality HLE or do not attend ECE. If children who come from lower social classes are those who obtain the highest learning benefits from being exposed to high-quality learning environments, then we gain evidence for the *substitution* hypothesis (left graph in Figure 4.2). Otherwise, we gain evidence for confirming the *complementarity* hypothesis (right graph in Figure 4.2).

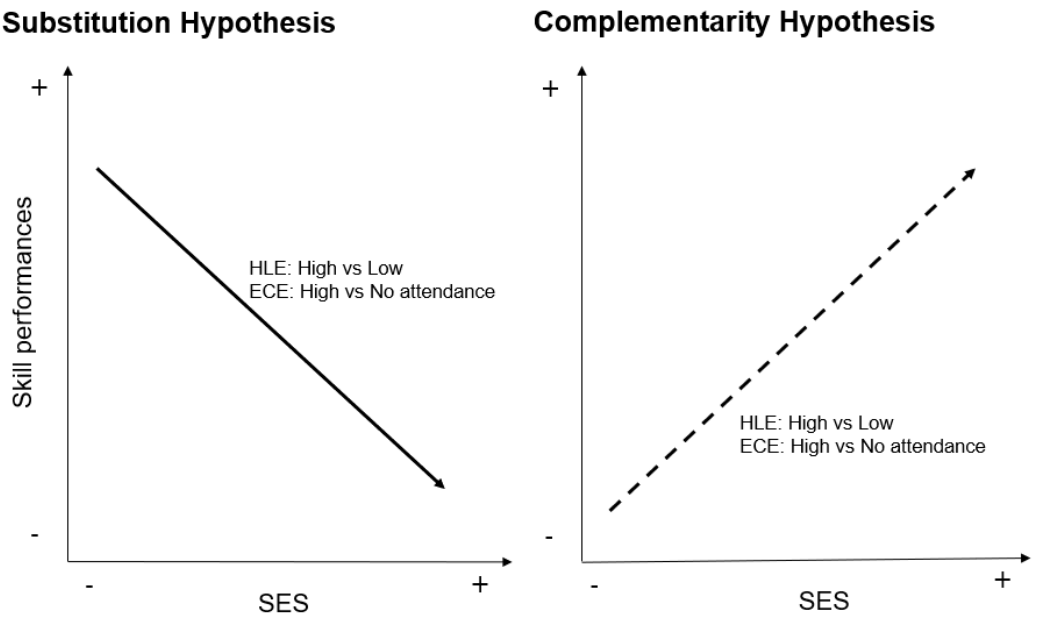

Figure 4.2 Substitution and complementarity hypotheses

Source) Own elaboration.

Finally, we ask whether the impact of ECE quality on skills is the same among children with HLE of different qualities. To detect the presence of either substitution or complementarity mechanisms, we calculate the difference (Δ) in skill performances between attending high-quality ECE and not attending ECE among those children who are cared for in high-quality HLE and among those who experienced poor quality HLE. If the difference between high-quality ECE attendees and not attendees is greater for those children who experience high-quality HLE than for those who live in poor quality HLE, we have evidence corroborating the substitution hypothesis, with high-quality ECE that compensates for poor HLE (equation 2). Otherwise, high-quality ECE attendance complements a high-quality HLE (equation 1), thus corroborating the complementarity hypothesis.

$$\Delta HLE_{high} < \Delta HLE_{low} \quad (1)$$

$$\Delta HLE_{high} > \Delta HLE_{low} \quad (2)$$

4.5. Data and sample

We use data from the Growing Up in Ireland (hereafter GUI), a recent nationally representative study that follows the development of two cohorts of children, i.e., the Infant and the Child cohort. We use information from the Infant cohort that collects information on

children's early cognitive and noncognitive development as well as on ECE and HLE quality, children's characteristics, family socio-economic and demographic attributes.

Access to the population was enabled through the Child Benefit register (CB), a universal social welfare payment given to all children under the age of 16 years (or under 18 years old, if children are in full-time education)[78] paid monthly to their mothers or stepmothers. Hence, the CB contains a (nearly) comprehensive list of relevant births, including a wide range of claimants' characteristics (Quail, Williams, Mccrory, et al. 2011).

From a population of 41,185 infants registered in the CB as being born between 1st December 2007 and 30th June 2008, 11,134 babies were randomly chosen using a systematic sampling procedure based on a random start and a fixed interval. The first interview took place between September 2008 and April 2009, when babies were 9 months old. Follow up interviews were conducted in 2010/2011, 2013/2014, 2015/2016, 2017/2018, when cohort members were respectively three, five, about eight, and nine years old. More specifically, the second wave (W2) comprises three years old children (and their families) who have been habitually resident in Ireland in Wave 1 (W1) and who continue to live in the country at the time of the interview[79]. In total, 9,793 families participated in W2 (88% of those families who participated in W1). A total of 10,586 families were eligible for interviews in Wave 3 (W3)[80], of these 9,001 completed the questionnaire (response rate: 80,8%) (Quail et al. 2019; Quail, Williams, Mccrory, et al. 2011).

4.6. Analytical sample

Because of inter-wave attrition, the sample size in the first three wave of the survey amounts to a total of 10,174 children and their families, 30,522 person-years. Longitudinal attrition over waves is a well-known drawback of longitudinal studies that become a noteworthy problem when systematically linked to respondents' attributes, such as gender, age, minority and marital status, household composition, education, workforce participation, and income. In GUI, an average of 10-12% of respondents are lost in each round of the survey, but attrition

[78] To qualify for CB families must meet the habitual residence condition that means, in practice, that applicants should prove a close link to Ireland, i.e.: they must be habitually resident in Ireland at the time of application with the intention to remain resident in the country in the foreseeable future (https://www.citizensinformation.ie/en/social_welfare/irish_social_welfare_system/social_assistance_payments/residency_requirements_for_social_assistance_in_ireland.html, retrieved on 02/03/2021).

[79] Losses in Wave 2 compared to Wave 1 were due to non-response attrition, attributable to, for example, a change of residence (e.g., families who had moved out of IE or who, being still resident within the country, had no forwarding addresses) or children's death.

[80] In W3, the target population is composed by children who participated in W2 with the addition of some families who participated in W1 but not in W2.

levels are higher among respondents from disadvantaged backgrounds: this means that attrition is associated with, for example, lower maternal education and family social class or that it is higher among single-parent families (Mccrory et al. 2013; Williams et al. 2019; McNamara, O'Mahony, and Murray 2020). We address this issue by generating inverse probability weighting for each round of the data, following the example proposed by Mari and Keizer (2021). Weights are separately estimated between W1 and W2, W2 and W3 and then multiplied within each household (see Appendix C Chapter 4, section Weighting for details). We perform additional sample exclusions for constructing our analytical sample. First, we included only children whose parents are couples and have completed compulsory school, i.e., are older than 16 years old. Second, we include only children whose main respondents did not change across waves. This avoids biases and inconsistencies of parental reports in assessing the main concept of interest over time. Third, we apply listwise deletion, thus excluding all observations with incomplete records in one or more measures used in the analysis. To account for these exclusions, we create new inverse probability weights for the chance of being included in the analytical sample (see Appendix Chapter C Weighting for more details).

Our final sample consists of 5,428 children and their parents (10,856 person-year observations) between W2 and W3[81]. Children are 3 and 5 years old when included in our observation period because not all variables of interest are captured in all waves (see Table 4.1 for an overview of the research design implemented in this study). Although our analyses cover only two years, this period is crucial since it precedes the start of compulsory school, and it is located shortly before and after attendance of junior infant school[82].

4.7. Variables

4.7.1. Outcomes

Cognitive abilities are captured by expressive English vocabulary and early reasoning skills, assessed using two tests, i.e., the Naming Vocabulary test (NA) and the Picture Similarities test (PS). During the NA, children are asked to name the item displayed by the interviewers from a picture book[83], while during the PS test children choose the stimulus that

[81] After the application of sampling weights, the weighted analytical sample comprised 5,079 children and their parents (i.e., 10,158 person-years observations)

[82] In Ireland, formal education is compulsory from the age of 6 to age 16 (or until students complete three years of post-primary education). Most children start primary schooling already at age 4, while practically all of them are in primary school by age 5. The first two years of primary school, called infant classes, are classified as early childhood education. See: https://eacea.ec.europa.eu/national-policies/eurydice/content/primary-education-21_en, retrieved on 25/10/2021).

[83] There are a total of 36 items ordered in terms of increasing difficulty.

shares elements or concepts in common with a picture given by the interviewers from four alternatives (Williams et al. 2019). To ease the interpretability and comparability of these tests across waves, we transform the original total test scores into z-scores with mean equals to 0 and a standard deviation equals 1. To higher scores correspond higher performances in cognitive tests.

We rely on the Strength and Difficulties Questionnaire (SDQ) to capture noncognitive skills. The SDQ is a parent-report measure[84] of children's behaviours developed by Goodman (1997) and it is a highly validated tool for screening psychopathologies in children and adolescents. Following previous literature (Goodman, Lamping, and Ploubidis 2010; Mari and Keizer 2021; Nixon, Layte, and Thornton 2019), we construct two scales of socio-emotional problems from the four original metric indexes at our disposal, i.e., emotional symptoms, conduct, hyperactivity, and peer problems. More specifically, we combine measures for emotional and peer relational problems into a scale capturing emotional (internalizing) problems, while we add up measures of conduct problems and hyperactivity generating a second index of behavioural (externalizing problems). Internal consistency of parental reports has proven to be reliable (Cronbach's alpha amounts to 0.78 for externalizing problems and to 0.73 for internalizing problems; Goodman, Lamping, and Ploubidis 2010, 1186). We z-standardise the two scales to have mean equals 0 and standard deviation equals 1. Higher scores correspond to higher socio-emotional and behavioural problems.

4.7.2. Independent variables

HLE structure. We construct a scale of SES based on three original ordinal variables. The first variable measures family educational level by grouping the highest educational level obtained by children's parents. The three categories are: (1) at least one parent holds maximum a lower secondary school level, (2) at least one parent holds maximum an upper secondary school level, (3) both parents hold a university degree. The second variable measures family social class by grouping parental social class through the dominance criterion in the latter categories: (1) never employed; (2) semi-skilled/unskilled manual, (3) non-manual/skilled manual, and (4) professional/managerial. Finally, the third variable measures family net income from the lowest (1) to the highest quintile (5). From these three variables, we apply the polychoric principal component analysis for obtaining a standardized measure of children's social origins, with mean equals 0 and standard deviations equal 1.

[84] In GUI, the parent who reports children's socio-emotional development was the primary caregiver, thus, mostly, mothers.

HLE educational process. Two dimensions relate to this concept: parenting styles and parental practices. The former modulates general educational processes, while the latter is a proxy for domain-specific educational processes. Both dimensions are age-specific, thus varying according to children's developmental stage.

General educational processes: We use two scales from the Longitudinal Study of Australian Children for capturing parenting styles: parental self-reported perceptions of (i) *warmth* i.e., responsive parenting, showing affection and awareness of children's need; and (ii) *consistency*, i.e., demandingness, setting and consistently applying age-appropriate rules and expectations. We keep answers from both parents for creating an average measure of parenting warmth and consistency. The latter scales have been divided into terciles, taking values (1) Low (T1), (2) Medium (T2), and (3) High (T3).

Domain-specific educational processes: To capture this concept, we look both at parent-child jointly and stimulating materials present at home. As regards the former, after having run a factor analysis with iterated principal axes to select the items, we construct an additive scale of literacy activities (Cronbach's Alpha equals 0.70) that includes the following practices when children are 3 years old (W2): (i) reading to the children, (ii) learning the ABC or the alphabet, (iii) counting, (iv) singing songs, (v) playing games, and (vi) painting[85]. In W3, when children are 5 years old, we select the items from a factor analysis with iterated principal axes for calculating an additive scale of parental literacy practices[86] (Cronbach's Alpha equals 0.56). The latter comprises the following items: (i) playing with children using toys or games/puzzles; (ii) visiting libraries; (iii) listening to children read; (iv) reading to children; (v) doing sport or physical activities; (vi) going on educational visits outside the home such as museums, farms[87]. Both scales have been then transformed into three-category variables, dividing the scales into terciles. Thus, the final variables which measure the frequency of parent-child joint interaction have values (1) Low (T1), (2) Medium (T2), and (3) High (T3). Finally, we consider the number of children's books owned by the family, recoding the original item from W2 and W3 into an

[85] The introduction to the battery measuring parental literacy practices in W2 was: "We are interested in the various kinds of activities that children do with their families. I would like you to think about activities which <child> may do at home. Please think about the usual pattern for <child> at the moment. Now I'd like to ask you about activities which <child> may do at home. On how many days in an average week does anyone at home [activity]" [0 days-7days]

[86] We decide here to rely only on primary caregivers' perspectives since secondary caregivers' opinions present lot of missing in the same items.

[87] The introduction to the battery measuring parental literacy practices in W3 was: "How often would you do any of the following with <child>?" and the responses allow for the following answer's categories: Never, hardly ever, occasionally, one or two times a week, every day.

ordinal variable, taking values (1) when families own a maximum of 20 children's books; (2) when books are from 21 to 30; (3) when children's books are more than 30.

ECE quality. In W2, five items capture ECE quality[88]. Originally, all items were expressed through a five categories Likert scale, ranging from (1) Strongly Agree to (5) Strongly disagree. Since parental opinions are highly skewed towards positive views, we decided to treat the original items as categorical rather than continuous. Therefore, we create a dummy variable for each item that takes value (1) if parents strongly agree with the statement, (0) otherwise. Then, we add these five nominal variables in an additive scale that ranges from 0 – i.e., lowest quality, to 5 – highest quality. The latter scale is finally recoded into a three-category variable that captures ECE quality with values (1) if children did not attend ECE, (2) if ECE is of low quality, (3) if ECE is of high quality[89].

In W3, parental perceptions of the ECE quality were recorded using two metric subscales from the Emlen scale linked to (i) the richness of the care environment, and (ii) the perceived quality of care. In W3, primary caregivers are asked to recall quality characteristics of formal care settings that their offspring experienced at four years old thanks to the FPSY scheme. Parents replied on a five-point Likert scale, ranging from "Never" to "Always"[90]: the higher the scores, the better the parental perception of the ECE quality. We aim to create a unique measure of ECE quality independently from children's participation in infant classes. Therefore, we apply the following passages: (i) we obtained the mean value from the two subscales measuring ECE quality for children who attend infant classes and for those who are not enrolled in infant schools; (ii) we divide each scale in quintiles. From these two 5-categories ordinal variables we create for both children who attend infant classes and those who do not attend them (iii) a categorical variable taking values (1) Low quality (1^{st}, 2^{nd}, and 3^{rd} quintile)

[88] (1) there are plenty of toys, books, pictures, and music for my child; (2) my caregiver knows a lot about children and their needs; (3) the place where my child is cared for is kept clean; (4) there are different play activities, e.g., water based, sand based, outdoor play, construction, painting etc. available; (5) My child spends time learning letters and numbers.

[89] High-quality means that parents declared to strongly agree with the statements proposed in all five original items. All other cases, i.e., when the ECE quality scale takes value from 0 to 4, are grouped in value 2, Low ECE quality.

[90] The question battery from which the two subscales were formed contained the following items: (a) there were lots of creative activities going on; (b) it was an interesting place for my child, 8c) there were plenty of toys, books, pictures, and music for my child; (d) in care, my child had many natural learning experiences; (e) the caregiver provided activities that are just right for my child; (f) my child felt safe and secure in care; (g) The caregiver was warm and affectionate toward my child; (h) It was a healthy place for my child; (i) My child was treated with respect; (j) My child was safe with this caregiver; (k) My child got a lot of individual attention; (l) My caregiver and I shared information; (m) My caregiver was open to new information and learning; (n) My caregiver showed she (he) knew a lot about children and their needs; (o) The caregiver handled discipline matters easily without being harsh; (p) My child liked the caregiver; (q) My caregiver was supportive of me as a parent; (r) My caregiver was happy to see my child.

and (2) High quality (4th and 5th quintile). Then, (iv) we create a nominal variable that takes value 0 when children do not attend infant classes; 1 otherwise. Finally, (v) we combine this latter dummy variable with the items measuring ECE quality (see (iii)) for obtaining our final variable of ECE quality that has values (1) if children did not attend ECE; (2) if ECE was of Low quality, and (3) if ECE was of High quality, regardless children's attendance to infant classes[91].

4.7.3. Covariates

We adjust all analyses for a series of both time-constant and time-varying controls. More specifically, we control for children's characteristics, such as children's sex, migration background[92], developmental skills at 8 months[93], and attendance of infant classes at 5 years old. Moreover, we include measures of previous ECE attendance, parental attachment[94], routine, care, and early literacy parental practices[95] measured in W1. Finally, we control for the area of residence[96]. For avoiding issues of overcontrolling and endogenous selection bias (VanderWeele 2015), we decide to not control for all possible variables that mediate the relation between SES and skill development, such as maternal employment.

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[91] In the empirical analysis, we used (2) as reference category since we are interested in visualizing the influence of the extreme categories (1) and (3) on early child development.

[92] Natives are those children who are born in Ireland and whose parents are both born in Ireland. All the others are set as having a migration background and, more precisely, this category comprises: (i) children with a 'mixed' background, i.e., those who, although born in Ireland, have at least one parent who is foreign-born; (ii) second-generation migrant, i.e., those who, although born in Ireland, have both parents who are foreign-born; and (iii) first-generation migrant, i.e., those children who, as their parents, are foreign-born.

[93] The Age and Stage Questionnaire (ASQ) aims at discovering indications for delay in child development by monitoring five domains, i.e., communication, gross motor, fine motor, problem solving, and personal/social abilities. Parents are asked to answer a range of questions within each domain (Quail, Williams, McCrory, et al. 2011). We create a scale of developmental skills at 8 months by combining scores from the above-mentioned ability domains. Then, we group the obtained score-points in a dummy variable taking value (1) if the examined child passed all five tests, (0) if he/she failed in at least one domain out of five.

[94] In W1, both primary and secondary caregivers were asked to give answer to items measuring quality of parental attachment by means of a subscale deriving from the Maternal Postnatal Attachment Scale (Condon and Corkindale 1998). This subscale is composed by 9 items, and it measures parental feelings towards their infants and about themselves as parents (e.g., patience and affection in dealing with their babies). We keep answers from both parents to create an average scale of parenting attachment. Then, we built up a three-category variable, based on terciles of the original metric scale. The latter takes value (1) when parenting attachment is Low; (2) when Medium; and (3) when High.

[95] We create a scale of parental care tasks by taking secondary caregivers' answers to the following items, which we recode to have response categories (1) Neither me nor my partner (2) Either me or my partner and (3) Both of us. the items measure who, at home, (i) baths him/her; (ii) feeds him/her; (iii) cuddles him / her, (iv) plays with him / her (e.g., clapping, rolling over, peek-a-boo), (v) taking him / her for walks, outings, visiting relatives or friends etc., (vi) changing his /her nappy, (vii) sings to him / her; (viii) picks up him / her when he/she cries. the parental routine scale, instead, brings together the following items: (i) getting up in the night to see to him / her (ii) gets him / her up in the morning (iii) dresses him / her in the morning. finally, the literacy scale brings together these two items (i) reading stories to him / her, (ii) shows him / her pictures in books.

[96] Place of residence is roughly divided between urban (coded as 1) and rural areas, coded as 0.

Table 4.1 Variables by survey wave and children's age

	Wave 1	Wave 2	Wave 3	Wave 5
	2008/2009	2010/2011	2013	2017/2018
	Age: 9 months	Age: 3 years	Age: 5 years	Age: 9 years
Dependent Variables				
Vocabulary	-	X	X	X
Picture Similarities	-	X	X	-
SDQ – Externalizing problems	-	X	X	X
SDQ – Internalizing problems	-	X	X	X
Independent Variables				
Family highest education level	X	X	X	X
Family occupational class	X	X	X	X
Family net income	X	X	X	X
Parenting styles	X	X	X	X
Parental practices	X	X	X	X
ECE quality	-	X	X	-
Controls				
Sex	X	X	X	X
Migrant background	X	X	X	X
Place of residence	X	X	X	X
Baseline abilities	X	-	-	-
Childcare attendance	X			
Infant school attendance	-	-	X	-

Source) GUI.

4.8. Empirical strategy

Our data allows us to have repeated observations for children in two-time points. Therefore, we adopt linear random effects (RE) models to maximize the available information, gaining insights from both the variance between and within-group of children. We apply a stepwise procedure, and we weighted the results[97].

In Equation (1), i stands for children, while t represents the study wave. y_{it} is our outcome of interest, i.e., children's cognitive and noncognitive performances; $\mathrm{SES_{it}}$ indicates children's social origins, i.e., our proxy for HLE structural characteristics, and β_1 represent the average influence of SES on skills, net of controls, i.e., the vector $\mathrm{Z_{it}}$.

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

In Equation (2), we include process features of HLE, thus adding items linked to both general and domain-specific educational processes HLE_{it}. β_2 accounts for the average influence of HLE process quality on skills, net of HLE structural characteristics and controls. In Equation (3), we add quality features of the formal learning environments, ECE_{it}. β_3 represent the average influence of ECE quality on skills, net of structural and process HLE and controls.

[97] To insert weights, we used the STATA command mixed, with random intercepts by level 2, i.e., household id.

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + \beta_2 HLE_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + \beta_2 HLE_{it} + \beta_3 ECE_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (3)$$

We introduce a set of interaction terms for testing for the substitution/complementarity hypothesis. More precisely, we test singularly (i) the multiplicative impact of children's social origins and HLE process quality (4), (ii) the interaction of children's social origins with ECE quality (5) and, (iii) the interaction between HLE process and ECE quality (6).

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + \beta_2 HLE_{it} + \beta_3 ECE_{it} + \beta_4 SES_{it} * HLE_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + \beta_2 HLE_{it} + \beta_3 ECE_{it} + \beta_4 SES_{it} * ECE_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (3)$$

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + \beta_2 HLE_{it} + \beta_3 ECE_{it} + \beta_4 HLE_{it} * ECE_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (4)$$

Finally, in Equation (7), we include all these three interactions jointly.

$$y_{it} = \alpha_{it} + \beta_1 SES_{it} + \beta_2 HLE_{it} + \beta_3 ECE_{it} + \beta_4 SES_{it} * HLE_{it} + \beta_5 SES_{it} * ECE_{it} + \beta_6 HLE_{it} * ECE_{it} + Z_{it} + \alpha_i + \varepsilon_{it} \quad (5)$$

4.9. Empirical results

In line with what has been identified by previous empirical findings and at the theoretical level, descriptive findings show that socially well-off children perform, on average, better in all ability domains than their low-SES peers (Figure C.1, Appendix C Chapter 4). Similarly, to greater responsiveness and demandingness at home, as well as to highly frequent parental engagement and adequate learning materials correspond better performances in both cognitive and noncognitive skills (Figures C.2 to C.5, Appendix C Chapter 4). Finally, children who attend high-quality ECE settings score better than children who attend low-quality childcare or were not enrolled in formal care settings (Figure C.6, Appendix C Chapter 4). These first hints suggest that part of the variation in early skills can be due to different quality aspects in both HLE and ECE. The following identifies whether and to what extent HLE and ECE quality dimensions act as possible mechanisms through which families transmit early inequalities in educational outcomes.

4.9.1. The determinants of early gaps in cognitive and noncognitive skills

As a first step, we look at the main effects of HLE and ECE quality on skill development. To ease the interpretation of the results, we move to Figure 4.3, which reports average marginal effects (AME) on early cognitive and noncognitive skills of HLE and ECE quality Predictions

are calculated for each skill on the final model, Model 7. Full Tables are reported in Appendix C Chapter 4, Tables C.4 to C.7.

Both structural and process dimensions of HLE matter for cognitive development. Net of other factors, a standard deviation increase on the scale of SES corresponds to an average increase of 0.12 and 0.8 standard deviation points on early vocabulary and reasoning performances (Figure 4.3). Alongside HLE structural features, parenting styles, parental involvement, and the presence of adequate educational materials enhance early vocabulary abilities (upper panel of Figure 4.3). More specifically, to a highly consistent parenting style and a highly frequent joint parent-child literacy involvement corresponds an improvement of 0.10 and 0.9 standard deviation points on vocabulary scores. Children who can count on a high number of books score 0.23 standard deviation points better in vocabulary tests than those who have 20 or less children's books at home. A high number of books and highly supportive parenting styles ameliorates early reasoning skills as well (0.20 and 0.11 standard deviation points, respectively). Finally, attending high-quality ECE rather than low quality ECE settings does not relate to early cognitive development.

As regards noncognitive skills, Figure 4.3 shows that a standard deviation increase on the scale of SES corresponds to fewer emotional (internalizing) and behavioural (externalizing) problems (-0.7 and -0.10 standard deviation points, respectively). The lower panel of Figure 4.3 highlights that a highly warm or consistent parenting style is beneficial for both emotional (-16 and -14 standard deviation points, respectively) and behavioural problems (-0.26 and -0.37 standard deviation points, respectively). At the same time, highly frequent parent-child interactions in literacy activities foster children's noncognitive skills of, on average, 0.12 and 0.13 standard deviation points. Many children's books at home rather than few enhances behavioural skills of, on average, 0.8 standard deviation points. Finally, attending high-quality ECE rather than low quality one is beneficial for both emotional and behavioural skills (-0.8 and -0.11 standard deviation points, respectively).

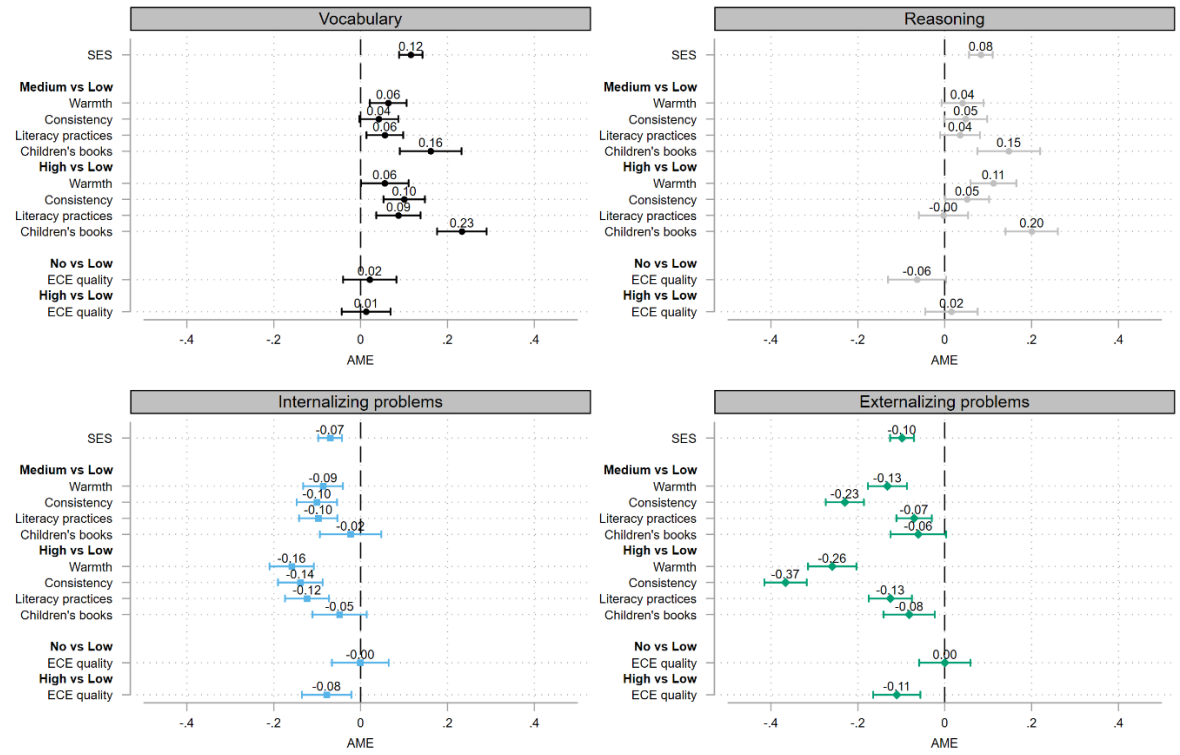

Figure 4.3 Average partial effects (APE) of HLE process and ECE quality dimensions on early cognitive and noncognitive skills with 95% confidence intervals (controlling for all variables included in M7).

Note) Weighted results. Predictions refer to Model 7 in Tables C.4 to C.7, Appendix C Chapter 4.
Source) Own calculations based on GUI.

All in all, we find confirmation for our first hypothesis (H1): high-SES children score better than their low-SES peers in all skill domains. Moreover, we find partial support for our second hypothesis (H2): parental involvement in literacy activities relates positively to early vocabulary and non-cognitive development, while the presence of adequate educational materials is relevant in boosting cognitive and behavioural skills. Our third hypothesis (H3) is also partially confirmed: highly consistent parenting matters for improving children's early vocabulary, emotional, and behavioural skills but it does not relate to reasoning abilities. High parental responsiveness links positively to noncognitive development and reasoning skills, but it does not matter for boosting early vocabulary competencies. Finally, in line with previous studies for Ireland (Neylon 2014), we find that high-quality ECE attendance does not associate with better cognitive development. However, the exposure to high-quality formal care settings fosters noncognitive development, thus partially corroborating our fourth hypothesis (H4).

4.9.2. The interactive role of quality dimensions on skill development

What happens to early educational outcomes if the quality of care experienced at home or in formal care settings varies according to children's social origins? Does the influence of ECE quality on skills depend on levels of HLE quality? To answer these questions, interactions were tested. To illustrate them and to ease the interpretation of the results, we move to Figure 4.4. Complete Tables are shown in Appendix C Chapter 4, Tables C.4 to C.7.

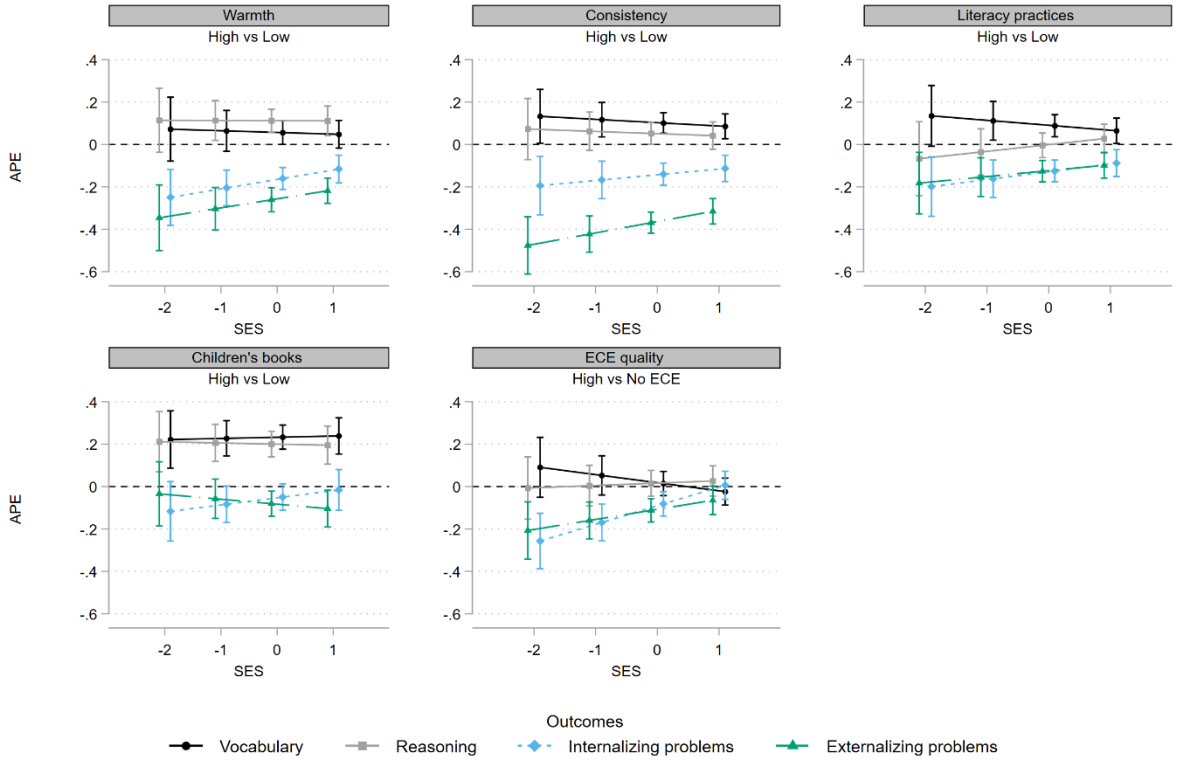

Figure 4.4 Average partial effects (APE) of HLE and ECE quality dimensions on early cognitive and noncognitive skills with 95% confidence intervals, by SES

Note) Weighted results. Predictions refer to Model 7 in Tables C.4 to C.7, Appendix C Chapter 4.
Source) Own calculations based on GUI.

Figure 4.4 shows the average partial effects on skills of HLE quality features (both structural and process) by different SES levels. Moreover, in the last panel, the Figure above displays the average partial effects on skills of ECE quality by different SES levels. For reasons of space, we compare the extreme categories, i.e., (i) low versus high HLE process quality; and (ii) high-quality ECE versus no ECE attendance. We find significant interactions for non-cognitive skills only and for HLE aspects that relate to parenting styles. More specifically, when significant, we find evidence corroborating the substitution hypothesis. Therefore, the learning benefits of experiencing highly responsive and consistent parenting styles on emotional and

behavioural skills are higher for low-SES than for high-SES children (first two graphs in the upper panel of Figure 4.4). High-quality HLE in terms of family climate compensates for being poor in socially deprived circumstances, thus supporting H3A.

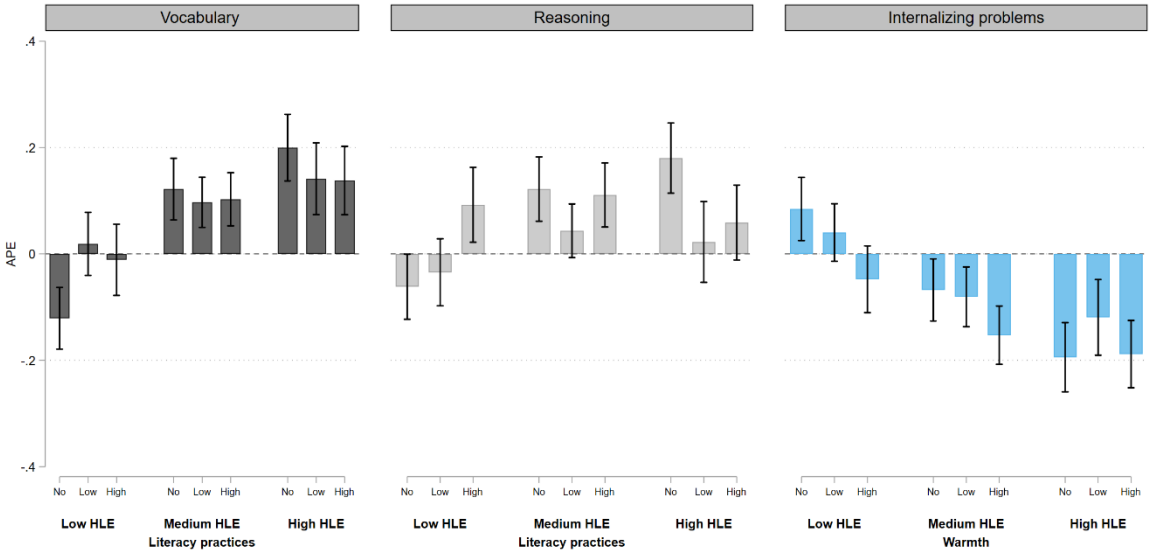

Figure 4.5 Average partial effects (APE) of ECE quality on early cognitive and noncognitive skills with 95% confidence intervals, by HLE process quality

Note) Weighted results. Predictions refer to Model 7 in Tables C.4 to C.7, Appendix C Chapter 4.
Source) Own calculations based on GUI.

Finally, to answer whether the effect of ECE quality on skills is the same among children exposed to HLE of different qualities, we move to Figure 4.5. The latter reports average partial effects (APE) on early skills of ECE quality by different levels of HLE quality, i.e., low, medium, and high. To detect whether there is a substitution of complementarity mechanism, we calculate the difference between attending high-quality ECE versus not separately for two groups, i.e., (1) for those children who experienced high-quality HLE, and (2) for those children who were not enrolled in formal care settings. If the difference of group (1) is greater than the difference of group (2), we have evidence for the substitution hypothesis. Otherwise, we confirm the complementarity hypothesis. Figure 4.5 displays APE for group differences that are statistically significant.

As regards cognitive skills, we find that high-quality ECE attendance complements HLE quality (H5B). This means that the learning benefits of attending high-quality ECE are higher for children who, at home, are highly stimulated thanks to frequent parental engagement in joint literacy activities. On the contrary, we find evidence supporting the substitution hypothesis (H5A) in the case of internalizing problems: the learning gains of attending high-

quality ECE on early emotional skills are greater for children whose parents score the lowest in terms of responsiveness to their offspring's needs than for those who live in a more attentive family climate.

4.10. Discussion

This paper has investigated the role of several quality dimensions of familiar and formal care learning environments in shaping skill development before entering primary education in Ireland. By jointly analysing quality aspects of both HLE and ECE, we connect literature from sociology, psychology, and pedagogy and we adopt the structure-process model as a suitable theoretical framework for predicting risks of poor educational outcomes in early childhood. This paper has focused on one of the first critical educational transitions within the Irish educational systems, looking at the period allocated shortly before and after enrolment in infant classes in primary schools.

We report three main findings. As a first point, we show that although parental SES matters for early development, with socially advantaged children scoring better in all ability domains than their low-SES peers, other features of the HLE are associated with cognitive and noncognitive abilities. The family climate in which children live, parental literacy involvement, and features of the home learning space are all confirmed to have direct and independent linkage with early skills formation. The quality of family climate, for example, is crucial for early differences in emotional skills, contributing to lessening conduct and attention disorders. Moreover, what parents do with their children is relevant for early vocabulary development and noncognitive skills. Setting up an adequate home learning space helps children's motivation to learn, thus increasing early cognitive abilities, but it also ameliorates children's early behavioural skills. Finally, this study corroborates previous ones in finding no relation between high-quality ECE attendance and literacy development, but it highlights that emotional and behavioural skills are improved by exposure to high-quality institutional care.

As a second point, we find that high-quality HLE and ECE work as equalizing tools on noncognitive development: children from low-SES families benefit the most from a highly responsive and consistent family climate and from experiencing high-quality institutional care. Therefore, if such parental inputs, when of high quality, compensate for poor social origins, socially disadvantaged parents should be (i) made more aware of the importance of a stimulating and nurturing HLE for the early educational success of their offspring, and (b) supported in effectively putting in place such parenting styles at home. This is in line with previous intervention studies (Kathy Sylva et al. 2008; Barone, Fougère, and Pin 2021).

As a third point, we find that, as regards cognitive skills, HLE domain-specific educational processes complement, rather than substitute, for attendance of high-quality ECE. Corroborating previous results (Anders et al. 2012), we notice that, for what concerns cognitive skills, high-quality literacy support at home is necessary for children to take advantage of high-quality ECE attendance. On the contrary, children whose parents are less supportive in their behaviours at home are those who, by attending high-quality ECE, obtain the highest returns on early emotional development.

Some limitations of this study are worth mentioning. Although we control for baseline levels of children's skills in various domains and early quality differences in both HLE and ECE, our results report associational estimates, rather than causal ones. Our analytical strategy is non-experimental, and it cannot control possible biases deriving from omitted variables, such as child endowments and genetic variation. Parents may vary their inputs, responses, and investments according to their offspring's abilities for example. Twin-study reports, for example, that high-SES parents offer more cognitive stimulation to their high-ability twin rather than their low-ability counterpart (Grätz 2015). Additionally, parents transmit to their offspring a set of genes that can shape interactions in the rearing environments and influence children's early educational outcomes (Hart, Little, and van Bergen 2021). Unfortunately, we are not able to control this potential genetic confounder. In general, further research is needed to confirm our conclusions to controlling for selection bias with the covariate approach taken in this study.

Finally, what parents value in terms of quality in Ireland may be valid for this country only. Indeed, "it is possible that parents in different countries will systematically differ in their perceptions of their children's ECE, based on their cultural context and the conditions of the childcare system in which they function" (Cryer, Tietze, and Wessels 2002, 260). In other words, this means that cultural influences as well as ECE system conditions, (e.g., in terms of availability, accessibility, affordability) vary across countries and, in turn, this might alter parental perceptions of childcare quality. More cross-country studies are therefore needed to detect to what extent these results are generalizable to other countries.

Despite these caveats, this study contributes further to the literature on child development and social stratification since it examines both facets of HLE and ECE quality, studying their heterogeneity in influencing cognitive and noncognitive skill development. Future studies should focus on the joint impact of ECE quality and HLE on skill development. In doing so, they should consider the multifaced nature of quality, thus separating, if feasible, structural from process features, both in HLE and ECE. This allows for understanding the

mechanisms behind inequalities in early skill transmission. Moreover, both educators and parental perceptions should be used for capturing ECE quality.

CONCLUSIONS

Every seed needs fertile ground and caring sowers for growing

Skills enable individuals to fully develop their potential in various life domains, from education to the work sphere, from health to civic participation. Yet individuals differ markedly in their competencies, with gaps that emerge early, well before primary school entrance. Moreover, these disparities tend to remain stable or diminish while in primary school, re-emerging in adolescence and persisting through adulthood. What lies behind the emergence of these differences? Unfortunately, sociology has somewhat overlooked this early life phase (see for an exception Blossfled et al. 2017), rather focusing on social inequalities in educational achievements and attainments that occur in other life stages, such as while in the school system (Jackson 2013; Blossfeld et al. 2016) or during adulthood (Blossfeld et al. 2014). This dissertation aimed to further contribute to the literature on child development and social reproduction by examining inequalities in learning outcomes that originates in early childhood and exploring the mechanisms by which these happen.

We followed recent discussions about the relevance of a multiplicity of abilities as predictors for successful participation in society by concentrating on cognitive and noncognitive skills. Indeed, alongside domain-specific cognitive skills, such as reading, literacy and mathematical literacy, other abilities matter in today's economy and society. These are labelled as noncognitive skills and include abilities such as motivation, socio-emotional skills, the ability to work with others, attention, self-regulation, and self-esteem. In this dissertation, we focused on both domains for gaining an accurate understanding of what may foster or hinder children's development shortly after birth. We decide to focus on early childhood for three main reasons. First, early childhood is a crucial period for the acquisition of knowledge and abilities: it is during the first five years of life that children rapidly acquire competencies in different ability domains, such as cognitive, socio-emotional, and motor skills. Second, early childhood lies the foundations for further learning and educational success: skills beget skills, early learning makes it easier to acquire skills at later age points. Third, skills are not unchangeable traits set in stone: although there is a genetic predisposition, there is also a tremendous space for flexibility. In other words, skills can be shaped and boosted, especially in crucial periods, such as the early years.

Consequently, we focused on the characteristics of the environments in which children grow and build their first abilities. If these learning environments are adequate, it is possible to set a solid basis, and it will be much easier to motivate, inspire, and teach children at later ages.

We can compare children to seeds that, for becoming plants, need a fertile ground from which they gain adequate nutrients. In addition, the attentive care of farmers, who water the seeds, remove weeds, and protect the seeds from bad weather and animals, is also important for healthy growth. In doing so, seeds are provided with a firm base for growing, which help them to resist a lot of strains while growing. Similarly, children need nourishing ground and responsive care to successfully develop. Learning does not happen in a vacuum, and although some children start their journey with a richer backpack than others, genes alone cannot determine developmental outcomes. Previous research indicates that experiences lived in supportive environments can stimulate children's brains, living epigenetic signatures (i.e., chemical traces) that, temporarily or permanently, affect how genes are turned on and off, thus establishing the foundations of learning capacities. Similarly, stressful and harsh experiences in the early years may damage children's potential, deactivating genes that can be useful for reacting to later life challenges, for example (Center on the Developing Child at Harvard University 2016).

According to Bronfenbrenner's bio-ecological model of personal development, children are competent agents who develop during the whole life course in a multitude of more or less proximal formal and informal settings. Children's relations with different actors and materials in each learning environment affect their abilities. Moreover, the quality of these early settings is foundational for children's present and future well-being and educational outcomes. Consequently, understanding the characteristics of the learning environments where children build their skills is the first important step to take. Among various learning environments, the family and the early childhood education systems appear to be, in our view, the most important settings where children develop in their childhood. The first environment in which children acquire basic abilities is the family. Parents are children first teachers, and they contribute with their behaviours, interactions, and educational materials to their offspring's early educational experiences. Primarily studied in the context of developmental psychology, the home learning environment has been a crucial factor in influencing children's early literacy and numeracy (Melhuish, 2010; Anders et al., 2012) and social and behavioural development (Kathy Sylva et al. 2010). Shortly after birth, parents are asked to make their first educational choices by enrolling their offspring in formal care settings. The number of children who participate in the early childhood education system has been growing over time, and, in recent years, we have witnessed a shift of perspective: from being a reconciliation tool, ECE is viewed as a place for supporting children in their education. Research reports that high-quality ECE attendance has

a beneficial influence on skills for all children but especially for those who come from socially disadvantaged backgrounds (Melhuish et al. 2015; Gambaro, Stewart, and Waldfogel 2014).

This dissertation has several purposes. The first aim was to examine the mechanisms under which early inequalities in learning may originate, examining the role of formal and informal care environments on skill development. The second aim was to provide the sociological literature with more recent evidence on the relevance and implications of learning experiences in the early years in the short and medium run. The third aim was to go beyond the relevance of cognitive skills, providing evidence for noncognitive skills as well. The fourth aim was to add evidence for countries other than the United Kingdom and the United States, where much of the research on this topic comes from. All these aims were addressed with sociological lenses, thus focusing on mechanisms of social reproduction by examining consequences for children from different social backgrounds. By drawing on the best survey data from a range of different countries, we contribute further to the literature on child development and social stratification by (i) examining the role of formal care education in affecting cognitive and noncognitive skills in the long run; by (ii) adopting a comprehensive theoretical framework that dynamically examined the relevance of diverse factors in influencing childcare choices; by jointly (iii) investigating the heterogeneity of quality characteristics at home and in ECE that can influence child development.

This work comes with an important limitation related to the difficulty in working with longitudinal data that encompass all the concepts of interests, i.e., cognitive and non-cognitive skills, family features in terms of socio-economic characteristics, parental care quality dimensions, ECE attendance, structural, and process quality. It has been difficult to find data that contain information on at least part of these dimensions. When available, we struggle to find standardized measures of abilities and quality of learning environments comparable to different time points. Datasets that contain, for instance, educators' views on the quality of their workplaces are lacking. The data we used in this dissertation collect either any information on ECE quality, i.e., PISA, or although available, as in the case of both NEPS and GUI, this information cannot be used since, due to the small sample size issues of representativeness, confidentiality, and statistical weighting need to be considered and finally impede us from taking advantage of the educators' questionnaires. Therefore, researchers need more consistent data for gaining a better understanding of the role of care arrangements on child development to help countries in their efforts to sustain children's early learning experiences with credible findings.

Despite this challenge, the main take-home messages of this dissertation are the following. Early childhood is a crucial period for child development and that the learning experiences collected in formal and informal care settings influence those acquired at later life points. However, our findings confirm that mechanisms of social reproduction are in place from the early years. More specifically, we gain evidence that there is social selectivity in the choice of care arrangements already at one year old and that the strength of this relation changes dynamically according to children's age (Chapter 3). Moreover, we find that gaps between children from different social backgrounds in cognitive and noncognitive skills are visible at preschool age (Chapter 4). Yet, although social origins drive parental childcare choices and children's educational outcomes, other factors need to be considered. We show that during the care selection process, discrepancies in care choices between families also occur according to costs and benefits considerations (Chapter 3), while quality characteristics of the home learning environments, such as the family climate, the learning space, and parental engagement, are pivotal for the acquisition of early competencies, especially for noncognitive skills (Chapter 4).

Early childhood education has also long-lasting influences on skills. Attending preschools at three years old affects positively cognitive and noncognitive skills, especially in countries where formal care is of high quality. Moreover, (high-quality) preschool attendance is most beneficial for the offspring of socially disadvantaged families. Differently, enrolment in childcare settings when younger than three years has a detrimental impact on later skills, which tend to be even worse for children from low-SES families than for their high-SES peers (Chapter 2). We believe that this finding is explicable by contextualizing the results. Indeed, our population, i.e., 15-years-old students, went to childcare between 2000 and 2002 and, at that time, quality in institutional care was still lacking and underdeveloped in most European countries. It was just with the ECE expansion that has involved mainly services for the under-three that debates around quality arose, although, in some countries, the debate and experimentation around ECEC are still ongoing[98]. Therefore, with more recent data, we expect a beneficial and enduring impact of ECEC attendance is measurable, yet particularly in those countries where quality standards and pedagogical curricula are provided and put effectively in place. As regards quality, we find evidence that high-quality ECE holds tremendous potential for children both in the short and in the long run. As above mentioned, high-quality preschool

[98] See, for example, the case of Italy with the "Orientamenti nazionali per i servizi educativi per l'infanzia", a strategy that involves the definition of pedagogical guidelines for an integrated ECE system, from 0 to 6 years old (https://www.istruzione.it/sistema-integrato-06/orientamenti-nazionali.html, retrieved on 07/12/2021).

is crucial for performances in secondary school (Chapter 2) while, at the same time, enrolment in high-quality ECE relates positively with children's emotional and behavioural development before primary school entry, even in a market-driven care system as the Irish one (Chapter 4). Therefore, we argue that the countries' efforts towards improving formal care quality for offering all children a strong start in life are the right way to go. Finally, we believe that researchers should struggle in investigating the mutual and synchronic influences on skills of various care arrangements. Although investments in high-quality ECE is important for sustaining children in their development, institutional care alone cannot fully reduce achievement gaps. The joint analysis of different quality dimensions of both parental and formal care highlights that low-SES parents should be made aware and supported in their parenting behaviours since the latter influences positively the early emotional and behavioural competencies of their offspring. At the same time, high-quality ECE attendance compensates for hostile and inattentive parenting at home. Parents should also be informed of the pivotal role that their literacy stimulation has on their offspring's early vocabulary and reasoning skills: some support at home is needed for children to take full advantage of the learning opportunities offered in high-quality ECE settings. The importance of helping parents in their educational challenges is even more important when an unexpected crisis occurs, such as that of the global COVID-19 pandemic that, especially during its first wave in 2020, made it impossible for many children to benefit from their right to education, imposing the closure of care services.

This dissertation left some issues unanswered, prompting questions for future research. As suggested by Van Lancker and Pavolini (2018) ECE use is a matter of both family preferences and policies. As such, future works on the use of early childhood education would need to integrate the care demand-side with supply-side indicators, thus considering that also countries' specific policies can limit the uptake of childcare, especially for socially disadvantaged children. However, there are between and within countries differences in childcare availability, affordability, and quality. Future research should aim at incorporating in its design administrative data that grasp the regional and municipal heterogeneity of childcare characteristics, especially for the under-threes.

Moreover, most of the evidence in this area is correlational, but, again, future research should apply a more robust causal design for understanding the impact of ECE on skills, both in the short and in the long run. It should be important to consider the temporal dimensions, thus further adding evidence on the enduring impact of ECE for the whole population, exploring the potential differential effects of ECE for children with different social backgrounds. In doing so, researchers should put more effort into understanding under which conditions ECE

attendance matters for skill development. In this vein, future works need to refer to a common theoretical framework, such as the structure-process model of educational quality, for incorporating in their designs structural and process quality components that are assessed similarly. This consistency in conceptualization and methods would enhance studies' comparability and it will provide a more detailed picture of the processes underlying the emergence of learning inequalities from early years.

Future studies should strongly point to the importance of a whole-child development strategy. Multiple contexts affect learning and, consequently, future works should aim at examining the joint role of different care arrangements on skill development. We know little about the interrelation of high ECE quality and high HLE quality, for example, but studying their simultaneous influence may furnish opportune policy recommendations for the implementation of educational plans that involve both children's' parents and educators. Finally, applying a whole-child development strategy also means that future studies should analyse, alongside skills, such as reading and mathematical literacy, also noncognitive skills, such as socio-emotional and behavioural abilities.

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Appendix A: CHAPTER 2

Table A.1 Average level of proficiency in reading, maths, and CPS by countries

	Reading				Mathematics				Collaborative Problem Solving				N
Country	mean	se	min	max	mean	se	min	max	mean	se	min	max	
BG	502	2	148	789	509	2	158	833	503	2	139	835	9,367
DE	518	3	138	819	511	3	189	805	533	3	168	876	5,592
ES	497	2	167	761	487	2	175	781	498	2	183	795	6,611
FR	503	2	126	820	496	2	153	785	497	2	118	811	5,911
UK	496	2	159	782	493	3	214	770	515	3	130	825	2,952
IT	486	3	139	791	491	3	170	832	480	3	110	821	11,243

Source) Own calculation based on PISA 2015.

Table A.2 ECEC attendance and duration by countries (row %)

Country	No	Yes	Early entry	Late entry	%	N
BG	85	15	5	10	100	9,367
DE	92	8	1	7	100	5,592
ES	49	51	15	36	100	6,611
FR	77	23	8	15	100	5,911
UK	84	16	5	11	100	2,952
IT	77	23	18	5	100	11,243

Source) Own calculation based on PISA 2015.

Table A.3 Preschool attendance and duration (weekly hours) by countries (row %)

Country	No	Yes	1-30	31-51	%	N
BG	60	40	20	20	100	9,367
DE	79	22	19	3	100	5,592
ES	36	64	50	14	100	6,611
FR	33	67	52	15	100	5,911
UK	61	39	37	2	100	2,952
IT	30	69	34	35	100	11,243

Source) Own calculation based on PISA 2015.

Table A.4 Distribution of (beliefs of) ECEC and PS mandatory, by country

	ECEC MANDATORY				PS MANDATORY			
	No	Yes	%	N	No	Yes	%	N
BG	99.41	0.59	100.00	9,367	88.22	11.78	100.00	9,367
DE	98.79	1.21	100.00	5,592	94.47	5.53	100.00	5,592
ES	93.20	6.80	100.00	6,611	75.19	24.81	100.00	6,611
FR	99.36	0.64	100.00	5,911	80.18	19.82	100.00	5,911
UK	98.15	1.85	100.00	2,952	93.25	6.75	100.00	2,952
IT	98.59	1.41	100.00	11,243	94.17	5.83	100.00	11,243

Note) Weighted data.
Source) Own calculations on PISA 2015.

Table A.5 Average SES by (beliefs of) ECEC being mandatory, by country

	ECEC MANDATORY - NO			ECEC MANDATORY YES		
	mean	SD	N	mean	SD	N
BG	0.43	0.83	9,307	0.34	0.82	60
DE	0.39	0.87	5,525	0.03	0.82	67
ES	-0.15	1.08	6,183	-0.66	1.05	428
FR	0.15	0.73	5,872	0.22	0.75	39
UK	0.49	0.77	2,897	0.62	0.79	55
IT	0.22	0.87	11,085	-0.09	0.82	158

Note) Weighted data.
Source) Own calculations on PISA 2015.

Table A.6 Average SES by (beliefs of) PS being mandatory, by country.

	PS MANDATORY - NO			PS MANDATORY: YES		
	mean	SD	N	mean	SD	N
BG	0.43	0.84	8,173	0.41	0.78	1,194
DE	0.39	0.87	5,289	0.44	0.88	303
ES	-0.14	1.09	4,994	-0.33	1.07	1,617
FR	0.15	0.74	4,721	0.16	0.72	1,190
UK	0.49	0.77	2,755	0.54	0.81	197
IT	0.24	0.87	10,443	-0.13	0.84	800

Note) Weighted data.
Source) Own calculations on PISA 2015

Table A.7 Association between ECEC attendance and SES terciles, by country.

	SES: Low			SES: Medium			SES: High			
	ECEC: NO	ECEC: YES	Tot (%)	ECEC: NO	ECEC: YES	Tot (%)	ECEC: NO	ECEC: YES	Tot (%)	N
BG	90.86	9.14	100.00	87.04	12.96	100.00	80.27	19.73	100.00	9,367
DE	92.93	7.07	100.00	93.09	6.91	100.00	89.63	10.37	100.00	5,592
ES	53.39	46.61	100.00	46.98	53.02	100.00	42.07	57.93	100.00	6,611
FR	85.53	14.47	100.00	77.26	22.74	100.00	66.58	33.42	100.00	5,911
UK	89.87	10.13	100.00	84.84	15.16	100.00	80.48	19.52	100.00	2,952
IT	82.00	18.00	100.00	76.78	23.22	100.00	72.45	27.55	100.00	11,243

Note) SES Low (1st tercile), SES Medium (2nd tercile), SES High (3rd tercile). Weighted results.
Source) Own calculation based on PISA 2015.

Table A.8 Association between ECEC duration and SES terciles, by country.

	SES: Low				SES: Medium				SES: High				
	No	Early	Late	Tot (%)	No	Early	Late	Tot (%)	No	Early	Late	Tot (%)	N
BG	90.86	2.40	6.74	100.0	87.04	3.64	9.32	100.0	80.27	7.27	12.46	100.0	9,367
DE	92.93	0.52	6.55	100.0	93.09	0.34	6.57	100.0	89.63	1.27	9.09	100.0	5,592
ES	53.39	10.71	35.90	100.0	46.98	13.91	39.11	100.0	42.07	22.97	34.95	100.0	6,611
FR	85.53	4.55	9.92	100.0	77.26	7.88	14.86	100.0	66.58	11.69	21.73	100.0	5,911
UK	89.87	1.29	8.84	100.0	84.84	3.99	11.17	100.0	80.48	7.50	12.02	100.0	2,952
IT	82.00	15.23	2.77	100.0	76.78	17.88	5.34	100.0	72.45	19.85	7.71	100.0	11,243

Note) SES Low (1st tercile), SES Medium (2nd tercile), SES High (3rd tercile). Weighted results.

Source) Own calculation based on PISA 2015.

Table A.9 Association between PS attendance and SES terciles, by country

	SES: Low			SES: Medium			SES: High			
	PS: NO	PS: YES	Tot (%)	PS: NO	PS: YES	Tot (%)	PS: NO	PS: YES	Tot (%)	N
BG	69.54	30.46	100.00	63.09	36.91	100.00	51.09	48.91	100.00	9,367
DE	77.56	22.44	100.00	73.05	26.95	100.00	70.41	29.59	100.00	5,592
ES	36.21	63.79	100.00	32.18	67.82	100.00	27.22	72.78	100.00	6,611
FR	32.91	67.09	100.00	24.57	75.43	100.00	14.22	85.78	100.00	5,911
UK	73.16	26.84	100.00	64.73	35.27	100.00	57.53	42.47	100.00	2,952
IT	35.04	64.96	100.00	24.86	75.14	100.00	23.61	76.39	100.00	11,243

Note) SES Low (1st tercile), SES Medium (2nd tercile), SES High (3rd tercile). Weighted results.
Source) Own calculation based on PISA 2015.

Table A.10 Association between PS duration and SES terciles, by country

	SES: Low				SES: Medium				SES: High				
	NO PS	1-30 w.h.	31 or more w.h.	Tot (%)	NO PS	1-30 w.h.	31 or more w.h.	Tot (%)	NO PS	1-30 w.h.	31 or more w.h.	Tot (%)	N
BG	70.14	14.82	15.04	100.0	63.45	19.08	17.47	100.0	51.40	24.43	24.17	100.0	9,367
DE	82.43	15.01	2.57	100.0	78.69	18.56	2.76	100.0	75.94	21.00	3.06	100.0	5,592
ES	40.05	50.02	9.92	100.0	35.17	50.61	14.22	100.0	29.44	48.00	22.56	100.0	6,611
FR	44.40	44.72	10.88	100.0	32.56	51.78	15.66	100.0	20.30	60.08	19.63	100.0	5,911
UK	72.16	27.69	0.14	100.0	63.22	35.17	1.62	100.0	55.30	42.04	2.66	100.0	2,952
IT	38.80	31.72	29.48	100.0	27.65	35.18	37.17	100.0	25.61	35.05	39.34	100.0	11,243

Note) SES Low (1st tercile), SES Medium (2nd tercile), SES High (3rd tercile). w.h.: weekly hours. Weighted results.
Source) Own calculation based on PISA 2015.

Table A.11 Average partial effects (APE) on reading at 15 years old of ECEC attendance with 95% confidence intervals, by SES and country

			BG						DE			
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-112	22	-5	0	-154	-69	-95	40	-2	0	-173	-16
-2.5	-109	20	-5	0	-148	-69	-88	38	-2	0	-164	-13
-2	-106	19	-6	0	-143	-69	-82	37	-2	0	-155	-9
-1.5	-103	18	-6	0	-137	-69	-76	36	-2	0	-147	-5
-1	-100	16	-6	0	-132	-68	-70	35	-2	0	-138	-1
-0.5	-98	15	-6	0	-127	-68	-64	34	-2	0	-131	4
0	-95	14	-7	0	-123	-66	**-57**	**34**	**-2**	**0**	**-123**	**9**
0.5	-92	14	-7	0	-119	-65	**-51**	**33**	**-2**	**0**	**-116**	**14**
1	-89	13	-7	0	-115	-63	**-45**	**33**	**-1**	**0**	**-110**	**20**
1.5	-86	13	-7	0	-112	-61	**-39**	**33**	**-1**	**0**	**-104**	**26**
2	-84	13	-6	0	-109	-58	**-33**	**33**	**-1**	**0**	**-98**	**33**
2.5	-81	13	-6	0	-107	-54	**-26**	**34**	**-1**	**0**	**-93**	**40**
3	-78	14	-6	0	-105	-50	**-20**	**35**	**-1**	**1**	**-88**	**48**
3.5	-75	15	-5	0	-104	-46	**-14**	**35**	**0**	**1**	**-84**	**55**
4	-72	16	-5	0	-103	-41	**-8**	**37**	**0**	**1**	**-79**	**64**
			FR						IT			
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-128	25	-5	0	-176	-79	-118	27	-4	0	-171	-64
-2.5	-125	23	-6	0	-169	-81	-114	26	-4	0	-165	-63
-2	-122	20	-6	0	-163	-82	-110	25	-4	0	-158	-61
-1.5	-120	18	-6	0	-156	-84	-106	24	-4	0	-152	-60
-1	-117	17	-7	0	-150	-85	-102	23	-5	0	-147	-58
-0.5	-114	15	-8	0	-144	-85	-98	22	-5	0	-141	-56
0	-112	14	-8	0	-138	-85	-95	21	-5	0	-136	-54
0.5	-109	12	-9	0	-134	-85	-91	20	-4	0	-131	-51
1	-106	12	-9	0	-130	-83	-87	20	-4	0	-126	-48
1.5	-104	12	-9	0	-127	-80	-83	20	-4	0	-122	-44
2	-101	13	-8	0	-126	-77	-79	20	-4	0	-119	-40
2.5	-98	14	-7	0	-125	-72	-76	20	-4	0	-115	-36
3	-96	15	-6	0	-125	-67	-72	21	-3	0	-112	-31
3.5	-93	17	-6	0	-126	-61	-68	21	-3	0	-110	-26
4	-91	18	-5	0	-127	-54	-64	22	-3	0	-107	-21
			ES						UK			
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-37	11	-3	0	-58	-16	**-13**	**39**	**0**	**1**	**-89**	**64**
-2.5	-37	10	-4	0	-56	-17	**-12**	**36**	**0**	**1**	**-82**	**59**
-2	-37	9	-4	0	-55	-18	**-11**	**33**	**0**	**1**	**-76**	**55**
-1.5	-37	9	-4	0	-54	-19	**-10**	**31**	**0**	**1**	**-70**	**50**
-1	-37	9	-4	0	-53	-20	**-9**	**28**	**0**	**1**	**-64**	**47**
-0.5	-36	8	-4	0	-53	-20	**-8**	**26**	**0**	**1**	**-58**	**43**
0	-36	8	-4	0	-53	-20	**-6**	**24**	**0**	**1**	**-53**	**40**
0.5	-36	9	-4	0	-53	-20	**-5**	**22**	**0**	**1**	**-49**	**38**

1	-36	9	-4	0	-54	-19	**-4**	**21**	**0**	**1**	**-46**	**37**
1.5	-36	9	-4	0	-54	-18	**-3**	**21**	**0**	**1**	**-44**	**37**
2	-36	10	-4	0	-55	-17	**-2**	**21**	**0**	**1**	**-43**	**38**
2.5	-36	11	-3	0	-57	-15	**-1**	**21**	**0**	**1**	**-43**	**40**
3	-36	11	-3	0	-58	-14	**0**	**22**	**0**	**1**	**-43**	**43**
3.5	-36	12	-3	0	-60	-12	**1**	**24**	**0**	**1**	**-45**	**47**
4	-36	13	-3	0	-61	-10	**2**	**25**	**0**	**1**	**-48**	**51**

Note) APE: average partial effects; SE: standard error; z: z statistics; p: p-value; min: minimum at 95%; max: maximum at 95%. In bold: non-statistically significant differences.

Source) Own calculation based on PISA 2015.

Table A.12 Average partial effects (APE) on maths at 15 years old of ECEC attendance with 95% confidence intervals, by SES and country

	BG						DE					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	**-60**	**102**	**-1**	**1**	**-259**	**139**	-54	24	-2	0	-102	-6
-2.5	**-58**	**100**	**-1**	**1**	**-253**	**137**	-49	23	-2	0	-94	-5
-2	**-56**	**98**	**-1**	**1**	**-247**	**136**	-45	21	-2	0	-86	-4
-1.5	**-54**	**96**	**-1**	**1**	**-241**	**134**	-40	19	-2	0	-78	-2
-1	**-52**	**94**	**-1**	**1**	**-236**	**132**	**-35**	**18**	**-2**	**0**	**-71**	**1**
-0.5	**-50**	**92**	**-1**	**1**	**-230**	**131**	**-30**	**17**	**-2**	**0**	**-64**	**4**
0	**-47**	**90**	**-1**	**1**	**-224**	**129**	**-26**	**17**	**-2**	**0**	**-58**	**7**
0.5	**-45**	**88**	**-1**	**1**	**-219**	**128**	**-21**	**16**	**-1**	**0**	**-53**	**11**
1	**-43**	**87**	**0**	**1**	**-213**	**127**	**-16**	**17**	**-1**	**0**	**-49**	**16**
1.5	**-41**	**85**	**0**	**1**	**-208**	**126**	**-12**	**17**	**-1**	**0**	**-45**	**22**
2	**-39**	**83**	**0**	**1**	**-203**	**125**	**-7**	**18**	**0**	**1**	**-42**	**28**
2.5	**-37**	**82**	**0**	**1**	**-197**	**124**	**-2**	**19**	**0**	**1**	**-39**	**35**
3	**-35**	**80**	**0**	**1**	**-192**	**123**	**3**	**20**	**0**	**1**	**-37**	**43**
3.5	**-33**	**79**	**0**	**1**	**-187**	**122**	**7**	**22**	**0**	**1**	**-36**	**50**
4	**-31**	**77**	**0**	**1**	**-182**	**121**	**12**	**24**	**1**	**1**	**-34**	**59**
	FR						IT					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-92	25	-4	0	-142	-42	-83	22	-4	0	-127	-40
-2.5	-90	24	-4	0	-136	-44	-78	21	-4	0	-119	-37
-2	-88	22	-4	0	-131	-45	-72	20	-4	0	-111	-34
-1.5	-86	20	-4	0	-125	-47	-67	19	-4	0	-104	-30
-1	-84	18	-5	0	-120	-48	-61	18	-3	0	-97	-26
-0.5	-83	17	-5	0	-116	-49	-56	17	-3	0	-90	-22
0	-81	16	-5	0	-111	-50	-50	17	-3	0	-83	-18
0.5	-79	15	-5	0	-108	-50	-45	17	-3	0	-78	-12
1	-77	14	-5	0	-105	-50	-40	17	-2	0	-72	-7
1.5	-75	14	-5	0	-102	-48	-34	17	-2	0	-67	-1
2	-73	14	-5	0	-101	-46	**-29**	**17**	**-2**	**0**	**-62**	**5**
2.5	-72	14	-5	0	-100	-43	**-23**	**18**	**-1**	**0**	**-58**	**12**
3	-70	15	-5	0	-100	-40	**-18**	**19**	**-1**	**0**	**-54**	**19**
3.5	-68	16	-4	0	-100	-36	**-12**	**20**	**-1**	**1**	**-51**	**27**
4	-66	18	-4	0	-101	-32	**-7**	**21**	**0**	**1**	**-48**	**34**
	ES						UK					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-41	10	-4	0	-61	-21	**-27**	**29**	**-1**	**0**	**-83**	**30**
-2.5	-41	10	-4	0	-60	-22	**-26**	**26**	**-1**	**0**	**-77**	**25**
-2	-40	9	-4	0	-59	-22	**-26**	**23**	**-1**	**0**	**-71**	**19**
-1.5	-40	9	-5	0	-57	-23	**-26**	**20**	**-1**	**0**	**-65**	**14**
-1	-40	9	-5	0	-57	-23	**-25**	**18**	**-1**	**0**	**-60**	**9**
-0.5	-39	9	-5	0	-56	-23	**-25**	**16**	**-2**	**0**	**-56**	**6**
0	-39	9	-5	0	-56	-22	**-25**	**14**	**-2**	**0**	**-52**	**3**
0.5	-39	9	-4	0	-56	-22	**-24**	**13**	**-2**	**0**	**-50**	**1**

1	-38	9	-4	0	-56	-21	**-24**	**13**	**-2**	**0**	**-49**	**1**
1.5	-38	9	-4	0	-56	-20	**-24**	**14**	**-2**	**0**	**-51**	**3**
2	-38	10	-4	0	-57	-19	**-23**	**15**	**-2**	**0**	**-53**	**7**
2.5	-37	10	-4	0	-58	-17	**-23**	**17**	**-1**	**0**	**-57**	**11**
3	-37	11	-3	0	-59	-16	**-23**	**20**	**-1**	**0**	**-62**	**16**
3.5	-37	12	-3	0	-60	-14	**-22**	**23**	**-1**	**0**	**-67**	**22**
4	-36	12	-3	0	-61	-12	**-22**	**26**	**-1**	**0**	**-72**	**28**

Note) APE: average partial effects; SE: standard error; z: z statistics; p: p-value; min: minimum at 95%; max: maximum at 95%. In bold: non-statistically significant differences.

Source) Own calculation based on PISA 2015.

Table A.13 Average partial effects (APE) on collaborative problem solving at 15 years old of ECEC attendance with 95% confidence intervals, by SES and country

			BG						DE			
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-75	26	-3	0	-126	-25	**-53**	**30**	**-2**	**0**	**-111**	**5**
-2.5	-73	25	-3	0	-121	-24	**-49**	**28**	**-2**	**0**	**-104**	**5**
-2	-70	24	-3	0	-116	-23	**-46**	**26**	**-2**	**0**	**-96**	**5**
-1.5	-67	23	-3	0	-112	-22	**-42**	**24**	**-2**	**0**	**-90**	**5**
-1	-64	22	-3	0	-107	-20	**-38**	**23**	**-2**	**0**	**-83**	**7**
-0.5	-61	22	-3	0	-103	-19	**-35**	**22**	**-2**	**0**	**-78**	**9**
0	-58	21	-3	0	-99	-17	**-31**	**22**	**-1**	**0**	**-73**	**11**
0.5	-55	21	-3	0	-96	-14	**-27**	**22**	**-1**	**0**	**-70**	**15**
1	-52	21	-3	0	-92	-12	**-24**	**22**	**-1**	**0**	**-67**	**20**
1.5	-49	21	-2	0	-89	-9	**-20**	**23**	**-1**	**0**	**-65**	**25**
2	-46	21	-2	0	-87	-5	**-16**	**24**	**-1**	**1**	**-64**	**31**
2.5	-43	21	-2	0	-85	-2	**-12**	**26**	**0**	**1**	**-63**	**38**
3	**-40**	**22**	**-2**	**0**	**-83**	**2**	**-9**	**28**	**0**	**1**	**-63**	**45**
3.5	**-37**	**22**	**-2**	**0**	**-81**	**6**	**-5**	**30**	**0**	**1**	**-63**	**53**
4	**-34**	**23**	**-1**	**0**	**-80**	**11**	**-1**	**32**	**0**	**1**	**-64**	**61**
			FR						IT			
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-70	32	-2	0	-133	-7	**-69**	**48**	**-1**	**0**	**-162**	**25**
-2.5	-67	31	-2	0	-126	-7	**-65**	**47**	**-1**	**0**	**-157**	**27**
-2	-63	29	-2	0	-120	-7	**-62**	**46**	**-1**	**0**	**-152**	**28**
-1.5	-60	27	-2	0	-114	-6	**-58**	**45**	**-1**	**0**	**-147**	**30**
-1	-57	26	-2	0	-108	-6	**-55**	**44**	**-1**	**0**	**-142**	**32**
-0.5	-54	25	-2	0	-103	-5	**-51**	**44**	**-1**	**0**	**-137**	**34**
0	-51	24	-2	0	-98	-4	**-48**	**43**	**-1**	**0**	**-132**	**36**
0.5	-48	23	-2	0	-93	-3	**-45**	**43**	**-1**	**0**	**-128**	**39**
1	-45	22	-2	0	-88	-1	**-41**	**42**	**-1**	**0**	**-124**	**41**
1.5	**-42**	**22**	**-2**	**0**	**-84**	**1**	**-38**	**42**	**-1**	**0**	**-120**	**44**
2	**-38**	**22**	**-2**	**0**	**-81**	**4**	**-34**	**42**	**-1**	**0**	**-116**	**47**
2.5	**-35**	**22**	**-2**	**0**	**-78**	**7**	**-31**	**41**	**-1**	**0**	**-112**	**50**
3	**-32**	**22**	**-1**	**0**	**-75**	**11**	**-28**	**41**	**-1**	**1**	**-109**	**53**
3.5	**-29**	**22**	**-1**	**0**	**-73**	**15**	**-24**	**41**	**-1**	**1**	**-105**	**57**
4	**-26**	**23**	**-1**	**0**	**-71**	**19**	**-21**	**42**	**0**	**1**	**-102**	**61**
	ES						UK					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	-38	11	-3	0	-60	-16	**-2**	**35**	**0**	**1**	**-69**	**66**
-2.5	-39	11	-3	0	-60	-17	**-2**	**32**	**0**	**1**	**-65**	**61**
-2	-39	11	-4	0	-60	-18	**-2**	**29**	**0**	**1**	**-60**	**55**
-1.5	-39	11	-4	0	-61	-18	**-3**	**27**	**0**	**1**	**-56**	**50**
-1	-40	11	-4	0	-61	-18	**-3**	**25**	**0**	**1**	**-52**	**46**
-0.5	-40	11	-4	0	-62	-18	**-4**	**23**	**0**	**1**	**-49**	**42**
0	-40	12	-4	0	-63	-18	**-4**	**22**	**0**	**1**	**-47**	**39**
0.5	-41	12	-3	0	-64	-17	**-4**	**21**	**0**	**1**	**-46**	**37**

1	-41	12	-3	0	-66	-17	**-5**	**21**	**0**	**1**	**-45**	**36**
1.5	-42	13	-3	0	-67	-16	**-5**	**21**	**0**	**1**	**-46**	**36**
2	-42	14	-3	0	-69	-15	**-5**	**22**	**0**	**1**	**-48**	**37**
2.5	-42	15	-3	0	-71	-14	**-6**	**23**	**0**	**1**	**-51**	**39**
3	-43	15	-3	0	-73	-13	**-6**	**25**	**0**	**1**	**-55**	**42**
3.5	-43	16	-3	0	-75	-11	**-7**	**27**	**0**	**1**	**-59**	**46**
4	-44	17	-3	0	-77	-10	**-7**	**29**	**0**	**1**	**-64**	**50**

Note) APE: average partial effects; SE: standard error; z: z statistics; p: p-value; min: minimum at 95%; max: maximum at 95%. In bold: non-statistically significant differences.
Source) Own calculation based on PISA 2015.

Table A.14 Average partial effects (APE) on reading at 15 years old of PS attendance with 95% confidence intervals, by SES and country

	BG						DE					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	47	13	4	0	22	73	**4**	**17**	**0**	**1**	**-28**	**37**
-2.5	45	11	4	0	23	68	**3**	**15**	**0**	**1**	**-27**	**34**
-2	43	10	4	0	23	63	**3**	**14**	**0**	**1**	**-25**	**31**
-1.5	41	9	5	0	24	58	**2**	**13**	**0**	**1**	**-24**	**28**
-1	39	8	5	0	24	54	**1**	**12**	**0**	**1**	**-23**	**26**
-0.5	37	7	5	0	23	50	**0**	**12**	**0**	**1**	**-23**	**24**
0	35	6	5	0	22	47	**0**	**11**	**0**	**1**	**-22**	**22**
0.5	33	6	5	0	20	45	**-1**	**11**	**0**	**1**	**-23**	**21**
1	31	7	4	0	17	44	**-2**	**11**	**0**	**1**	**-23**	**20**
1.5	28	8	4	0	13	44	**-3**	**11**	**0**	**1**	**-25**	**20**
2	26	9	3	0	9	44	**-3**	**12**	**0**	**1**	**-26**	**20**
2.5	24	10	2	0	4	44	**-4**	**12**	**0**	**1**	**-29**	**20**
3	**22**	**12**	**2**	**0**	**-1**	**45**	**-5**	**13**	**0**	**1**	**-31**	**21**
3.5	**20**	**13**	**2**	**0**	**-6**	**46**	**-6**	**14**	**0**	**1**	**-34**	**22**
4	**18**	**15**	**1**	**0**	**-11**	**47**	**-6**	**16**	**0**	**1**	**-37**	**24**
	FR						IT					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	47	19	2	0	10	83	**30**	**18**	**2**	**0**	**-5**	**64**
-2.5	49	17	3	0	16	83	**29**	**16**	**2**	**0**	**-4**	**61**
-2	52	15	3	0	22	83	**28**	**15**	**2**	**0**	**-3**	**58**
-1.5	55	14	4	0	28	83	**26**	**15**	**2**	**0**	**-2**	**55**
-1	58	13	4	0	33	84	**25**	**14**	**2**	**0**	**-2**	**53**
-0.5	61	12	5	0	37	86	**24**	**13**	**2**	**0**	**-2**	**51**
0	64	12	5	0	41	88	**23**	**13**	**2**	**0**	**-3**	**49**
0.5	67	12	6	0	44	91	**22**	**13**	**2**	**0**	**-4**	**48**
1	70	13	6	0	46	95	**21**	**14**	**2**	**0**	**-6**	**48**
1.5	73	13	5	0	47	100	**20**	**14**	**1**	**0**	**-8**	**47**
2	76	15	5	0	48	105	**19**	**15**	**1**	**0**	**-10**	**48**
2.5	79	16	5	0	48	110	**18**	**16**	**1**	**0**	**-13**	**48**
3	82	18	5	0	48	117	**17**	**17**	**1**	**0**	**-16**	**49**
3.5	85	19	4	0	47	123	**15**	**18**	**1**	**0**	**-20**	**51**
4	88	21	4	0	47	129	**14**	**19**	**1**	**0**	**-23**	**52**
	ES						UK					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	**18**	**10**	**2**	**0**	**-2**	**38**	**7**	**25**	**0**	**1**	**-41**	**56**
-2.5	**17**	**10**	**2**	**0**	**-1**	**36**	**10**	**22**	**0**	**1**	**-33**	**53**
-2	**17**	**9**	**2**	**0**	**-1**	**34**	**13**	**19**	**1**	**1**	**-25**	**51**
-1.5	**16**	**9**	**2**	**0**	**-1**	**32**	**16**	**17**	**1**	**0**	**-18**	**49**
-1	**15**	**8**	**2**	**0**	**-1**	**31**	**18**	**15**	**1**	**0**	**-11**	**47**
-0.5	**14**	**8**	**2**	**0**	**-2**	**30**	**21**	**13**	**2**	**0**	**-4**	**47**
0	**13**	**9**	**2**	**0**	**-4**	**30**	24	12	2	0	1	47
0.5	**12**	**9**	**1**	**0**	**-5**	**30**	27	11	2	0	5	48

1	**12**	**10**	**1**	**0**	**-7**	**31**	29	11	3	0	8	51
1.5	**11**	**10**	**1**	**0**	**-10**	**31**	32	12	3	0	9	55
2	**10**	**11**	**1**	**0**	**-12**	**32**	35	13	3	0	9	61
2.5	**9**	**12**	**1**	**0**	**-15**	**33**	37	15	2	0	7	67
3	**8**	**13**	**1**	**1**	**-18**	**35**	40	18	2	0	6	75
3.5	**7**	**15**	**1**	**1**	**-21**	**36**	43	20	2	0	4	82
4	**7**	**16**	**0**	**1**	**-24**	**37**	46	23	2	0	1	90

Note) APE: average partial effects; SE: standard error; z: z statistics; p: p-value; min: minimum at 95%; max: maximum at 95%. In bold: non-statistically significant differences.
Source) Own calculation based on PISA 2015.

Table A.15 Average partial effects (APE) on maths at 15 years old of PS attendance with 95% confidence intervals, by SES and country

	BG						DE					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	50	12	4	0	26	73	**20**	**14**	**1**	**0**	**-7**	**47**
-2.5	48	11	5	0	27	68	**20**	**13**	**2**	**0**	**-6**	**45**
-2	46	9	5	0	28	64	**19**	**12**	**2**	**0**	**-4**	**43**
-1.5	44	8	6	0	28	59	**19**	**11**	**2**	**0**	**-3**	**41**
-1	42	7	6	0	28	55	**18**	**10**	**2**	**0**	**-2**	**39**
-0.5	40	6	6	0	28	52	**18**	**10**	**2**	**0**	**-2**	**37**
0	38	6	6	0	26	49	**17**	**10**	**2**	**0**	**-1**	**36**
0.5	36	6	6	0	24	48	**17**	**9**	**2**	**0**	**-2**	**36**
1	34	7	5	0	20	47	**16**	**10**	**2**	**0**	**-2**	**35**
1.5	32	8	4	0	16	47	**16**	**10**	**2**	**0**	**-3**	**35**
2	30	9	3	0	12	48	**16**	**10**	**2**	**0**	**-5**	**36**
2.5	28	11	3	0	7	49	**15**	**11**	**1**	**0**	**-6**	**36**
3	26	12	2	0	2	49	**15**	**12**	**1**	**0**	**-8**	**37**
3.5	**24**	**14**	**2**	**0**	**-3**	**51**	**14**	**12**	**1**	**0**	**-10**	**39**
4	**22**	**15**	**1**	**0**	**-8**	**52**	**14**	**13**	**1**	**0**	**-13**	**40**
	FR						IT					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	37	15	3	0	9	66	**37**	**107**	**0**	**1**	**-173**	**247**
-2.5	40	13	3	0	14	67	**40**	**109**	**0**	**1**	**-174**	**254**
-2	44	12	4	0	20	68	**43**	**111**	**0**	**1**	**-174**	**260**
-1.5	47	11	4	0	25	69	**46**	**113**	**0**	**1**	**-174**	**267**
-1	50	11	5	0	29	71	**50**	**114**	**0**	**1**	**-175**	**274**
-0.5	53	11	5	0	33	74	**53**	**116**	**0**	**1**	**-175**	**281**
0	57	11	5	0	36	77	**56**	**118**	**0**	**1**	**-176**	**287**
0.5	60	11	5	0	38	81	**59**	**120**	**0**	**1**	**-176**	**294**
1	63	12	5	0	40	86	**62**	**122**	**1**	**1**	**-177**	**301**
1.5	66	13	5	0	42	91	**65**	**124**	**1**	**1**	**-177**	**308**
2	70	14	5	0	43	97	**69**	**126**	**1**	**1**	**-178**	**315**
2.5	73	15	5	0	43	102	**72**	**128**	**1**	**1**	**-179**	**322**
3	76	17	5	0	44	108	**75**	**130**	**1**	**1**	**-180**	**329**
3.5	79	18	4	0	44	115	**78**	**132**	**1**	**1**	**-180**	**337**
4	83	20	4	0	44	121	**81**	**134**	**1**	**1**	**-181**	**344**
	ES						UK					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	**17**	**9**	**2**	**0**	**-1**	**35**	**-14**	**23**	**-1**	**1**	**-58**	**31**
-2.5	**16**	**8**	**2**	**0**	**-1**	**32**	**-10**	**21**	**0**	**1**	**-50**	**31**
-2	**14**	**8**	**2**	**0**	**-1**	**30**	**-6**	**19**	**0**	**1**	**-42**	**31**
-1.5	**13**	**8**	**2**	**0**	**-2**	**28**	**-2**	**17**	**0**	**1**	**-35**	**31**
-1	**11**	**8**	**1**	**0**	**-4**	**27**	**2**	**15**	**0**	**1**	**-27**	**32**
-0.5	**10**	**8**	**1**	**0**	**-5**	**26**	**6**	**14**	**0**	**1**	**-21**	**33**
0	**9**	**8**	**1**	**0**	**-8**	**25**	**10**	**13**	**1**	**0**	**-15**	**35**
0.5	**7**	**9**	**1**	**0**	**-10**	**25**	**14**	**12**	**1**	**0**	**-10**	**38**

1	**6**	**10**	**1**	**1**	**-13**	**25**	**18**	**12**	**1**	**0**	**-6**	**42**
1.5	**4**	**10**	**0**	**1**	**-16**	**25**	**22**	**13**	**2**	**0**	**-4**	**47**
2	**3**	**11**	**0**	**1**	**-19**	**25**	**26**	**14**	**2**	**0**	**-2**	**53**
2.5	**2**	**12**	**0**	**1**	**-22**	**26**	**30**	**15**	**2**	**0**	**-1**	**60**
3	**0**	**13**	**0**	**1**	**-25**	**26**	**34**	**17**	**2**	**0**	**0**	**67**
3.5	**-1**	**14**	**0**	**1**	**-29**	**27**	**38**	**19**	**2**	**0**	**0**	**75**
4	**-3**	**15**	**0**	**1**	**-32**	**27**	**42**	**21**	**2**	**0**	**0**	**83**

Note) APE: average partial effects; SE: standard error; z: z statistics; p: p-value; min: minimum at 95%; max: maximum at 95%. In bold: non-statistically significant differences.
Source) Own calculation based on PISA 2015.

Table A.16 Average partial effects (APE) on collaborative problem solving at 15 years old of PS attendance with 95% confidence intervals, by SES and country

	BG						DE					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	49	12	4	0	26	73	**22**	**15**	**1**	**0**	**-8**	**51**
-2.5	47	11	4	0	27	68	**20**	**14**	**1**	**0**	**-7**	**47**
-2	45	9	5	0	27	63	**19**	**13**	**1**	**0**	**-6**	**44**
-1.5	43	8	5	0	27	59	**17**	**12**	**1**	**0**	**-6**	**40**
-1	41	7	6	0	27	55	**16**	**11**	**1**	**0**	**-6**	**38**
-0.5	39	6	6	0	27	51	**14**	**11**	**1**	**0**	**-6**	**35**
0	37	6	6	0	25	49	**13**	**10**	**1**	**0**	**-7**	**33**
0.5	35	6	6	0	23	47	**11**	**10**	**1**	**0**	**-9**	**32**
1	33	7	5	0	19	46	**10**	**11**	**1**	**0**	**-11**	**31**
1.5	31	8	4	0	15	46	**8**	**11**	**1**	**0**	**-13**	**30**
2	29	9	3	0	11	47	**7**	**12**	**1**	**1**	**-16**	**30**
2.5	27	10	3	0	6	47	**5**	**13**	**0**	**1**	**-19**	**30**
3	24	12	2	0	1	48	**4**	**14**	**0**	**1**	**-23**	**31**
3.5	**22**	**13**	**2**	**0**	**-4**	**49**	**3**	**15**	**0**	**1**	**-27**	**32**
4	**20**	**15**	**1**	**0**	**-9**	**50**	**1**	**16**	**0**	**1**	**-31**	**33**
	FR						IT					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	**29**	**16**	**2**	**0**	**-2**	**61**	**4**	**23**	**0**	**1**	**-40**	**48**
-2.5	32	15	2	0	3	60	**3**	**22**	**0**	**1**	**-39**	**46**
-2	34	13	3	0	8	61	**3**	**21**	**0**	**1**	**-37**	**44**
-1.5	37	13	3	0	12	62	**3**	**20**	**0**	**1**	**-37**	**42**
-1	40	13	3	0	15	64	**3**	**20**	**0**	**1**	**-36**	**41**
-0.5	42	13	3	0	17	68	**2**	**20**	**0**	**1**	**-36**	**41**
0	45	14	3	0	18	72	**2**	**20**	**0**	**1**	**-37**	**40**
0.5	48	15	3	0	18	77	**2**	**20**	**0**	**1**	**-38**	**41**
1	50	17	3	0	18	83	**1**	**21**	**0**	**1**	**-39**	**42**
1.5	53	18	3	0	17	89	**1**	**21**	**0**	**1**	**-41**	**43**
2	55	20	3	0	16	95	**1**	**22**	**0**	**1**	**-43**	**44**
2.5	58	22	3	0	14	102	**0**	**24**	**0**	**1**	**-46**	**46**
3	61	25	2	0	13	109	**0**	**25**	**0**	**1**	**-49**	**49**
3.5	63	27	2	0	11	116	**0**	**26**	**0**	**1**	**-52**	**51**
4	66	29	2	0	9	123	**-1**	**28**	**0**	**1**	**-55**	**54**
	ES						UK					
SES levels	APE	SE	z	p	min	max	APE	SE	z	p	min	max
-3	**13**	**9**	**1**	**0**	**-5**	**31**	**10**	**26**	**0**	**1**	**-41**	**62**
-2.5	**12**	**8**	**1**	**0**	**-5**	**28**	**11**	**24**	**0**	**1**	**-36**	**57**
-2	**10**	**8**	**1**	**0**	**-5**	**25**	**11**	**21**	**1**	**1**	**-31**	**53**
-1.5	**8**	**7**	**1**	**0**	**-6**	**22**	**11**	**19**	**1**	**1**	**-27**	**49**
-1	**6**	**7**	**1**	**0**	**-7**	**20**	**11**	**17**	**1**	**1**	**-23**	**45**
-0.5	**5**	**7**	**1**	**1**	**-9**	**18**	**11**	**16**	**1**	**0**	**-19**	**42**
0	**3**	**7**	**0**	**1**	**-11**	**17**	**12**	**14**	**1**	**0**	**-16**	**39**
0.5	**1**	**8**	**0**	**1**	**-14**	**16**	**12**	**14**	**1**	**0**	**-15**	**38**

1	**-1**	**8**	**0**	**1**	**-17**	**15**	**12**	**13**	**1**	**0**	**-15**	**38**
1.5	**-2**	**9**	**0**	**1**	**-20**	**15**	**12**	**14**	**1**	**0**	**-15**	**40**
2	**-4**	**10**	**0**	**1**	**-24**	**15**	**12**	**15**	**1**	**0**	**-17**	**42**
2.5	**-6**	**11**	**-1**	**1**	**-27**	**16**	**12**	**17**	**1**	**0**	**-20**	**45**
3	**-8**	**12**	**-1**	**1**	**-31**	**16**	**13**	**19**	**1**	**1**	**-24**	**49**
3.5	**-9**	**13**	**-1**	**0**	**-35**	**16**	**13**	**21**	**1**	**1**	**-28**	**54**
4	**-11**	**14**	**-1**	**0**	**-39**	**17**	**13**	**23**	**1**	**1**	**-33**	**58**

Note) APE: average partial effects; SE: standard error; z: z statistics; p: p-value; min: minimum at 95%; max: maximum at 95%. In bold: non-statistically significant differences.
Source) Own calculation based on PISA 2015.

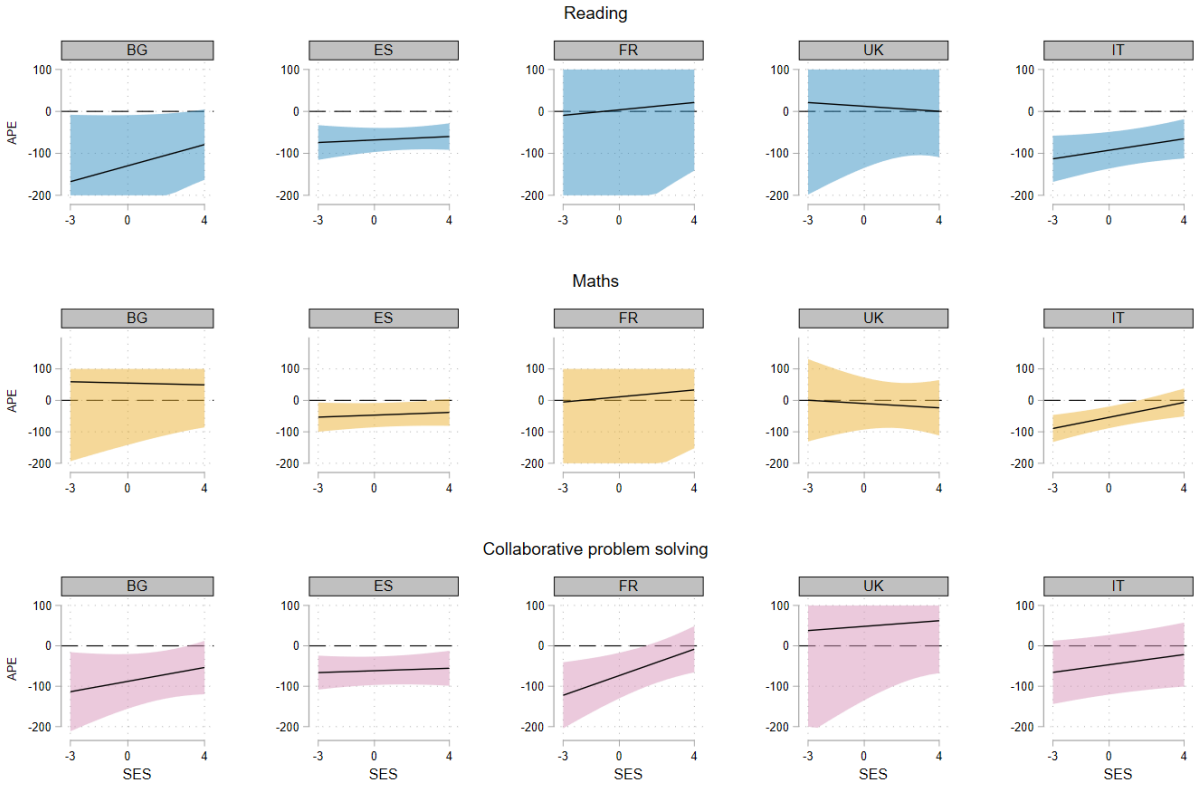

Figure A.1 Average partial effects (APE) on skills of early ECEC attendance with 95% confidence intervals, by SES and country

Note) Reference category: No PS; confidence intervals are capped on reading in BG, FR, and the UK; on maths in FR; on collaborative problem-solving in the UK
Source) Own calculations on PISA 2015

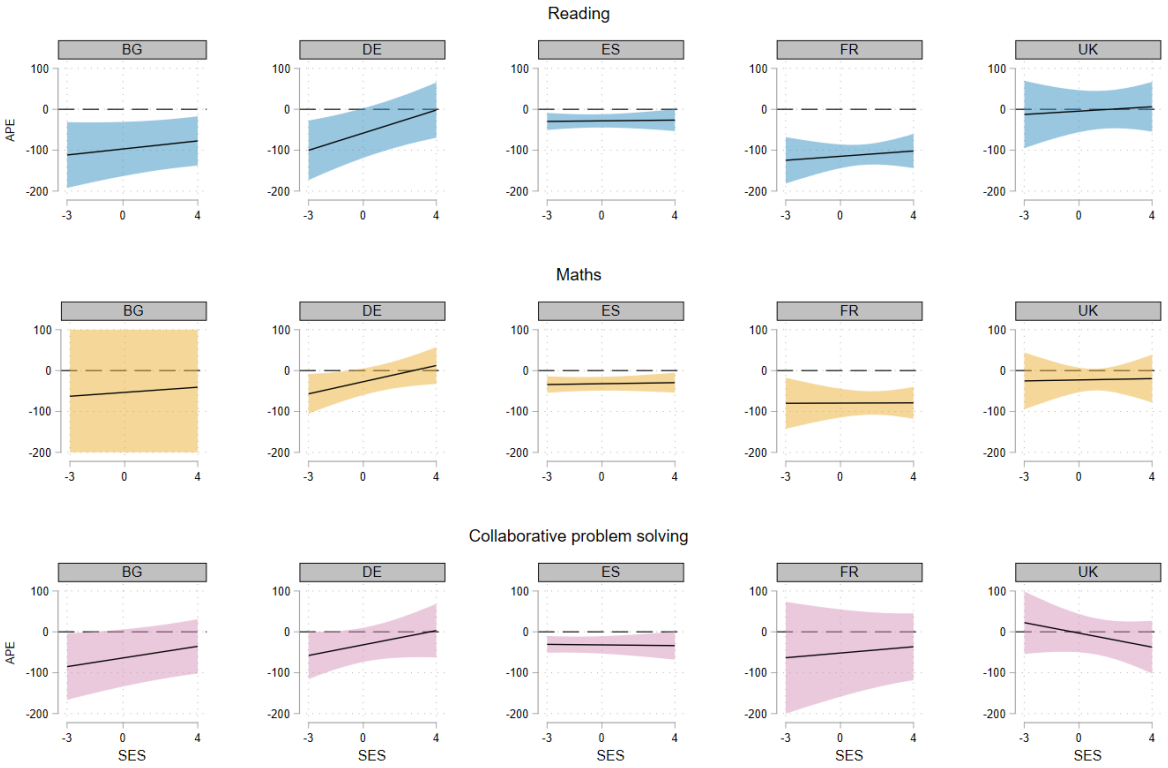

Figure A.2 Average partial effects (APE) on skills of late ECEC attendance with 95% confidence intervals, by SES and country

Note) Reference category: No PS; confidence intervals are capped on maths in BG
Source) Own calculations on PISA 2015

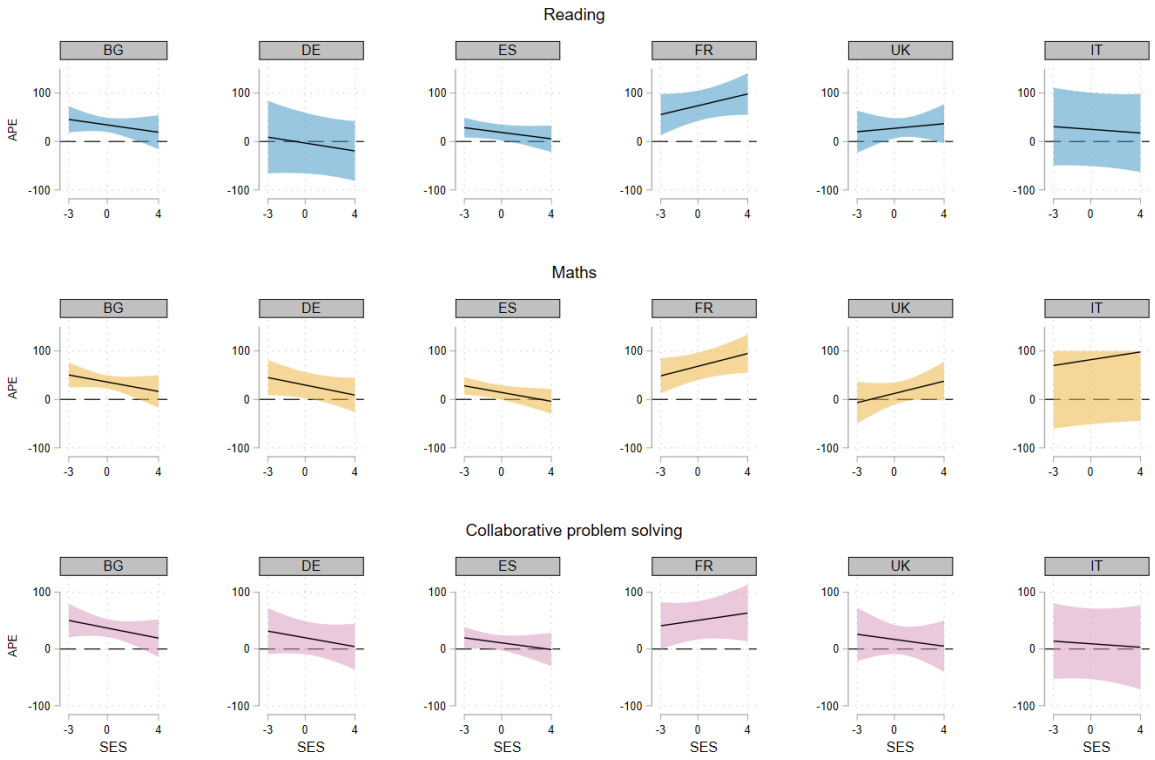

Figure A.3 Average partial effects (APE) on skills of preschool attendance for maximum 30 weekly hours with 95% confidence intervals, by SES and country

Note) Reference category: No PS; confidence intervals are capped on maths in IT
Source) Own calculations on PISA 2015

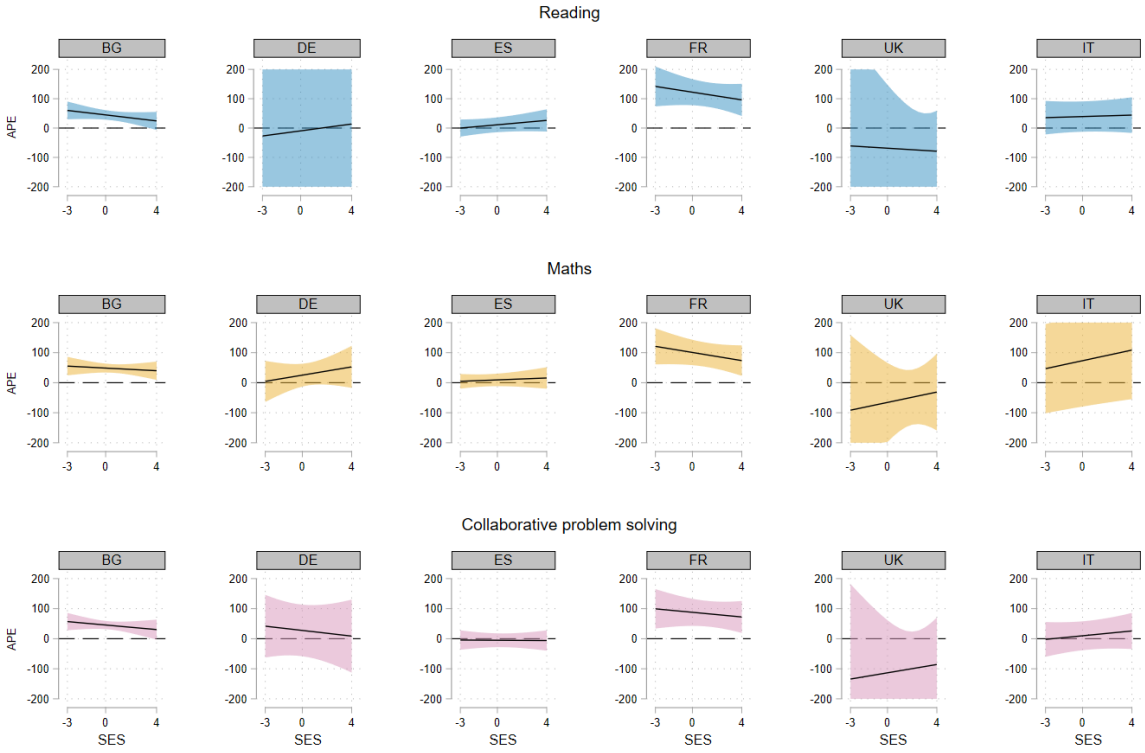

Figure A.4 Average partial effects (APE) on skills of preschool attendance for more than 30 weekly hours with 95% confidence intervals, by SES and country

Note) Reference category: No PS; confidence intervals are capped on reading in DE and UK; on maths in the UK and IT; on collaborative problem-solving in the UK.
Source) Own calculations on PISA 2015.

Table A.17 Linear regression models with endogenous treatment effects on readings skills of ECEC attendance, by country

	BG	DE	ES	FR	IT	UK
Y: Reading skills						
Gender (RC.: Male)						
Female	17.48***	20.53***	18.31***	27.90***	19.64***	19.86***
	(3.07)	(3.25)	(3.20)	(3.90)	(4.44)	(3.53)
Migrant background (RC.: native)						
Migrant	-39.75***	-35.25***	-15.12***	-18.56***	-13.85***	-0.23
	(3.98)	(5.95)	(4.10)	(6.77)	(4.71)	(5.95)
SES	49.66***	37.79***	29.19***	72.78***	38.51***	34.41***
	(2.37)	(2.25)	(2.10)	(3.36)	(2.31)	(2.97)
ECE*SES (RC.: ECEC attendance: No)						
ECEC attendance: Yes	5.60	12.37**	0.18	5.32	7.63*	2.06
	(3.73)	(5.41)	(2.38)	(5.13)	(4.03)	(6.87)
ECEC attendance (RC: No)						
Yes	-94.72***	-57.39*	-36.37***	-111.80***	-94.67***	-6.49
	(14.40)	(33.64)	(8.40)	(13.50)	(21.00)	(23.97)
Constant	498.18***	506.29***	514.43***	507.88***	491.52***	469.52***
	(3.51)	(4.56)	(4.51)	(4.75)	(5.90)	(4.66)
Y: ECEC attendance						
Migrant background (RC.: native)						
Migrant	-0.49***	-0.31***	-0.19***	0.01	0.10**	-0.07
	(0.04)	(0.06)	(0.05)	(0.05)	(0.05)	(0.09)
SES	0.23***	0.12***	0.16***	0.37***	0.16***	0.20***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)
ECEC mandatory (RC.: No)						
Yes	1.83***	2.13***	6.78***	1.24***	1.40***	2.39***
	(0.23)	(0.18)	(1.26)	(0.18)	(0.17)	(0.29)
Constant	-1.04***	-1.43***	-0.01	-0.83***	-0.82***	-1.15***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
variance (e. reading)	9334.10***	8449.27***	7025.88***	12600.98***	9050.56***	7387.41***
	(418.25)	(419.18)	(291.21)	(727.98)	(659.61)	(304.61)
corr(e.ECEC,e.reading)	0.66***	0.30*	0.39***	0.68***	0.56***	0.19
	(0.07)	(0.18)	(0.06)	(0.05)	(0.11)	(0.14)
N	9367	5592	6611	5911	11243	2952

Note) Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variance of ECEC attendance is constrained to be 1.
Source) Own calculations on PISA 2015.

Table A.18 Linear regression models with endogenous treatment effects on readings skills of PS attendance, by country

	BG	DE	ES	FR	IT	UK
Y: Reading skills						
Gender (RC.: Male)						
Female	16.87***	19.06***	17.43***	26.42***	18.30***	18.90***
	(3.00)	(3.21)	(3.20)	(3.80)	(4.36)	(3.46)
Migrant background (RC.: native)						
Migrant	-23.95***	-33.67***	-11.81***	-13.17**	-14.91***	2.02
	(3.40)	(6.02)	(3.90)	(5.64)	(4.13)	(5.70)
SES	45.01***	38.77***	28.56***	50.26***	36.84***	29.73***
	(2.72)	(2.38)	(2.51)	(4.28)	(3.65)	(3.58)
ECEC attendance (RC.: Yes)						
ECEC attendance: No	-0.33	10.40*	4.49	-10.30**	12.68***	-9.58
	(3.38)	(6.02)	(3.60)	(4.31)	(3.83)	(6.20)
PS*SES (RC: PS attendance: No)						
Yes	-4.16	-1.53	-1.66	5.95	-2.20	5.45
	(3.53)	(3.35)	(2.79)	(4.53)	(3.64)	(5.98)
PS attendance (RC.: No)						
Yes	34.68***	-0.32	13.19	64.36***	23.15*	23.81**
	(6.36)	(11.28)	(8.59)	(11.96)	(13.25)	(11.60)
Constant	468.89***	492.81***	484.38***	443.57***	445.56***	469.20***
	(4.37)	(7.85)	(7.33)	(9.46)	(10.99)	(7.25)
Y: PS attendance						
Migrant background (RC.: native)						
Migrant	-0.59***	-0.29***	-0.21***	-0.36***	-0.33***	-0.23***
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.08)
SES	0.28***	0.08***	0.16***	0.35***	0.18***	0.25***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
PS mandatory (RC.: No)						
Yes	2.26***	2.26***	7.21***	1.54***	0.82***	1.94***
	(0.08)	(0.13)	(2.57)	(0.09)	(0.12)	(0.15)
Constant	-0.39***	-0.70***	0.22***	0.59***	0.58***	-0.55***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)
Variance (e.reading)	7487.22***	8257.49***	6407.27***	9120.54***	7449.60***	7122.86***
	(190.78)	(322.53)	(182.73)	(288.45)	(244.95)	(268.95)
corr(e.PS,e.reading)	0.05	0.19**	0.11*	-0.05	0.08	0.00
	(0.04)	(0.07)	(0.06)	(0.07)	(0.08)	(0.08)
N	9367	5592	6611	5911	11243	2952

Note) Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variance of PS attendance is constrained to be 1.
Source) Own calculations on PISA 2015.

Table A.19 Linear regression models with endogenous treatment effects on maths skills of ECEC attendance, by country.

	BG	DE	ES	FR	IT	UK
Y: Math skills						
Gender (RC.: Male)						
Female	-12.61***	-18.44***	-17.78***	-6.73**	-17.45***	-7.83*
	(2.76)	(3.02)	(2.35)	(3.26)	(3.98)	(4.05)
Migrant background (RC.: native)						
Migrant	-39.23***	-34.28***	-21.60***	-22.36***	-7.21*	4.14
	(8.94)	(4.49)	(3.62)	(5.76)	(3.86)	(5.81)
SES	46.74***	35.36***	29.90***	63.46***	32.19***	37.28***
	(4.23)	(2.03)	(1.76)	(3.37)	(2.19)	(2.69)
ECE*SES (RC.: ECEC attendance: No)						
ECEC attendance: Yes	4.22	9.46*	0.68	3.65	10.96***	0.63
	(5.23)	(5.00)	(2.09)	(4.64)	(3.91)	(6.85)
ECEC attendance (RC: No)						
Yes	-47.48	-25.71	-39.11***	-80.73***	-50.48***	-24.70*
	(90.24)	(16.70)	(8.53)	(15.69)	(16.82)	(13.97)
Constant	514.89***	518.16***	525.33***	513.17***	505.14***	481.94***
	(14.68)	(3.46)	(4.96)	(4.49)	(4.92)	(3.74)
Y: ECEC attendance						
Migrant background (RC.: native)						
Migrant	-0.49***	-0.32***	-0.19***	0.02	0.10**	-0.07
	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.09)
SES	0.22***	0.12***	0.16***	0.36***	0.16***	0.20***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)
ECEC mandatory (RC.: No)						
Yes	2.00***	2.15***	7.14***	1.45***	1.49***	2.40***
	(0.57)	(0.17)	(1.65)	(0.19)	(0.17)	(0.28)
Constant	-1.04***	-1.43***	-0.01	-0.84***	-0.82***	-1.15***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.02)	(0.04)
variance(e.math)	8044.69***	6596.68***	6524.16***	8525.71***	8108.87***	6307.68***
	(1080.29)	(220.43)	(276.10)	(536.36)	(370.32)	(224.57)
corr(e.ECEC,e. math)	0.46	0.12	0.40***	0.60***	0.28***	0.23**
	(0.54)	(0.10)	(0.06)	(0.08)	(0.10)	(0.09)
N	9367	5592	6611	5911	11243	2952

Note) Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variance of ECEC attendance is constrained to be 1.
Source) Own calculations on PISA 2015.

Table A.20 Linear regression models with endogenous treatment effects on maths skills of PS attendance, by country.

	BG	DE	ES	FR	IT	UK
Y: Math skills						
Gender (RC.: Male)						
Female	-13.29***	-19.85***	-18.42***	-8.37***	-19.03***	-8.50**
	(2.63)	(2.97)	(2.29)	(3.12)	(3.90)	(4.04)
Migrant background (RC.: native)						
Migrant	-26.59***	-32.27***	-18.46***	-17.39***	-2.74	5.58
	(3.19)	(4.52)	(3.55)	(4.93)	(12.99)	(5.79)
SES	43.54***	35.91***	30.32***	44.61***	25.68***	32.29***
	(2.77)	(2.22)	(2.25)	(4.01)	(9.32)	(3.59)
ECEC attendance (RC.: Yes)						
ECEC attendance: No	-5.58	11.22**	4.84	-6.57*	14.04***	2.22
	(4.36)	(5.61)	(3.69)	(3.71)	(3.87)	(5.15)
PS*SES (RC: PS attendance: No)						
Yes	-3.98	-0.90	-2.80	6.47*	6.32	7.89
	(3.49)	(2.80)	(2.55)	(3.81)	(5.16)	(5.20)
PS attendance (RC.: No)						
Yes	37.84***	17.38*	8.70	56.65***	55.93	9.97
	(5.93)	(9.61)	(8.28)	(10.58)	(118.10)	(12.74)
Constant	496.12***	501.59***	496.70***	458.38***	443.40***	473.27***
	(4.80)	(7.32)	(6.98)	(9.55)	(86.28)	(7.14)
Y: PS attendance						
Migrant background (RC.: native)						
Migrant	-0.59***	-0.29***	-0.21***	-0.36***	-0.33***	-0.23***
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.08)
SES	0.28***	0.08***	0.16***	0.35***	0.18***	0.25***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
PS mandatory (RC.: No)						
Yes	2.26***	2.26***	7.66***	1.54***	0.76***	1.94***
	(0.08)	(0.13)	(1.92)	(0.09)	(0.20)	(0.15)
Constant	-0.39***	-0.70***	0.22***	0.59***	0.58***	-0.55***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)
var(e.math)	6906.67***	6495.40***	5947.48***	6565.97***	8182.41***	6096.28***
	(158.49)	(213.53)	(193.42)	(194.63)	(1727.95)	(206.95)
corr(e.PS,e.math)	0.05	0.04	0.11*	-0.06	-0.13	0.05
	(0.04)	(0.07)	(0.06)	(0.07)	(0.76)	(0.09)
N	9367	5592	6611	5911	11243	2952

Note) Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variance of PS attendance is constrained to be 1.
Source) Own calculations on PISA 2015.

Table A.21 Linear regression models with endogenous treatment effects on collaborative problem-solving (CPS) skills of ECEC attendance, by country

	BG	DE	ES	FR	IT	UK
Y: CPS skills						
Gender (RC.: Male)						
Female	26.87***	29.23***	20.10***	28.15***	26.59***	32.20***
	(3.32)	(3.17)	(2.98)	(3.76)	(4.34)	(4.04)
Migrant background (RC.: native)						
Migrant	-37.13***	-30.17***	-12.13**	-21.67***	4.54	0.64
	(4.54)	(4.98)	(5.24)	(5.19)	(4.45)	(6.64)
SES	40.79***	29.36***	22.90***	49.63***	30.26***	30.49***
	(2.43)	(2.27)	(2.19)	(3.39)	(2.83)	(3.11)
ECE*SES (RC.: ECEC attendance: No)						
ECEC attendance: Yes	5.87	7.38	-0.77	6.26	6.83*	-0.76
	(3.76)	(6.26)	(2.39)	(4.62)	(4.04)	(6.86)
ECEC attendance (RC: No)						
Yes	-57.88***	-30.95	-40.46***	-50.93**	-48.07	-3.93
	(21.08)	(21.64)	(11.50)	(23.82)	(43.06)	(21.94)
Constant	492.66***	517.23***	515.06***	491.80***	469.48***	484.64***
	(4.63)	(3.93)	(6.55)	(6.30)	(10.03)	(4.48)
Y: ECEC attendance						
Migrant background (RC.: native)						
Migrant	-0.50***	-0.32***	-0.19***	0.03	0.10**	-0.06
	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.09)
SES	0.23***	0.12***	0.16***	0.36***	0.16***	0.20***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.04)
ECEC mandatory (RC.: No)						
Yes	2.12***	2.16***	6.79***	1.50***	1.45***	2.38***
	(0.29)	(0.17)	(1.43)	(0.21)	(0.18)	(0.28)
Constant	-1.04***	-1.43***	-0.01	-0.84***	-0.82***	-1.15***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.02)	(0.04)
var(e.cps)	8666.78***	8991.91***	7580.72***	9155.05***	8800.52***	8969.31***
	(451.67)	(284.27)	(349.02)	(546.17)	(701.79)	(361.05)
corr(e.ECEC,e.cps)	0.49***	0.15	0.39***	0.43***	0.27	0.16
	(0.11)	(0.12)	(0.08)	(0.13)	(0.26)	(0.13)
N	9367	5592	6611	5911	11243	2952

Note) Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variance of ECEC attendance is constrained to be 1.
Source) Own calculations on PISA 2015.

Table A.22 Linear regression models with endogenous treatment effects on collaborative problem-solving (CPS) skills of PS attendance, by country.

	BG	DE	ES	FR	IT	UK
Y: CPS skills						
Gender (RC.: Male)						
Female	25.74***	27.70***	19.40***	26.56***	25.32***	31.55***
	(3.19)	(3.09)	(2.96)	(3.72)	(4.25)	(4.02)
Migrant background (RC.: native)						
Migrant	-23.92***	-28.39***	-9.37*	-17.64***	3.16	1.85
	(3.76)	(4.99)	(5.04)	(5.07)	(4.61)	(6.60)
SES	37.53***	30.27***	23.16***	35.75***	30.52***	28.39***
	(2.68)	(2.44)	(2.42)	(4.82)	(3.91)	(3.75)
ECEC attendance (RC.: Yes)						
ECEC attendance: No	-4.28	11.13**	3.55	-14.86***	11.35***	-12.78*
	(3.64)	(5.12)	(3.79)	(4.05)	(3.55)	(6.68)
PS*SES (RC: PS attendance: No)						
Yes	-4.13	-2.94	-3.53	5.27	-0.64	0.36
	(3.44)	(3.35)	(2.67)	(5.15)	(4.41)	(5.95)
PS attendance (RC.: No)						
Yes	36.89***	12.82	2.86	44.96***	1.87	11.51
	(6.06)	(10.30)	(7.10)	(13.81)	(19.65)	(14.26)
Constant	471.89***	501.68***	490.35***	459.02***	449.85***	491.54***
	(5.09)	(7.26)	(6.68)	(10.89)	(15.16)	(8.34)
Y: PS attendance						
Migrant background (RC.: native)						
Migrant	-0.59***	-0.29***	-0.21***	-0.36***	-0.33***	-0.23***
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.08)
SES	0.28***	0.08***	0.16***	0.35***	0.18***	0.25***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
PS mandatory (RC.: No)						
Yes	2.26***	2.26***	6.80***	1.54***	0.82***	1.94***
	(0.08)	(0.13)	(1.74)	(0.09)	(0.12)	(0.15)
Constant	-0.39***	-0.70***	0.22***	0.59***	0.58***	-0.55***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)
var(e.cps)	7554.53***	8867.75***	6961.59***	8069.17***	8417.97***	8803.34***
	(162.37)	(248.04)	(199.75)	(234.03)	(362.38)	(330.70)
corr(e.PS,e.cps)	0.04	0.08	0.15***	-0.05	0.18	0.05
	(0.04)	(0.07)	(0.05)	(0.09)	(0.13)	(0.08)
N	9367	5592	6611	5911	11243	2952

Note) Standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Variance of PS attendance is constrained to be 1.

Source) Own calculations on PISA 2015.

Appendix B: CHAPTER 3

Table B.1 Research design

Factors	**Wave 1** 6-8 months	**Wave 2** 16-17 months	**Wave 3** 25-27 months	**Wave 4** 37-39 months
Outcome				
ECE attendance		X	X	X
SES				
Parental educational level	X			
Family net income	X	X		
Place of residence				
Living in West DE	X			
Family structure				
Working mothers		X		
Marital status	X			
Number of siblings	X			
Partner working hours	X			
Grandparents	X	X		
Other relatives	X	X		
Children's characteristics				
Sex	X			
Immigration background	X			
Low weight at birth	X			
Sensorimotor skills	X			
Temperament: negative affectivity	X	X		
Costs and benefits				
Perceived financial costs	X	X		
Prospects of being employed	X	X		
Prospects of cognitive enrichment	X	X		
Prospects of social skills development		X		
Work-care beliefs				
Importance of being employed	X			
Social costs	X			
Importance of social skills		X		

Source) NEPS, SC1.

Table B.2 Summary statistics of the imputed dataset (N.: 3,184)

	Wave	Mean or %	SD	Min.	Max.
OUTCOME					
ECE attendance					
	2				
No		82.19			
Yes		17.81			
	3				
No		42.35			
Yes		57.65			
	4				
No		15.05			
Yes		84.95			
SES					
Parental education	1				
Low		14.39			
Medium		48.81			
High		36.80			
Family net income					
	1	0.00	1.00	-0.01	0.07
	2	0.00	1.00	-0.07	0.01
PLACE OF RESIDENCE					
Living in East DE (incl. Berlin)	1				
No		79.81			
Yes		20.19			
CHILDREN'S CHARACTERISTICS					
Sex	1				
Male		51.00			
Female		49.00			
Migration background	1				
Yes		29.27			
No		70.73			
Low birth at weight	1				
Yes		5.60			
No		94.40			
Temperament: Negative affectivity					
	1	0.00	1.00	-0.04	0.03
	2	0.00	1.00	-0.03	0.05
Sensorimotor skills	1	0.00	1.00	-0.04	0.03
FAMILY STRUCTURE					
Maternal employment: 12 months before birth	2				
No		26.29			
Yes		73.71			
Marital status	1				
Single		26.82			
Married		70.01			
Separated/divorced		3.17			
Number of siblings	1	0.00	1.00	-0.04	0.03
Partner working's hours	1	0.00	1.00	-0.08	0.00
Informal care: grandparents					
	1				
Yes		20.56			
No		79.44			
	2				
Yes		22.47			
No		77.53			
Informal care: other relatives					
	1				
Yes		7.46			

No		92.54
	2	
Yes		3.46
No		96.54
COSTS & BENEFITS		
Kinderkrippe: Financial costs	1	
A lot		16.81
Some		31.71
Very little		51.48
Kindergarten: Financial costs	2	
A lot		39.93
Some		35.98
Very little		24.09
Kinderkrippe: Prospects of being employed	1	
Very little		19.94
Some		25.15
A lot		54.91
Kindergarten: Prospects of being employed	2	
Very little		17.64
Some		25.91
A lot		56.45
Kinderkrippe fosters cognitive development	1	
Very little		26.07
Some		32.29
A lot		41.70
Kindergarten fosters cognitive development	2	
Very little		2.88
Some		25.44
A lot		71.68
Kindergarten fosters social skills development	2	
Very little		3.64
Some		34.45
A lot		61.91
WORK-CARE BELIEFS		
Importance of being employed	1	
Very little		30.97
Some		29.30
A lot		39.73
Social costs	1	
A lot		23.52
Some		16.39
Very little		60.09
Importance of social skills	2	
Very little		5.85
Some		20.71
A lot		73.44

Notes) Summary statistics derived from multiple imputation techniques (m=50), metric variables have been standardized to having mean equals to 0 and standard deviation equals to 1.
Sources) Own calculations based on NEPS, SC1.

Table B.3 Sample characteristics (listwise deletion)

	Wave	N	Mean or %	SD	Min	Max
OUTCOME						
ECE attendance						
	2					
No		2180	81.59			
Yes		492	18.41			
	3					
No		988	41.05			
Yes		1419	58.95			
	4					
No		324	14.22			
Yes		1954	85.78			
SES						
Parental education	1					
Low		447	14.44			
Medium		1515	48.93			
High		1134	36.63			
Family net income						
	1	2615	0.00	1.00	-1.69	14.83
	2	2470	0.00	1.00	-0.96	28.62
PLACE OF RESIDENCE						
Living in East DE (incl. Berlin)	1					
No		2479	79.99			
Yes		620	20.01			
CHILDREN'S CHARACTERISTICS						
Sex	1					
Male		1582	51.05			
Female		1517	48.95			
Migrant background	1					
Yes		909	29.33			
No		2190	70.67			
Low birth at weight	1					
Yes		173	5.59			
No		2924	94.41			
Temperament: Negative affectivity						
	1	3006	0.00	1.00	-3.02	1.90
	2	2662	0.00	1.00	-3.87	1.61
Sensorimotor skills	1	2856	0.00	1.00	-4.66	2.58
FAMILY STRUCTURE						
Maternal employment 12 months before birth	2					
No		652	24.42			
Yes		2018	75.58			
Marital status	1					
Single		825	26.72			
Married		2165	70.13			
Separated/divorced		97	3.14			
Number of siblings	1	3099	0.00	1.00	-0.80	6.25
Partner weekly working hours	1	2624	0	1.00	-4.31	4.60
Informal care: grandparents						
	1					
Yes		640	20.66			
No		2458	79.34			
	2					
Yes		596	22.31			
No		2076	77.69			
Informal care: other relatives						

	1		
Yes		231	7.46
No		2867	92.54
	2		
Yes		85	3.18
No		2587	96.82
COSTS & BENEFITS			
Kinderkrippe: Financial costs	1		
A lot		516	16.86
Some		972	31.75
Very little		1573	51.39
Kindergarten: Financial costs	2		
A lot		1011	38.01
Some		974	36.62
Very little		675	25.38
Kinderkrippe: Prospect of being employed	1		
Very little		607	20.06
Some		763	25.21
A lot		1656	54.73
Kindergarten: Prospect of being employed	2		
Very little		433	16.85
Some		663	25.80
A lot		1474	57.35
Kinderkrippe fosters cognitive development	1		
Very little		803	26.19
Some		991	32.32
A lot		1272	41.49
Kindergarten fosters cognitive development	2		
Very little		75	2.81
Some		673	25.22
A lot		1921	71.97
Kindergarten fosters social competences	2		
Very little		95	3.58
Some		905	34.06
A lot		1657	62.36
WORK-CARE BELIEFS			
Importance of being employed	1		
Very little		965	31.19
Some		909	29.38
A lot		1220	39.43
Social costs	1		
A lot		726	23.57
Some		505	16.40
Very little		1849	60.03
Importance of social skills	2		
Very little		156	5.84
Some		559	20.93
A lot		1956	73.23

Notes) Summary statistics based on valid cases only; metric variables have been standardized to have a mean of 0 and standard deviation (SD) of 1.
Source) Own calculations based on NEPS, SC1.

Table B.4 Missing information (count and percentual frequencies) over 3,184 total observations

	Wave	n	%
OUTCOME			
ECE attendance			
	2	512	16.08
	3	777	24.40
	4	906	28.45
SES			
Parental education	1	88	2.76
Family Net Income			
	1	569	17.87
	2	714	22.42
PLACE OF RESIDENCE			
Living in East DE (incl. Berlin)	1	85	2.67
CHILDREN'S CHARACTERISTICS			
Sex	1	85	2.67
Migration background	1	85	2.67
Low birth at weight	1	87	2.73
Temperament: negative affectivity			
	1	178	5.59
	2	522	16.39
Sensorimotor skills	1	328	10.30
FAMILY STRUCTURE			
Maternal Employment 12 Months Before Birth	2	514	16.14
Marital Status	1	97	3.05
Number of Siblings	1	85	2.67
Informal care: Grandparents			
	1	86	2.70
	2	512	16.08
Informal care: Other Relatives			
	1	86	2.70
	2	512	16.08
Partner Working Hours	1	560	17.59
COSTS AND BENEFITS			
Kinderkrippe: Financial costs	1	123	3.86
Kindergarten: Financial costs	2	524	16.46
Kinderkrippe: Prospects of being employed	1	158	4.96
Kindergarten: Prospects of being employed	2	614	19.28
Kinderkrippe fosters cognitive development	1	118	3.71
Kindergarten fosters cognitive development	2	515	16.17
Kindergarten fosters social development	2	527	16.55
WORK-CARE BELIEFS			
Importance of being employed	1	90	2.83
Social costs	1	104	3.27
Importance of social skills	2	513	16.11

Source) Own calculations based on NEPS, SC1.

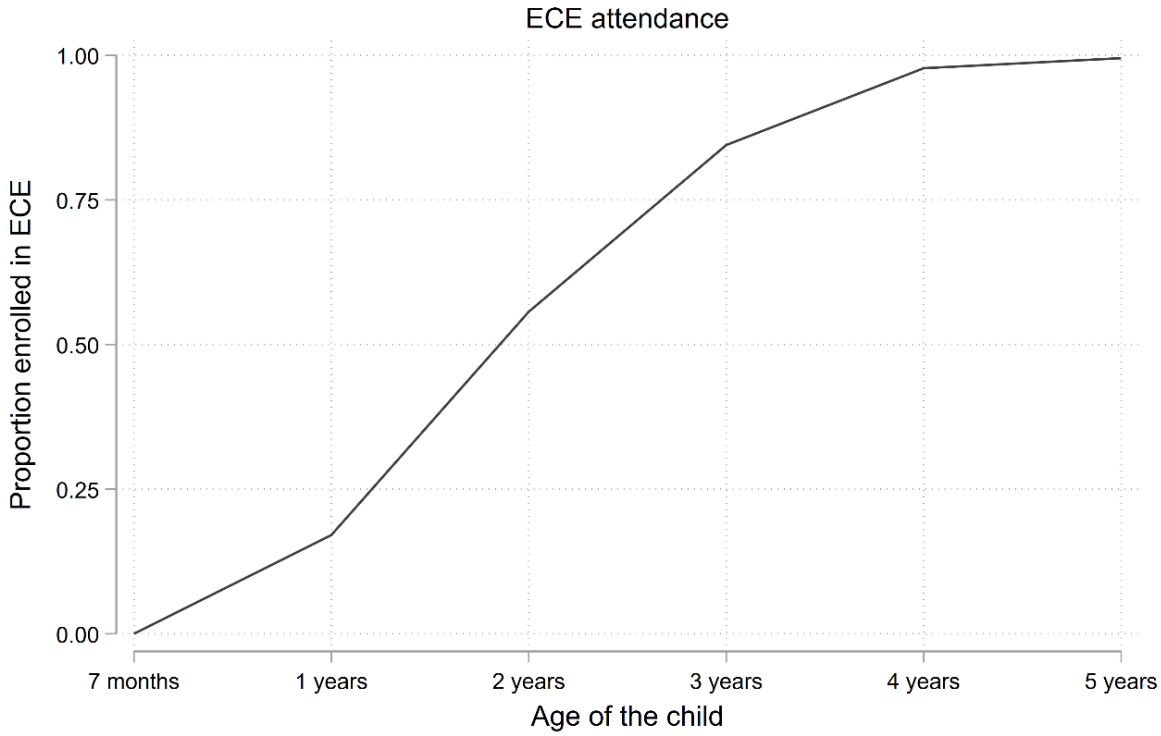

Figure B.1 ECE attendance by children's age (Kaplan-Meier estimates)

Source) Own calculations based on NEPS, SC1.

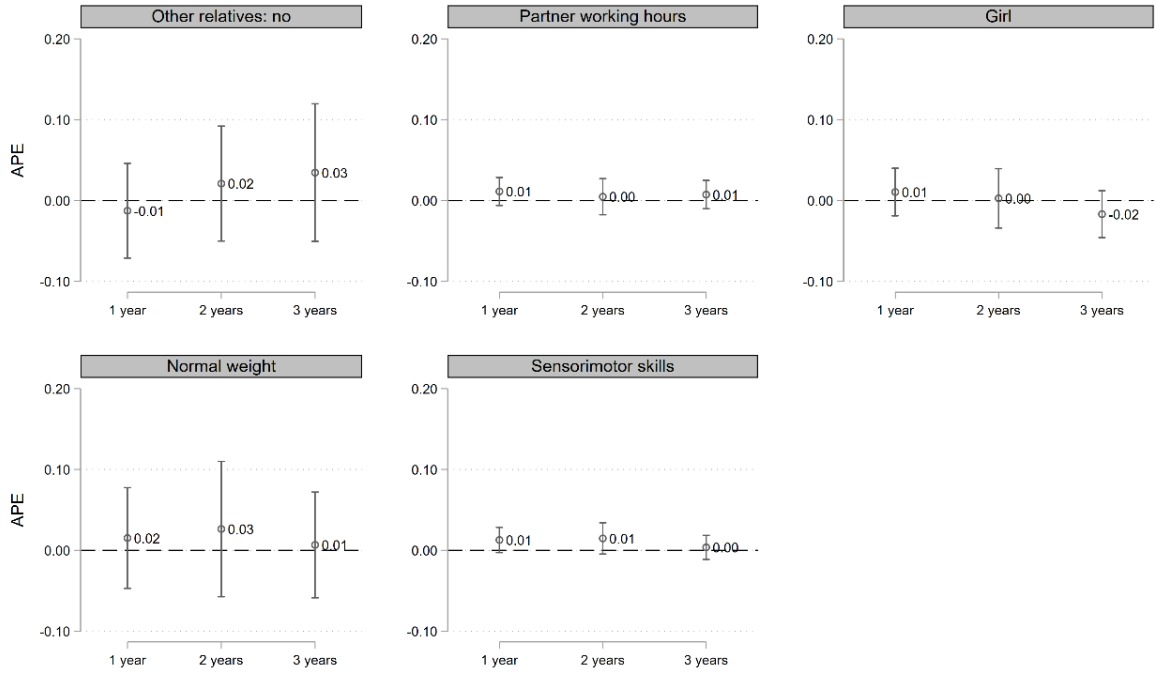

Figure B.2 The non-significant relationship between ECE attendance with family structure and children's characteristics: average partial effects and 95% confidence intervals (N.: 3,184)

Notes: The estimate of APE for other relatives' availability to care is adjusted for children's characteristics, family structure, partner working hours, grandparental availability, parental education, place of residence.
The estimate of APE for partner working hours is adjusted for children's characteristics, marital status, number of siblings, family net income, maternal employment, parental education, place of residence. The estimate of APE for sex is adjusted for migration background, parental education, place of residence. The estimated APE for weight at birth is adjusted for migration background, sex, parental education, place of residence. The estimate APE for cognition is adjusted for other children's attributes, family factors, parental education, place of residence.
Source) Own calculations based on NEPS, SC1.

Appendix C: CHAPTER 4

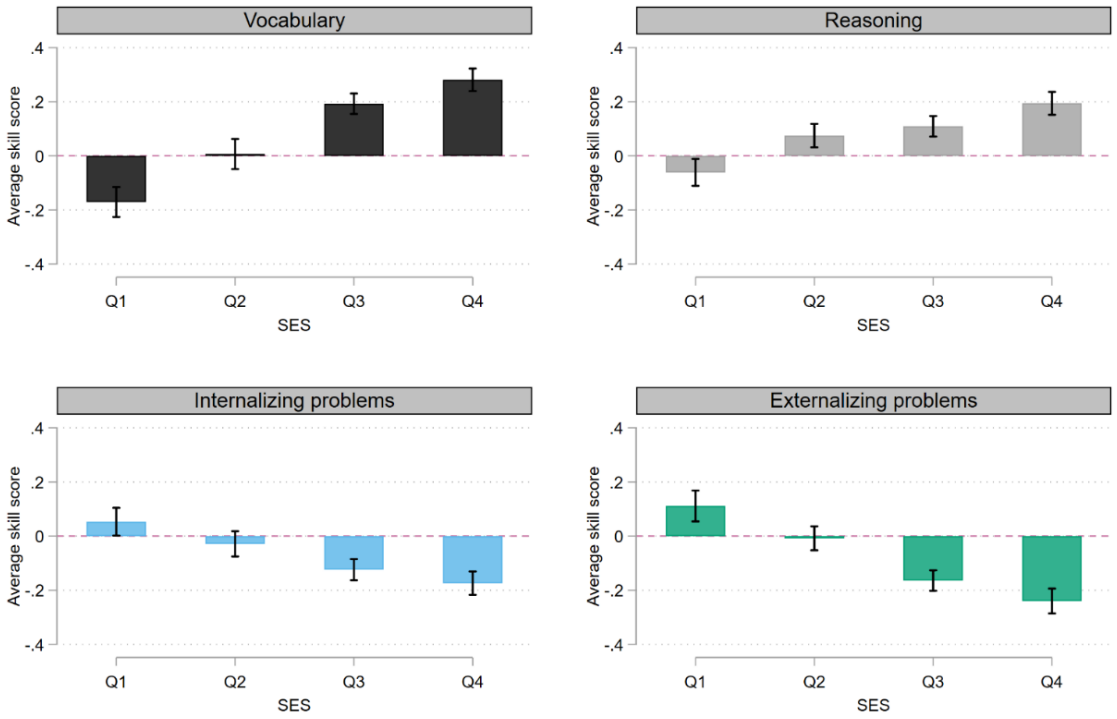

Figure C.1 Conditional means with 95% confidence intervals of cognitive and noncognitive scores, by children's social origins

Note) Weighted results. SES has been divided in quartiles, from the lowest (Q1) to the highest (Q4).
Source) Own calculations based on GUI, Wave 2 & Wave 3.

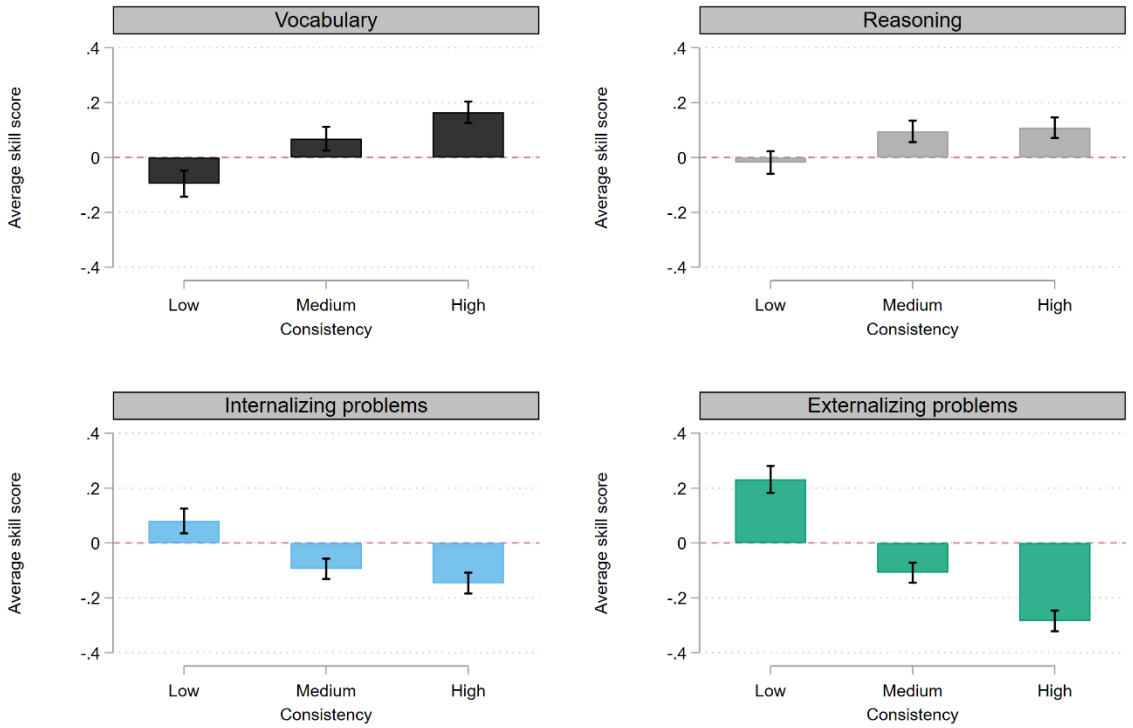

Figure C.2 Conditional means of cognitive and noncognitive scores, by parenting styles: consistency

Note) Weighted results
Source) Own calculations based on GUI, Wave 2 & Wave 3.

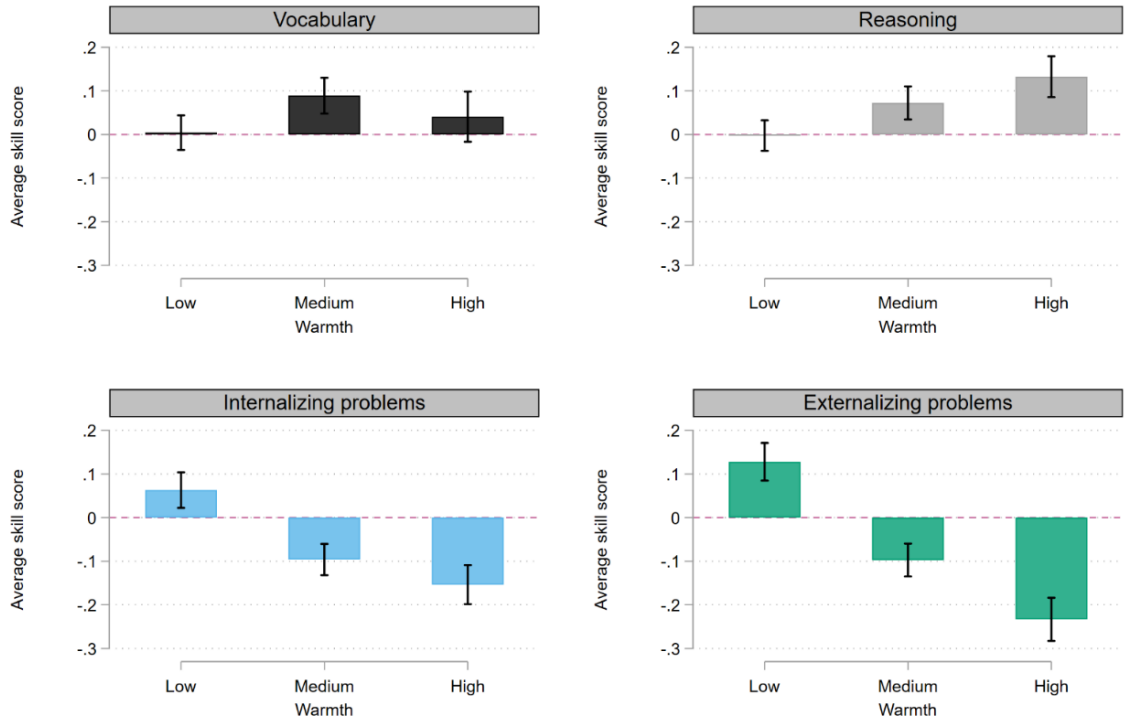

Figure C.3 Conditional means with 95% confidence intervals of cognitive and noncognitive scores, by parenting styles: warmth

Note) Weighted results. SES has been divided in quartiles, from the lowest (Q1) to the highest (Q4).
Source) Own calculations based on GUI, Wave 2 & Wave 3.

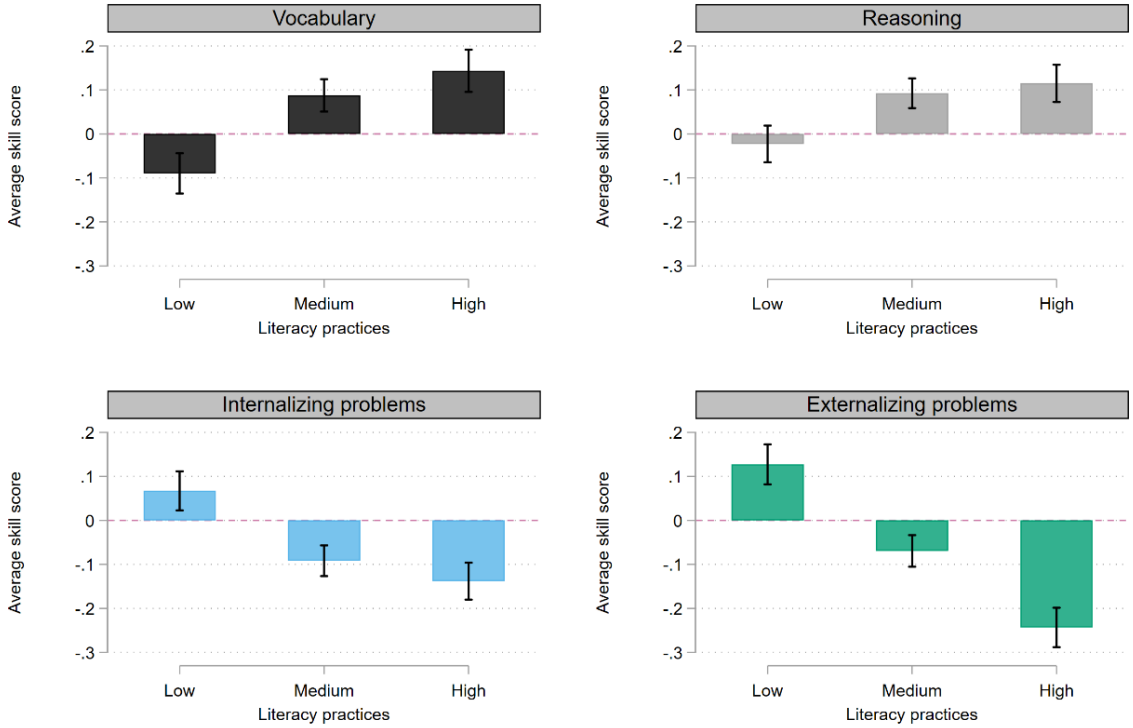

Figure C.4 Conditional means with 95% confidence intervals of cognitive and noncognitive scores, by joint parent-child literacy practices

Note) Weighted results. SES has been divided in quartiles, from the lowest (Q1) to the highest (Q4).
Source) Own calculations based on GUI, Wave 2 & Wave 3.

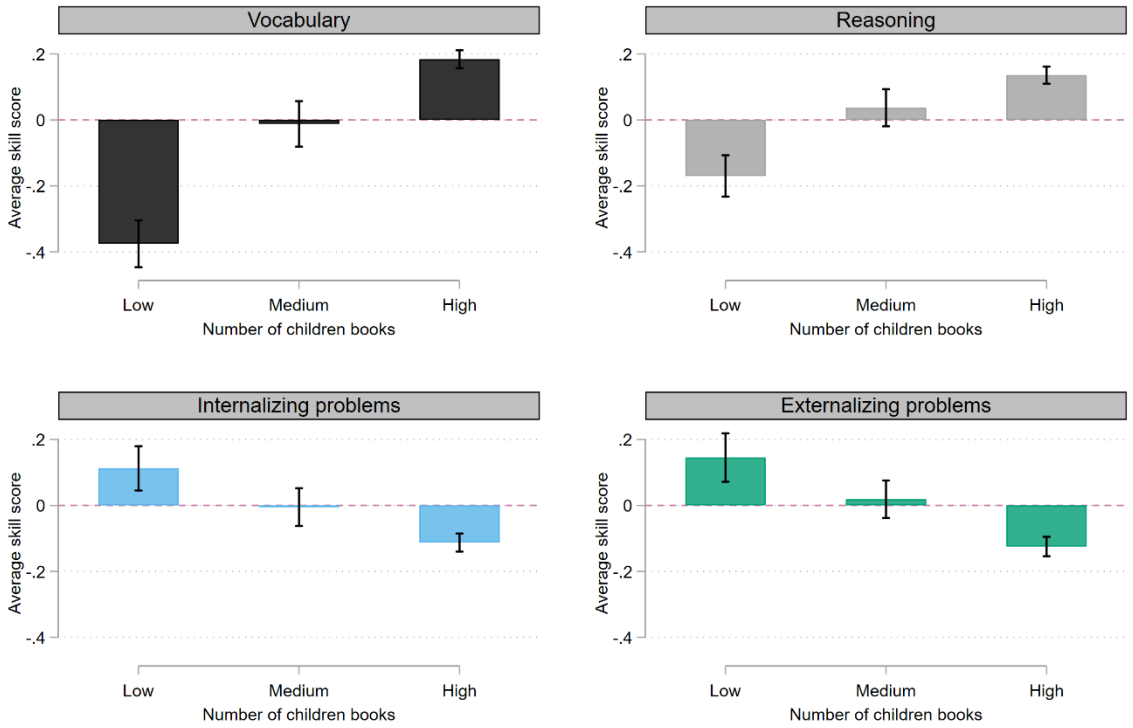

Figure C.5 Conditional means with 95% confidence intervals of cognitive and noncognitive scores, by number of children's books

Note) Weighted results. SES has been divided in quartiles, from the lowest (Q1) to the highest (Q4).
Source) Own calculations based on GUI, Wave 2 & Wave 3.

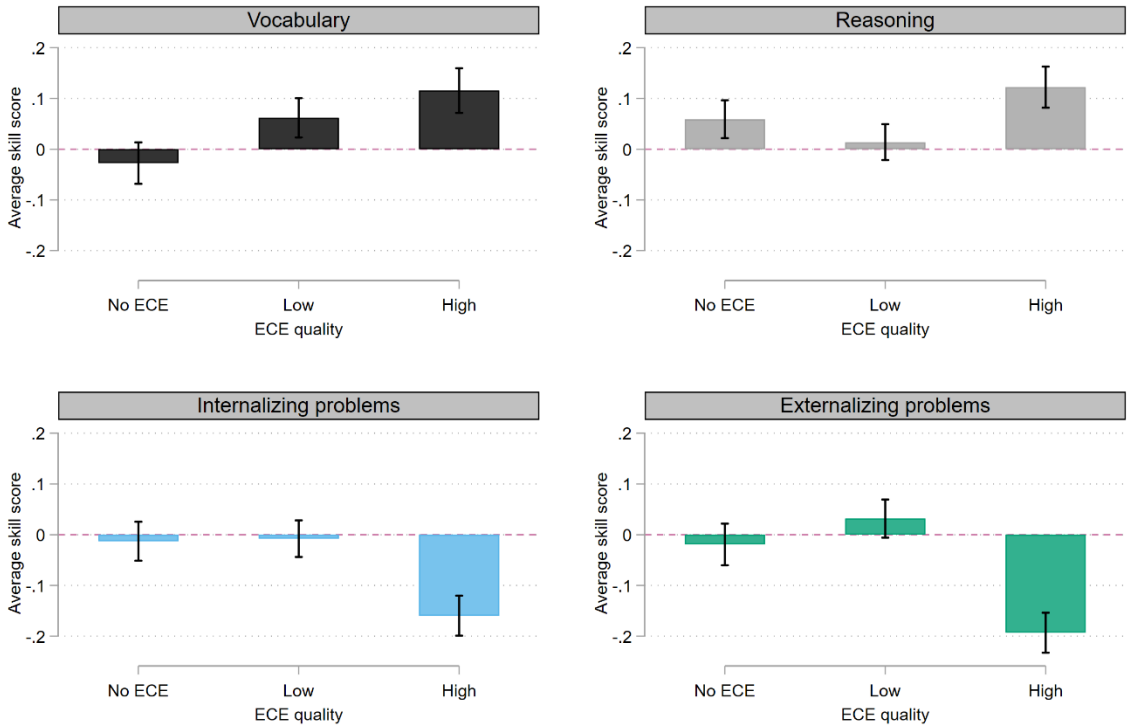

Figure C.6 Conditional means with 95% confidence intervals of cognitive and noncognitive scores, by ECE quality

Note) Weighted results

Source) Own calculations based on GUI, Wave 2 & Wave 3.

Table C.1 Missing data among participants in waves 2-3 (N. 7,993)

	Wave	% Missing	N. missing
Vocabulary	2	5.63	450
	3	1.23	98
Reasoning	2	2.10	168
	3	0.83	66
Externalizing problems	2	0.08	6
	3	0.04	3
Internalizing problems	2	0.05	4
	3	0.03	2
SES	2	12.96	1036
	3	9.52	761
Parenting styles: warmth	2	0.03	2
	3	0.04	3
Parenting styles: consistency	2	0.06	5
	3	0.09	7
Parental literacy practices	2	0.08	6
	3	0.03	2
Number of children's books	2	0.03	2
	3	0.01	1
Area of residence	2	0.39	31
	3	0.28	22
Skill development at 8 months	2&3	2.94	235
Parental attachment at 9 months	2&3	0.10	8

Source) Own calculations based on GUI.

Table C.2 Summary statistics of the variables included in the analysis

	Mean (or %)	SD	Min	Max	Obs.
OUTCOME					
Vocabulary	0.0	1.0	-4.47	3.84	10,856
Reasoning	0.0	1.0	-4.71	4.05	10,856
Externalizing problems	0.0	1.0	-1.58	4.40	10,856
Internalizing problems	0.0	1.0	-1.14	5.21	10,856
HLE: Structure					
SES	0.0	1.0	-2.40	1.48	10,856
HLE: Process					
General educational process					
Warmth					
Low	39.39				4,276
Medium	34.63				3,759
High	25.99				2,821
Consistency					
Low	33.19				3,050
Medium	32.92				3,060
High	33.89				3,224
Domain-specific educational processes					
Literacy practices					
Low	32.26				2,998
Medium	42.21				3,959
High	25.53				2,377
Children's books					
20 or less	15.59				1,692
21 to 30	16.39				1,779
More than 30	68.03				7,385
ECE					
ECE quality					
No ECE	36.19				3,929
Low	35.57				3,862
High	28.23				3,065
CONTROLS					
Children's sex					
Boy	50.18				5,448
Girl	49.82				5,408
Migration background					
Migrant	29.59				3,212
Native	70.41				7,644
Area of residence					
Rural	62.20				6,752
Urban	37.80				4,104
ASQ: Pass/failed - 8 months (W1)					
Fail	8.24				894
Pass	91.76				9,962

Attendance to ECEC (W1)		
No	85.50	9,282
Yes	14.50	1,574
Parenting styles – attachment (W1)		
Low	49.74	5,400
Medium	43.37	4,708
High	6.89	748
Parental Care activities (W1)		
Low	26.33	2,858
Medium	51.62	5,604
High	22.05	2,394
Parental Literacy activities (W1)		
Low	50.29	5,460
Medium	19.86	2,156
High	29.85	3,240
Parental Routine activities (W1)		
Low	28.13	3,054
Medium	48.54	5,270
High	23.32	2,532
Attendance of Junior Infant Schools (W3)		
No	30.93	3,358
Yes	69.07	7,498

Note) Unweighted results
Source) Own calculations based on GUI (W2 & W3).

Table C.3 Summary statistics of the variables included in the analysis (observations. 10,158)

	Mean (or proportion)
OUTCOMES	
Vocabulary	0.0432**
Reasoning	0.0601***
Externalizing problems	-0.0485***
Internalizing problems	-0.0511***
HLE structure	
SES	0.0414**
HLE process	
Warmth	
Low	0.383***
Medium	0.342***
High	0.275***
Consistency	
Low	0.346***
Medium	0.325***
High	0.328***
Literacy practices	
Low	0.330***
Medium	0.418***
High	0.253***
Children's books	
20 or less	0.191***
21-30	0.173***
More than 30	0.636***
ECE	
ECE quality	
No ECE	0.373***
Low quality	0.355***
High quality	0.272***
CONTROLS	
Sex	
Boy	0.505***
Girl	0.495***
Migrant background	
Migrant	0.333***
Native	0.667***
Area of residence	
Rural	0.595***
Urban	0.405***
Developmental tests at 8 months	
Fail	0.083***
Pass	0.917***
ECEC attendance	
No	0.871***
Yes	0.129***
Junior Infant Schools	
No	0.287***
Yes	0.713***
Parental attachment at 9 months	
Low	0.462***
Medium	0.416***
High	0.121***
Parental care practices at 9 months	
Low	0.299***
Medium	0.488***
High	0.213***
Parental literacy practices at 9 months	

Low	0.524***
Medium	0.188***
High	0.288***
Parental routine practices at 9 months	
Low	0.326***
Medium	0.452***
High	0.222***

Note) Weighted results.
Source) Own calculations based on GUI (W2 & W3).

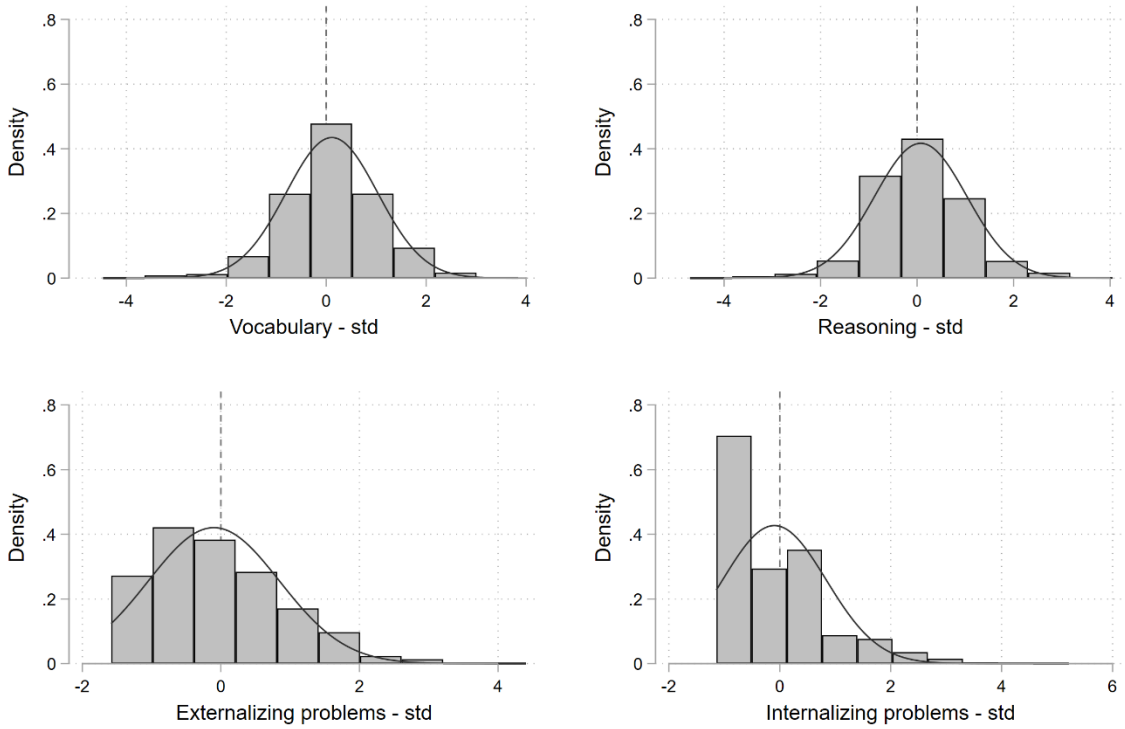

Figure C.7 Histogram with normal distributions of early cognitive and non-cognitive skills

Note) Unweighted results
Source) Own calculations based on GUI; W2 & W3.

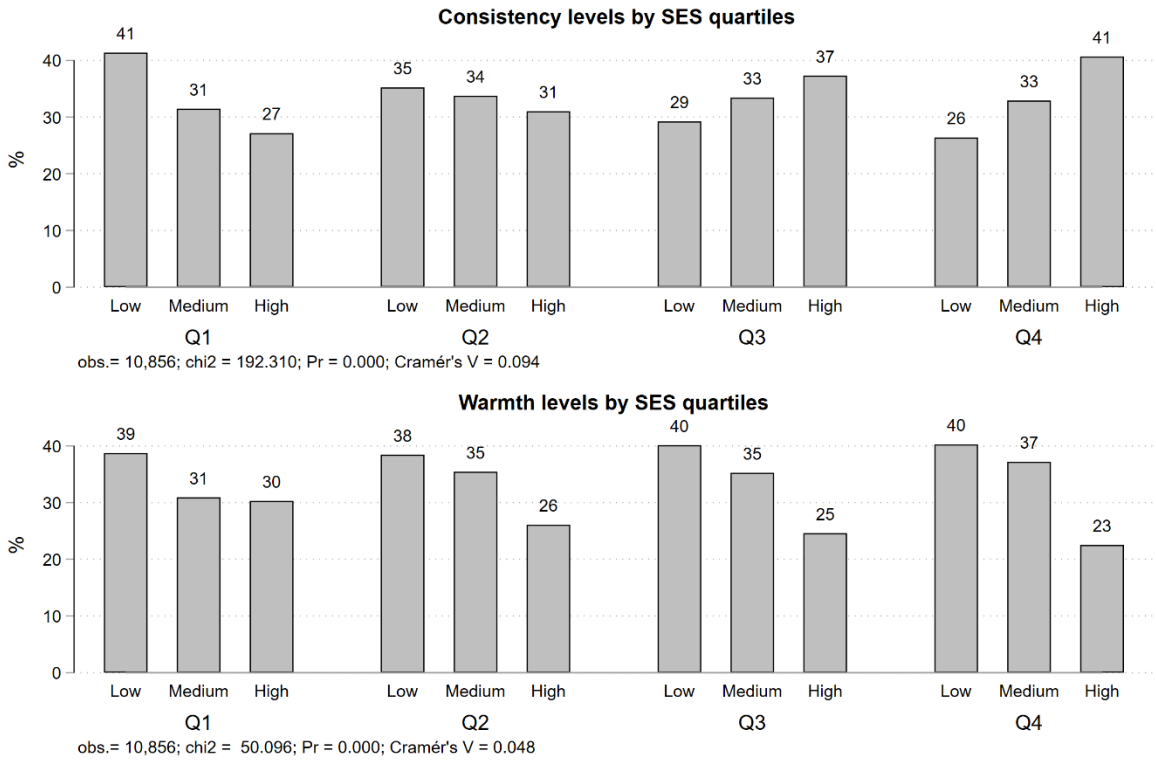

Figure C.8 Bivariate association between domain general HLE and SES quartiles

Note) Unweighted results
Source) Own calculations based on GUI, W2 & W3.

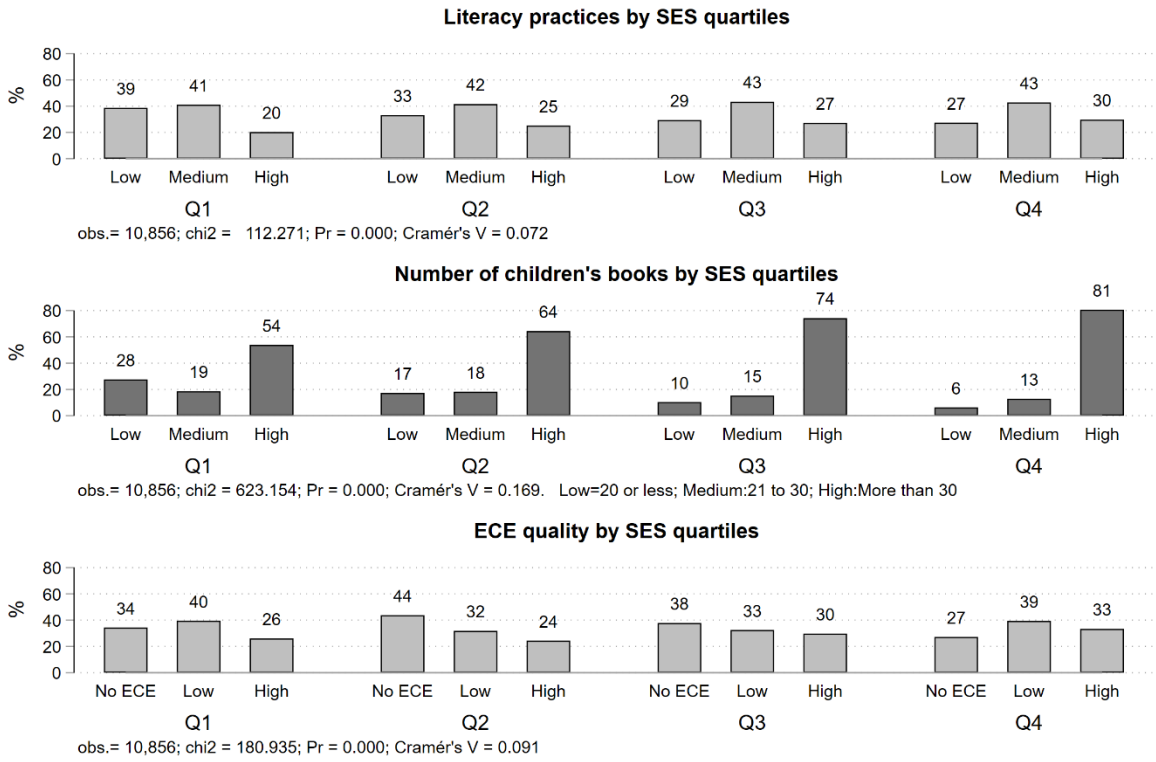

Figure C.9 Bivariate association between domain specific HLE, ECE quality and SES quartiles

Note) Unweighted results
Source) Own calculations based on GUI, W2 & W3.

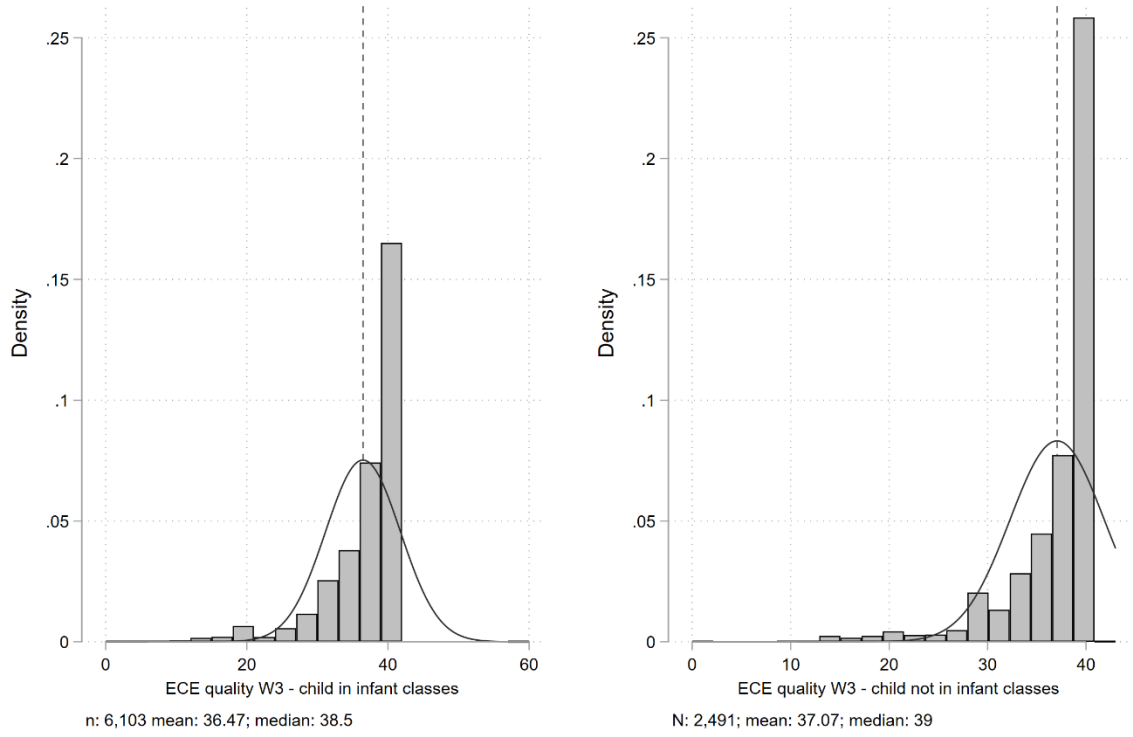

Figure C.10 Distribution of ECE quality in W3 for those children who were enrolled in infant classes (left figure) and those who were not (right figure)

Note) Unweighted results, N. 11,134.
Source) Own calculations based on GUI.

Table C.4 Random effects linear regression models on vocabulary performances

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
HLE structure							
SES	0.14***	0.11***	0.11***	0.11***	0.07***	0.11***	0.07**
	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)	(0.03)
CONTROLS							
Children's age (RC.: 3 years)							
5 years	0.09***	0.07***	0.04*	0.04*	0.05*	0.05**	0.05**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Sex (RC.: Boy)							
Girl	0.17***	0.16***	0.16***	0.16***	0.16***	0.16***	0.16***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Migrant background (RC.: Migrant)							
Native	0.28***	0.27***	0.27***	0.27***	0.27***	0.27***	0.27***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ASQ test 8 months (RC.: Fail)							
Pass	0.20***	0.18***	0.18***	0.18***	0.18***	0.17***	0.17***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Parenting styles – warmth (RC.: Low)							
Medium	0.02	0.01	0.01	0.01	0.01	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
High	0.07	0.06	0.06	0.06	0.07	0.06	0.07
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
HLE - Care activities (RC.: Low)							
Medium	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
HLE - Literacy activities (RC.: Low)							
Medium	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	0.05*	0.04	0.04	0.04	0.04	0.04	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
HLE - Routine activities (RC.: Low)							
Medium	0.08***	0.07**	0.07**	0.07**	0.07**	0.07**	0.07**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	0.11***	0.10***	0.10***	0.10***	0.10***	0.10***	0.10***
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
ECEC attendance (RC.: No)							
Yes	0.03	0.02	0.02	0.02	0.02	0.02	0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Junior Infant School (RC.: No)							
Yes	0.04*	0.06**	0.06**	0.06**	0.06**	0.05**	0.06**
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Area of residence (RC.: Rural)							
Urban	-0.11***	-0.11***	-0.11***	-0.11***	-0.11***	-0.11***	-0.11***

	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
HLE process							
Parenting styles: consistency (RC.: Low)							
Medium		0.04*	0.04*	0.04*	0.04*	0.05	0.05
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		0.10***	0.10***	0.10***	0.09***	0.11***	0.12***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
Parenting styles: warmth (RC.: Low)							
Medium		0.06***	0.06***	0.06***	0.06***	0.05	0.05
		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
High		0.05*	0.05*	0.05*	0.06**	0.03	0.02
		(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.04)
Parental literacy practices (RC.: Low)							
Medium		0.05**	0.05**	0.05**	0.05**	-0.00	0.00
		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
High		0.08***	0.08***	0.09***	0.09***	0.02	0.04
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Children's books (RC.: 20 or less)							
21 to 30		0.20***	0.19***	0.19***	0.18***	0.13**	0.13**
		(0.04)	(0.04)	(0.04)	(0.04)	(0.06)	(0.06)
More than 30		0.26***	0.26***	0.25***	0.25***	0.14***	0.16***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
ECE							
ECE quality (RC.: Low)							
No ECE			-0.03	-0.04	-0.03	-0.26***	-0.21***
			(0.03)	(0.03)	(0.03)	(0.06)	(0.07)
High			-0.01	-0.01	-0.01	-0.13*	-0.11
			(0.02)	(0.02)	(0.02)	(0.08)	(0.08)
ECE*HLE							
Parenting styles: consistency							
No ECE*Medium						-0.04	-0.06
						(0.05)	(0.05)
No ECE*High						-0.02	-0.04
						(0.05)	(0.06)
High*Medium						0.05	0.04
						(0.05)	(0.05)
High* High						-0.00	-0.01
						(0.05)	(0.05)
Parenting styles: warmth							
No ECE*Medium						-0.00	0.00
						(0.05)	(0.05)
No ECE*High						0.04	0.06
						(0.06)	(0.06)
High*Medium						0.06	0.06
						(0.05)	(0.05)
High* High						0.04	0.05
						(0.06)	(0.06)
Parental literacy practices							
No ECE*Medium						0.14***	0.13***
						(0.05)	(0.05)

No ECE*High						0.17***	0.15**
						(0.06)	(0.06)
High*Medium						0.02	0.01
						(0.05)	(0.05)
High* High						-0.01	-0.02
						(0.06)	(0.06)
Children's books							
No ECE*Medium						0.13	0.11
						(0.08)	(0.08)
No ECE*High						0.19***	0.14**
						(0.06)	(0.06)
High*Medium						-0.02	-0.02
						(0.09)	(0.09)
High* High						0.12*	0.09
						(0.07)	(0.07)
SES*HLE							
Parenting styles: consistency (RC.: Low)							
Medium				0.04			0.04
				(0.03)			(0.03)
High				-0.01			-0.02
				(0.03)			(0.03)
Parenting styles: warmth (RC.: Low)							
Medium				-0.00			-0.01
				(0.02)			(0.02)
High				0.00			-0.01
				(0.03)			(0.03)
				(0.00)			(0.00)
Parental literacy practices (RC.: Low)							
Medium				0.01			0.01
				(0.02)			(0.02)
High				-0.02			-0.02
				(0.03)			(0.03)
Children's books (RC.: 20 or less)							
21 to 30				-0.03			-0.02
				(0.04)			(0.04)
More than 30				-0.00			0.01
				(0.03)			(0.03)
SES*ECE							
No ECE					0.10***		0.08***
					(0.02)		(0.02)
High quality					0.05**		0.04*
					(0.02)		(0.03)
Constant	-0.50***	-0.78***	-0.75***	-0.75***	-0.75***	-0.61***	-0.64***
	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)
Observations	10,158	10,158	10,158	10,158	10,158	10,158	10,158
Number of groups	5,079	5,079	5,079	5,079	5,079	5,079	5,079

Note) Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10; weighted results.
Source) Own calculations on GUI.

Table C.5 Random effects linear regression models on reasoning performances

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
HLE structure							
SES	-0.08***	-0.06***	-0.06***	-0.15***	-0.03	-0.06***	-0.11***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.02)	(0.01)	(0.04)
CONTROLS							
Children's age (RC.: 3 years)							
5 years	-0.02	-0.02	0.00	-0.00	0.01	-0.00	-0.00
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Sex (RC.: Boy)							
Girl	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Migrant background (RC.: Migrant)							
Native	-0.05**	-0.05**	-0.05**	-0.05**	-0.05*	-0.05**	-0.05*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ASQ test 8 months (RC.: Fail)							
Pass	-0.12***	-0.10**	-0.10**	-0.11**	-0.10**	-0.10**	-0.11**
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Parenting styles – warmth (RC.: Low)							
Medium	-0.20***	-0.17***	-0.17***	-0.17***	-0.17***	-0.17***	-0.17***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
High	-0.13**	-0.09	-0.09	-0.09	-0.10	-0.09	-0.10
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
HLE - Care activities (RC.: Low)							
Medium	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.04	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
HLE - Literacy activities (RC.: Low)							
Medium	-0.01	0.00	0.00	0.00	-0.00	0.00	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	0.03	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
HLE - Routine activities (RC.: Low)							
Medium	-0.06*	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.07*	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
ECEC attendance							

(RC.: No)							
Yes	-0.05*	-0.05*	-0.04	-0.04	-0.05	-0.04	-0.05
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Junior Infant School (RC.: No)							
Yes	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Area of residence (RC.: Rural)							
Urban	0.07***	0.07***	0.08***	0.07***	0.08***	0.08***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
HLE process							
Parenting styles: consistency (RC.: Low)							
Medium		-0.10***	-0.10***	-0.10***	-0.10***	-0.12***	-0.12***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.14***	-0.14***	-0.14***	-0.14***	-0.11***	-0.11***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Parenting styles: warmth (RC.: Low)							
Medium		-0.09***	-0.08***	-0.09***	-0.09***	-0.08**	-0.08**
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.17***	-0.16***	-0.16***	-0.16***	-0.12***	-0.11***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Parental literacy practices (RC.: Low)							
Medium		-0.10***	-0.10***	-0.09***	-0.10***	-0.09**	-0.09***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.11***	-0.12***	-0.12***	-0.12***	-0.13***	-0.16***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Children's books (RC.: 20 or less)							
21 to 30		-0.05	-0.05	-0.04	-0.04	0.07	0.07
		(0.04)	(0.04)	(0.03)	(0.04)	(0.07)	(0.07)
More than 30		-0.07**	-0.07**	-0.06**	-0.06**	-0.01	-0.02
		(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.06)
ECE							
ECE quality (RC.: Low)							
No ECE			0.01	0.01	0.01	0.17**	0.11
			(0.03)	(0.03)	(0.03)	(0.08)	(0.08)
High			-0.07***	-0.07***	-0.07***	-0.05	-0.06
			(0.02)	(0.02)	(0.02)	(0.09)	(0.09)
ECE*HLE							
Parenting styles: consistency							
No ECE*Medium						0.04	0.06
						(0.05)	(0.05)

No ECE*High			-0.07	-0.04
			(0.05)	(0.05)
High*Medium			0.00	0.00
			(0.06)	(0.06)
High* High			-0.04	-0.04
			(0.06)	(0.06)
Parenting styles: warmth				
No ECE*Medium			-0.03	-0.03
			(0.05)	(0.05)
No ECE*High			-0.11**	-0.14***
			(0.05)	(0.05)
High*Medium			0.03	0.02
			(0.05)	(0.05)
High* High			0.03	0.02
			(0.06)	(0.06)
Parental literacy practices				
No ECE*Medium			-0.03	-0.02
			(0.05)	(0.05)
No ECE*High			0.04	0.07
			(0.06)	(0.06)
High*Medium			0.02	0.02
			(0.06)	(0.05)
High* High			0.02	0.03
			(0.06)	(0.06)
Children's books				
No ECE*Medium			-0.23***	-0.19**
			(0.09)	(0.09)
No ECE*High			-0.12*	-0.05
			(0.07)	(0.07)
High*Medium			-0.07	-0.06
			(0.10)	(0.10)
High* High			-0.04	-0.03
			(0.08)	(0.08)
SES*HLE				
Parenting styles: consistency (RC.: Low)				
Medium	0.05**			0.05**
	(0.03)			(0.03)
High	0.02			0.03

				(0.03)			(0.03)
Parenting styles: warmth (RC.: Low)							
Medium				0.03			0.04
				(0.03)			(0.02)
High				0.04			0.04
				(0.03)			(0.03)
Parental literacy practices (RC.: Low)							
Medium				0.01			0.00
				(0.02)			(0.02)
High				0.02			0.04
				(0.03)			(0.03)
Children's books (RC.: 20 or less)							
21 to 30				0.01			0.00
				(0.04)			(0.04)
More than 30				0.05			0.03
				(0.03)			(0.03)
ECE*SES							
ECE quality							
No ECE					-0.10***		-0.11***
					(0.02)		(0.02)
High					-0.02		-0.02
					(0.02)		(0.03)
Constant	0.26***	0.47***	0.47***	0.47***	0.46***	0.39***	0.41***
	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.09)
Observations	10,158	10,158	10,158	10,158	10,158	10,158	10,158
Number of groups	5,079	5,079	5,079	5,079	5,079	5,079	5,079

Note) Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10; weighted results.
Source) Own calculations on GUI.

Table C.6 Random effects linear regression models on internalizing problems

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
HLE structure							
SES	-0.08***	-0.06***	-0.06***	-0.15***	-0.03	-0.06***	-0.11***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.02)	(0.01)	(0.04)
CONTROLS							
Children's age (RC.: 3 years)							
5 years	-0.02	-0.02	0.00	-0.00	0.01	-0.00	-0.00
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Sex (RC.: Boy)							
Girl	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Migrant background (RC.: Migrant)							
Native	-0.05**	-0.05**	-0.05**	-0.05**	-0.05*	-0.05**	-0.05*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ASQ test 8 months (RC.: Fail)							
Pass	-0.12***	-0.10**	-0.10**	-0.11**	-0.10**	-0.10**	-0.11**
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Parenting styles – warmth (RC.: Low)							
Medium	-0.20***	-0.17***	-0.17***	-0.17***	-0.17***	-0.17***	-0.17***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
High	-0.13**	-0.09	-0.09	-0.09	-0.10	-0.09	-0.10
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
HLE - Care activities (RC.: Low)							
Medium	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.04	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
HLE - Literacy activities (RC.: Low)							
Medium	-0.01	0.00	0.00	0.00	-0.00	0.00	0.00
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	0.03	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
HLE - Routine activities (RC.: Low)							
Medium	-0.06*	-0.05	-0.05	-0.05	-0.05	-0.05	-0.05
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.07*	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
ECEC attendance							

(RC.: No)							
Yes	-0.05*	-0.05*	-0.04	-0.04	-0.05	-0.04	-0.05
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Junior Infant School (RC.: No)							
Yes	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Area of residence (RC.: Rural)							
Urban	0.07***	0.07***	0.08***	0.07***	0.08***	0.08***	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
HLE process							
Parenting styles: consistency (RC.: Low)							
Medium		-0.10***	-0.10***	-0.10***	-0.10***	-0.12***	-0.12***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.14***	-0.14***	-0.14***	-0.14***	-0.11***	-0.11***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Parenting styles: warmth (RC.: Low)							
Medium		-0.09***	-0.08***	-0.09***	-0.09***	-0.08**	-0.08**
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.17***	-0.16***	-0.16***	-0.16***	-0.12***	-0.11***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Parental literacy practices (RC.: Low)							
Medium		-0.10***	-0.10***	-0.09***	-0.10***	-0.09**	-0.09***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.11***	-0.12***	-0.12***	-0.12***	-0.13***	-0.16***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Children's books (RC.: 20 or less)							
21 to 30		-0.05	-0.05	-0.04	-0.04	0.07	0.07
		(0.04)	(0.04)	(0.03)	(0.04)	(0.07)	(0.07)
More than 30		-0.07**	-0.07**	-0.06**	-0.06**	-0.01	-0.02
		(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.06)
ECE							
ECE quality (RC.: Low)							
No ECE			0.01	0.01	0.01	0.17**	0.11
			(0.03)	(0.03)	(0.03)	(0.08)	(0.08)
High			-0.07***	-0.07***	-0.07***	-0.05	-0.06
			(0.02)	(0.02)	(0.02)	(0.09)	(0.09)
ECE*HLE							
Parenting styles: consistency							
No ECE*Medium						0.04	0.06
						(0.05)	(0.05)

No ECE*High			-0.07	-0.04
			(0.05)	(0.05)
High*Medium			0.00	0.00
			(0.06)	(0.06)
High* High			-0.04	-0.04
			(0.06)	(0.06)
Parenting styles: warmth				
No ECE*Medium			-0.03	-0.03
			(0.05)	(0.05)
No ECE*High			-0.11**	-0.14***
			(0.05)	(0.05)
High*Medium			0.03	0.02
			(0.05)	(0.05)
High* High			0.03	0.02
			(0.06)	(0.06)
Parental literacy practices				
No ECE*Medium			-0.03	-0.02
			(0.05)	(0.05)
No ECE*High			0.04	0.07
			(0.06)	(0.06)
High*Medium			0.02	0.02
			(0.06)	(0.05)
High* High			0.02	0.03
			(0.06)	(0.06)
Children's books				
No ECE*Medium			-0.23***	-0.19**
			(0.09)	(0.09)
No ECE*High			-0.12*	-0.05
			(0.07)	(0.07)
High*Medium			-0.07	-0.06
			(0.10)	(0.10)
High* High			-0.04	-0.03
			(0.08)	(0.08)
SES*HLE				
Parenting styles: consistency (RC.: Low)				
Medium	0.05**			0.05**
	(0.03)			(0.03)
High	0.02			0.03

				(0.03)			(0.03)
Parenting styles: warmth (RC.: Low)							
Medium				0.03			0.04
				(0.03)			(0.02)
High				0.04			0.04
				(0.03)			(0.03)
Parental literacy practices (RC.: Low)							
Medium				0.01			0.00
				(0.02)			(0.02)
High				0.02			0.04
				(0.03)			(0.03)
Children's books (RC.: 20 or less)							
21 to 30				0.01			0.00
				(0.04)			(0.04)
More than 30				0.05			0.03
				(0.03)			(0.03)
SES*ECE							
ECE quality (RC. Low)							
No ECE					-0.10***		-0.11***
					(0.02)		(0.02)
High quality					-0.02		-0.02
					(0.02)		(0.03)
Constant	0.26***	0.47***	0.47***	0.47***	0.46***	0.39***	0.41***
	(0.06)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)	(0.09)
Observations	10,158	10,158	10,158	10,158	10,158	10,158	10,158
Number of groups	5,079	5,079	5,079	5,079	5,079	5,079	5,079

Note) Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10; weighted results.
Source) Own calculations on GUI.

Table C.7 Random effects linear regression models on externalizing problems

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
HLE structure							
SES	-0.12***	-0.10***	-0.09***	-0.15***	-0.09***	-0.10***	-0.14***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.02)	(0.01)	(0.04)
CONTROLS							
Children's age (RC.: 3 years)							
5 years	-0.02	-0.02	-0.00	-0.00	0.00	-0.01	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Sex (RC.: Boy)							
Girl	-0.22***	-0.22***	-0.22***	-0.22***	-0.22***	-0.22***	-0.22***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Migrant background (RC.: Migrant)							
Native	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
ASQ test 8 months (RC.: Fail)							
Pass	-0.13***	-0.10**	-0.10**	-0.10**	-0.10**	-0.10**	-0.10**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Parenting styles – warmth (RC.: Low)							
Medium	-0.23***	-0.18***	-0.17***	-0.18***	-0.17***	-0.18***	-0.18***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
High	-0.08	-0.01	-0.01	-0.02	-0.02	-0.01	-0.02
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
HLE - Care activities (RC.: Low)							
Medium	0.00	0.02	0.01	0.01	0.01	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	0.01	0.04	0.04	0.04	0.04	0.04	0.04
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
HLE - Literacy activities (RC.: Low)							
Medium	-0.02	-0.00	-0.01	-0.01	-0.01	-0.01	-0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.06**	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
HLE - Routine activities (RC.: Low)							
Medium	-0.00	0.01	0.01	0.01	0.01	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
High	-0.00	0.02	0.02	0.02	0.02	0.02	0.02
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
ECEC attendance							

(RC.: No)							
Yes	0.03	0.04	0.05	0.05*	0.05	0.05	0.05
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Junior Infant School (RC.: No)							
Yes	0.04*	0.03	0.03	0.03	0.03	0.03	0.03
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Area of residence (RC.: Rural)							
Urban	0.02	0.04	0.04*	0.04*	0.04*	0.04*	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
HLE process							
Parenting styles: consistency (RC.: Low)							
Medium		-0.24***	-0.23***	-0.23***	-0.23***	-0.23***	-0.23***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.37***	-0.37***	-0.37***	-0.37***	-0.35***	-0.35***
		(0.02)	(0.02)	(0.03)	(0.02)	(0.04)	(0.04)
Parenting styles: warmth (RC.: Low)							
Medium		-0.14***	-0.13***	-0.13***	-0.13***	-0.12***	-0.12***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
High		-0.27***	-0.25***	-0.26***	-0.25***	-0.33***	-0.32***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
Parental literacy practices (RC.: Low)							
Medium		-0.07***	-0.07***	-0.07***	-0.07***	-0.03	-0.03
		(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)
High		-0.12***	-0.12***	-0.12***	-0.12***	-0.07*	-0.08*
		(0.02)	(0.02)	(0.03)	(0.02)	(0.04)	(0.04)
Children's books (RC.: 20 or less)							
21 to 30		-0.06*	-0.06*	-0.06*	-0.05*	-0.07	-0.08
		(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.06)
More than 30		-0.09***	-0.08***	-0.08***	-0.08**	-0.10**	-0.11**
		(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
ECE quality (RC.: Low)							
No ECE			-0.00	0.00	0.00	0.04	0.03
			(0.03)	(0.03)	(0.03)	(0.07)	(0.07)
High			-0.10***	-0.11***	-0.11***	-0.14*	-0.13
			(0.02)	(0.02)	(0.02)	(0.09)	(0.09)
ECE*HLE							
Parenting styles: consistency							
No ECE*Medium						-0.03	-0.02
						(0.05)	(0.05)
No ECE*High						-0.06	-0.05

		(0.06)	(0.06)
High*Medium		0.02	0.01
		(0.05)	(0.05)
High* High		-0.00	-0.01
		(0.06)	(0.06)
Parenting styles: warmth			
No ECE*Medium		-0.04	-0.04
		(0.05)	(0.05)
No ECE*High		0.08	0.07
		(0.05)	(0.05)
High*Medium		0.00	-0.00
		(0.05)	(0.05)
High* High		0.14**	0.14**
		(0.06)	(0.06)
Parental literacy practices			
No ECE*Medium		-0.06	-0.06
		(0.06)	(0.05)
No ECE*High		-0.07	-0.06
		(0.06)	(0.06)
High*Medium		-0.05	-0.06
		(0.05)	(0.05)
High* High		-0.08	-0.08
		(0.06)	(0.06)
Children's books			
No ECE*Medium		0.02	0.03
		(0.08)	(0.08)
No ECE*High		0.02	0.04
		(0.06)	(0.07)
High*Medium		0.03	0.02
		(0.09)	(0.09)
High* High		0.04	0.04
		(0.07)	(0.07)
SES*HLE			
Parenting styles: consistency (RC.: Low)			
Medium	0.07***		0.06***
	(0.02)		(0.02)
High	0.05*		0.05*
	(0.03)		(0.03)
Parenting styles: warmth (RC.: Low)			

Medium				0.03			0.03
				(0.03)			(0.03)
High				0.05			0.04
				(0.03)			(0.03)
Parental literacy practices (RC.: Low)							
Medium				0.00			0.00
				(0.02)			(0.02)
High				0.02			0.03
				(0.03)			(0.03)
Children's books (RC.: 20 or less)							
21 to 30				0.01			0.00
				(0.04)			(0.04)
More than 30				-0.01			-0.02
				(0.03)			(0.03)
SES*ECE							
ECE quality (RC. Low)							
No ECE					-0.04		-0.04
					(0.03)		(0.03)
High					0.01		0.01
					(0.02)		(0.03)
Constant	0.28***	0.63***	0.64***	0.64***	0.64***	0.63***	0.64***
	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)
Observations	10,158	10,158	10,158	10,158	10,158	10,158	10,158
Number of groups	5,079	5,079	5,079	5,079	5,079	5,079	5,079

Note) Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10; weighted results.
Source) Own calculations on GUI.

Weighting

Inter-wave attrition is an almost unavoidable problem in longitudinal surveys that, when systematically related to child or family characteristics, represent a relevant issue for inference. Moreover, not valid responses may also hamper data representativeness. We decide to construct several probability weights to deal with (i) attrition, and (ii) missing values on relevant variables. We base our weighting procedures on the work by Mari and Keizer (2021).

Firstly, we create inverse probability weights for correcting for sample attrition using logistic regression models. We calculate the probability of not being lost due to follow-up between Wave 1 and Wave 2, and between Wave 2 and Wave 3 respectively. At the numerator, we calculate the probability of not being lost due to follow-up in a given Wave, conditionally on being observed at the previous wave. Hence, for Wave 2 we estimate an 'empty' logistic regression model using the whole sample (N.: 9,967), while for Wave 3 we estimate weights on those who were present in Wave 2 (N.: 8,771). At the denominator, we calculate the probability of not being lost due to follow-up conditionally to some covariates. In Wave 2, we

estimate logistic models for the probability of not being lost on the following set of individual and family covariates, which are all measured in Wave 1: dummies for lone-parent household, the father being not resident, whether the family lives in an urban or rural area, sex of the child, whether the child has siblings, maternal works before childbirth, maternal age[99], housing tenure, current social class[100], and whether the primary respondent's family struggled to make ends meet when 16 years old. For Wave 3, we regress the probability of being lost due to follow-up in Wave 3 on the same set of variables defined in Wave 1 plus additional controls measured in Wave 2, and namely: dummies for parental job loss, the birth of a new sibling, whether the family moved, whether the parents of the target child separated. Finally, the weights for Waves 2 and Waves 3 are multiplied to obtain our final weight, which is our probability weights for loss to follow-up.

Secondly, we estimate inverse probability weights for the inclusion in the analytical sample**.** At the numerator, we calculate the probability of being included in our final sample, conditional of being observed in both Wave 2 and Wave 3. At the denominator, we model via logistic regression the probability of being included in the analytical sample conditional on a set of covariates measured in both Wave 1 and Wave 2. The covariates in Wave 1 are: father being not resident, whether the family lives in an urban or rural area, sex of the child, whether the child has siblings, maternal working status before childbirth, maternal age, housing tenure, current social class, and whether the primary caregiver's family struggled to make ends meet when the primary caregiver was 16 years old; covariates in Wave 2 are dummies for parental job loss.

Finally, we combined weights for (i) loss due to follow-up in Wave 2, (ii) loss due to follow-up in Wave 3, and (iii) inclusion in the final sample through multiplication. Our final weight, which considers both attrition and exclusion from the analytical sample, has a mean equal to 0.99 and a standard deviation equal to 0.47.

[99] (1) In her 20s or younger, (0) In her 30s or older.

[100] (1) Professional/managerial class; (0) Never employed, employed in semi-skilled/unskilled manual professions, employed in non-manual/skilled manual professions.

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