Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Early Parenting Practices, Child School Readiness and Early Academic Performance

Mirela Conica

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Supervised by: Dr Jean Quigley & Dr Elizabeth Nixon

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Summary

School readiness and early academic achievement are fundamental to children's long-term academic performance, as well as social, physical, and mental health later in life. Thus, one salient goal for educators, researchers and policymakers is to identify and subsequently promote factors that ensure children are well equipped to benefit from education upon school entry. As it is well established, development is driven by children's interaction with their social environment across time. During the formative years preceding school entry, children's social environment primarily comprises interacting with mothers and fathers. It follows that the type of parenting practices in which mothers and fathers engage with their child prior to formal education is fundamental for children's school readiness and early academic functioning.

Although the crucial role that parents play for child development is well recognised, understanding which parenting practices should be encouraged to promote school readiness is challenging, largely arising from the lack of an agreed upon definition of school readiness and early achievement. Do children depend on literacy and numeracy skills to perform well academically or is it their social competence that enables learning and achievement? Further, do parents and educators concur with regards to the types of skills they endorse in order to prepare children for school? A comprehensive understanding of how early parenting practices relate to child academic performance can only be achieved insofar as careful consideration is given to these persistent questions.

Accordingly, the present thesis aims to first systematically review the existent parenting and school readiness research base to (1) gain insight into how school readiness has been conceptualised within the developmental field and (2) to identify the types of parenting practices that have been empirically linked with outcomes indicative

of school readiness. Second the thesis undertakes a series of individual studies based on primary and secondary data analysis to examine longitudinal associations between aspects of early parent-child interaction that have theoretical relevance to early academic achievement, but have been empirically examined to a lesser extent, and children's indices of school readiness and early scholastic performance.

Chapter 1 discusses the importance of school readiness and early academic achievement, the defining properties of school readiness and the conceptual and methodological challenges associated with it. Chapter 2 outlines the importance of parent-child interaction for child development, mechanisms of parenting influence and their effect on child development.

Chapter 3 provides an overview of the current research base on the longitudinal association between parenting practices and child school readiness through a systematic review. Findings indicated that school readiness was primarily assessed in terms of child language, literacy, numeracy, cognition, socioemotional and behavioural competence and by global measures of school readiness. The review further indicated that parenting related to these outcomes either directly (via parent-child interaction) or indirectly (via the home learning environment; HLE). Of the direct mechanisms, the most examined aspect was parental sensitivity, followed by cognitive stimulation or a combination of both. Of the indirect pathways, the majority of studies focused on the HLE with a negligible number examining parent involvement in early childhood education. Findings of this review were used to inform the remainder of the studies in this thesis.

Chapter 4 provides an outline of the methodology employed by each individual study.

Chapter 5 presents four studies based on primary data analysis which examine direct mechanisms of parenting during toddlerhood and preschool years that relate to children's language, literacy and numeracy, cognition, and socioemotional development during middle childhood. Specifically, Study 1 in Chapter 5 examines how parent-child linguistic alignment at all levels of language structure relate to child language quality and complexity, verbal comprehension, and literacy skills. Findings indicate that both parents aligned with children to a similar extent and there was some evidence to suggest that parents engaged in complementary alignment. Children also aligned their language to that of their parents in similar proportions.

The systematic review further suggested that language use during parent-child interaction can also influence child numeracy skills. Therefore, Study 2 in Chapter 5 first described maternal, paternal, and children's use of one type of language, decontextualised language during toddlerhood and preschool years. The study further explored associations between the use of decontextualised language in toddlerhood and preschool years and children's literacy and numeracy skills in middle childhood. Findings indicated that maternal decontextualised language during toddlerhood was negatively linked with child reading skills in middle childhood, but the reverse was observed in preschool years; maternal decontextualised language during mother-pre-schooler interaction was positively associated with child reading skills suggesting that the benefits of decontextualised language may become apparent later in development. Mothers', fathers', and children's decontextualised language during preschool years was also positively linked with child numeracy in middle childhood.

A further linguistic mechanism that has emerged as important to child development is contingent conversational turn-taking. However, this process has primarily been examined in relation to child language development despite theoretical arguments which also implicate it in cognitive growth. Accordingly, Study 3 in Chapter 5 examined how mother-father-child contingent turn-taking in toddlerhood and preschool years related to child executive functioning in middle childhood. Findings attest to the importance of engaging children in meaningful conversation and communicating *with* the child rather than *at* the child. Results also tentatively suggest that fathers may play a particularly important role with respect to the development of children's executive processes.

The semantic connectedness between conversational turns that parents and children engage in also have theoretical relevance to children's socioemotional competence. Arguably, meaningfully connected back-and-forth exchanges are foundational for pragmatic and social development. Therefore, with the aim of examining the role of this process to children's socioemotional outcomes, Study 4 in Chapter 5 examined how connected conversational turns in toddlerhood and preschool years during triadic mother-father-child interaction related to children's socioemotional difficulties in middle childhood. Findings suggested that contingent turn-taking during toddlerhood, but not preschool years, was linked with fewer socioemotional difficulties. As such, results indicate that toddlerhood may represent a particularly fertile period during which parents can buffer against socioemotional problems.

Chapter 6 presents two studies based on secondary data analysis which investigate indirect mechanisms of parenting influence. Specifically, Study 1 in Chapter 6 employed structural equation modelling of Growing Up in Ireland (GUI) data (national longitudinal cohort study of children in Ireland) to examine how the formal literacy (e.g., teaching the alphabet) and numeracy (e.g., teaching counting) as well as the informal literacy (e.g., reading to child) and numeracy (e.g., playing board games) environment at three years related to child vocabulary, pragmatic language, literacy and numeracy and socioemotional skills at five- and nine-years-old. The study revealed that only the informal literacy and numeracy environment demonstrated both domain-specific and cross-domain positive effects on children's language and numeracy outcomes but not on socioemotional outcomes, at five- and nine-years-old. These results suggest that even casual cognitively stimulating activities that do not directly focus on active teaching may benefit children's educational outcomes.

Study 2 in Chapter 6 explored another element of the HLE by characterising paternal and child language use during a shared reading interaction with wordless and text-based picture books. The study found that the text-based picture book elicited greater paternal language quality, more language that extended the topic, and more conversational utterances. In contrast, the wordless picture book elicited more labelling and descriptive utterances. Thus, different book types may be useful in eliciting distinct aspects of paternal language input during father-child interaction. The study further found that children's language quantity was greater in the wordless picture book condition whereas their language quality was greater in the text-based condition. Moreover, fathers' language with both book types showed differential links with children's language quantity, complexity, and quality. The study therefore provides preliminary evidence that variation in book content may encourage different types of learning with distinct effects on different domains of child language.

Finally, Chapter 7 synthesises the findings of all studies included in this thesis, outlines the strengths and limitations of the thesis, discusses theoretical and practical implications of findings, and concludes with suggestions for future research directions.

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Conica, M., Nixon, E., & Quigley, J. (2023). Talk outside the box: Parents' decontextualized language during preschool years relates to child numeracy and literacy skills in middle childhood. *Journal of Experimental Child Psychology*, *236*, 105746. doi:10.1016/j.jecp.2023.105746 (Chapter 5, Study 2)

Conica, M., Nixon, E., & Quigley, J. (2023). Domain-specific and cross-domain effects of the home literacy and numeracy environment at 3 years on children's academic competencies at 5 and 9 years. *Developmental Psychology*. doi:10.1037/dev0001515 (Chapter 6, Study 1)

Conica, M., Kelly, L., Nixon, E., & Quigley, J. (2023). Father and toddler language during shared book reading with text-based and wordless picture books. *Reading Research Quarterly*. doi:10.1002/rrq (Chapter 6, Study 2)

Conica, M., L., Nixon, E., & Quigley, J. (under review). A systematic review of the associations between parenting practices prior to school entry and children's school readiness. *Psychological Bulletin*. (Chapter 3)

Conica, M., Nixon, E., & Quigley, J., (under review). Parent-Child Linguistic Alignment in Toddlerhood and Preschool Years Relates to Child Language in Middle Childhood. Cognition. (Chapter 5, Study 1)

Chapter 1

School Readiness and Early Academic Achievement

The Importance of School Readiness and Early Academic Performance

School readiness broadly refers to a set of rudimentary skills that children require to successfully adjust to the school environment and to learn and perform academically at a satisfactory level (Forget-Dubois et al., 2007). Not only does school readiness influence children's initial scholastic experiences but it also largely defines their later success in life (Zaslow et al., 2010). Children who perform well early in their education are more likely to complete high/secondary school, to attend higher level education, and receive higher salaries (Reynolds, 2010). These children are also less likely to require remediated education later in their academic career, are less likely to be incarcerated and to avail of financial support programs (Reynolds., 2010). Arguably, children who begin school equipped with the necessary skills to engage with the school environment are poised to learn and develop a broader skillset that would enable them to successfully engage in employment later in life.

While the benefits of a positive school start tend to appear later in development, the foundation for academic success is laid during the early childhood years (Entwisle et al., 2005; Karoly et al., 2005; Knudsen et al., 2006; Pianta et al., 2007). Consequently, a comprehensive understanding of the foundations and development of children's school readiness and later academic success mandates a longitudinal approach which explores the early childhood experiences that enable some children to arrive at school better equipped to succeed than others (Barclay & Doll, 2001; Doll & Hess, 2001).

School Readiness: A Work in Progress

The Purpose of Assessing School Readiness

Given the compelling evidence which attests to the importance of early academic performance to children's long-term success, ensuring a positive school start has become a principal objective in early childhood pedagogy. Assessing school readiness is a critical step in ensuring children can engage with, and benefit from, the scholastic environment and therefore have an optimal start to their academic careers. Examining a child's school readiness provides an overview of their competencies and potential during the transition to formal education. This evaluation assists educators and parents in understanding a child's strengths while also identifying areas where they may need additional support. Accordingly, these assessments can be used for curriculum development and the tailoring of educational approaches to meet the specific needs of each individual child by ensuring optimal levels of challenge and support.

School readiness assessments are also used to identify developmental delays and learning difficulties early in a child's educational journey. This exercise facilitates early intervention to address any challenges and provide appropriate support to ensure that all children have equal opportunities to succeed in school. Along these lines, schools, policymakers, and educational organisations use school readiness assessments for policy development as well as resource allocation. This evaluation further informs the development of initiatives aimed at improving early childhood education, including the provision of funding for both program expansion as well as special education services and targeted interventions. Moreover, data collected from school readiness assessments can be used to track patterns of school readiness across different populations, regions, and demographic groups. This information can be used to identify populations at risk for poor educational outcomes and hence target areas for resource allocation with the aim of narrowing the achievement gap.

Finally, school readiness assessments are an invaluable research resource as these can be used to study, and promote, factors that influence children's preparedness for school. These assessments can subsequently inform the development, implementation, and evaluation of early childhood education programs and interventions, assess the effectiveness of early childhood education initiatives and policies, and encourage parents and educators to become active partners in their child's education by engaging in home-based support and becoming involved in their child's learning.

Defining and Redefining School Readiness

The importance of school readiness to early childhood education has been firmly established among both early educators and policy makers for over 200 years (National Education Goals Panel, 1997; Pestalozzi, 1894). Yet despite decades of research, a clear definition of school readiness and how it should be assessed remains elusive (Justice et al., 2009; Yoon, 2015). Traditionally, largely influenced by Piaget's theory of cognitive development (Piaget, 1936), school readiness was viewed from a maturational perspective. Children were considered ready for formal education when they reached a specific age, usually five to seven years (Meisels, 1999; Snow, 2006). It was assumed that by this age children naturally developed the necessary skills to engage with the school environment. One implication of this perspective was that caregivers and early childhood services were assumed to play no role with respect to promoting children's readiness for school. Yet this view is refuted by numerous empirical studies which demonstrate that early parenting and pre-school interventions play a positive role in preparing children for formal education (see Mol et al., 2008 for a meta-analysis). As a result, the maturational perspective of school readiness has been deemed too narrow (Kagan & Rigby, 2003).

Following increased recognition of the importance of studying child development from a developmental systems perspective (Cairns & Cairns, 2006), greater emphasis was placed on defining school readiness in terms of children's individual abilities as opposed to age (Graue, 2006). School readiness has therefore more recently been defined as a set of skills that children are expected to possess during the transition to formal education to successfully adapt to, and engage with, the school environment (Graue, 2006). Elsewhere it has been described as "the state of child competencies at the time of school entry that are important for later success" (Snow, 2006, p.9). This interactionist perspective recognises that school readiness results from the 'goodness-of-fit' between child and environment and is reflected in UNICEF's (2012) framework which attributes three elements to a child's school readiness: (1) a child's readiness for school which refers to their competence to engage with, and learn from, the school environment; (2) schools' readiness for children, which refers to the school's ability to support a child's learning and cater to their individual needs, and; (3) family readiness for school, which refers to a family's involvement in children's education. This re-operationalisation of school readiness distinguishes 'school readiness' from 'learning readiness' and highlights that while children are always ready to learn, this may not always coincide with what adults are trying to teach (Bingham & Whitebread, 2012). School readiness in contrast strives to create a fit between *what* children are ready to learn and ensuring that the external environment is correspondingly aligned to meet children's learning potential.

Conceptual Considerations

Despite research advances in understanding early academic performance, a clear operationalisation of school readiness is yet to be agreed upon (Graue, 2006; Snow, 2006). This difficulty in defining school readiness likely stems from debate regarding the importance of cognitive versus non-cognitive skills to children's early education (Graue, 2009; LaParo & Pianta, 2000). On the one hand, parents tend to consider children's cognitive competencies, such as language and numeracy, to be indicative of school readiness. Theoretically, well-developed language skills such as more diverse vocabularies can assist children in developing code-related skills such as print knowledge and phonological awareness, and subsequently learning to read (Mitchell & Brady, 2013). Larger vocabularies may also promote better performance in math-related activities (Powell & Nelson, 2017). Arguably, both word learning and understanding early math concepts requires children to engage in symbolic representation and as such depend on children's foundational language skills (LeFevre et al., 2010).

Moreover, children who transition into school with well-developed pragmatic language skills can understand verbal instructions, ask for clarification under uncertainty, articulate ideas coherently and engage in conversation with peers (Wasik & Hindman, 2014). As a result, these children are poised to effectively adjust to the academic environment. Children with poorer social communication skills, on the other hand, tend to perform worse academically as they have difficulty inhibiting impulsive behaviour and engage in fewer learning behaviours partly due to these less developed skills (Camarata & Gibson, 1999; Clark et al., 2002).

Similarly, early numeracy skills set a strong foundation for children's later mathematics achievement (Aubrey et al., 2006; Aubrey & Godfrey, 2003). For instance, counting competencies such as enumeration and number-word sequence during kindergarten have been found to facilitate children's acquisition of basic arithmetic skills during the first years of primary school (Aunola et al., 2004; Desoete et al., 2009; Jordan et al., 2007; Koponen et al., 2007; Kurdek, & Sinclair, 2001). Furthermore, neuropsychological evidence suggests that the ability to evaluate magnitudes or symbols representing magnitudes may play a crucial role for later development of mathematical skills (e.g., Butterworth, 1999; Dehaene, 1997; Feigenson et al., 2004; Piazza et al., 2004). Similarly, subitizing (evaluating small quantities without explicit counting) is an important precursor of counting ability (Le Corre et al., 2006).

A further cognitive aptitude indicative of school readiness is children's executive functioning (EF; Brod et al., 2017). EF refers to a collection of higher order cognitive processes including cognitive flexibility, inhibitory control and working memory (Diamond, 2013). These processes are considered fundamental to school readiness as they promote children's abilities to engage in complex reasoning and problem solving (Blair & Diamond, 2008). EF further facilitates self-regulation such as persevering in the face of challenging tasks, sitting still during class and withstanding distraction (Blair & Raver, 2015). Children with higher EF may thus be better equipped to inhibit disruptive behaviour, to pay attention and behave appropriately with peers and teachers.

On the other hand, teachers tend to consider non-cognitive competencies, and specifically socioemotional skills such as managing emotional situations and developing appropriate emotion regulation strategies (Harrington et al., 2020), as representative of school readiness. These skills are considered essential for children to effectively navigate academic environments and to adjust to new rules and new relationships, all of which are likely to elicit myriad emotions (Blair & Raver, 2015). Children who can self-regulate tend to behave in accordance with expectations of academic environments, experience fewer distractions and can therefore maximally benefit from school (Harrington et al., 2020). That is, in the absence of distractions, children are likely to show greater task engagement and assimilation of information (Eisenberg et al., 2005; Graziano et al., 2007) which in turn leads to more efficient learning, better grades and higher scores on standardised tests (Gumora & Arsenio, 2002).

In addition, children with better socio-emotional skills display increased social competence (Blair & Raver, 2015), higher self-esteem and increased acceptance from peers (Thompson, 2014). Conversely, children with lower socio-emotional skills are more likely to experience conflict with teachers and peers and are at risk of social exclusion (Newcomb et al., 1993; Parker & Asher, 1987). Moreover, children who are less efficient at regulating emotions tend to have difficulty attending to instructions from teachers and assimilating and recalling information (Raver et al., 2007). It follows that children with fewer socio-emotional skills are at increased risk of experiencing adverse academic outcomes (Ladd et al., 1999; Pianta & Stuhlman, 2004).

However, from a research perspective, school readiness should be multidimensionally operationalised. Children's cognitive and non-cognitive skills should not be viewed as mutually exclusive as both are likely to jointly influence a child's capacity to engage with the school context (Justice et al., 2009; Yoon, 2015).

Methodological Considerations

The lack of clear definition of school readiness has methodological implications leading to difficulty in selecting which child outcomes to measure and the relevant instruments to appropriately capture those outcomes. This challenge must be addressed given the difficulty in accurately measuring the progress made by children during a period of schooling without reference to their baseline skills (i.e., prior to any formal instruction). Accordingly, several school readiness assessments have been developed such as Performance Indicators in Primary Schools (PIPS) across several countries including the Reception Baseline Assessment in the UK (Department of Education, Training and Skills, 2021), the Bracken School Readiness Assessment in the US (Bracken, 2007) and the Australian Early Development Index in Australia (Australian Government, 2021). However, these screening measures tend to have limited predictive validity for academic success (Snow, 2006). For instance, meta-analytic evidence reveals a moderate effect size for the link between early screening and academic outcomes and a small effect size for the link between early screening and socio-emotional outcomes (La Paro & Pianta, 2000).

This poor predictive validity reflects the complexities associated with implementing a 'one size fits all' method to assessing school readiness. A more useful exercise may be to renounce such a reductive approach which concentrates on specific skills, such as reading and counting, and consider a wider range of skills and abilities including pattern recognition, problem solving, self-regulation and perseverance (see Jane, 2022). In doing so, careful consideration must be given to how these criteria are organised, presented, and scored. For instance, in Wales school readiness is assessed in terms of language, literacy and communication, mathematical development, physical development, personal and social development, and wellbeing and cultural diversity (Welsh Government, 2017). While a seemingly promising step towards a more comprehensive measurement of school readiness, it must be noted that these categories are not equally weighted. While the mathematical development category consists of 17 components, the personal and social development, and wellbeing and cultural diversity has only 6. Therefore, this assessment places children with stronger numerical competencies at an advantage compared to children with well-developed social and emotional skills. The issues associated with such readiness tests become even more evident considering the multiple stakeholders who diverge in perspectives regarding the importance of cognitive (i.e., parents) or social (i.e., teachers) skills to children's school readiness (Snow, 2006).

The shift towards operationalising school readiness in terms of a wider range of skills would further diverge from the traditional approach of using IQ as an index of readiness to learn. The need to depart from using IQ tests as a school readiness screening measure is increasingly evident within developmental literature. First, child scores on such tests are generally scaled based on norms arranged in accordance with age level (Febriyanti & Listiara, 2020). Therefore, this procedure somewhat reflects a maturational approach of determining school readiness insofar as it rests on a conceptual consideration of child age as an indicator of child academic aptitude. Second, IQ tests may exhibit cultural and linguistic biases that can disadvantage children from diverse backgrounds. Children from non-dominant cultural backgrounds or whose first language does not correspond with that of the test may not experience the necessary conditions to perform optimally on traditional IQ tests, leading to potential underestimation of their abilities.

Finally, IQ tests, such as the Weschler Tests of Intelligence, typically focus on cognitive abilities including problem-solving, memory, and logical reasoning. Yet, as has been theoretically argued, school readiness encompasses a broader range of skills including, but not limited to, socio-emotional functioning, motor skills, creativity and adaptability. Thus, to facilitate a more comprehensive conceptualisation of school readiness there is a need for a transactional theory-data-theory driven approach. An exploratory, but nevertheless theoretically motivated, empirical inquiry into the longitudinal association between a range of child competencies at school entry and their later academic performance can feed back into theory development and ultimately facilitate a more comprehensive definition of school readiness.

In addition to *what* outcomes are assessed, *how* these outcomes are assessed also has implications for determining whether a child is ready for school. The concept of assessment indicates a process between two or more people where one observes another's actions and makes a judgement, highlighting the critical role that the adult plays in examining a child's school readiness, be it a parent, practitioner, or researcher. Thus, the influence of how assessments are performed on child school readiness scores must be addressed. Judgements based on observations of children compared to those based on performance on specific tasks or practitioner questions tend to differ (Jane, 2022).

While teacher report is considered a reliable measure of child outcomes there are several unconscious biases which can influence judgement (Kowalski et al., 2018). First, social and cognitive skills may be easily conflated, and practitioners have been found to associate communicative fluency with stronger cognitive skills, while children who are less articulate are presumed to possess poorer levels of understanding (Kowalski et al, 2018).

Additionally, practitioners may perceive a child's score as reflective of their pedagogical competence and may equate lower scores with poorer teaching (Jane, 2022) resulting in inflated child readiness evaluations. Demographic characteristics can also impact a practitioner's evaluation of child aptitude. For instance, children from families of lower socioeconomic status are perceived as poorer performers compared to their more economically advantaged counterparts (Auwarter & Arguete, 2008). Gendered expectations are also known to play a role, with educators perceiving females to display stronger language and interactive skills while males are perceived to perform better on physical tasks (Kreitz-Sandberg, 2016; Prioletta, 2018). The impact of these conscious or unconscious preconceptions is significant given that these have the potential of labelling a child as either above or below average with direct implications for a child's future academic potential (Roberts-Holmes & Bradbury, 2016).

One way to bypass these limitations may be to examine school readiness using a combination of diverse methods. For instance, children's performance on technology-based tasks may provide more objective indices of certain skills such as inhibitory control, cognitive flexibility and working memory. Such measures tend to have high reliability as they are consistent and replicable, and high validity insofar as they are accurately designed and are typically standardised. Moreover, they provide precise measurements and as such are invaluable in identifying subtle differences in child abilities. Nevertheless, while this approach would offset biases associated with parent or teacher report, children's experience with and knowledge of technology must be considered as children with prior access to, and interaction with, such tasks may be at an advantage.

Additionally, school readiness may be assessed through direct assessments, using age-appropriate standardised instruments, administered by researchers who are blind to participant status. One advantage of such evaluations is that children receive the same instruction, guidance, feedback, and support, insofar as researchers follow protocol and administer assessments in a consistent manner. Yet, despite advantages associated with standardised instruments, there are ethical dilemmas which must be considered. How should a child who has demonstrated counting skills in a free-play scenario but refuses to count during formal assessment be scored? Likewise, should a child who demonstrates an understanding of concepts that measure vocabulary but is responding mischievously receive a low language score? Arguably, such behaviour may be more indicative of social-emotional development rather than mathematical or language skills.

Relatedly, children's own understanding and interpretation of readiness assessments are also likely to influence their scores. In particular, it has been suggested that children tend to perceive an activity as work rather than play if an adult is present (McInnes et al., 2013). Thus, school readiness assessors bear the responsibility of developing tactics that co-create a mutual understanding and avoid giving children the impression that they are under examination to promote optimal co-operation.

The above listed limitations demonstrate the importance of using a wide range of methods and measures to comprehensively capture a child's skills and abilities. While all methods of assessment have limitations, each contributes valuable information pertaining to a child's competencies. Teachers and parents are uniquely positioned to provide evaluations about children as observed in natural settings, over long periods of time in diverse situations while they interact with a range of individuals from peers to educators. Conversely, performance-based tasks and direct assessment can provide accurate, objective scores independent of biases related to children's individual and sociodemographic attributes.

In addition to methodological rigour, the study of school readiness and early academic achievement must recognise that learning is cumulative and perpetual and hence school readiness is a continuous rather than static concept. In other words, school readiness is a process rather than a state and as such should be assessed longitudinally.

In general, school readiness assessments tend to mirror those used later in education with importance placed on summative tests that yield quantitative results. Yet, early years pedagogy is a unique area of education rooted in distinct theoretical perspectives (Jane, 2022). It is evident that summative and standardised tests can only capture the particular skill under examination at the specific time of assessment and disregard the holistic development and idiosyncratic learning styles of each child (MacBlain et al., 2017; Nutbrown, 2001). Consequently, school readiness assessments should undertake a longitudinal design and adopt ipsative testing approaches which capture a child's progress by comparing their current scores against their previous performance (Broadfoot, 2015). Such an approach would allow the focus to shift from what a child can or cannot do to the learning potential a child displays. Moreover, a longitudinal study of readiness as a dynamically evolving process would facilitate insight into developmental trajectories and critical periods of development as well as identification of early predictors of child academic performance.

Practical Considerations

In addition to addressing conceptual and methodological issues, school readiness remains subject to pragmatic and political concerns. Early academic performance involves multiple stakeholders including not only parents, teachers, and researchers but also policymakers, advocacy groups and children themselves, all of which have a vested interest in children's academic success. While all stakeholders share a common desired outcome, each differs with regards to their conception about the skills necessary to arrive at the respective outcome. These divergent perspectives must be considered if alignment is to be facilitated between research, policy and practice which can combine efforts to promote young children's educational attainment. While there are strong, compelling arguments in favour of a research informed definition of school readiness, the variety of alternative perspectives must be considered if assessment measures are to be of value to all stakeholders. Therefore, an important first step in advancing the school readiness discourse is to comprehensively review the state of the research base and identify how school readiness is operationalised within the extant literature.

Second, there is a need for continued efforts to collect representative and generalisable data via methodologically rigorous methods and psychometrically robust instruments and to disseminate findings in a manner accessible to all stakeholders. This exercise is particularly important given that research findings can be used not only to educate parents but also to inform, guide and reform early childhood interventions and policies, with significant influence on how schools function.

The success of this second step is similarly hindered by the lack of a clear definition of school readiness and what exactly is considered to constitute competence. While it is important to take account of the various definitions of readiness, the early education field would also benefit from continuous theory development and theory-driven research. Excessive focus on empirical considerations risks defining school readiness within the confines of what has already been measured, or rather by the availability of existing methods. Thus, striving for balance, and addressing the gap between theory and assessment bears promising implications for the development and understanding of school readiness.

Steps Towards Promoting School Readiness and Early Academic Achievement

Following numerous research findings which converge on the importance of early academic performance, several public pre-kindergarten (pre-k) programs have been developed to promote school readiness and hence equalise children's educational opportunities. However, these programs have only been partially successful. For example, in the US while the majority of children at risk for educational delays attend a pre-k program, approximately half continue to demonstrate poor performance across academic and socio-emotional domains (Isaacs, 2012). Furthermore, only a quarter of these children have the necessary literacy and math skills that are expected upon kindergarten entry (Bernstein et al., 2014). Research focus must therefore expand in an effort to identify, and subsequently optimise, additional aspects of children's environments that foster school readiness. One promising area of interest is the parent-infant interaction. A focus on early infancy through to preschool years may be particularly productive as this is a time of rapid development during which children are most susceptible to environmental influence (Hodel, 2018). For instance, children's EF is thought to undergo the most rapid development during infancy compared to any other life period (Diamond, 2020). Similarly, there is significant expansion in vocabulary between the age of 18 months and 5 years. Children use approximately 50 words at 18 months yet by the time they turn 6 years old children possess a vocabulary of around 10,000 words (Diesendruck, 2007).

The importance of parenting practices (i.e., the quality of parent-infant interaction and that of the environment within which a child grows) for children's achievement of developmental milestones is well established. It is also widely recognised that experiences encountered early in life tend to exert an enduring influence on child development (Lloyd et al., 2010). Nevertheless, comparatively little is known about the longitudinal association between early parenting practices and children's school readiness and early academic performance.

Conclusion

The importance of early academic achievement has been convincingly demonstrated and is reflected in growing research efforts to define and assess school readiness. Although the most productive way of studying school readiness remains under debate, an effective approach to advance the early academic achievement field may be to recognise that child functioning is dynamic, periodic and contextually influenced. Thus a fluid operationalisation of school readiness, inclusive of both cognitive and non-cognitive competencies, holds promise to provide important insights with regard to children's transition to, adjustment and early performance within formal education settings.

Moreover, while several pre-school programs aimed at promoting school readiness have been developed, implemented and evaluated there remains scope for further examination of early factors that may be implicated in equipping children for school. Given that during preschool years parents are children's primary interactive partners, scrutinising aspects of early parenting practices conducive to school readiness is an important research objective.

Chapter 2

Parenting Behaviours, Children's School Readiness and Early Academic Performance

Given the enduring and persistent consequences of a positive early school start to children's later academic performance, mental and physical health, and sociodemographic adjustment, identifying factors that promote school readiness and early academic performance is a critical research responsibility. The fundamental role that parents play in this regard is well established. Transactional theories of development consistently emphasise the importance of social context, and in particular that of mothers and fathers, to child development (e.g., Hayes et al., 2022; Sameroff, 2009). One particularly influential theory that has stood the test of time through many iterations, and one that bears practical implications for the study of parenting and child development, is Bronfenbrenner's ecological theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2006).

Theoretical Framework

Based on a Process-Person-Context-Time (PPCT) model the theory describes how child development is influenced by a range of factors which do not exert independent influence but rather interact synergistically (Tudge et al., 2022). The PPCT model is formally recognised as the most appropriate research design for the examination of hypotheses derived from bioecological theory (Tudge et al., 2022). Having elaborated upon proximal processes in one proposition and upon the concurrent influence of person attributes, context, and time on those processes in a second proposition, Bronfenbrenner stated that: "Propositions I and II are theoretically interdependent and subject to empirical test. An operational research design that permits their simultaneous investigation is referred to as a Process-Person-Context-

Time model" (Bronfenbrenner & Morris, 1998, p.996). Thus, to gain a deeper understanding of the factors influencing child development prior to formal schooling each element of the PPCT model must be considered in detail.

Processes

Processes, and more specifically proximal processes, are considered to be the most important element of the model and arguably the key driving force behind child development (Xia et al, 2020). As described in the PPCT model, proximal processes refer to the reciprocal interactions between the developing child and one or more individuals, objects, and symbols in their surrounding environment. These include, but are not limited to, interacting with parents, or playing with friends (i.e., one or more individuals), playing with toys such as building with blocks (i.e., objects) and engaging in reading (i.e., symbols). For development to occur, these reciprocal interactions must evolve and become "progressively more complex" with time (Bronfenbrenner & Morris, 1998, p.996). This growing complexity in turn assists developing children in acquiring increased knowledge and skills while also reducing problem behaviours and inhibiting dysfunction (Xia et al, 2020).

The importance of progressively advancing proximal processes is mirrored in Vygotsky's theory of development which similarly suggests that children's developmental outcomes can only benefit from mature interactional partners' behaviour insofar as this behaviour operates within the child's zone of proximal development (ZPD). The ZPD refers to the difference between a child's "actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p.86).

The remaining three elements of the PPCT model, namely person, context, and time, operate to influence child development synergistically, and do so through these proximal processes.

Person

Person characteristics can take one of three forms, namely force, resource and demand (Bronfenbrenner & Morris, 1998). Force characteristics refer to dynamic individual attributes which may either foster and facilitate proximal processes or interfere with and impede them from operating. Characteristics that sustain proximal processes and are therefore conducive to positive development are described as "developmentally generative" and include curiosity, mastery motivation, persistence, and self-efficacy (Bronfenbrenner & Morris, 2006, p. 810). Conversely, those that are likely to hinder development are termed "developmentally disruptive" and include distractibility, impulsiveness, inattentiveness, and explosiveness (Bronfenbrenner & Morris, 2006, p. 810).

Resource characteristics refer to biological, cognitive, or experiential resources that interact with proximal processes to influence development. For instance, gestational age has been shown to influence parent-child interaction such that the quality of mother-child interaction at 18 and 36 months is less optimal with preterm and very preterm children compared to full-term born children (Harel-Gadassi et al., 2020). Likewise, a child who enters school with reading skills has clearly had more literacy experiences and is therefore more poised to perform well compared to a child with no prior reading experience.

Finally, demand characteristics refer to factors or attributes that either encourage or discourage reactions or behaviours from the social environment and hence foster or prevent the occurrence of processes. For instance, a happy-looking child is likely to elicit more positive reactions from teachers and peers compared to a visibly irritable child. In some cultures, gender is sufficient to influence the initiation or lack thereof of processes, such as discouraging women from enrolling in science and mathematics classes (see Xia et al., 2020).

In giving consideration to the role of person in the PPCT model, Bronfenbrenner illustrates the transactional nature of children's interaction with their surrounding environment. That is, individual differences shape the experiences of interactional partners and these experiences in turn influence individual characteristics (Sameroff, 1983). A child's individual characteristics and propensities such as their state of arousal, cognitive status, temperament, and emotional expressiveness actively contribute to their interaction with their caregivers and therefore influences their own development. For instance, infants who show greater positive affect are likely to elicit greater positivity from parents. Parent behaviour may in turn escalate infant behaviour resulting in a transactional relationship between interactional partners (Kiff et al., 2011). As they co-ordinate and synchronise behaviour, infants and parents are poised to experience higher quality of interaction. Conversely, fretful infants are likely to elicit poorer parenting behaviour from caregivers (Boeldt, et. al., 2012) which in turn may negatively reinforce infant disruptive behaviour.

A child's role in shaping their own development is further highlighted by research on Gene-Environment correlations. Gene–environment correlations (rGE) refer to environmental factors that are influenced by a child's genetic material (Quinn & D'Onofrio, 2020). Akin to person characteristics, rGE can occur in three forms, namely passive, active, and evocative (Scarr & McCartney, 1983; Plomin et al., 1977). Passive rGE occur when the social environment within which a child resides is composed by those individuals who passed their genes on to the respective child. For instance, parental depression is a well-documented risk factor for child adjustment (Conica et al., 2020; Quinn & D'Onofrio, 2020). Further, depression is both partially heritable and known to interfere with optimal parenting. It follows that parents could transmit their genetic vulnerability for depression to their children, and these genetic factors which predispose to depression may in turn correlate with increased likelihood of receiving inconsistent parenting (Quinn & D'Onofrio, 2020). Active rGE, on the other hand, occur when children select their environment based on their genetically inherited traits. For instance, precocious children with greater intellectual abilities may ask to be read to more, may themselves read for pleasure and may select more challenging classes as they enter education, all of which would further promote their intellectual development. Finally, evocative rGE occur when children's genetically inherited traits elicit specific environmental responses. Evidence suggests that a child's behaviour during interaction with parents, which is genetically influenced, can elicit a parent's engagement in either negative or positive parenting practices (Avinun & Knafo, 2013). For instance, a child's temperament, which has a genetic component (Cloninger et al., 2019), may evoke specific responses from parents; a highly sociable and outgoing child might receive more positive social reinforcement from parents compared to a capricious or withdrawn child.

Context

While Bronfenbrenner's theory did not neglect the role of individual characteristics on development in his earlier versions of the theory (Bronfenbrenner, 1979; Rosa & Tudge, 2013; Tudge et al., 2022) it is evident that most emphasis in his earlier ecological writings was placed on the influence of context. Context was described as a collection of concentric nested structures of environment akin to a set of Russian nesting dolls; a metaphor so powerful that it quickly became the symbol of his theory, and likely the reason why to this day his theory is perceived as one about the role of context on development by many scholars (Tudge et al., 2009; 2016).

The first and most salient of these structures is termed the microsystem and includes the immediate environment, such as the home or classroom, within which children can engage in proximal processes with people, objects, and symbols. The mesosystem, although typically depicted as a second layer, is in fact a series of "relationships existing between two or more settings; in short it is a system of two or more microsystems" (Bronfenbrenner, 1999, p.17). Examining how interactions between the home and school relate to child development would be considered as the study of the mesosystem.

Next, Bronfenbrenner described the exosystem, which once again may best be conceptualised not as a surrounding structure but rather a context within which wider factors, such as institutions and workplaces, interact with the developing individual. For instance, unpleasant events at work may influence how a parent interacts and recalibrate their threshold for specific behaviours with a child when they return home.

The final, overarching structure is the macrosystem which exerts its influence on processes indirectly through the microsystem. This context includes, but is not limited to, social class, ethnicity, and culture such as values, practices, identity, and beliefs of a socio-cultural group.

Socioeconomic Status. Perhaps the most studied contextual influence on child development is the socioeconomic status (SES) of the family within which the child resides. Optimal child outcomes are typically rooted in warm and sensitive parent-child interactions, appropriate cognitive stimulation, consistent routines, and clear limit-setting (Bornstein, 2002). However, as the family stress model suggests, a low socioeconomic status is generally accompanied by unstable incomes, disruption of family relationships, and unpredictable work schedules all of which elicit psychological stress and consequently negatively impact child outcomes (Conger & Conger, 2002). For instance, financial loss or persistent poverty restricts a family's capacity to provide food, shelter, clothing, and safety which in turn provoke parental depression and anxiety (McLoyd, 1990). While the link between parental mental health and child outcomes is well-documented across the entire spectrum of SES (e.g., Pierce et al., 2020), relations between parenting stress and poor parenting behaviour are stronger in families who live in deep poverty (Petterson & Albers, 2001). In fact, families who are socioeconomically disadvantaged engage in harsher parenting practices such as physical discipline (Dodge et al., 1994; Linver et al., 2002), less sensitive and responsive parenting (Dodge et al., 1994; Jackson et al., 2000; Smith et al., 2001) and display lower levels of parental support (Jackson et al., 2000). These parenting behaviours in turn can have a deleterious effect on the parent-child relationships and result in poor child outcomes (Petterson & Albers, 2001).

For instance, empirical data have demonstrated an association between income and behaviour problems among three- and five-year-old children; however this link was mediated by authoritarian, harsh parenting related to maternal emotional distress (Linver et al., 2002). Financial strain has also been linked with increased maternal depressive symptoms which led to poorer parenting quality and in turn to negative child behavioural outcomes (Jackson et al., 2000). Thus, one mechanism through which SES influences child development is through its influence on parenting behaviours and hence the quality of parent-child interaction.

It follows that improving the quality of parent-child interaction may represent one pathway through which the negative effects of SES may be mitigated. Indeed, data from the classic study of the Great Depression found that fathers who were emotionally stable were less likely to endorse negative parenting practices, in spite of dramatic income loss, which in turn had a positive influence on their child's self-esteem (Elder & Caspi, 1988). Similarly, nurturing and involved parenting have been found to buffer against the negative association between income stress and child development (Conger & Conger, 2002). Therefore, the family stress model demonstrates one mechanism through which SES operates on child outcomes and more importantly highlights an opportunity for intervention and improvement of child outcomes through home visits and parental education.

It is noteworthy that economic strain can also impact child development indirectly via its influence on the quality of the home learning environment. Financial struggles limit a family's potential to provide material resources and experiences, to provide a calm and safe living environment and to spend quality time with their child, factors which are necessary for healthy development (Hetzner et al., 2010). Indeed, children who grow up in socioeconomically disadvantaged families have limited access to a range of learning materials including books and educational toys (Bradley et al., 2001). Moreover, impoverished families are also more likely to reside in darker, more cluttered, less clean, and less safe environments compared to more economically advantaged families (Bradley et al., 2001). This increased environmental chaos characterised by lack of structure and routines is further conducive to poor social and emotional child outcomes (Evans et al., 2005). Although high quality parent-child interaction can mitigate the effects of lack of learning materials and environmental chaos on child development, poor families face the dilemma of balancing time-related and monetary needs as they frequently sacrifice quality time with children for work (Ryan et al., 2006).

In addition, SES can impact child development through its influence on children's early childhood education (ECE) environments. There is compelling evidence which attests to the importance of high quality ECE, characterised by low child-to-adult ratios, highly educated and qualified caregivers, stimulating and responsive caregiving and availability of toys and learning materials, to children's social and cognitive development (Blau, 2001; Lamb & Ahnert, 2006; Shonknoff & Phillips, 2000). This evidence is particularly relevant to children from low SES backgrounds as high quality ECE has been found to promote school readiness and later academic success, as well as social stability and financial independence later in life (Heckman & Lochner, 2001), with the strongest effects observed among the most economically disadvantaged children (Brooks-Gunn, 2003; Brooks-Gunn et al., 1993).

However, not all ECE environments provide high quality care. For instance, data from the Early Childhood longitudinal Study Birth cohort (ECLS-B) indicates that three quarters of infants and toddlers in ECE were in low-to-medium quality care whereas only one quarter were in high quality care centres (Mulligan & Flanagan, 2006). Nevertheless, these findings are encouraging considering that when high quality care is available children from low-income households can experience long-term positive outcomes.

Finally, families, homes, and ECE environments all inhere within, and interact with, characteristics of communities and neighbourhoods. Processes such as organisational participation, community monitoring and quality of social ties are all likely to affect child development (Hetzner et al., 2011). For instance, neighbours may exercise social control and act as role models and hence influence children's internalisation of social norms and acceptable behaviour (Xue et al., 2005). Unfortunately, impoverished families frequently have limited choice with regards to their residential area and often find themselves in neighbourhoods associated with social disorganisation such as high levels of unemployment, crime, and few recreational resources such as parks and playgrounds (Brooks-Gunn & Duncan, 1997). Living in such disadvantaged areas has been linked with higher child anxiety, depression, and behaviour problems (Chase-Lansdale et al., 1997) and more severe mental health problems even after accounting for maternal depression and baseline child mental health scores (Xue et al., 2005).

Culture. A further contextual structure with significant influence on child development is culture. Culture is generally defined as a system of shared beliefs, norms, values, ideas behaviours, customs and symbols that guide and regulate daily living (Bornstein, 2015). Considering culture in the study of child development is essential as cultural norms influence parental expectations of how children should be raised and how children should interact with adults. For instance, in Europe and the US where culture is characterised as individualistic, emphasis is placed on personal goals and autonomy whereas in many Asian countries such as China, Japan and Korea, where culture is characterised as interdependent (Fatehi et al., 2020), the emphasis is on shared goals and connected interdependence.

As a direct consequence of these cultural norms, parenting practices in Western societies foster independence, competitiveness, self-efficacy and self-expression whereas parents from Eastern cultures (with some exceptions) promote conformity, obedience, social interdependence and respect for elders (Keller & Otto, 2009). For instance, European American mothers tend to structure their child's behaviour via indirect means such as suggestions whereas Puerto Rican mothers rely on direct means of command such as restraints and physical positioning (Harwood et al., 1999). It is therefore evident that diversity in cultural norms result in differential effects of parenting on child development across different cultural groups.

Culture also influences child development by dictating the parenting roles that caregivers undertake. For instance, in some cultures fathers undertake complex child caregiving responsibilities and are referred to as “house husbands” whereas in others they are assumed to play a less relevant role in child development (“honored guests”; see Bornstein, 2015, p.3). On the other hand, across many cultures throughout the world having multiple caregivers, such as relatives, siblings and even non-familial adults, is the norm (Bornstein, 2015).

Moreover, there have also been radical differences documented in what parents from different cultures value. Parents from most societies communicate with children from birth and perceive children as understanding interactive partners; however in some cultures speaking with infants who are themselves not yet capable of producing speech is seen as nonsensical and so caregivers rarely engage in this behaviour (Bornstein, 2015; Cristia et al., 2019; Feldman, 2019). Likewise, there are cultures within which play is seen as an important developmental activity while others perceive the sole purpose of play to be amusement and do not see it as part of their parenting responsibility (Bornstein, 2015).

Culture further influences how child attributes are valued. Across every society there are children who are shy, yet responses to shyness differ between cultures. For instance, Chinese mothers perceive shyness as positive and reward it with warm and accepting attitudes. Conversely, Canadian mothers display a more punitive attitude towards shyness. These differences in parenting in response to child attributes have direct consequences for children later in life; shy Chinese children tend to excel in school and are more positively appraised by their peers and teachers, whilst shy

Canadian children tend to perform worse academically (Chen et al., 1995; Chen et al., 1999). That is not to say that beliefs always translate to behaviours, but rather that they co-exist and interact in complex and dynamic ways. Consequently, understanding how culture influences and gives meaning to parenting and child outcomes is critical.

Time

Finally, the PPCT model includes the concept of time across three levels, specifically microtime, mesotime and macrotime. Microtime refers to activities and events during the course of proximal processes including the continuity or disruptions in a child's engagement with an activity or interaction. For example, microtime includes the duration of child and parent engaging in joint attention during an interactive episode and working together to return to and remain on task following disruptions. Mesotime focuses on whether proximal processes occur consistently across days, weeks, and months, such as reading with children, visiting the library, and engaging in cultural outings. Macrotime however refers to "the changing expectations and events in the larger society, both within and across generations, as they affect, and are affected by, processes and outcomes of human development over the life course" (Bronfenbrenner & Morris, 1998, p. 995). These include increased access to, and encouragement of, females in education and greater female pursuit of male-dominated careers. A more current example would be the changes which followed the Covid-19 pandemic which transformed the educational system with regards to how curricula are delivered and expectations around child engagement with educational material. The key premise is that development can be measured only if children are studied longitudinally allowing sufficient time for developmental outcomes of interest to progress (Bronfenbrenner & Morris, 1988).

Applying the PPCT Model to the Study of Early Academic Performance

All four components of the PPCT model simultaneously interact to influence child development, or rather the developmental outcome of interest within a research study. Essentially, child development can be represented by $\mathrm{D}_t = f_{(t-P)}\left(\mathrm{PE}_{(t-P)}\right)$ where development(al outcome) (D) is seen as a result of the interaction, or proximal processes, (f) between person (P) and environment (E) over time (t). While each element is crucial to child development, proximal processes arguably play the most important role and have in fact been described as the "primary engines of development" (Bronfenbrenner & Morris, 1998, p.996).

Bronfenbrenner proposed four types of proximal processes, namely (1) genetic transmission, (2) effects of physical and physiological states of the child, (3) interpersonal interactions, relations, and attitudes (particularly caregiver-child interactions within families), and (4) effects of the immediate physical environment such as the home learning environment (Tudge et al., 2022). While the first two processes are less tractable, the latter two are amenable to intervention and are therefore particularly worthy of further inquiry regarding their role in promoting children's educational outcomes**.** Understanding how early parenting practices may exert an enduring influence on children's school readiness and early academic performance bears profound implications for both educators and parents alike. Not only does it have the potential to empower caregivers to make informed parenting decisions and hence optimise their role as key stakeholders in their child's education, but it also opens avenues for targeted interventions and resources aimed at promoting educational outcomes and holistic child development.

Proximal Processes: Parent-Child Interaction

The importance of social interaction to children's development has long been recognised among caregivers, educators, and researchers alike. As Vygotsky convincingly demonstrated, children depend on more mature, more skilled others for appropriate guidance and support to develop and acquire competencies (Vygotsky, 1978). During the years prior to formal education, children primarily interact with mothers and fathers in the home environment and, as such, parents are ideally placed to scaffold children's development and prepare them for school.

Along with recognition of the importance of parent-child interaction to child development came a burgeoning number of studies examining the role of parenting on child outcomes. The first wave of studies primarily focused on parenting styles characterised by a combination of parental support and control (Baumrind, 1991; Maccoby & Martin, 1983). One limitation of this approach is that parenting is depicted as static and fixed, implying that parents consistently fall into one parenting category throughout their child's life.

A second attempt at understanding the role of parent-child interaction to child development aimed to examine broad domains of parent behaviour (Bornstein & Tamis-LeMonda, 2010) that assumed a more active role on the parent's behalf, while children were perceived as passive recipients of parenting. These domains included nurturant, material, didactic, and social caregiving (Bornstein, 2006). It was later demonstrated that nurturant caregiving, such as attending to an infant's health and physical needs, is seldom studied in research as there tends to be minimal variation in this domain between families (Bornstein & Tamis-LeMonda, 2010).

Material caregiving refers to the provision of learning resources, such as books and cognitively stimulating toys. Didactic parenting refers to parent's scaffolding, regulation, and assistance with how the child interacts with their environments by creating learning opportunities and encouraging engagement with learning materials.

Finally, social caregiving refers to parenting behaviour that promotes child social engagement.

Clearly these parenting domains as well as parental linguistic input while they interact with children have implications for child development. While exploring broad domains of parenting behaviour during parent-infant interaction is informative, this approach may be too reductionist for a comprehensive understanding of parenting and child development. Moreover, an exclusive focus on parental behaviour neglects the principle of proximal processes and assumes that parenting is unidirectional and independent of children's own states, behaviours, and attributes. This narrow approach may not adequately capture the full range of parenting behaviours and attitudes, leading to a limited understanding of parenting dynamics.

An alternative, more nuanced approach to the study of parenting and child development is to perform fine-grained analyses of dynamic parent and child behaviours that take place during episodes of parent-child interaction and that have been found to meaningfully relate to child outcomes (Bornstein & Tamis-LeMonda, 2010). This approach examines the quality of interactional constructs including, but not limited to, parental warmth, responsiveness, and supportiveness towards the child, cognitive stimulation and scaffolding of child skills, as well as linguistic diversity and complexity that is attuned to children's developmental competence. From this perspective, the influence of child behaviour and attributes on parenting practices is acknowledged. It recognises that parental responsiveness depeneds on *child behaviour*, supportiveness occurs in response to *child attempts* at skill mastery and linguistic and cognitive stimulation is adapted to *children's concurrent skills and abilities.*

These constructs fall into two main dimensions and are frequently measured along a continuum. More specifically, warmth, responsiveness and supportiveness reflect a parent's ability to identify, correctly interpret, and appropriately respond to a child's bid for attention, attempt at communication and state of arousal and can range from sensitive to insensitive/unresponsive. Cognitive stimulation, scaffolding and the use of diverse and complex language in contrast captures a parent's support and encouragement of child skill mastery beyond what they could achieve independently. In Vygotskian terms, these parenting types reflect parental behaviour that operates within children's ZPD, or as Zuckerman (2007, p.181) put it, within children's "individual range of learning potential". Although, the argument is by no means that these dimensions comprehensively and holistically capture infants' and parents' experiences during interactions, research has consistently and convincingly demonstrated their predictive validity with regards to child outcomes.

Parenting and Child Language Development. One of the most impressive aspects of early child development is the speed with which children acquire language (Bornstein, 2002). While the role of the social environment in this process is clearly established (Tomasello, 2000; Vygotsky, 1962), the types of parenting behaviours that are most important for child language across different periods of development are still under investigation.

Child-directed speech (CDS), the simplified register characterised by exaggerated tone and prosody that parents use during communication with young children, has been found to play a crucial role in child language development (Rowe, 2012; Rowe & Weisleder, 2020). For instance, exaggerated prosodic qualities are often used by parents to highlight new and relevant information as well as to emphasise focus (Fernald & Mazzie, 1991). Features of CDS such as changes in pitch, lengthening of syllables and pauses can assist infants in discriminating words and identifying boundaries between them (Soderstrom, et al., 2008).

As children become more sophisticated language users, their linguistic proficiency is further propelled by parents' language diversity and complexity (Song et al., 2014). Children who are exposed to more language also encounter more repetitions and increased opportunities to learn new words. Similarly, more diversity in parental linguistic input promotes a larger child vocabulary by fostering children's inference of word meanings from the larger semantic network within which they are presented.

Not only quantity, quality and complexity of language are implicated in child language growth but also parental interactional behaviours. For instance, parental contingent responsiveness which refers to immediate parental responses that relate to, and maintain, a child's focus of attention (Roth, 1987) has also been found to positively influence child language. It has been demonstrated that contingent responsiveness fosters language development as it facilitates the development of a back-and-forth conversation (see Rowe & Weisleder, 2020). This type of responsiveness gives children the opportunity to experience turn-taking while also providing input that is informative (Tamis-LeMonda et al., 2014). Studies consistently demonstrate that children whose parents respond contingently and verbally, and who do so frequently from birth, tend to have larger vocabularies later in life (Donnellan et al., 2020; Goldstein & Schwade, 2008). Moreover, a higher frequency of conversational turns experienced by four-year-olds has been linked with stronger white-matter connectivity in the dorsal language tract, particularly near Broca's area during language processing (Romeo et al., 2018).

Parenting and Child Cognitive Development. Crucially, the positive effects of parent-child interaction to children's language have also demonstrated cascading effects on children's cognitive development. Indeed, there is evidence which demonstrates the mediatory role of child verbal ability in associations between parenting quality and child cognitive development (Landry et al., 2002). Arguably, the complex demands of language comprehension and production during interaction foster children's abilities to organise information in mind and to understand cause-and-effect which consequently benefits cognitive growth (Song et al., 2014).

Parent-child interaction has also been implicated in the development of children's executive functioning (EF) skills (Fay-Stammbach et al., 2014; Helm et al., 2020). For example, parental scaffolding, which refers to both verbal and non-verbal parenting behaviours that encourage children to persist with challenging tasks, has been linked with children's EF. Scaffolding may occur through parental encouragement of children's individual opinions and actions as well as through autonomy support (Matte-Gagné & Bernier, 2011). Mothers who support children's autonomy during the first three years of life have children with better EF skills during preschool and with higher academic achievement in elementary school and high school (Bindman et al., 2015).

Other parenting behaviour associated with EF includes responsive or sensitive parenting which incorporate parental warmth and positive affect (Bernier et al., 2012). Greater parental sensitivity and responsiveness have been shown to predict greater gains in children's EF skills from the age of three to five years (Blair et al., 2014). In contrast, parental negative affect has been shown to negatively predict children's EF at three years old, controlling for child verbal ability and maternal education (Cuevas et al., 2014). Arguably, the association between sensitive and responsive parenting and children's EF may be best explained by attachment theory, which postulates that parental sensitivity contributes to secure attachments (i.e., positive emotional bonds between children and their caregivers; Cassidy & Shaver, 2018). Indeed, evidence suggests that toddlers with secure attachments show better EF skills in kindergarten (Bernier et al., 2012).

Parenting and Child Socioemotional Development. Parent-child attachment is also important for children's socio-emotional development (Bowlby, 1973; Bretherton & Munholland, 2008). Children with secure attachments tend to have higher quality relationships and to display fewer internalising and externalising behaviours (Groh et al., 2017). The sensitivity and responsiveness displayed by mothers during infancy is particularly important for children's later inter- and intra-personal development (Braungart-Rieker et al, 2001; DeWolff & van IJzendoorn, 1997; Lieberman et al., 2005). Parents who are sensitive during parent-infant interactions instil a sense of competency in their child as an interactive partner and demonstrate that others can respond to their communicative bids appropriately. For example, a sensitive parent would respond to their distressed infant by calming and soothing them and would alter their behaviour in the case of an overly excited infant in order to prevent overstimulation (Tronick, 2007).

Consequently, children learn to regulate their emotions – both positive and negative – in the context of parent-infant interactions and later transfer these skills to relationships with peers and teachers. Indeed, children with better self-regulation skills tend to elicit more positive social relationships over time (Raikes et al., 2007).

Parents may also foster children's socio-emotional development by modelling adequate emotion regulation strategies through language and behaviour (Blair et al., 2004; Boyer, 2009). Similarly, parents can acknowledge and validate their child's feelings, by labelling emotions and by providing children with opportunities to regulate intense feelings (Ellis et al., 2014).

Indirect Effects of Parenting on Child Academic Performance: The Home Learning Environment

In addition to what parents do with children, the learning opportunities that parents provide for children also play a role in children's development. As the Family Investment Model (FIM, Haveman & Wolfe, 1995) indicates, the influence of sociodemographic factors on child development operates via parental provision of cognitively stimulating resources and activities, otherwise known as the home learning environment (HLE; Iruka et al., 2012; Raver et al., 2007). The longitudinal association between HLE and children's school readiness as well as later academic success is well documented (Connor et al., 2005; Elardo et al., 1977; Fanti & Henrich, 2010; McCarty et al., 2005; Melhuish et al., 2008). Children who grow up in supportive and cognitively stimulating environments tend to have better language skills (Connor et al., 2005; Elardo et al., 1977; Foster et al., 2005; Gottfried, 1984; Storch & Whitehurst, 2001), better math achievement (Anders et al., 2012; Melhuish et al., 2008; Young-Loveridge, 1989) and display fewer externalising behaviours (Fanti & Henrich, 2010; Jackson et al., 2000; Price et al., 2013). For example, across five large scale data sets, cognitive stimulation and access to reading resources at three years old were associated with children's cognitive and behavioural development at five years old (Leventhal et al., 2004). Similarly, the home literacy (i.e., teaching letters, shared book reading; Sénéchal & LeFevre, 2002) and numeracy (i.e., teaching numbers, shapes; LeFevre et al., 2010) environment are predictive of children's language and math skills in preschool (Anders et al., 2012; Lehrl et al., 2020; Melhuish et al., 2008; Niklas & Schneider, 2015).

The HLE is not only important for children's development of literacy and numeracy skills, but also EF (Korucu et al., 2020). Among U.S. pre-schoolers (aged 54 months), parental provision of a rich literacy environment characterised by greater frequency of engagement in storybook reading, identifying sounds and letters and printing letters is linked with children's better performance on a number of EF tasks (Korucu et al., 2020). It is likely that the HLE offers an ideal context within which parents can promote their children's EF development. That is, a high quality HLE may foster structured, organised parent-infant interactions that encourage children to sustain attention and withstand distraction which subsequently facilitate learning (Evans et al., 2000; Sénéchal, 2006; Skwarchuk et al., 2014). Negative parenting behaviour and disorganisation on the other hand are predictive of greater externalising problems in children transitioning to elementary school (Eamon, 2000; Price et al., 2013; Yildirim & Roopnarine, 2015).

The strongest evidence for the predictive influence of the HLE on children's development comes from intervention studies. Meta-analytic findings of HLE interventions have identified the home environment as a tractable antecedent of child outcomes. For example, the combined results of 16 intervention studies assessing parental involvement reveal an improvement in children's reading and spelling skills in primary school (Sénéchal & Young, 2008). Further evidence comes from a meta-analysis of interventions designed to promote dialogic reading (Mol et al., 2008). Dialogic reading refers to shared book reading during which a parent engages with their child, highlights words, emphasises sounds, asks questions and expands upon material within the book. The combined results of 16 studies showed that children whose parents received the intervention demonstrated greater vocabulary growth compared to their counterparts whose parents engaged in 'reading-as-usual' (Mol et al., 2008). Notably, larger effect sizes were observed among younger children (aged two- to three-years-old), emphasising the importance of early intervention.

Even non-intensive interventions can exert a significant and durable influence on children's outcomes. For instance, Niklas and Schneider (2017) delivered a two-step HLE intervention to German parents of 58- to 78-month-old children. The intervention focused on the importance of reading to children frequently, visiting libraries, teaching children grapheme-phoneme correspondence, playing word games and engaging in dialogic reading. Compared to the control group, the intervention group showed greater increases in quality of HLE over time. Children of parents who received the intervention in turn showed greater phonological awareness eight months later, a time when they were preparing for school entry. However, there was no evidence for an effect of the intervention on children's vocabulary, which further highlights the need to systematically examine how specific aspects of the HLE may be differentially linked with child outcomes. Similarly, among Australian parents of four-year-old children, a non-intensive family HLE intervention was found to positively influence children's fluid reasoning 20 weeks later (Niklas et al., 2016). Fluid reasoning denotes the ability to form concepts, reason and engage in problem solving, while concurrently integrating new rules and information. This cognitive ability is associated with both math and literacy skills (Evans et al., 2000; Floyd et al., 2003) and is considered essential for academic success (Schneider et al., 2014).

Parenting Practices and Child Development from a Family Systems Perspective

The developmental field has significantly advanced the literature on parenting practices and children's development. In particular the growing awareness of fathers' importance to child development and increasing number of studies that include fathers have somewhat redressed the previous bias towards a primary focus on mother-child dyadic interaction (Volling et al., 2019). Nevertheless, insight from comparative studies of maternal and paternal interactive styles primarily stem from dyadic interactions. This approach limits conclusions regarding parent-child processes as it neglects to account for the systemic nature of families. In accordance with family systems theory (FST; Minuchin, 1985) the presence of an additional partner alters the dynamics of an interaction and thus observations from dyadic interactions do not generalise to triadic contexts.

Indeed, parents are known to behave differently towards their child during dyadic compared to triadic interaction. For instance, mothers tend to be less engaging and responsive (Belsky et al. 1984; Clarke-Stewart 1978; Lindsey & Caldera 2006) during triadic compared to dyadic contexts whereas fathers tend to be less demanding (Pellegrini et al. 1987). Further, fathers tend to display less positive affect, engage in less physical play, and communicate less with their infants when mothers are present compared to when they are not (Goldberg et al., 2002). Similar findings have been reported among older children whereby both mothers and fathers displayed closeness and warmth towards their 32-month-old children in dyadic contexts, but fathers were more distanced and less involved than mothers in triadic contexts (de Mendonça et al., 2011).

However elsewhere, while both mothers and fathers were found to produce more speech and more syntactically complex speech during dyadic than triadic interactions with two-year-old children, maternal language was syntactically more complex than fathers' language during the triadic interactions (Quigley & Nixon, 2022). Moreover, both mothers and fathers displayed more diverse vocabularies during dyadic compared to triadic interaction (Quigley & Nixon, 2022). Similarly, both mothers and fathers have been found to produce less speech in triadic compared to dyadic contexts although the variability in the quantity of speech observed was greater for fathers

(Nandy et al., 2021). Fathers were also shown to produce more directives than mothers during dyadic interactions (Nandy et al., 2021).

While the large number of studies inclusive of dyadic interactions have proven invaluable to the child development field, there is a comparatively underdeveloped research base on triadic interaction. From a family systems perspective, a comprehensive understanding of how early parent-child interactions influence children's school readiness and early academic performance necessitates an increased focus on triadic interaction. Such an approach allows for the study of mother-child interaction in the context of father-child interaction and *vice versa* thereby providing additional insight into how early social interactions with caregivers relate to children's academic performance.

The Present Study

The burgeoning research on child development recognises parenting as a complex and multi-dimensional construct which is dynamically linked to diverse child outcomes. Given that children vary widely in their cognitive and social competencies upon school entry, and that this variation has critical implications for their future academic, social and health outcomes, understanding the role that parents play in preparing children for school is a research imperative. Accordingly, the present thesis aims to first systematically review the current research field and identify parenting practices that promote school readiness as operationalised by the developmental field (Chapter 3).

Second, following an overview of the methodology employed (Chapter 4), informed by the systematic review, the thesis aims to examine how aspects of parent-child interaction during the years preceding formal schooling relate to children's indices of school readiness and early academic performance such as language, literacy, numeracy, cognitive and social development. Such an exercise can identify target behaviours to inform parenting interventions aimed at promoting school readiness which may in turn reduce disparities between children's academic trajectories and ultimately promote social mobility.

One of the most examined parenting behaviours in relation to child development is the quantity, quality, and complexity of parental linguistic input during interaction with children. However, it has recently been theorised that not only *what* but also *how* parents communicate with children can influence child language development. Accordingly, Chapter 5, Study 1 in this thesis examines how trajectories of mother-father-child linguistic alignment at all levels of language structure during toddlerhood and preschool years relate to children's language diversity, complexity, verbal comprehension, and literacy skills in middle childhood.

Parental language not only influences child language and literacy skills, but also benefits children's numeracy development. This effect has been attributed to the symbolic representation skills necessary for abstract reasoning such as letter-sound and number-symbol correspondence foundational for language and numeracy respectively. Therefore, Chapter 5, Study 2 in this thesis explores how decontextualised language – talk that requires cognitive abstraction and transcends the here-and-now including talk about the past or future, pretend talk, or cause-and-effect statements – in toddlerhood and preschool years relates to child literacy and numeracy in middle childhood.

A further domain that has been deemed important to children's school readiness and early academic performance is cognitive functioning, and more specifically executive function (EF). Although myriad studies attest to the importance of parental responsiveness and scaffolding to child EF, a less studied aspect of parent-child interaction in relation to these skills, but one that warrants further research, is conversational turn-taking. Conversational turn-taking is cognitively demanding as it depends on a set of complex skills, such as monitoring and predicting the end of an incoming turn, planning a response (i.e., temporal contingency) and establishing shared intentionality (i.e., semantic contingency), all of which map directly onto EF. Therefore, in Chapter 5, Study 3 a further aim of this thesis was to examine how mother-father-child contingent turn taking in toddlerhood and preschool years related to child executive functioning in middle childhood.

The semantic connectedness between conversational turns in which parents and children engage also has theoretical relevance to children's socioemotional competence. Arguably, meaningfully connected back-and-forth exchanges are foundational for pragmatic and social development; turn-taking not only requires children to interpret their interlocutor's language input but also to develop self-regulatory skills such as attending to incoming speech, awaiting their turn, and inhibiting disruptive impulses. Therefore, with the aim of examining the role of this process to children's socioemotional outcomes, Study 4 in Chapter 5 examined how connected conversational turns in toddlerhood and preschool years during triadic mother-father-child interaction related to children's socioemotional difficulties in middle childhood.

Parenting practices also influence child development indirectly such as via the home learning environment (HLE) and shared-reading practices. Studies in this area have primarily operationalised the HLE as a global construct and only recently have scholars highlighted its multidimensionality. Rooted in this developing, more nuanced approach to examining the HLE, Study 1 in Chapter 6 employed structural equation modelling of data from a national longitudinal study of children and youth in Ireland (Growing Up in Ireland, GUI) to examine how the formal literacy (e.g., teaching the alphabet) and numeracy (e.g., teaching counting) as well as the informal literacy (e.g., reading to child) and numeracy (e.g., playing board games) environment at three years related to child vocabulary, pragmatic language, literacy and numeracy and socioemotional skills at five- and nine-years-old.

Akin to the wealth of research on the HLE, focus on the influence of shared book reading has also been extensive. However, while studies increasingly include fathers in child research, most insight with regards to shared reading and child development is informed by research with mothers. Thus, Study 2 in Chapter 6 aimed to characterise paternal and child language use during a shared reading interaction with wordless and text-based picture books, and to examine associations between father and child language during interaction with both types of book.

Chapter 7 in this thesis discusses findings of all studies and integrates them within wider literature and theory on parent-child interaction, the HLE and child school readiness and early academic performance. The general discussion further addresses the strengths and limitations of the thesis, outlines the implications, and suggests future research directions.

Chapter 3

As educational systems worldwide continue to evolve, policymakers, educators, parents, and researchers alike are increasingly recognizing the significance of school readiness in shaping a child's educational trajectory. The role that parent-child relationships play in this regard is also well established; research consistently demonstrates the influence of early, cognitively stimulating, parent-child ineraction and access to educational materials on children’s early academic success. Yet a clear strategic approach to promoting school readiness is nevertheless missing, arguably due to a lack of a school readiness definition, and hence difficulty in identifying the parenting practices that promote it. Therefore, a systematic synthesis of the existing evidence base is essential to provide a cohesive understanding of this intricate relationship. Accordingly, this chapter presents a systematic review which aims to comprehensively examine and synthesise findings from the existing research field on early parenting practices and school readiness. In doing so, the study aims to discern how school readiness has been conceptualised and measured allowing for a shift towards a more comprehensive assessment of the construct. This exercise will further elucidate which parenting behaviours have been examined as precursors to early academic performance and hence where there is scope for further research inquiry

A Systematic Review of the Associations Between Parenting Practices Prior to School Entry and Children's School Readiness.

Abstract

The present study aimed to systematically review the longitudinal association between parenting practices during preschool and children's school readiness. Following abstract and full-text screening, 79 of the 4936 studies identified met the inclusion criteria. The review revealed that research primarily examined the home learning environment followed by parental sensitivity with fewer studies focusing on cognitive stimulation and less on involvement in early childhood education as predictors of school readiness. Findings indicate that 68.42% of studies identified significant relations whereas 31.58% found non-significant relations between parenting practices and child outcomes. The most consistent significant results pertained to shared book-reading and composite measures of parenting. Findings of the review bear implications for potential interventions, future research, and parenting resources.

Keywords: parenting, home learning environment, school readiness, systematic review

Introduction

School readiness broadly refers to children's competencies prior to school entry which are crucial for later academic success (Snow, 2006). Children who enter school with robust language, cognitive, socio-emotional and behavioural skills are poised to learn and perform well in an academic setting. However, a proportion of children are unprepared as they transition into the school environment and compared with their school-ready counterparts embark on their academic journey at a disadvantage (Doyle et al., 2012). The repercussions of such an unequal starting point persist throughout children's academic careers (Lee & Burkham, 2002) and are linked with lower employment (Rouse et al., 2005) and poorer psychological wellbeing later in life (Brooks-Gunn, 2003). Nevertheless, poor outcomes are not inevitable. Children's competencies are a product of the interaction between their genetic inheritance and the environment within which they develop (e.g., Tucker-Drob et al., 2011). A corollary is that children's school readiness may be fostered by optimising children's exposure to environments that promote the expression of these competencies.

Key Indices of School Readiness

Upon entry to formal education, the school curriculum assumes that children are school-ready, namely that they possess the basic language and cognitive skills necessary for engagement with the academic environment (Wackerle-Hollman et al., 2015). In fact, pragmatic (i.e., social communication) and structural (i.e., vocabulary) language skills upon school entry are one of the strongest indicators of school readiness (e.g., Rowe et al., 2012). Theoretically, children who transition into school with well-developed pragmatic language skills can understand verbal instructions, ask for clarification under uncertainty, articulate ideas coherently and engage in conversation with peers. Similarly, structural language skills, such as larger vocabularies, have also been shown to assist children in developing code-related skills such as print knowledge and phonological awareness, and subsequently in learning to read (Mitchell & Brady, 2013).

Moreover, larger vocabularies are also associated with better performance in math-related activities (Powell & Nelson, 2017). Evidence suggests that children's vocabulary in preschool is associated with symbolic math skills such as counting and word problem solving, above and beyond other cognitive skills (Purpura & Ganley, 2014).

Children's cognitive skills, such as executive functioning (EF), are also predictive of academic success (Brod et al., 2017). EF refers to a collection of higher order cognitive processes including cognitive flexibility, inhibitory control and working memory (Blair & Diamond, 2008). These processes are crucial to school readiness as they promote children's abilities to engage in complex reasoning and problem solving (Blair & Diamond, 2008).

However, the formal school environment requires not only academic competencies but also social-emotional and behavioural skills. For instance, school requires children to self-regulate, persevere when faced with challenging tasks, sit still during class and withstand distraction (Blair & Raver, 2015). In addition, children must have the ability to inhibit disruptive behaviour, pay attention and interact appropriately with teachers and peers.

Thus, children who enter school with robust language, cognitive and socio-emotional and behavioural skills are more likely to learn and perform well in formal educational settings and to elicit positive reinforcement from their teachers. Consequently, these children are at higher likelihood of entering a perpetuating cycle of academic success. Given that during the pre-school years parents are children's key socialising agents, identifying core parenting practices conducive to children's school readiness is essential.

Core Parenting Practices and Children's School Readiness

Considerable evidence attests to the importance of parenting behaviours to children's academic, socio-emotional, and behavioural development. For instance, proximal parenting behaviours such as parental lexical diversity, contingent responsiveness, and decontextualised talk (i.e., language that is not in the here-and-now such as talking about the future, providing causal explanation or engaging in pretence play) have been consistently linked with children's linguistic development during the early years of life (e.g., Rowe, 2012). Similarly, parental scaffolding, sensitive and responsive parenting which includes warmth and affect have been linked with children's language, cognition, numeracy, and literacy during preschool (e.g., Barnett et al., 2020).

Distal parenting practices, such as the home learning environment (HLE), have also proven instrumental to children's school readiness. Engaging in cognitively stimulating activities and providing children with learning resources have been found to predict children's language (King & Purpura, 2021), cognition (Bono et al., 2016), numeracy, literacy, and social-emotional development (Ferretti & Bub, 2017). Moreover, several intervention studies provide compelling evidence regarding the importance of the HLE to children's school readings (e.g., Kim & Reiley, 2021).

Thus, research on child development recognises parenting as a complex and multi-dimensional construct which is dynamically linked to diverse child outcomes. Nevertheless, there remains a need for the synthesis and organisation of existent findings to understand which parenting behaviours may be most relevant for children's school readiness and to additionally identify missing links that warrant further research.

The Present Study

Despite consensus that children's developmental trajectories have their foundations in early childhood, to date, no study has conducted a comprehensive review of the various aspects of early parenting practices that might be conducive to children's school readiness. In addition to identifying targets for parenting interventions, such a review is likely to detect areas where further scrutiny is needed and therefore guide future research directions. Accordingly, the present paper aims to systematically review the association between parenting practices prior to school entry and children's school readiness. Specifically, the review aims to identify how proximal parenting practices (including parent communicative behaviours, supportive behaviours and socialisation behaviours) during parent-infant interaction and distal parenting practices (including the provision of learning materials, and engagement in educational activities) are associated with key indices of school readiness (including language, cognitive, social-emotional and behavioural domains of development) in children as they transition to formal schooling.

Method

Protocol and Reporting Standards

The present study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Eligibility Criteria

Types of Studies

The systematic review included (i) original, peer-reviewed articles that examined associations between proximal and distal parenting practices prior to school entry and children's school readiness, (ii) articles published in English, (iii) longitudinal or cohort designs, (iv) non-intervention studies, (v) studies that have quantified the statistical association between exposure (parenting practices) and outcome (school readiness), (vi) studies employing any method of assessment (i.e., studies were considered regardless of whether assessment occurred directly or through participant report) and (vii) no historical date limit was imposed. Cross sectional studies, qualitative studies, intervention studies, other empirical studies (i.e., validation) and scientific works (i.e., reviews) were excluded. The present review focused on peer-reviewed articles rather than grey literature as it aimed to identify associations between parenting practices and child school readiness *as operationalised by the research field*.

Types of Participants

The review included (i) typically developing children who had not yet started school at the exposure timepoint and (ii) children who were no younger than four years old and were in no later than their first term of school at the outcome timepoint. Studies with caregivers other than parents, children with a diagnosed disability or children already enrolled in school at the exposure timepoint were excluded.

Type of Parenting Practices

The review included (i) any type of behaviour that the parent displayed towards the child including communicative behaviours (e.g., contingent responsiveness, lexical diversity), supportive behaviours (e.g., scaffolding, autonomy encouragement), socialisation behaviours (e.g., modelling emotion regulation strategies, engaging in rough-and-tumble play) and (ii) the home learning environment (i.e., learning resources, educational activities).

Types of Outcomes

The review included studies that assessed child performance on (i) standardised measures of school readiness (e.g., Woodcock-Johnson Psycho-Educational Battery) and (ii) measures of children's development across domains that are directly related to school readiness including language, cognitive, socio-emotional, and behavioural development collected during the transition to school.

Search Methods for Identification of Studies

Information Sources

Four databases that are frequently searched in reviews of education research were selected for this review. These included PsycINFO, PsycARTICLES, ERIC, and PubMed.

Search

Following a scoping review of the literature and consultation with field experts the following keywords were identified: parent, mother, father, preschool, kindergarten, early childhood, school readiness and school preparedness. Subsequently, search options inclusive of Boolean operators, MESH terms and truncation operators were performed to combine searches for each database. All searches were conducted on April 15, 2021. The full search strategy is included in the supplementary material (see Appendix A here).

Data Collection and Analysis

All three authors of the present paper were involved in screening studies for eligibility and in the data extraction process.

Study Selection

All identified studies were imported into the online software Covidence (https://www.covidence.org). Studies were screened for relevance based on titles and abstracts and later based on full texts by pairs of two independent reviewers.

Data Extraction and Management

Following full text screening, data were extracted from studies by pairs of two independent reviewers in accordance with the inclusion and exclusion criteria.

Information regarding characteristics of the study population (i.e., age, ethnicity, sex, education, and socioeconomic status), research design, country of origin, parenting practices, child outcomes, method of assessment and key findings was extracted.

Risk of Bias in Included Studies

Quality assessment of included studies was assessed using the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools). The tool offers a framework which allows assessment of risk of bias, namely the risk of either under or overestimating the observed effects otherwise known as internal validity. All studies were appraised in terms of having a 'Low', 'High' or 'Unclear' risk of bias across 14 domains. For each domain, studies that were rated as having a 'High' or 'Unclear' risk received a score of '1' whereas studies that were rated as 'Low' in risk received a score of '0'. Scores were summed across domains to give an overall risk-of-bias score. Studies with an overall score of '0-5' were considered to have low risk-of-bias, scores of '6-10' indicated moderate risk-of-bias and scores of '11-15' indicated high risk-of-bias. Full description of quality assessment domains is provided in Table S1 in Appendix B here.

Qualitative Synthesis

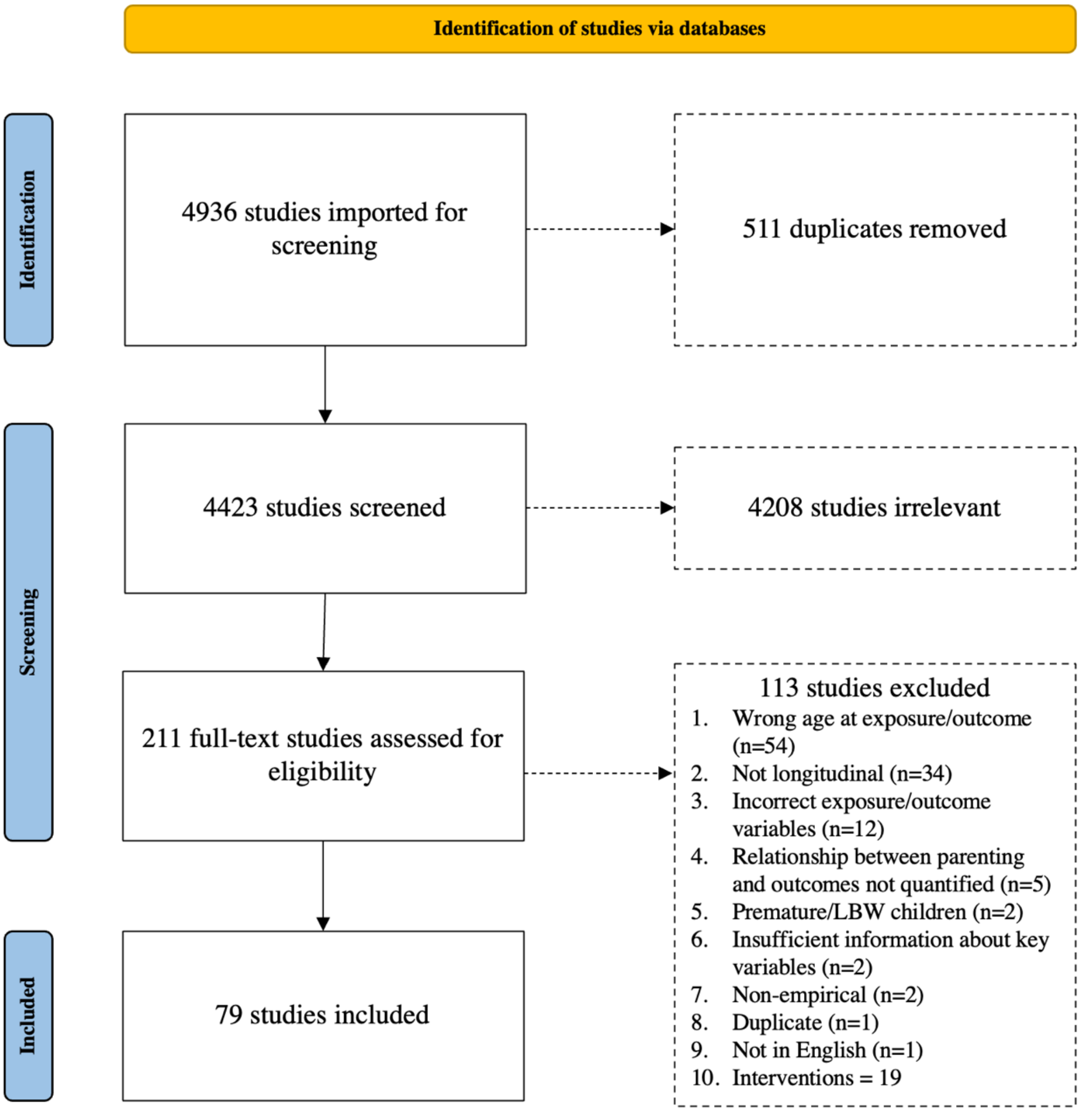
Following data extraction, a narrative synthesis approach was performed whereby similarities and differences across parenting practices and child outcomes were examined. A description of country of origin, study design, number of participants, child sex breakdown, parenting practices, child outcomes, child age and key findings for each individual study is provided in Table S2 in Appendix C in supplementary material (here)Demographic information, confounders/covariates considered and duration of follow up for each individual study is presented in Table S4 in Appendix D in supplementary material here . Although, in its present state, this review presents findings in a binary manner, it is currently under revision to also include a meta-analysis and therefore provide a more nuanced synthesis of results.

Results

Study Selection

Results of the systematic search are presented in a PRISMA flow diagram (see Figure S1 in Appendix E). Following the removal of 511 duplicates, the search yielded 4423 potentially eligible studies. Following Title and Abstract screening there were 98 studies remaining for full text review. Of the 98 studies, 79 met the inclusion criteria (reasons for study exclusion, and number of studies screened at each stage are provided in the PRISMA diagram in Figure 3.1). At each stage of the screening process, studies were assessed by two independent reviewers. All references of included studies are presented in Appendix F in supplementary material (here).

Figure 3.1
PRISMA flow diagram of all included and excluded studies in the systematic review



Study Characteristics

Quality of Studies Included in the Review

Following quality assessment 84.81% of studies were classified as low risk-of-bias and the remaining 15.19% were considered moderate risk-of-bias. Individual risk-of-bias scores are presented Table S5 in appendix G (here)

Participant Characteristics

Participant characteristics of studies included in the review are presented in Table 1.1.

Table 1.1

Characteristics of All Studies Included in the Review.

Characteristic	K	%	Characteristic	M (SD)/K	Min-Max/%
Year of Publication			**Parent Included**		
<1999	4	5.1	Mothers	50	63.3
2000-2009	4	5.1	Fathers	1	1.3
2010-2019	52	65.8	Both	18	22.8
2020-2021	19	24.1	Unclear	10	12.7
Sample Size			**Child Sex**		
<100	12	15.2	0-30% male	1	1.3
100-500	23	29.1	31-70 % male	69	87.3
500-1000	12	15.2	71-100% male	1	1.3
>1000	32	40.5	Not reported	8	10.1
Study Design			**Child Age (months)**		
Longitudinal	43	54.4	Exposure	31.94 (16.44)	4.66-68.4
Cohort	36	45.6	Outcome	59.44 (8.47)	42-84
Country of Origin			**Parent Age (years)**		
US	66	83.5	Mothers	27.91 (4.41)	18.93-36.37
UK	2	2.5	Fathers	32.92 (3.37)	28.52-39.09
Australia	3	3.8	**Follow-Up Duration**		
Canada	3	3.8	Months	26.32 (15.28)	4-60
China	2	2.5			
Finland	2	2.5			
Chile	1	1.3			

Note. Fathers' age was not reported in 23 studies and mothers' age was not reported in 43.

Summary of Results by Parenting Domain

The systematic review identified four overarching parenting domains, namely, sensitivity, cognitive stimulation, the HLE, and involvement in early childhood education (ECE), as predictors of children's school readiness. An overview of the parenting practices within each domain is provided in Figure 1.1.

Child school readiness outcomes identified included language, cognitive skills (including EF, IQ, effortful control, and attention regulation), numeracy and literacy skills, social-emotional and behavioural competence (including internalising and externalising behaviours and adjustment problems), approaches to learning, daily living skills, mastery motivation, task orientation, persistence, work habits, loneliness and overall school readiness as measured by comprehensive screening instruments (e.g., Woodcock-Johnson Tests of achievement; see Table S6 in Appendix F for a detailed description of assessment of both parent and child variables within each individual study here.

Parental Sensitivity and Children's School Readiness

Parental sensitivity was examined by 30 studies, comprising 37.97% of the studies reviewed. Of these, 57.58% assessed parental sensitivity via observation, 33.33% via parent report, while the remaining studies used a combination of either observation and parent report, direct assessment and parent report, or teacher perception (3.03% respectively). With regards to children's school readiness, 48.48% measured child outcomes via direct assessment, 18.18% via a combination of direct assessment and parent (15.15%) or teacher (9.09%) report, via teacher or parent report only (6.07%), with the remaining studies via a combination of teacher, parent, and child report, with some including observational measures also (3.03% respectively).

Eleven child outcomes were assessed in relation to parental sensitivity, namely language, including receptive and expressive vocabulary (k=13), cognition, including children's EF and IQ (k=7), numeracy skills (k=12), literacy skills (k=12) social-emotional and behavioural competence such as peer-satisfaction, problem behaviours, inattention, consideration, hostility, and delay of gratification (k=19), overall school readiness (k=7), approaches to learning (k=1), mastery motivation (k=1) and persistence (k=1), task orientation (k=1), daily living skills (k=1), preacademic work habits (k=1), and children's experience of loneliness (k=1). Sample size, risk-of-bias classification, and duration of follow-up for each individual study are presented in Table 1.2.

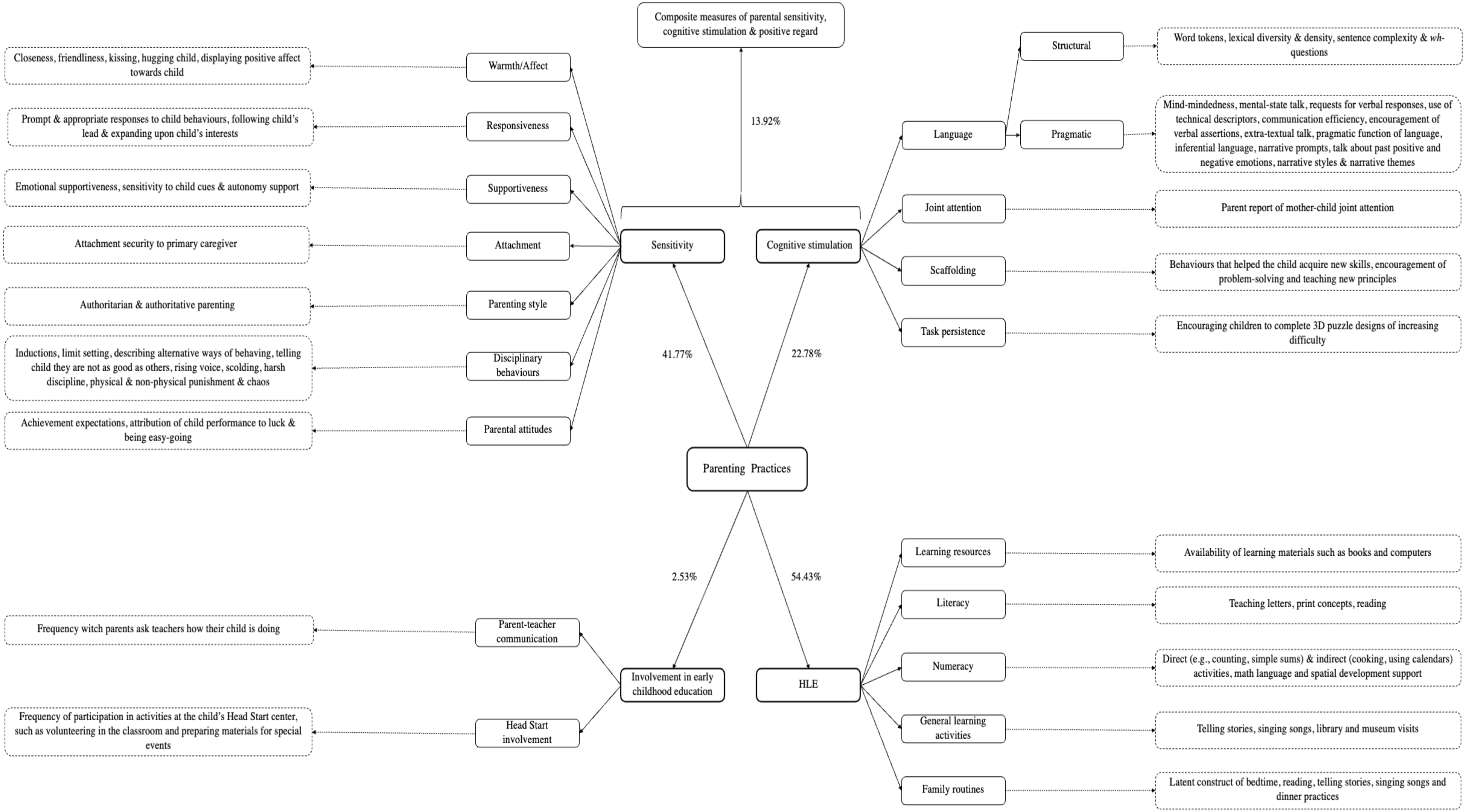
Children's Language. Results indicated positive relations between parental sensitivity and children's language in seven studies (see studies 4, 10, 19-21, 25, 29 in Table 2). Of these, one study found that sensitive behaviours related differentially with children's language as a function of family socioeconomic status (see study 21 in Table 2). In contrast, five studies reported non-significant associations with child language (see studies 12, 15, 23, 26, 30 in Table 1.2).

Children's Cognitive Skills. Parental sensitive behaviours showed positive relations with children's cognition in three studies (see studies 3, 4, 6 in Table 2) whereas four studies reported non-significant links (see studies 8, 16, 21, 30 in Table 1.2).

Children's Numeracy Skills. Of the ten studies that examined numeracy, nine reported significant links with children's numeracy skills. Of these, eight showed positive associations with children's numeracy (see studies 7, 12, 15-18, 20, 23 in Table 1.2) with one reporting significant links for mothers, but not fathers (see study 23 in Table 1.2). A further study showed that behaviours such as describing alternative ways of behaving were positively linked with children's math performance whereas raising voice, scolding, yelling, and non-physical punishment were negatively linked (see study 29 in Table 1.2). However, one study reported non-significant associations (see study 1 in Table 1.2).

Figure 1.1.

Flowchart Providing an Overview of the Types of Parenting Practices Within Each Parenting Construct.



Note. % = percentage of studies in the review that assessed respective parenting construct; Totals exceed 100% as many studies assessed multiple parenting practices.

Children's Literacy Skills. With regards to children's literacy, six studies reported positive significant links (see studies 7, 12, 15, 16-18 in Table 1.2) whereas four reported non-significant associations (see studies 1, 5, 20, 23 in Table 1.2).

Children's Social-Emotional and Behavioural Competence. Of the 17 studies that examined social-emotional and behavioural competence as outcomes in relation to parental sensitivity, 11 found significant positive associations (see studies 3, 15, 17, 19, 21, 22, 25-28 in Table 1.2). Of these, one study found that sensitive behaviours related differentially with children's externalising problems as a function of family socioeconomic status (see study 21 in Table 1.2). A further study found that low sensitivity, such as controlling behaviour, was related with children's behaviour problems through parental spanking (see study 1 in Table 1.2). However, six studies did not identify significant effects (see studies 4, 14, 18, 20, 24, 30 in Table 1.2).

Children's Overall School Readiness. Of the seven studies that assessed parental sensitivity as a predictor of children's overall school readiness, six reported significant effects. Five found direct positive associations (see studies 6, 9, 11, 13, 24 in Table 1.2), whereas one study found that maternal sensitivity was a significant predictor of school readiness only among children who began school with average preacademic skills (see study 14 in Table 1.2). Specifically, among children with average preacademic skills, authoritarian parenting increased the likelihood that these children would remain within the average group or would be at-risk of moving to a lower-performing group. One study however reported non-significant effects (see study 30 in Table 1.2).

Children's Mastery Motivation, Task Persistence and Task Orientation. Neither mastery motivation (see study 13 in Table 1.2) nor task persistence (see study

20 in Table 1.2) showed significant links with parental sensitivity. Similarly, there were no significant associations with children's task orientation (see study 13 in Table 1.2).

Table 1.2
Associations Between Parental Sensitivity and Children's School Readiness

Study	Authors	N	Risk-of-Bias	Follow-Up (months)	Association												
					LG	C	N	L	SEB	SR	MM	TP	TO	AL	DLS	PWH	LN
1	Ansari & Gershoff (2016)	1020	Low	24			Ns	Ns	+					+			
2	Barth & Parke (1993)	45	Moderate	6													+
3	Bernier et al. (2020)	225	Low	57		+			+								
4	Bono et al. (2016)	122	Low	48	+	+			Ns								
5	Delgado & Stoll (2015)	4550	Low	60				Ns									
6	Estrada et al. (1987)	67	Moderate	12-24		+				+							
7	Gibbs & Forste (2014)	7500	Low	39			+	+									
8	Helm et al. (2020)	151	Low	24		Ns											
9	Hess et al. (1984)	47	Moderate	12						+							
10	Hughes et al. (2018)	568	Low	6	+				+						+		
11	Kriebel & Brown (2020)	130	Low	6-9						+							
12	Leerkes et al. (2011)	263	Low	12	Ns		+	+								Ns	
13	MacPhee et al. (2018)	207	Low	12						+	Ns		Ns				
14	McWayne et al. (2012)	2236	Low	12-24					Ns	+							
15	Merz et al. (2015)	209	Low	12	Ns		+	+	+								
16	Meuwissen & Carlson (2018)	89	Low	20		Ns	+	+									
17	Mollborn & Dennis (2012)	800	Low	28			+	+	+								
18	Nelson et al. (2016)	4800	Low	36-48			+	+	Ns								
19	Parker et al. (1999)	173	Low	9	+				+								
20	Prendergast & MacPhee (2018)	2977	Low	24-36	+		+	Ns	Ns			Ns					
21	Razza et al. (2010)	1046	Low	24	+	Ns			+								
22	Razza & Raymond (2013)	1007	Low	18 & 24					+								
23	Ren et al. (2020)	336	Low	7	Ns		+	Ns									
24	Ruberry et al. (2018)	306	Low	36					Ns	+							
25	Russell et al. (2016)	1264	Low	18-57	+												
26	Tompkins & Villaruel (2020)	37	Moderate	4	Ns				+								
27	Vernon-Feagans et al. (2016)	1145	Low	22					+								
28	Walls & Pellerin (2020)	450	Low	24					+								
29	Weegar et al. (2018)	5513	Low	24	+		+										
30	Zajicek-Farber et al. (2014)	2977	Low	24	Ns	Ns			Ns	Ns							

Note. + = positive association; - = negative association; Ns = non-significant association; LG = Language; C = Cognition; N=Numeracy; L = Literacy; SEB = Social-Emotional and Behavioural; SR = School Readiness; MM = Mastery Motivation; TP = Task Persistence; TO = Task Orientation; AL = Approaches to Learning; DLS = Daily Living Skills; PWH = Preacademic Work Habits; LN = Loneliness

Children's Approaches to Learning. Although there were no direct links between parental sensitive behaviours and children's approaches to learning, one study did identify that controlling behaviour was linked with lower approaches to learning through spanking (see study 1 in Table 1.3).

Children's Daily Living Skills and Preacademic Work Habits. One study reported that teacher perceived parental supportiveness positively related to children's daily living skills (see study 10 in Table 1.2), whereas another study found no significant links between sensitivity and children's pre-academic work habits (see study 12 in Table 1.2).

Children's Experience of Loneliness. Only one study included child report with regards to school readiness (see study 2 in Table 1.2). Findings showed that whereas mothers' sensitivity during interaction was associated with children's experiences of loneliness, this was not the case for fathers. However, the study displayed moderate risk-of-bias, had a small sample size of 45 participants, and short duration of follow-up (6 months; see study 2 in Table 1.2).

Parental Cognitive Stimulation and Children's School Readiness

Twenty studies examined parental cognitive stimulation in relation to children's school readiness, making up 25.32% of the review. Of these, 83.33% assessed parenting behaviours via observational methods, 11.11% used a combination of observational methods and parent report, and 5.56% used observation and direct assessment. Children's outcomes were assessed through direct assessment in 33.33% of studies, through direct assessment and observation in 16.67% of studies, through direct assessment and parent report, through direct assessment, observation, and teacher report and through teacher report only in a further 11.11% respectively. A combination of direct assessment and teacher report was used in 5.56% and a similar 5.56% used parent report and observation.

Seven child outcomes were examined in relation to parental cognitive stimulation. These included child language, such as oral language, vocabulary, narrative contributions and emotional content of narratives (k=10), cognition in terms of effortful control (k=2), numeracy (k=6), literacy skills (k=6), social-emotional and behavioural competence such as emotion knowledge, externalising and internalising behaviours, self-regulation and prosocial behaviour (k=7), overall school readiness (k=6), mastery motivation (k=1), and preacademic work habits (k=1). Sample size, risk-of-bias classification, and duration of follow-up for each individual study are presented in Table 1.3.

Children's Language. Of the 11 studies that assessed children's language outcomes, six reported positive significant associations (see studies 1, 2, 12-14, 16 in Table 1.3). Of these, one study found that parental inferential language was positively linked with children's language skills only among children with above average language skills at baseline but not among children with below average language skills at baseline (see study 12 in Table 1.3). A second study found that associations between parental stimulation and child language differed as a function of socioeconomic status (see study 14 in Table 1.3). Conversely, five studies reported non-significant links between parental cognitive stimulation and children's language outcomes (see studies 3, 4, 9, 10, 18 in Table 1.3).

Children's Cognitive Skills. Of the studies that examined child cognition one found that mothers' mind-mindedness was related to child effortful control, however, this association was mediated by children's language skills (see study 2 in Table 1.3). The second study did not report any significant effects (see study 14 in Table 1.3).

Children's Numeracy Skills. Of the six studies that examined children's numeracy skills, three reported significant relations with parental cognitive stimulation (see studies 1, 19, 20 in Table 1.3) and three reported non- significant links (see studies 6, 9, 12 in Table 1.3).

Children's Literacy Skills. Of the six studies that focused on literacy, only one reported significant positive effects (see study 1 in Table 1.3) whereas the rest found non- significant associations (see studies 6, 9, 12, 13, 18 in Table 1.3).

Children's Social-Emotional and Behavioural Competence. With regards to social-emotional and behavioural competence, four studies reported significant links with parents' cognitive stimulation (see studies 5, 8, 10, 14 in Table 1.3) and three did not report any significant associations (see studies 12, 17, 18 in Table 1.3). Again, of these, one study found the link between stimulation and children's externalising problems to vary in accordance with family socioeconomic status (see study 14 in Table 1.3).

Children's Overall School Readiness. Of the six studies that examined children's overall school readiness, two studies found direct significant positive associations (see studies 7, 8 in Table 1.3) and two found significant positive indirect relations (see studies 2, 3 in Table 1.3). Specifically, maternal mind-mindedness was found to predict children's school readiness via child effortful control and language skills (see study 2 in Table 1.3). Similarly, mothers wh-questions and lexical diversity related to child school readiness though children's language skills at pre-kindergarten age (see study 3 in Table 1.3). The remaining two studies found no significant effects (see studies 5, 17 in Table 1.3).

Children's Mastery Motivation. The study that assessed child mastery motivation as an outcome found that dyadic persistence was associated with children's social mastery motivation with teachers and peers but not with object mastery motivation (see study 11 in Table 1.3). However, the study was classified as moderate risk-of-bias, having a score towards the upper limit. Moreover, although there were 100 participants, length of follow up was only 4 months.

Children's Preacademic Work Habits. One study reported that parental cognitive stimulation did not relate significantly to children's preacademic work habits (see study 9 in Table 1.3).

Composite Parental Sensitivity and Cognitive Stimulation and Children's School Readiness

There were 13 studies that examined a composite of parental sensitivity and cognitive stimulation as a predictor of children's school readiness, making up 16.46% of the review. Within all these studies parenting was examined via observational measures. Children's outcomes were examined via direct assessment in 54.55% of the studies, via a combination of direct assessment and parent report in 18.18%, via direct assessment and teacher report in 9.09% and via teacher report only in a further 9.09%.

There were seven child outcomes assessed in relation to parental sensitivity and cognitive stimulation. These included child language (k=6), cognition (k=1), numeracy (k=6), literacy (k=7), social- emotional and behavioural competence (k=8), overall school readiness (k=2), approaches to learning (k=1) and persistence (k=1). Sample size, risk-of-bias classification, and duration of follow-up for each individual study are presented in Table 1.4.

Children's Language. Of the six studies that examined children's language outcomes, all reported statistically significant positive associations with parent sensitivity and cognitive stimulation (see studies 3, 5, 7, 8, 11, 13 in Table 1.4).

Children's Cognitive Skills. Similarly, the study that examined children's cognition also found that it was positively predicted by parent sensitivity and cognitive stimulation (see study 8 in Table 1.4).

Children's Numeracy Skills. Six of the eight studies that examined children's numeracy skills reported significant associations (see studies 1, 2, 5, 7, 11, 13 in Table 1.4) and two found no significant effects (see studies 9, 12 in Table 1.4).

Children's Literacy Skills. Seven of the nine studies that examined children's literacy reported significant positive effects (see studies 2, 3, 5, 7, 11, 12, 13 in Table 1.4) and two reported non-significant effects (see studies 1, 9 in Table 1.4).

Children's Social-Emotional and Behavioural Competence. Of the nine studies that examined children's outcomes in terms of social-emotional and behavioural competence, six found significant positive associations (see studies 3, 7, 8, 10-13 in Table 1.4) whereas two found non-significant associations (see studies 4, 9 in Table 1.4).

Children's Overall School Readiness. With regards to overall school readiness, all three studies reported significant positive effects (see studies 6, 8, 10 in Table 1.4). Of these, one found that mothers' and fathers' sensitivity and stimulation were differentially, yet complementarily, related to children's school readiness (see study 6 in Table 1.4).

Children's Approaches to Learning. The one study that examined children's approaches to learning found that it was unrelated to mothers' sensitivity and cognitive stimulation (see study 3 in Table 1.4).

Children's Persistence. Similarly, the study that focused on child persistence as an outcome found it to be non-significantly related to maternal scaffolding (see study 11 in Table 1.4).

The Home Learning Environment and Children's School Readiness

Forty-three studies examined the HLE in relation to children's school readiness, comprising 54.43% of the review. Of these, 67.44% assessed the HLE via parent report whereas 32.56% used observational measures. With regards to child outcomes, 60.47% of studies used direct assessment, 16.28% used direct assessment with parent report, 6.98% used direct assessment with teacher report, 4.65% used teacher report only, 2.33% used parent report only, direct assessment and observation, teacher report and observation, direct assessment, teacher, and parent report and a combination of direct assessment, observation, parent and teacher report respectively.

Eight child outcomes were assessed in relation to the HLE, specifically children's language (k=21), cognition including attention regulation (k=5), numeracy (k=24), literacy (k=24), social-emotional and behavioural competence (k=17), overall school readiness (k=5), preacademic work habits (k=1), and approaches to learning (k=2). Sample size, risk-of-bias, and follow-up duration for all studies are presented in Table 1.5.

Children's Language. Sixteen studies reported significant positive relations between the HLE and children's language skills (see studies 4, 5, 7, 11-14, 16, 19, 28, 30, 34, 35, 37, 39, 42 in Table 1.5). Of these, one found differing relations between the HLE and children's language depending on family socioeconomic status (see study 30 in Table 1.5). In contrast, five studies found no evidence for statistically significant links between the HLE and children's language (see studies 10, 20, 27, 31, 43 in Table 1.5).

Children's Cognitive Skills. Of the five studies that assessed child cognition three found that it was significantly positively predicted by the HLE (see studies 4, 14, 22 in Table 1.5). The remaining two studies reported non-significant links (see studies 30, 43 in Table 1.5).

Children's Numeracy Skills. Findings pertaining to numeracy indicate that there were positive significant relations with the HLE in 17 studies (see studies 8, 9, 11, 12, 15-19, 22, 24-26, 32, 33,39,40, 42 in Table 1.5). However, 7 reported non-significant relations between the HLE and numeracy (see studies 2, 3, 10 ,13, 31, 36, 37 in Table 1.5).

Children's Literacy Skills. With regards to literacy, significant positive effects were identified in 21 studies (see studies 2, 3, 5, 6, 8, 9, 11, 15, 16, 18, 22, 23, 24-26, 31-33, 35, 39, 40 in Table 1.5). However, of these, one found that only mothers', but not fathers' report of home learning stimulation activities was related to children's reading (see study 2 In Table 1.5). Three studies reported non-significant effects (see studies 10, 27, 37 in Table 1.5).

Children's Social-Emotional and Behavioural Competence. Eighteen studies examined social-emotional and behavioural competence. Of these, 13 reported significantly positive associations with the HLE (see studies 5, 8, 13, 14, 24, 25, 28, 30, 33-35, 38, 41 in Table 1.5). Moreover, one study reported an additional negative association between frequency with which child helped with household tasks and children's lower task-orientation, higher disruption, and lower compliance (see study 28 in Table 1.5). In another study, the positive associations were found to vary as a function of socioeconomic status (see study 30 in Table 1.5). The remaining five studies found non-significant links between the HLE and children's social-emotional and behavioural competence (see studies 4, 20, 21, 31, 43 in Table 1.5).

Children's Overall School Readiness. Finally, of the five studies that assessed overall school readiness three reported significant positive links (see studies 1, 29, 38 in Table 1.5) and two reported non-significant effects (see studies 21, 43 in Table 1.5).

Children's Approaches to Learning. Both studies that focused on children's approaches to learning found that they were positively significantly linked with the HLE (see studies 5, 26 in Table 1.5)

Children's Preacademic Work Habits. The one study that examined children's preacademic work habits found that it was not significantly predicted by the HLE (see study 16 in Table 1.5).

Involvement in Early Childhood Education

Only two studies focused on relations between parental involvement in early childhood education (ECE) and children's school readiness, representing 2.53% of the review. One of these studies assessed parental involvement via teacher report whereas the second used observational measures. Children's outcomes were measured through direct assessment in both studies. There were two outcomes of interest with regards to parent involvement in ECE, namely social-emotional and behavioural competence (K=1) and overall school readiness (K=2). Sample size, risk-of-bias classification, and duration of follow-up for each individual study are presented in Table 1.6.

Children's Social-Emotional and Behavioural Competence. Findings indicated that among children identified as having behavioural problems at home, parent involvement in Head Start served as a protective factor, increasing children's chances of moving from a low-average to a high-average preacademic performance profile (see study 2 in Table 1.6).

Children's School Readiness. One study found that parent involvement in Head Start served as a protective factor with children whose parents were involved in center-based activities being more likely to move from an average preacademic profile to a high preacademic performance profile (see study 2 in Table 1.6). The second study found no significant relations between parent-teacher preschool communication and children's school readiness (see study 1 in Table 1.6).

Table 1.3

Associations between Parental Cognitive Stimulation and Children's School Readiness.

Study	Authors	N	Risk-of-Bias	Follow-Up (months)	Association LG	C	N	L	SEB	SR	MM	PWH
1	Barnett et al. (2020)	2250	Low	24	+		+	+				
2	Bernier et al. (2017)	204	Low	60	+	+				+		
3	Cristofaro & Tamis-LeMonda (2011)	75	Low	24	Ns					+		
4	Farrant & Zubrick (2013)	2369	Low	24	Ns							
5	Garner & Toney (2020)	120	Moderate	4-5					+	Ns		
6	Gibbs & Forste (2014)	7500	Low	39			Ns	Ns				
7	Hess et al. (1984)	47	Moderate	12						+		
8	Jahromi et al. (2018)	204	Low	36					+	+		
9	Leerkes et al. (2011)	263	Low	12	Ns		Ns	Ns				Ns
10	Leyva et al. (2014)	65	Low	6	Ns				+			
11	Lunkenheimer & Wang (2017)	100	Moderate	4							+	
12	Merz et al. (2015)	209	Low	12	+		Ns	Ns	Ns			
13	Neuman et al. (2018)	70	Low	~ 9	+			Ns				
14	Razza et al. (2010)	1046	Low	24	+	Ns			+			
15	Razza & Raymond (2013)	1007	Low	18 & 24								
16	Rowe et al. (2012)	62	Low	32	+							
17	Ruberry et al. (2018)	306	Low	36					Ns	Ns		
18	Schick & Melzi (2016)	127	Moderate	~ 9	Ns			Ns	Ns			
19	Sorariutta & Silven (2018)	66	Low	12-24			+					
20	Sorariutta & Silven (2017)	66	low	24-36			+					

Note. + = positive association; - = negative association; Ns = non-significant association; ~ = approximate duration due to unclear report within respective study; LG = Language; C = Cognition; N=Numeracy; L = Literacy; SEB = Social-Emotional and Behavioural; SR = School Readiness; MM = Mastery Motivation; PWH = Preacademic Work Habits.

Table 1.4

Associations between Composite Parental Sensitivity and Cognitive Stimulation and Children's School Readiness.

Study	Authors	N	Risk-of-Bias	Follow-Up (months)	Association LG	C	N	L	SEB	SR	AL	P
1	Caughy et al. (2020)	312	Low	24			+	Ns				
2	Caughy et al. (2017)	333	Low	24			+	+				
3	Chazan-Cohen et al. (2009)	1273	Low	49	+			+	+		Ns	
4	Hartz & Williford (2015)	1100	Moderate	36-48					Ns			

5	Martin et al. (2013)	1771	Low	24-48	+		+	+				
6	Martin et al. (2010)	723	Low	15-16						+		
7	Martoccio et al. (2014)	127	Low	~47	+			+	+			
8	Allhusen et al. (2003)	1002	Low	45	+	+			+	+		
9	Palermo et al. (2019)	714	Moderate	12-36			Ns	Ns	Ns			
10	Palermo et al. (2018)	714	Low	~24					+	+		
11	Prendergast & MacPhee (2018)	2977	Low	24-36	+		+	+	+			Ns
12	Rispoli et al. (2019)	4550	Low	28-43			Ns	+	+			
13	Tamis-LeMonda et al. (2019)	2204	Low	12-60	+		+	+	+			

Note. + = positive association; - = negative association; Ns = non-significant association; ~ = approximate duration due to unclear report within respective study; LG = Language; C = Cognition; N=Numeracy; L = Literacy; SEB = Social-Emotional and Behavioural; SR = School Readiness; AL = Approaches to Learning; P = Persistence.

Table 1.5

Associations between the HLE and Children's Language, Cognitive, Numeracy, Literacy, Social-Emotional and Behavioural Skills, and School Readiness.

Study	Authors	N	Risk-of-Bias	Follow-Up	Association							
				(months)	LG	C	N	L	SEB	SR	AL	PWH
1	Ansari & Crosnoe (2015)	6250	Low	24						+		
2	Baker (2018)	880	Low	36			Ns	+				
3	Baker (2014)	826	Low	24			Ns	+				
4	Bono et al. (2016)	122	Low	48	+	+			Ns			
5	Chazan-Cohen et al. (2019)	1273	Low	49	+			+	+		+	
6	Delgado & Stoll (2015)	4550	Low	60				+				
7	Farrant & Zubrick (2013)	2369	Low	24	+							
8	Ferretti & Bub (2017)	3250	Low	15			+	+	+			
9	Gibbs & Forste (2014)	7500	Low	39			+	+				
10	Iruka (2020)	700	Low	12	Ns		Ns	Ns				
11	Iruka et al. (2012)	9282	Low	~30			+	+				
12	King & Purpura (2021)	125	Moderate	4	+		+					
13	King et al. (2020)	1364	Low	18	+		Ns		+			
14	Korucu & Schmitt (2020)	4898	Low	24	+	+			+			
15	Koury & Votruba-Drzal (2014)	6350	Low	36			+	+				
16	Leerkes et al. (2011)	263	Low	12	+		+	+				NS
17	Lombardi & Dearing (2021)	140	Low	36-48			+					
18	Lombardi et al. (2017)	140	Low	36-48			+	+				
19	McCormick et al. (2020)	307	Low	6-7	+		+					
20	McKean et al. (2016)	1398	Low	24-26	Ns				Ns			
21	McWayne et al. (2012)	2236	Low	12-24					Ns	Ns		

22	Melhuish et al. (2008)	2558	Low	12-24		+	+	+			
23	Merz et al., (2014)	226	Low	~17				+			
24	Mollborn & Dennis (2012)	800	Low	28			+	+	+		
25	Nelson et al. (2016)	4800	Low	36-48			+	+	+		
26	Nelson (2005)	14880	Low	Unclear			+	+			+
27	Neuman et al. (2018)	70	Moderate	~9	Ns			Ns			
28	Parker et al. (1999)	173	Low	9	+				+		
29	Prior et al. (2011)	1005	Low	12						+	
30	Razza et al. (2010)	1046	Low	24	+	Ns			+		
31	Ren et al. (2021)	588	Low	6-12	Ns		Ns	+	Ns		
32	Riser et al. (2020)	650	Low	30			+	+			
33	Rispoli et al. (2019)	4550	Low	28-43			+	+	+		
34	Russell et al. (2016)	1264	Low	18-57	+				+		
35	Schick & Melzi (2016)	127	Moderate	~9	+			+	+		
36	Son & Hur (2020)	46	Moderate	6-9			Ns				
37	Son & Morrison (2010)	1080	Low	18	+		Ns	Ns			
38	Son & Peterson (2017)	897	Low	18					+	+	
39	Tamis-LeMonda et al. (2019)	2204	Low	12-60	+		+	+			
40	Votruba-Drzal et al. (2013)	6350	Low	36			+	+			
41	Walls & Pellerin (2020)	450	Low	24					+		
42	Weegar et al. (2018)	5513	Low	24	+		+				
43	Zajicek-Farber et al. (2014)	2977	Low	24	Ns	Ns			Ns	Ns	

Note. + = positive association; - = negative association; Ns = non-significant association; ; LG = Language; C = Cognition; N=Numeracy; L = Literacy; SEB = Social-Emotional and Behavioural; SR = School Readiness; AL = Approaches to Learning; PWH = Preacademic Work Habits

Table 1.6

Associations between Parental Involvement in Early Childhood Education and Children's Social-Emotional and Behavioural Competence and School Readiness

Study	**Authors**	**N**	**Risk-of-Bias**	**Follow-Up (months)**	**Association**	
					SEB	**SR**
1	Iruka et al. (2020)	700	Low	12		Ns
2	McWayne et al. (2012)	2236	Low	~12	+	+

Note. + = positive association; - = negative association; Ns = non-significant association; SEB = Social-Emotional and Behavioural; SR = School Readiness.

Discussion

The transition to formal schooling is an important milestone of childhood. During this time children largely set the course for their academic careers (Lee & Burkham, 2002), future employment status (Rouse et al., 2005) and psychological wellbeing (Brooks-Gunn, 2003). Yet, a successful academic start requires children to possess the necessary cognitive and social skills to effectively engage with the school environment. Given that prior to school entry parents represent children's key socialising agents, the present systematic review aimed to identify which parenting practices early in development are positively associated with children's school readiness.

The review identified 79 studies that examined children's school readiness. Findings suggest that research on school readiness has primarily focused on the HLE, followed by parental sensitivity with less focus on parental cognitive stimulation and negligible attention to parental involvement in ECE. In addition, some studies examined how composites of parental sensitivity and cognitive stimulation relate to children's school readiness.

The primary child outcomes examined were children's language, cognition, numeracy, literacy, social-emotional and behavioural competence, and overall school readiness. There was a relatively smaller proportion of studies that focused on children's mastery motivation, task orientation and persistence, approaches to learning, daily living skills, preacademic work habits and children's experience of loneliness. These findings suggest that the child development field primarily considers cognitive and social skills to be indicative of school readiness. This observation highlights that, despite theoretical arguments for a shift towards defining school readiness in terms of a wider range of competencies, this concept is nevertheless narrowly defined within the research field. Yet, it is likely that children depend upon motivation to engage with school material, and that children with more efficient work habits are better equipped to learn, achieve and to evoke positive reinforcement from teachers. Likewise, children who can readily adapt to novel and academically demanding environments, who are creative and efficient problem solvers and who can effortlessly transition from one task to another are more likely to thrive in a scholastic environment. Hence, an important next step in the school readiness literature is to diversify the range of indices assumed to be reflective of school readiness in order to mitigate the risk of suggesting that certain domains of development are more important than others for early school adjustment (e.g., Snow, 2006).

It is noteworthy that while the number of studies eligible for inclusion in this review is large relative to other systematic reviews, scaled to the abundant research base on parent-child interaction and children's development, it can be regarded as modest. Further, despite the vast research base on school readiness, studies reviewed in this paper were heterogenous and therefore produced mixed findings. Given that some report significant, while others report non-significant effects reaching a firm conclusion regarding the best predictors of school readiness remains a challenge.

Parental Sensitive Behaviours and Children's School Readiness

Findings pertaining to parental sensitive behaviours and children's school readiness are mixed. Some studies suggest that parenting behaviours such as warmth, positive affect, supportiveness, respect for autonomy and disciplinary behaviours are positively related with children's language, cognition (e.g., Bono et al., 2016), numeracy (e.g., Gibbs & Forste, 2014, Weegar et al., 2018), literacy (e.g., Meuwissen & Carlson, 2018, Ansari & Gershoff, 2016), social-emotional and behavioural development (e.g., Vernon-Feagans et al., 2016; Tompkins & Villaruel, 2020) and overall school readiness (e.g., MacPhee et al., 2018). Other studies however report non-significant associations (e.g., Bono et al., 2016 social; Razza et al., 2010; Ren et al., 2020).

One study found that children of mothers who displayed responsiveness and sensitivity were less likely to identify as lonely, and more likely to perceive having positive peer relationships (e.g., Barth & Parke, 1993). Despite the small sample size of 45 participants and short follow-up duration of 6 months, this is the only study that included child report. Although direct assessment, teacher and parent report provide valuable information regarding child development, children's awareness of their competence and social standing is likely to influence their scholastic experience and performance. Hence, while largely omitted from research, children's insight with regards to their readiness to engage with and learn in a formal educational environment holds promise to provide unique insights with regards to the skills and competencies that they invoke, or depend upon, to perform well. Thus, future research might benefit from inclusion of children's own perception of their readiness for school.

Parental expectations for children's educational achievement were positively related to children's numeracy development (e.g., Nelson et al., 2016) and literacy skills (e.g., Nelson et al., 2016) but not to children's social-emotional and behavioural development (e.g., Nelson et al., 2016). These findings are in concert with trends in developmental literature which suggest that, compared to teachers, parents are more likely to endorse child cognitive competencies such as literacy and numeracy while preparing their child for formal education (Mitchell & Brady, 2013). However, in another study parents' kindergarten readiness beliefs did not demonstrate significant relations with children's literacy (e.g., Delgado & Stoll, 2015). It is noteworthy that the study did not report child gender breakdown, maternal age, or whether and which covariates were included in analysis. Thus, it is possible that other factors may have interacted or accounted for the observed null effect.

Mixed findings were identified with regards to parenting styles which showed significant associations with children's overall school readiness (e.g., MacPhee et al., 2018) but were not related to children's social-emotional and behavioural development (e.g., McWayne et al., 2012). Given that both studies measured parenting styles via parent report, these observations further align with documented evidence that parents tend to emphasise cognitive skills over socioemotional functioning as important for school (Mitchell & Brady, 2013).

It is noteworthy that although attachment security was examined by a small proportion of studies, it emerged as an important predictor of children's language (e.g., Russell et al., 2016), cognitive skills, and prosocial behaviour (e.g., Bernier et al., 2020). Considering the large sample sizes and adequate follow-up durations, these studies provide convincing evidence that secure attachments play an important role for children's linguistic and cognitive development. Arguably children who experience positive and responsive interactions with caregivers are more likely to develop strong social skills, including empathy, cooperation, and the ability to form positive relationships with peers and teachers. Likewise, caregivers who engage in responsive and rich verbal interactions with their children contribute to the development of strong communication skills, while the sense of security and trust established early in development allows children to approach new learning experiences with confidence, promoting cognitive growth and problem-solving abilities. Therefore, future studies are encouraged to continue examining how the secure attachment between a child and their caregivers can promote additional skills and competencies that allow children to excel at school

A number of studies focused on less commonly examined indices of school readiness and found that parental discipline was positively related to children's approaches to learning (e.g., Ansari & Gershoff, 2016) and teacher perceived family supportiveness was associated with children's daily living skills (e.g., Hughes et al., 2018). However, emotional support and discipline were not significantly related to children's mastery motivation and task orientation (e.g., MacPhee et al., 2018), task persistence (e.g., Prendergast & MacPhee, 2018) or preacademic work habits (e.g., Leerkes et al., 2011). It is noteworthy that these child competencies have been minimally examined and this niche in research represents scope for future studies to corroborate a link, or lack thereof, between parenting practices and these indices of school readiness.

Parental Cognitive Stimulation and Child School Readiness

Evidence pertaining to parental cognitive stimulation and children's school readiness development is similarly inconclusive. Parental cognitive guidance was found to positively relate to children's language, numeracy, literacy (e.g., Barnett et al., 2020), social-emotional and behavioural competence, and overall school readiness (e.g., Jahromi et al., 2018) in some studies but not in others (e.g., Razza et al., 2010; Gibbs & Forste, 2014; Ruberry et al., 2018). These inconsistent findings may stem from the heterogeneity of measures and assessment methods used to examine behaviours of interest and child outcomes, as well as different sample sizes which ranged from 204 to 7500. Therefore, to allow for a more nuanced interpretation of findings, a next step for the current review is to perform a meta-analysis which will allow for a more meaningful conclusion with regards to the importance of this parenting behaviour for children's school readiness.

Some aspects of parental pragmatic language such as mind-mindedness, mental state talk and inferential language were positively associated with children's language development (e.g., Bernier et al., 2017; Merz et al., 2015), cognitive skills (Bernier et al., 2017), social-emotional and behavioural development (e.g., Garner & Toney, 2020) and overall school readiness (e.g., Bernier et al., 2017). Bernier and colleagues' (2017) study on mind-mindedness is particularly influential as it featured a sample size of 204 participants and a follow-up duration of 60 months with frequent assessments at 1, 2, 3, 4 and 6 years of age (Bernier et al., 2017). Mind-mindedness refers to a parent's sensitivity to their child's emotional states. A caregiver's understanding and appropriate responsiveness to their child's emotions can help the child to learn effective emotional regulation strategies. These in turn may foster a child's management of the social and emotional challenges that arise in a school setting. Further, mind-minded caregivers' responsive and reciprocal interactions with children, acknowledging their thoughts and feelings, can promote the development of strong social skills, including empathy, perspective-taking, and the ability to navigate social situations.

Findings also suggest that caregivers who practice mind-mindedness engage in rich and meaningful conversations with children. This practice supports the development of language and communication skills, which are essential for effective participation in classroom activities, following instructions, and expressing oneself to peers and teachers. In addition, mind-minded caregiving involves recognising and responding to a child's cognitive abilities and interests which may promote cognitive development by encouraging curiosity, exploration, and problem-solving. Thus, not only does it contribute compelling evidence regarding the benefits of parental mind-mindedness but also provides an impetus for further inquiry into the relevance of mind-mindedness to children's school readiness.

However, other aspects of pragmatic language such as narrative prompts, use of cognitive and metacognitive information, talk about past positive and negative emotional experiences, elaborative utterances and pragmatic function of language were not significantly related with children's language, numeracy, literacy, and social-emotional and behavioural competence (e.g., Cristofaro & Tamis-Lemonda, 2011; Leerkes et al., 2011; Leyva et al., 2014; Schick & Melzi, 2016). It is possible that these studies may have been underpowered to detect the likely smaller but real effects of pragmatic language on child school readiness, which may account for the non-significant observations. With one exception (Leerkes et al., 2011), all studies that examined these aspects of pragmatic language featured modest sample sizes while examining numerous associations which may have limited their power. Given the theoretical implications of pragmatic language to child development, future research with larger sample sizes is encouraged to continue examining the role of this verbal behaviour for children's school readiness.

Similarly, some aspects of parents' structural language such as word types and lexical diversity, density and sentence complexity were positively related to children's language (e.g., Neuman et al., 2018; Rowe et al., 2012) but not with children's literacy (e.g., Neuman et al., 2018). In a further study, while parents' *wh*-questions and lexical diversity were not associated with children's language, they did show positive relations with overall school readiness (e.g., Cristofaro & Tamis-Lemonda, 2011). The few significant associations between parents' language and children's language and literacy are surprising given the well-documented association between parent language input and child language development. These inconsistent findings warrant further research into the role of parental cognitive stimulation and children's language development.

Moreover, only one study examined joint attention and found it to be unrelated to child language (Farrant & Zubrick, 2013). This finding contradicts extant research with infants which suggests that joint attention is fundamental to the development of language (Adamson et al., 2019). However, this observation is arguably a function of the measure used to assess child language, specifically 'risk of poor vocabulary'. It is likely that joint attention will show positive, significant relations with alternative child language measures such as those observed during interaction or directly assessed. Hence, an increased focus on the role that joint attention might play for children's school readiness is necessary.

Furthermore, parent-child dyadic task persistence was found to positively relate to children's mastery motivation (e.g., Lunkenheimer & Wang, 2017) whereas displays of cognitive and metacognitive information were not significantly related to children's preacademic work habits (e.g., Leerkes et al., 2011). It is noteworthy that these skills have been subjected to less research interest and thus a conclusion regarding the parenting practices that foster them is elusive. Nevertheless, mastery motivation and efficient work habits are likely to enhance a child's ability to learn and achieve in an academic setting and thus their inclusion in future research is encouraged.

Therefore, while there is some support for the importance of parents' cognitive stimulation and children's school readiness there is also evidence for non-significant associations. Given that many school curricula that children arrive at school with basic numeracy, literacy skills, and social skills it is imperative to continue to examine cognitively stimulating practices that foster the growth of these skills. Future studies should aim to not only replicate existent findings, but also examine alternative parenting constructs that positively impact children's skill development. For instance, although behaviours such as conversational turn-taking, linguistic alignment and contingent responsiveness have been convincingly described as important to child language development, and empirically demonstrated as such with younger children (e.g., Donnelly & Kidd, 2021), their relation to children's preacademic numeracy and literacy remains unexamined.

Composite Parental Sensitivity and Cognitive Stimulation

Findings from studies that examined a composite of parental sensitivity and cognitive stimulation are more aligned. All studies that assessed parenting in terms of sensitivity, cognitive stimulation and positive regard found that it positively predicted children's language (e.g., Tamis-LeMonda et al., 2019), cognitive skills (Allhusen et al., 2003) and overall school readiness (e.g., Martin et al., 2010). Similarly, most studies that examined children's numeracy, literacy, and social-emotional outcomes in relation to parental sensitivity and cognitive stimulation identified positive significant associations (e.g., Caughy et al., 2020; Prendergast & MacPhee, 2018; Tamis-LeMonda et al., 2019) with some reporting non-significant findings (e.g., Caughy et al., 2020; Palermo et al., 2019). In contrast this composite of parenting behaviour did not show significant relations with children's approaches to learning (Chazan-Cohen et al., 2009) nor with children's persistence (Prendergast & MacPhee, 2018). Given the little research focus allocated to these skills their association with parenting practices remains poorly understood.

Overall, these findings suggest that a more comprehensive operationalisation of parenting may result in a more coherent narrative of the parenting practices that are predictive of children's school readiness. It may be that it is not specific parenting practices in isolation that relate to children's school readiness but rather a combination of cognitive stimulation complemented by sensitivity. This hypothesis aligns with Vygotsky's theory of development which suggests that children develop through interactions with more experienced partners who encourage them to develop increasingly sophisticated skills (e.g., cognitive stimulation) within their zones of proximal development (e.g., sensitivity).

The Home Learning Environment and Children's School Readiness

The largest proportion of studies included in the review examined the HLE as a predictor of school readiness. Within this domain studies similarly yielded a divided body of evidence. For instance, comprehensive assessments of the HLE via the Home Observation for Measurement of the Environment (HOME) inventory (Bradley & Caldwell, 1984) have primarily shown positive relations with children's language (e.g., Bono et al., 2016), cognition (e.g., Korucu & Schmitt, 2020), numeracy (e.g., Koury & Votruba-Drzal, 2014), literacy (e.g., Chazan-Cohen et al., 2009), social-emotional and behavioural competence (e.g., Chazan-Cohen et al., 2009), and overall school readiness (e.g., Son & Peterson, 2017). However, there were also non-significant findings reported (e.g., Bono et al., 2016; King et al., 2020; Neuman et al., 2018; Razza et al., 2010).

Similarly, cognitively stimulating activities such as playing board games, storytelling, singing songs and rhymes as well as access to learning resources such as books and computers showed positive relations with children's language (e.g., Leerkes et al., 2011), cognitive skills (Melhuish et al., 2008), numeracy (e.g., Iruka et al., 2012), literacy (e.g., Baker, 2018), social-emotional and behavioural skills (e.g., Rispoli et al., 2019), and overall school readiness (e.g., Ansari & Crosnoe, 2015) in some studies. However, others reported non-significant links (e.g., Iruka, 2020; McKean et al., 2016; McWayne et al., 2012).

The home numeracy environment also showed some positive relations with children's language (e.g., King & Purpura, 2021), numeracy (e.g., Lombardi & Dearing, 2021), literacy (e.g., Ren et al., 2021) and some non-significant ones with language (e.g., Ren et al., 2021), numeracy (e.g., Son & Hur, 2020), literacy (e.g., Ren et al., 2021) and social-emotional and behavioural competence (e.g., Ren et al., 2021). Collectively, these findings highlight the multidimensionality of school readiness and further highlight the enduring difficulty associated with operationalising and defining school readiness. Although findings are inconsistent, making strides within this field is, although challenging, possible. In other words, a synthesis and meta-analysis of findings – an important next step of the current review - can provide more clarity with regards to the early parenting practices that are conducive to school readiness.

The focus on cross domain effects of the home numeracy environment on children's language represents another emergent research area of interest in the child development field. For instance, it has been suggested that home numeracy environments may promote children's language due to the complex verbal explanations that may unfold as parents scaffold children's numeracy skills (Napoli & Purpura, 2018). Furthermore, math-related talk has also been described as one type of decontextualised talk, which is a known contributor to child language development (Ebert et al., 2020). However, the evidence base pertaining to the home numeracy environment and children's school readiness, and more specifically whether it exerts domain specific or also cross domain effects, is scant. Therefore, future studies with a focus on the early numeracy environment will make important contributions to the developmental field as these bear the potential of informing cost-effective parenting and early childhood interventions.

Literacy activities such as print practices were found to positively predict children's language, literacy, and social skills (e.g., Schick & Melzi, 2016). In contrast, the literacy environment did not demonstrate any significant links with children's numeracy skills (Baker, 2018; 2014). However, elsewhere it has been suggested that literacy activities can predict children's numeracy skills just as well as numeracy activities (Manolitsis et al., 2013). Thus, findings of the present review do not align with existing evidence from studies with older children. It is noteworthy that both studies in this review were based on a three-item measure of parent report. It is likely that observational studies may provide more encouraging findings regarding the link between literacy activities and children's numeracy skills.

Family routines were associated with children's social skills in one study (e.g., Ferretti & Bub, 2017) but not in another (Zajicek-Farber et al., 2014). Moreover, family routines were not related to child language, cognitive skills, or overall school readiness (Zajicek-Farber et al., 2014). However, given that only two studies examined this aspect of the HLE, the role that it may play for children's school readiness remains uncertain.

The one aspect of the HLE that consistently emerged as a positive predictor of children's school readiness was shared book reading. Shared reading was positively related to children's language (e.g., Farrant & Zubrick, 2013), numeracy (e.g., Gibbs & Forste, 2014), literacy (e.g., Nelson et al., 2016), social-emotional and behavioural competence (e.g., Walls & Pellerin, 2020) and overall school readiness (e.g., Prior et al., 2011). These findings are encouraging as they highlight that shared reading is an important early childhood practice with positive effects across multiple domains of child development. However, there remains scope for further inquiry into the benefits of shared book reading. For instance, while shared book reading was assessed in terms of parent report of frequency and duration of shared book reading (e.g., Farrant & Zubrick, 2013), more can be learned by examining the effects of dialogic reading. It may be that children's skills are fostered by what parents do to engage the child during reading episodes rather than by the amount of time spent reading. Moreover, it may be useful to examine how picture book shared reading relates to child language as this may prove an effective way of preparing children for school among less literate families.

Only two studies focused on children's approaches to learning, and both found them to be positively related to HOME assessed HLE (Chazan-Cohen et al., 2009) and to cognitively stimulating activities (e.g., Nelson, 2005). In contrast cognitively stimulating activities were not significantly associated with children's preacademic work habits (e.g., Leerkes et al., 2011). Again, given the limited evidence base with regards to these non-cognitive skills, their relation to the HLE remains unclear.

Involvement in Early Childhood Education and Children's School Readiness

Only two studies examined the association between parent involvement in ECE and children's school readiness. Of these, one found that parent involvement in Head Start such as volunteering in the classroom and preparing materials for special events positively predicted children's social-emotional and behavioural competence as well as overall school readiness (McWayne et al., 2012). The second study however found that preschool parent-teacher communication was not associated with school readiness (Iruka, 2020). Yet, given that parent-teacher communication was assessed via one item teacher report (how often parents ask how their child is doing; Iruka, 2020), this finding must be interpreted tentatively.

It is therefore evident that parent involvement in ECE is underrepresented in the school readiness literature. This research gap must be addressed considering a recent meta-analysis which found that parent involvement in older children's education (elementary and secondary school) is positively associated with children's academic achievement, social-emotional adjustment and negatively with children's delinquency (Barger et al., 2019).

Future Directions

According to the present review, there remains a need for continuous research efforts to identify parenting behaviours that consistently relate positively with children's school readiness. It may be particularly useful to examine how distinct parenting domains may work in complementary ways to promote children's school readiness. In addition, there is a need for increased focus on how parent involvement in ECE relates to child outcomes. Existing evidence with older children suggests that it is a positive predictor of children's school adjustment (Barger et al., 2019). Moreover, some preliminary evidence identified in this review also points to its importance to children's social-emotional and behavioural development as well as overall school readiness (McWayne et al., 2012).

Relatedly, although a clear definition of school readiness is yet to be agreed upon (e.g., Snow, 2006), the research field must expand the range of indices considered to indicate whether a child is ready for school. By keeping a narrow focus on cognitive and social skills the school readiness literature risks suggesting these skills are more important for early school performance than are other skills such as work habits, approaches to learning, mastery motivation as well as science and art competencies. Thus, there is a need for innovative approaches to examining school readiness as these may explain greater proportions of the variation observed and reduce inconsistencies in findings between studies.

It is noteworthy that a larger proportion of studies included only mothers compared to studies that included just fathers, or both mothers and fathers. Thus, the increased recognition of fathers' importance to child development is not reflected in the school readiness literature. Moving forward, researchers should aim to recruit both mothers and fathers as such an exercise will provide important information regarding similar, differential, or complementary effects of maternal and paternal parenting practices on school readiness.

Finally, there is a need for research pertaining to school readiness to expand beyond WEIRD (western, educated, industrialised, rich, and democratic) participants. Within the present review, all but one study were undertaken in WEIRD countries with the majority taking place in the US. It is unknown whether the parenting practices identified in this review are similarly related with school readiness in different cultures, less developed countries and perhaps less literate participants.

Strengths and Limitations

Prior to discussing the implications of the present review, a number of limitations and strengths must be acknowledged. First, the decision to include numerous indices of school readiness has resulted in high heterogeneity between studies. Nevertheless, such an approach permitted a comprehensive exploration of the types of parenting practices that prepare children for a successful school start. It is however worth noting that a narrower approach in the future with focus on individual indices of school readiness may facilitate the performance of a meta-analysis and therefore allow for stronger conclusions regarding links between parenting practices and school-related outcomes.

Second, as is the case with all systematic reviews, the findings may be influenced by publication bias (i.e., the possibility that significant findings are more likely to be published than non-significant ones). Thus, study pre-registration is encouraged to mitigate this bias. Moreover, the lack of pre-registration of the current review represents a further limitation of the study. Although steps were taken to mitigate the risks associated with the absence of pre-registration by clearly reporting the search strategy, the inclusion and exclusion criteria, and by including at least two reviewers at all stages of the review process who were blind to each other's decision, the omission of pre-registration remains a limitation. The review is currently under revision to include meta-analysis and all planned statistical analyses will be pre-registered.

Third, while the majority of studies displayed low risk-of-bias, indicative of good internal validity, there remains a need for greater methodological rigour. Several studies within the review did not clearly report demographic information such as participants' age, education and socioeconomic status, length of follow-up, whether the study adjusted for confounders or covariates or which parent(s) the study focused on. Thus, the extent to which studies can be appropriately compared is limited and the generalisability of their findings is unknown.

Fourth, although the tool used to assess risk-of-bias in this review provides a transparent method for appraising the internal validity of studies, it remains subject to limitations. For instance, a bias assessment was not always possible as many studies did not report sufficient information. As a result, many studies were marked as 'Unclear' across certain domains. This difficulty in appraising bias, alongside the dichotomous nature of the tool may render the tool less sensitive to between-study heterogeneity. Nevertheless, the tool is frequently used in systematic reviews of longitudinal observational studies.

Finally, sample sizes varied considerably, ranging from 37 to 9282 participants across. However, despite the large variation, most studies featured large-scale datasets. These large sample sizes represent an important strength in the school readiness literature as unlike small convenience samples, large samples increase statistical power, increase the accuracy with which both small and large effects are identified, and therefore provide reliable information for policy makers.

Implications and Conclusion

The present review bears implications for research, policy, and practice relating to parenting and children's early education. First, it synthesises the extant research on parenting and school readiness and highlights parenting practices that foster a successful transition to formal schooling. Second, it identifies parenting practices that have been less subjected to research, namely parental cognitively stimulating practices such as conversational turn taking and contingent responsiveness and involvement in ECE. The review suggests that examining potentially complementary parenting domains may reveal additional insights into the mechanisms through which parenting practices promote children's school readiness.

Third, the review calls for greater methodological rigour to enhance the reproducibility of findings. Convincing findings can only be obtained if empirical work is thoroughly and transparently documented. Further, it highlights the need for adequate follow-up durations to allow accurate identification of longitudinal relations between parenting and children's school readiness. Findings of such studies will undoubtedly provide important information for caregivers, early childhood practitioners and policymakers.

Finally, while there remain steps to be taken towards a comprehensive understanding of parenting practices and children's school readiness, the outcome of the review is a positive one. Although several studies found non-significant associations, all studies that did report significant findings converged on the same assumption: sensitive and cognitively stimulating parenting, the HLE and involvement in early childhood education are positive precursors to children's school readiness. Moreover, the studies of this review showed that each parenting construct is frequently linked with multiple child outcomes. Therefore, these parenting practices represent profitable targets for early childhood interventions.

Chapter 4

Methodology

The present thesis consists of a series of studies which employ observational methods, direct assessment and participant report and features both primary and secondary data analysis in order to examine the longitudinal association between parent-child interaction, parenting practices and school readiness and child outcomes. This chapter provides an overview of the methodology employed by the studies based on primary data analysis whereas detailed outlines of each study's method and materials are provided in subsequent chapters.

Study Design

The present thesis reports on three waves of data collected as part of an observational longitudinal study conducted at the Infant and Child Research Lab at Trinity College Dublin. Families participated when children were two-years-old (Wave 1), three- to four-years-old (Wave 2) and at the time of the final wave of data collection which was conducted as part of this thesis, children were seven- to nine-years-old (Wave 3).

The use of a longitudinal design accords with the aims of the present study which

examines antecedents of child school readiness and early academic performance. Such a design allows for a dynamic view of child development as it captures continuity, change, and trajectories of interactive behaviours and permits greater insight into how children reach developmental milestones. A longitudinal design also allows for an examination of consistency and fluctuation in behaviours across time, such as how parents and children align linguistically with each other, engage in contingent conversational turns, and embed decontextualised language in conversation, from toddlerhood to preschool years. It further allows an examination of how variability in these behaviours throughout the years preceding formal schooling relate to children's later academic adjustment and performance. While longitudinal analyses are insufficient to permit causal inferences, they do allow for stronger inferences regarding the direction of effects.

Moreover, observing families and tracking development over time allows for the identification of critical periods of development during which interventions may be most effective. This is particularly relevant for research with young children, given that the rapid development they undergo during the toddlerhood and preschool years means that different interactive behaviours may need to be targeted at different stages of development. Consequently, longitudinal designs are invaluable for child research which can inform policy decisions and guide the development of interventions and early childhood programs.

The studies in the present thesis employed observational methods as the gold standard approach for studying the quality of parent-child interaction and were particularly appropriate for the study of the behaviours of interest in this study. First, they allow for the identification of automatic and rapidly changing behaviour that may occur outside participants' awareness, such as contingent turn-taking, and may thus be impossible to accurately capture through self-report measures, especially from young children (Gardner, 2000). Second, they provide insight into behaviours that are defined and operationalised by researchers in a consistent and reliable manner and therefore offset systematic bias risks associated with participant report (Eddy et al., 1998; Fergusson et al., 1993; Prescott et al., 2000).

Across all studies, participants were observed as they engaged in triadic structured interaction for a duration of five minutes. Triadic interaction was selected to account for the systemic nature of families and to capture the transactional influence that each family member may exert on all other interactional partners. It therefore provided a holistic, ecologically valid, and comprehensive view of family processes and provided an insight into how children interact with multiple caregivers simultaneously.

The use of structured interaction was considered the most appropriate for addressing the aims of the present study. First, structured interactions permit a degree of control over variables of interest and ensure that all participants engage in similar activities under similar conditions. It therefore not only allows for addressing specific aspects of research questions such as transactional aspects of parent-child relationships, sensitivity, and responsiveness to child attributes and behaviours, but also increases the internal validity of studies. Further, given the longitudinal design of the study, structured interaction allowed for the same activities to be observed consistently across timepoints facilitating the assessment of trajectories of behaviours of interest from toddlerhood to preschool years. Second, due to the clearly defined tasks and procedures *a priori*, the use of structured interaction permits study replicability and as such enhances the rigour and reliability of the research. Moreover, it readily allows for comparability of interactive behaviours across different age-groups and populations which can facilitate the identification of developmental milestones and trends. Finally, the use of structural interaction bears practical implications. Specifically, findings from such studies can be readily applied in parenting interventions and educational strategies.

The duration of interactions selected in the current thesis is in accordance with evidence which suggests that five minutes are sufficient to capture typical parent and child interactive behaviours (Kemppinen et al., 2005). It was also considered appropriate for the age of the child at the time of assessment. Families were observed in interaction as part of a longer data collection period (approximately 90 – 120 minutes), during which children were developmentally assessed and extensive questionnaires were completed by mothers and fathers in a laboratory setting. Considering children's young age and the behavioural challenges associated with it, and the implications of participant fatigue for the reliability of data collected, it was considered appropriate to implement five-minute interactions during data collection. While free-play interactions are known to facilitate toddler participation in discourse (Kwon et al., 2013), the present study employed structured interaction based on research which suggests that parents tend to interact more with their child during structured play tasks with the aim of preparing children for school (Hirsh-Pasek et al., 2009).

Although observational methods are the benchmark for studying parent-child interactions, the other areas of interest in this study, namely children's school readiness and early academic performance, required different methods. Accordingly, observational measures were supplemented by parent report, teacher report, direct assessment, and child performance on standardised computerised tasks and national tests of achievement. Parents and teachers have unique access to developmental information pertaining to their child as they observe children in diverse settings across prolonged periods of time as they engage with peers and their surrounding environment, information which is difficult to capture during one data collection session in laboratory settings. Further, despite unconscious biases associated with participant report, data provided by parents and teachers may be considered ecologically valid as their report of child behaviour is derived from observation of children in their natural environments.

Moreover, any participant biases have been offset by the inclusion of direct assessments using standardised instruments which allowed for an objective, comprehensive assessment of child development. Direct assessment also increases the reliability and validity of data and allows for trajectories of development to be observed over time, which directly complements the aims of the present, longitudinal study. Finally, child performance provides unique insight into specific skills that are difficult to accurately capture via participant report, observation, or even direct assessment. For example, executive function processes such as cognitive flexibility and inhibitory control operate at a rapid speed (at the level of milliseconds) and as such can only be appropriately measured via technology-based measures of child performance. This triangulated approach to data collection represents a strength of this study as it mitigates the risk of shared method variance while also representing the multiple stakeholders implicated in children's school readiness and early academic performance.

Participants

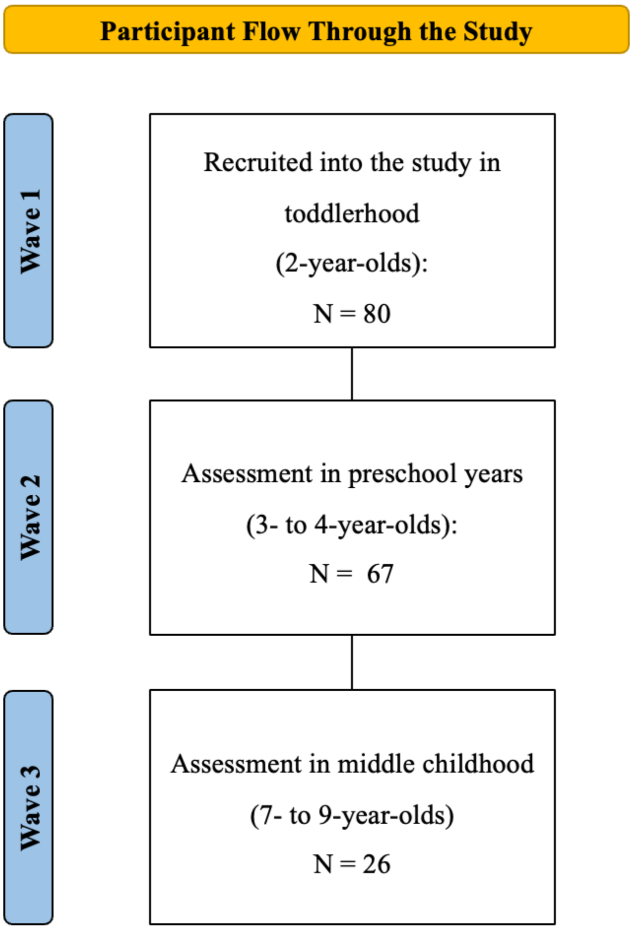
Participants in this study are part of a larger longitudinal study on parent-child interaction at Trinity College Dublin launched in 2016. Initially, families were recruited through parenting forums, participant panels, social media, crèches, and snowballing, resulting in an original sample size of 80 families. Families participated in this study at three timepoints, at Wave 1 when children were two-years-old (toddlerhood), at Wave 2 when children were three- to four-years-old (preschool years), and at Wave 3 when children were eight- to nine-years-old (middle childhood). Data for Waves 1 and 2 were collected as part of the original larger study whereas data for Wave 3 were collected as part of the studies presented in this thesis. Given participant attrition that is common to longitudinal designs, only families who participated at all three timepoints were included in analyses, resulting in a sample size of 26 mother-father-child triads (see Figure 2.1).

The attrition rate in the present study was 16.25% from Wave 1 to Wave 2 and 61.19% from Wave 2 to Wave 3. Post-hoc power analyses for each individual study presented in Chapter 5 using G*Power calculator indicated that Study 1 had a power of

64.1%, Study 2 had a power of 84.5%, Study 3 had a power of 56% and Study for had a power of 60.9%.

Figure 2.1

Rates of Participation in the Present Study at Waves 1, 2 and 3



There were no statistically significant differences between participants who remained in the study and those who withdrew in terms of maternal age t (75) = 1.23, p

= .11, paternal age *t* (74) = 1.05, *p* = .15, maternal education $x^2(5) = 1.42$, *p* = .84, paternal education $x^2(5) = 7.12$, *p* = .21 or child gender $x^2(1) = 1.63$, *p* = .20 (39 male and 41 female at Wave 1). There were also no statistically significant differences between children's scores on the cognitive (*t* (77) = .02, *p* = .49), language (*t* (76) = .85, *p* = .20) or social-emotional (*t* (70) = 1.12, *p* = .13) subscales of the Bayley Scales of Infant and Toddler Development (Bayley, 2006).

The final set of participants included in the studies in the present thesis were 26 Irish mothers, fathers and their typically developing child (10 male and 16 female). Children ranged in age from 22.17 to 27.13 months (*M* = 24.28, *SD* = 1.45) in toddlerhood, from 34.60 to 54.40 months (*M* = 43.13, *SD*=7.16) during preschool years and from 7.67 to 9 years (*M* = 8.58, *SD* = .27) in middle childhood. Fathers ranged in age from 29 to 55 years (*M* = 36.92, *SD* = 5.61) and mothers were aged between 30 and 48 years (*M*=35.77, *SD*=4.93) at the time of first testing. Families were well educated, with 80.80% of mothers and 69.20% of fathers having a bachelor's degree or higher. All families were monolingual (Irish-English) and co-habiting in the family home at the time of assessment.

Procedure

The studies presented in this thesis received ethical approval from the School of Psychology Ethics Committee at Trinity College Dublin (See Appendix A). At Wave 1 and Wave 2 parents provided written consent (see Appendix A) while at Wave 3 parents and teachers provided consent (see Appendix A) and assent was sought from children prior to any data collection.

Wave 1

At Wave 1, when children were toddlers, families were invited to participate in the study at the Infant and Child Research Lab at Trinity College Dublin. Upon arrival to the university, families were introduced to a child-friendly lab which was equipped with a colourful foam playmat, children's table and chair set, and a range of age-appropriate toys (see Figure 2.2). Families were allowed to familiarise themselves with the lab and asked to complete consent forms, while the researcher played with the child to build trust and rapport and establish a comfortable environment to facilitate later assessment.

Next families were instructed to engage in a triadic free-play interaction for a duration of five minutes as they normally would at home. Mothers, fathers, and children were presented with a variety of toys, such as toy cars, building blocks, and Mr. Potato Head, designed to facilitate imaginative, creative, and humorous play. Following the free-play interaction, families engaged in a triadic structured play interaction for a further five minutes. Participants were presented with a gender-neutral toy-set and instructed to play as they normally would for a duration of five minutes. The toy-set consisted of a teddy bear skills puzzle board which contained six removable pieces of clothing each designed to elicit specific dressing activities such as zipping, tying, lacing, buckling, buttoning, and snapping.

Figure 2.2

Infant and Child Research Lab Participant Observation Room

Following triadic interactions, either the language or cognitive part of the Bayley Scales of Infant and Toddler Development (BSID-III; Bayley, 2006) was administered to children in the presence of one parent (e.g., the father) while the second parent (e.g., the mother) completed a battery of questionnaires pertaining to their sociodemographic background, family dynamics and child functioning in a neighbouring room.

Next, participants engaged in dyadic free- and structured-play interactions, and the order in which children engaged with mothers and fathers was counterbalanced. Free play interactions were similar to triadic free-play interactions whereby participants were offered an assortment of toys to play with. For structured dyadic interactions participants were presented with a magnetic puzzle board consisting of ten fish puzzle pieces and a magnetic fishing rod. The task required participants to use the fishing rod to remove the ten fish pieces from the board. Once removed, children were required to return each fish piece to its corresponding slot on the board.

Families were video- and audio-recorded using two indoor AXIS Q6035 PTZ Dome Network cameras (Axis Communications, Lund, Sweden) and a professionally calibrated Beyerdynamic MPC66 v SW 12–84 V microphone mounted unobtrusively in discrete locations within the playroom. All recordings were transmitted to a hard drive with the use of Mangold VideoSyncPro 1.5 video-recording software (Mangold International, Arnstorf, Germany). To minimise observer effects, researchers remained in a control room which was equipped with a one-way window and located adjacent to the lab (see Figure 2.3)

Following dyadic interactions, children were offered a short break before the second part of the BSID-III was administered in the presence of the child's second parent (e.g., the mother) while the first (e.g., the father) also completed the battery of questionnaires.

Once assessment was finalised and mothers and fathers had completed the questionnaires, children were presented with a participation certificate and stickers, and families were debriefed and thanked for their visit.

Figure 2.3

Image of Infant and Child Research Lab Control Room

Wave 2

At Wave 2 when children were pre-schoolers, families were invited to return to the lab to engage in a similar triadic interaction with their child as they did in toddlerhood. First, families engaged in triadic free-play interactions for a duration of five minutes, during which mothers, fathers and children were presented with a variety of toys. Next, participants engaged in triadic structured play interactions for a further five minutes. Families were presented with a gender-neutral toy, namely a jungle building set, and instructed to play with their child as they normally would.

Next, children were developmentally assessed with either the BSID-III if they were three-year-olds or the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-IV; Wechsler, 2012) if they were four-year-olds. Assessment was administered in the presence of one parent while the second completed a battery of questionnaires in a separate room. Following assessment, dyadic interactions were recorded and the order in which children engaged with mothers and fathers was counterbalanced. Dyadic free play interactions were similar to triadic free-play interactions (i.e., participants were permitted to engage with a variety of toys). However, the toy used in dyadic structured interaction differed for each parent. During the first structured dyadic interaction with the first parent (e.g., mother; counterbalanced) dyads were presented with a set of interlocking bristle blocks which could be used to build various structures that were illustrated in the toy instructions.

Children were subsequently offered a short break before engaging in a series of tasks designed to measure executive functioning carried out by trained researchers and a research assistant. Children's performance on these tasks was assessed in the presence of the second parent while the first completed the study questionnaires.

Next, the second structured dyadic interaction with the second parent (e.g., father) was recorded. For this interaction, dyads were presented with a different building set consisting of connectors called Kid K'Nex. Both sets used with mothers and fathers are designed to stimulate imagination and encourage motor skills, hand-eye coordination, dexterity, and cognitive skills. All interactions were audio and video recorded according to the same protocol as implemented at Wave 1. Families were then debriefed, thanked and children were awarded a certificate of participation.

Given that this longitudinal study undertakes a family systems perspective and seeks to understand how mother-child interaction unfolds in the presence of father-child interaction and *vice versa*, only triadic interactions were included in analyses.

Wave 3

At Wave 3, when children were in middle childhood families were invited to participate in the study remotely due to the restrictions imposed by the Covid-19 pandemic. As per ethical guidelines, prior to data collection families were required to provide consent via the online annotator and document signing platform DocHub which they accessed via a request sent to their email. Once consent was obtained, families were provided with a link to a battery of questionnaires accessible through the online platform Qualtrics which was to be completed at their convenience. Families were further invited to attend a video conferencing call via an electronic link to participate in the remaining part of the study.

Given the impersonal nature of remote interactions, the first part of the call was used to engage in informal conversation with children and their parents to ensure that children were comfortable to engage in subsequent tasks. Children were then told about the kind of tasks and activities in which they would engage and were informed that they could take frequent breaks and that they could refuse to participate in a task without consequence. Following this, assent was sought from children and assessment began.

The first part of data collection entailed a direct assessment of child developmental domains using the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV; Wechsler, 2004). To facilitate remote administration, the Picture Concepts, Matrix Reasoning and Picture Completion subscales of the WISC-IV, which require child engagement with materials, were scanned and uploaded to the online platform Qualtrics accessible only to the researcher. During assessment, the researcher shared their screen which contained the subscales and gave children access to the computer such that they could interact with the tasks (i.e., by clicking on the relevant pictures). The scales were administered according to protocol (i.e., presented in exact order, discontinued after specified number of child errors). Figures 2.4 and 2.5 provide examples of how items from these scales were presented to children.

Figure 2.4

Sample Item from the Picture Concepts Subscale of the WISC-IV

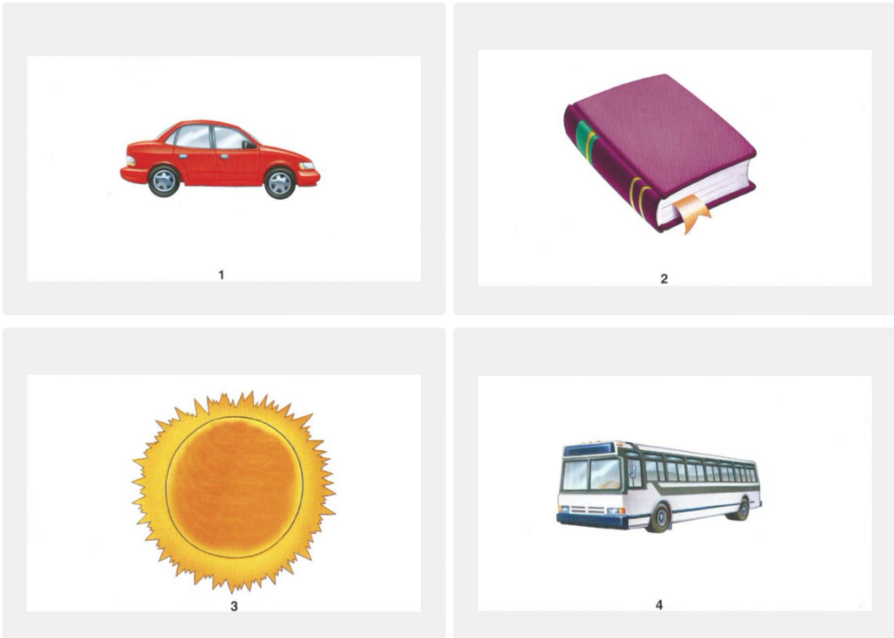
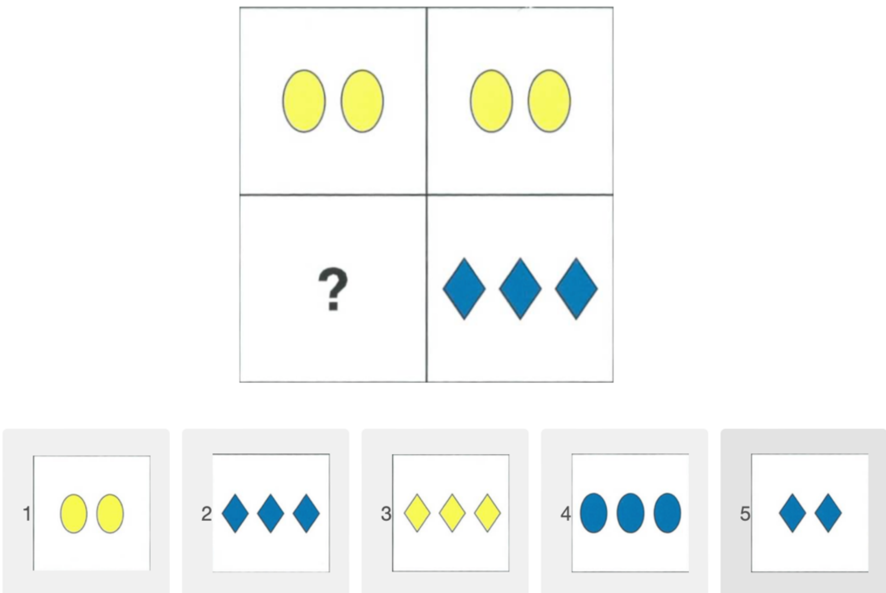


Figure 2.5

Sample Item from the Matrix Reasoning Subscale of the WISC-IV



The remaining subscales used in this study, namely the Similarities, Digit Span, Vocabulary, Letter-Number Sequencing, Comprehension and Arithmetic were administered verbally as per standard conventions.

Next, children's executive functioning, including inhibitory control, cognitive flexibility and working memory, was examined via their performance on a series of tests using Inquisit Millisecond software (www.millisecond.com). Children participated via screen sharing and remote control of the researcher's computer. Prior to participation, children were allowed up to three practice trials for each task to allow for familiarisation with procedures. Subsequently, their accuracy and reaction time on each test was recorded by the Inquisit Millisecond software and exported to an Excel file to the researcher's computer immediately post testing.

Finally, children were presented with a wordless picture book via screen sharing and instructed to compose a narrative based on the book's illustrations. The book which is entitled 'David Goes to School' by David Shannon, consists of 17 pages and features a young protagonist who engages in a series of activities at school. A PDF of the book presented to children in this study can be accessed at https://issuu.com/conicam/docs/wpb. All child narratives were audio-recorded for subsequent analysis.

In addition to parent and child participation, following parental permission children's teachers were also invited to participate in this study. Teachers similarly provided consent via DocHub and were subsequently asked to complete the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997), as well as provide children's literacy and numeracy scores on national standardised tests of performance via Qualtrics.

Measures

While participants in this study completed a battery of questionnaires, only the measures used in the present study are outlined below. Only participant socio-demographic information and data derived from the structured interactions (described in Chapter 5) from Waves 1 and 2 were included as part of the present study.

Battery of Questionnaires

Socio-demographic information. Both mothers and fathers responded to a series of questions pertaining to their age, level of education and their child's age and gender at each wave.

Strengths and Difficulties Questionnaire. Parents and teachers reported children's socioemotional functioning on the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) at Wave 3. The questionnaire consists of 25 questions regarding the child's behaviour during the previous six months on a three-point scale ranging from 0 (not true) to 2 (certainly true). The items are combined to yield five subscales (each consisting of 5 items), namely (1) emotional symptoms (2) conduct problems, (3) hyperactivity/inattention, (4) peer relationship problems, and (5) prosocial behaviour. The first four subscales can be further combined to produce an overall score of socioemotional difficulties.

Direct Assessment

Wechsler Intelligence Scale for Children–Fourth Edition. Children were developmentally assessed using the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV; Wechsler, 2004) at Wave 3. Children were assessed in terms of their Verbal Comprehension, Perceptual Reasoning and Working Memory.

Verbal Comprehension. The Similarities, Vocabulary and Comprehension subscales were used to collectively measure children's Verbal Comprehension. The

Similarities subscale assesses a child's verbal concept formation and reasoning skills via 23 questions. Children are asked to explain how two words (or concepts) are alike with the aim of capturing their abstract reasoning skills, expressive language, and auditory comprehension. Drawing relations between concepts becomes progressively more difficult with administration, ranging from 'In what way are red and blue alike, how are they the same?' to 'In what way are ice and steam alike, how are they the same?' and 'In what way are space and time alike, how are they the same?'. Item administration continues until a child produces five consecutive erroneous answers. Responses are awarded a score of either '0', '1', or '2' based on quality dictated by the WISC-IV manual. The first item of this scale is a trial item to ensure children understand instructions, and as such is not scored. The following two items are awarded a maximum score of '1' while all remaining items can receive a score of up to '2', allowing for a maximum score of 44.

The Vocabulary subscale measures a child's verbal fluency, concept formation, receptive and expressive language skills via 36 questions. Children are required to provide verbal explanations of words of progressively increasing complexity. Sample items include 'What is a bicycle?', 'What does absorb mean?', and 'What does garrulous mean?'. Children are awarded as core of '0', '1', or '2' based on response quality. The first five items are scored as either '0' or '1' whereas all remaining items can receive up to a score of '2'. The maximum score possible for this subscale is 68.

The Comprehension subscale measures children's general knowledge, practical judgement in social situations and their moral conscience via 21 questions. Children are asked to reason and explain actions, activities, and situations that they would be expected to be familiar with. Sample items include 'Why is it important to apologise when you know you've hurt someone?', 'Why do we put stamps on letters?', and 'Why is freedom of speech important in a democracy?'. Scores range from '0' to '2' for all items with a maximum possible score of 42. Raw scores for the Similarities, Vocabulary and Comprehension subscales are converted to scaled scores to give an overall Verbal Comprehension Index.

Perceptual Reasoning. Children's perceptual reasoning was measured using the Picture Concepts, Matrix Reasoning and Picture completion subscales of the WISC-IV. The Picture Concepts task requires children to examine two or three rows of pictured concepts and identify one single picture (by clicking) from each row that shares a common characteristic with the single pictures from all other rows (e.g., pictures 1 and 4 in Figure 2.2). Children are awarded a score '0' or '1' and testing discontinues after five consecutive scores of 0. The maximum score possible for this task is 28.

The Matrix Reasoning subtest assesses a child's visual processing skills, spatial perception, and abstract reasoning. Children are required to identify the missing image from a range of items, visual patterns, and colourful matrices (e.g., picture 2 in Figure 2.3). Scores range from '0' to '1' and administration discontinues after 4 consecutive scores of 0 or after 4 scores of 0 on 5 consecutive items. The maximum scores achievable for this subtest is 35.

Finally, the Picture Completion subscale measures children's ability to recognise familiar items, suppress surrounding details and identify missing parts. In this study children indicated the missing part either verbally or by pointing to the relevant part using their mouse on a shared computer screen. Responses were scored as either correct and received a score of '1' or incorrect and received a score of '0', allowing for a maximum score of 38. Administration discontinued after 6 consecutive scores of '0'.

Working Memory. Children's working memory was measured via a combination of the Digit Span, Letter-Number Sequencing and Arithmetic subscales of the WISC-IV. The Digit Span measures children's short-term memory and attention. Children were required to attend to a verbally recited series of numbers of increasing length and repeat them as heard (forward digit span) or in reverse order (backward digit span). Both the forward and backward digit span consist of eight trials with two items in each trial. Children were awarded a score of '1' for each correct response to each item, with a maximum possible score of 32. Administration discontinued after scores of '0' on both items of a trial.

The Letter-Number Sequencing subtest measures a child's attention span, short term memory, sequencing skills, and processing abilities. Children are required to listen to a series of letters and numbers read in random order and to recall the series with numbers in chronological order followed by the letters in alphabetical order. For instance, a correct response to the item 'D-8-M-1' would be '1-8-D-M'. The subtest consists of 10 trials with three items in each. Children are awarded a score of '1' for each correctly recalled item with a maximum possible score of 30. Testing discontinues when a child responds incorrectly to all three items of a trial.

Finally, the Arithmetic subscale measures children's reasoning, numeracy and mental arithmetic ability via 34 word problems. Sample items are presented in order of increasing difficulty and include 'Michelle is 2 years younger than Peter and 5 years older than Sam. If Sam is 6 how old is Michelle?' and 'Kathy's lunch bill was 22.50. If she leaves a 15% tip how much money does she need to pay?'. Testing discontinues after 4 consecutive incorrect answers. The three subscales are combined to provide an overall index of Working Memory.

Performance Based Measures

Executive Function. Children's inhibitory control and cognitive flexibility were assessed via the Flanker fish task (Schonert-Reichl et al., 2015) and the Hearts and Flowers task (Davidson et al., 2006) respectively, administered remotely at Wave 3.

Inhibitory Control. The Flanker fish task (Schonert-Reichl et al., 2015) was used to measure children's inhibitory control using Inquisit Millisecond software (www.millisecond.com). The task requires children to focus on one target stimulus while ignoring distracting stimuli. The stimuli (a series of fish facing either left or right) are presented on a computer screen in three block types. The first type, referred to as standard Flanker, contains a series of blue fish, during which children must respond by pressing a key based on the direction of the target fish while ignoring the peripheral fish. The second type, referred to as reverse Flanker, contains a series of pink fish and children must respond based on the direction of the peripheral fish while ignoring the centred fish. Both blocks include congruent and incongruent trials. Finally, the third type is a mixed block which includes both blue fish (with the instruction to focus on the centred fish) and pink fish (with the instruction to focus on the peripheral fish). During the mixed trial children must hold both rules in mind and respond accordingly.

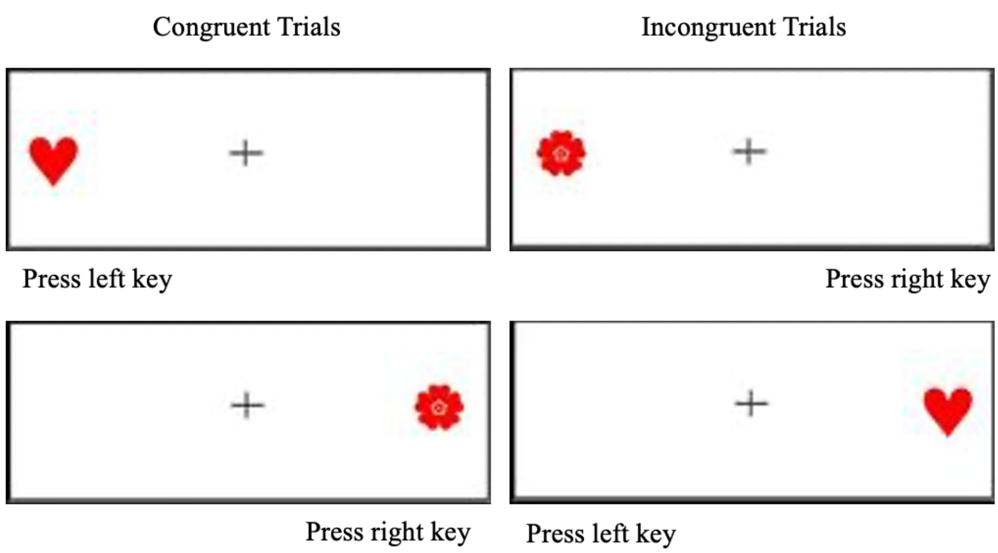
Children were permitted up to three practice sessions to ensure they understood the task demands. The experimental trials were then presented in 8 blocks each consisting of 10 trials with a 1-minute break between blocks. During each trial, a fixation cross was first presented on a computer screen for a duration of 450ms, followed by a stimulus which was presented for up to 3000ms. Children's average accuracy (i.e., the proportion of correct responses) and reaction time (RT) in milliseconds (ms) were used as indices of inhibitory control.

The flanker task is a widely used measure of inhibitory control (Fan et al., 2014; Mullane et al., 2014). It is considered a valid measure of activity in the anterior cingulate cortex, a brain region responsible for inhibitory control and conflict monitoring (Fan et al., 2003). The task has also demonstrated sensitivity to differences in inhibitory control among children with and without ADHD (see Mullane, 2009 for a systematic review).

Cognitive Flexibility. The Hearts and Flowers task (Camerota et al., 2019) was used to assess children's cognitive flexibility via Inquisit Millisecond software (www.millisecond.com). The task requires children to press a button on the same side of a screen when an image of a heart is presented and a button on the opposite side of the screen when an image of a flower is presented. Images are presented in blocks consisting of hearts only, flowers only and a mixture of both (see Figure 2.6 for examples trials administered during this task).

Figure 2.6

Example of Trials of the Hearts and Flowers Task Presented to Children in This Study



Children completed three practice trials to ensure they understood the task instruction. Practice trials were followed by 12 heart trials, 12 flower trials and 33 mixed trials. Stimuli were presented on screen for up to 2500ms, depending on whether a child responded. Inter-stimuli intervals lasted 1000ms.

Children's accuracy scores (i.e., proportion of correct responses) and RT in milliseconds on the flowers only block reflects inhibitory control while their accuracy and RT on the mixed block (hearts and flowers) is used as a measure of cognitive flexibility. The HF has demonstrated sensitivity to improvements in four- to five-year-old children's EF following the Tools of the Mind preschool program (Diamond et al., 2007).

Child Literacy. Teachers provided reports of children's reading and spelling scores on the Drumcondra Reading and Spelling tests. The Drumcondra tests are standardised national assessments designed to measure children's vocabulary and comprehension administered to children in schools in Ireland. Scores between 80 and 89 indicate 'low average' performance, between 90 and 109 indicate 'average' performance, between 110 and 119 indicate 'high-average' performance and between 120 and 130 indicate 'above-average' performance.

Child Numeracy. Teachers reported children's math performance on the Sigma-T test. The Sigma-T test is designed to assess children's cognitive skills such as spatial and numerical reasoning. The test is a standardised national assessment administered to children in schools in Ireland. Scores between 80 and 89 indicate 'low average' performance, between 90 and 109 indicate 'average' performance, between 110 and 119 indicate 'high-average' performance and between 120 and 130 indicate 'above-average' performance.

Study Preregistration

The studies included in this thesis have not been pre-registered and this represents a limitation of this work. Preregistration offers the advantage of specifying the study's methods and hypotheses in advance which may mitigate biases associated with *post hoc* decision-making. Pre-registration of these elements is required to be undertaken prior to any data collection. Given the longitudinal nature of this study, data for Waves 1 and 2 had already been collected prior to this thesis, which precluded an *ad-hoc* specification of study design, methods, and hypotheses. Nevertheless, it is important to note that an analysis plan can and should be pre-registered even post data collection. Unfortunately, due to lack of awareness early in the research process, the studies in this thesis were not preregistered. This absence of preregistration introduces the possibility of hindsight bias and may leave room for unintended flexibility in analytical decisions. While precautions have been taken to minimize bias through transparent reporting, robust methodology, clear data analysis plans and open access data, the lack of preregistration remains a limitation.

Conclusion

The following chapter (Chapter 5) presents four individual studies, which examine direct mechanisms of influence of parenting practices on early child academic performance, based on the overall methodology outlined in the current chapter. The methodology employed by the individual studies, as well as the statistical analysis plan, is further described in detail within each respective study. Chapter 6 presents two additional studies, which examine indirect mechanisms of influence of parenting practices on child school readiness, based on secondary data analysis. Finally, Chapter

7 concludes with a synthesis and critical discussion of all findings observed in the present study.

Chapter 5

Direct Effects of Parenting on Children's Early Academic Performance

As illustrated by the systematic review presented in Chapter 3, the role of social interaction to child development has been clearly established. Children depend on more mature interactional partners to develop competencies and acquire and refine their skills. During the formative years preceding formal education children primarily interact with mothers and fathers. Accordingly, the influence that the quality of these interactions exerts on child development must be comprehensively examined. Therefore, the present chapter presents four individual studies based on primary data analysis. The chapter examines how aspects of parent-child interaction that were less represented in the systematic review, during triadic interaction in toddlerhood and preschool years, relate to child language, literacy and numeracy, cognitive and social skills.

Study 1. Children's Language Skills

One of the most examined cognitively stimulating parenting behaviour is the quantity, quality, and complexity of parental linguistic input during interaction with children. While the importance of large vocabularies and sentence diversity to child language growth is incontestable, it has been recently theorised that not only *what* but also *how* parents communicate with children can influence child language development. More specifically, linguistic alignment, the re-use of an interlocutor's language that can occur at different levels of language structure, which by definition is responsive and contingent on child language, has been proposed as a key mechanism via which child language is scaffolded. However, few studies have examined different types of alignment, few have focused on child alignment to parents, and none have included both mothers and fathers. Accordingly, the first study in this chapter examines how maternal, paternal and child semantic, lexical, and syntactic alignment during toddlerhood and preschool years relates to child language quality and complexity, verbal comprehension, and literacy skills in middle childhood.

Parent-Child Linguistic Alignment in Toddlerhood and Preschool Years Relates to Child Language in Middle Childhood

Abstract

The present study examined how 26 Irish mother-father-child triads (16 female) engage in linguistic alignment, the re-use of an interlocutor's language at different levels of linguistic structure, during toddlerhood (T_1) and preschool years (T_2) and how this linguistic alignment relates to children's language in middle childhood (T_3). At T_1 and T_2 semantic, lexical, and syntactic alignment was coded from transcribed interactions. At T_3 children's language quality and complexity (wordless picture-book narratives), verbal comprehension (WISC-IV) and literacy skills (performance based) were obtained. Results suggest that parents engage in similar proportions of alignment with children. Longitudinally, different types of alignment were dynamically linked with child language. Findings demonstrate that both mothers and fathers can fine-tune their language in accordance with their child's linguistic aptitude. Results further bear implications for linguistic theory, speech and language therapists and early childhood education.

Keywords: linguistic alignment, child language, toddlerhood, preschool years, middle childhood, longitudinal

Introduction

The case for the importance of early language skills to later academic performance has been convincingly made (e.g., Bleses et al., 2016; Roulstone et al., 2011). Children with competency in diverse language domains such as vocabulary, phonology, syntax, and narrative production are well equipped to engage in decoding and reading comprehension (Bishop & Snowling, 2004; Bowyer-Crane et al., 2008). These skills in turn enable children to engage with texts and to produce written material which forms the basis of typical formal academic assessment. Moreover, through language children can articulate ideas and hence successfully interact with peers, teachers, and the broader academic environment (Denham & Brown, 2010; Taylor et al., 2004; Von Salisch et al., 2015). Accordingly, language skills are considered fundamental for school readiness and early academic achievement (Weisleder & Fernald, 2013).

The significance of fostering language development early in ontogeny becomes increasingly evident as children transition from "*learning to read*" to "*reading to learn*" (Fiester, 2010). Within the United States (US), approximately 85% of the primary school curriculum is delivered through textbooks, worksheets, computers, and smart boards (Fielding-Barnsley & Purdie, 2005). Thus, children with language skills below grade level tend to struggle to keep up with their counterparts academically (Fiester, 2010). In contrast, children who meet grade level literacy standards are four times more likely to successfully complete school than their less-literate peers (Fiester, 2010). It is therefore alarming that in 2015 approximately 64% of fourth grade children in the US fell below grade level reading proficiency (Kena et al., 2015). Similarly, in Europe, data from 23 countries suggest that approximately 13 million children under the age of 15 years experience literacy difficulties whereas one in five 15-year-old children display poor reading skills (OECD, 2013).

Such low literacy rates bear tremendous implications for educational, health and economic outcomes not only for each child individually but also at a national level (Fiester, 2010; Sum et al., 2009). It is therefore imperative to promote children's language development early in childhood such that they embark on their academic journeys poised to succeed.

Language Development during Early Childhood

Parent-child interaction is fundamental to child language development especially during early childhood. Both quantity and quality of child-directed speech (CDS) during the first three years of life have been found to positively predict children's language outcomes and emergent literacy skills above and beyond parental education, socioeconomic status and race or ethnicity (Dickinson & Porche, 2011; Hart & Risley, 1995; Huttenlocher et al., 2010; Rowe, 2012; Weisleder & Fernald, 2013). Children whose caregivers produce more words exhibit more diverse vocabularies, better language processing skills and greater literacy skills (Hoff & Naigles, 2002; Hurtado et al., 2008; Huttenlocher et al, 1991; Weisleder & Fernald, 2013; Zimmerman et al., 2009). Parental lexical diversity is also an established predictor of child language (e.g., Huttenlocher et al., 2010; Pan et al., 2005) even after accounting for quantity of parental speech (Rowe, 2012). Likewise, the diversity of grammatical subjects in parents' speech predicts growth in children's sentence diversity from 21 to 30 months (Hadley et al., 2017). Parental syntactic diversity also benefits pre-schoolers' language skills. For instance, among four- and five-year-olds, parents who engage in greater proportions of complex speech have children who also produce more complex speech both at home and at school (Huttenlocher et al., 2002).

Yet exposure to rich language input is only one of likely many mechanisms through which children develop language competencies. It has been recently suggested that children's language may also be influenced by more subtle interactional mechanisms. In fact, linguistic alignment, the tendency for interlocutors to re-use each other's vocabulary, pronunciations, and syntactic structures (e.g., Foushee et al., 2022), may be one such interactional mechanism through which children's linguistic competencies develop.

Fine-Tuning, Linguistic Alignment and Child Language Development

As the fine-tuning hypothesis suggests (Snow, 1989), parents promote children's language development by calibrating their linguistic input to their child's language skills. For instance, evidence suggests that fathers' lexical diversity during interaction is related to children's language abilities and behaviour in real time (Quigley & Nixon, 2019). Elsewhere paternal repetition during parent-infant interaction was found to be greater with children who had lower vocabularies compared to children with higher vocabularies (Conica et al., 2020; Schwab et al., 2018). Another fine-tuning mechanism that parents engage in is reformulating or expanding upon children's utterances, also known as recasts (e.g., Chouinard & Clark, 2003). Parental use of recasts has been longitudinally linked with children's correct use of grammatical structures (Che et al., 2015, 2018; Che & Brooks, 2021; Morgan et al., 1995; Saxton et al., 2005; Taumoepeau, 2016) and lexical growth (Taumoepeau, 2016).

A similar fine-tuning process is contingent responsiveness which refers to parent language input that is related to, or dependent on, children's individual language productions and behaviour. Parental contingent responsiveness facilitates the development of a back-and-forth conversation which in turn fosters language development (see Rowe & Weisleder, 2020). This type of responsiveness gives children the opportunity to experience turn-taking while also providing input that is informative (Tamis-LeMonda et al., 2014). Studies consistently demonstrate that children whose parents respond contingently and verbally, and who do so frequently from birth, tend to have larger vocabularies later in life (Donnellan et al., 2020; Goldstein & Schwade, 2008). Thus, by aligning their language input in accordance with their children's evolving language skills caregivers continuously stimulate language development (e.g., Yurovsky et al., 2016).

Type of Linguistic Alignment

Although the existing evidence base is compelling, studies have rarely distinguished between type, rate, and degree of alignment. Yet, recent research has suggested that linguistic alignment can occur at various levels (e.g., Foushee et al., 2022). First, interlocutors may engage in lexical alignment which involves the repetition of one's partner's words. Second, there might be syntactic alignment whereby conversational partners re-use and expand upon each other's sentence constructions. Third, parents and children may engage in semantic alignment whereby they contribute to ongoing conversation without changing the topic (see Table 2.1). Discriminating between the re-use of child utterances (e.g., semantic and lexical alignment) and introduction of new but related words (e.g., semantic but not lexical alignment) may offer additional insights regarding child language development.

Table 2.1
Examples of Parent-Child Lexical, Syntactic and Semantic Alignment.

Alignment	**Child**			**Parent**				
Lexical	Look! verb	An article	**elephant!** noun	That determiner	is verb	the article	Big adjective	**elephant!** noun
Syntactic	A ***article***	big ***adjective***	elephant. ***noun***	And conjugate	the ***article***	Scary ***adjective***	lion. ***noun***	
Semantic	**Lion**	**lion**	**lion!**	Yes,	I	hear	it	**roaring.**

Note. Lexical alignment – the parent repeats the child's word 'elephant', highlighted in bold; Syntactic alignment - although parent does not repeat child's words, the 'article, adjective, noun' sequence is produced by both child and parent, highlighted in bold and italics; Semantic alignment – the parent elaborates on the child's word 'lion' by introducing the related word 'roaring', highlighted in bold and underlined.

A further useful exercise might be to differentiate between rate (i.e., the number of conversational turns during which a parent responds contingently) and degree of alignment (i.e., the number of lexical or syntactic units re-used by the parent), as these are likely to differentially relate to child language. For instance, data from adult-adult interactions indicate that degree of alignment may play a unique role in establishing productive conversation (Dideriksen et al., 2022a).

Although linguistic alignment has been shown to facilitate speech processing, promote communication and facilitate the accomplishment of shared goals (Fusaroli et al., 2012; Ireland et al., 2011), lexical, syntactic, and semantic alignment during parent-child conversation have rarely been jointly considered (see Fusaroli et al., 2021 for an exception). Yet such research is needed, especially in light of recent findings which found that syntactic alignment rates at two years were positively related to children's word types at four years, whereas semantic alignment was linked with both child word types as well as mean length of utterance (Fusaroli et al., 2021).

Moreover, given that syntactic alignment as a fine-tuning mechanism is inherently dynamic, assessing its trajectory over time may help identify which aspects of alignment are most relevant for child language at different stages of development. Such trajectory analyses are particularly warranted given evidence which suggests that caregiver linguistic alignment tends to decrease from the time children are aged one to when they turn four-years-old (Denby & Yurovsky, 2019).

In addition, existing research on parental fine-tuning (e.g., repetition, recasts, expansions, contingent responsiveness) has primarily assessed its relation to child language outcomes among children aged two- to four-years old. There remains a need for longitudinal studies to assess links between linguistic alignment during preschool and language performance among school-aged children (e.g., Rowe & Snow, 2020), especially during the first years of school as children are building foundations for their academic trajectories.

Finally, although the majority of existing research has relied on computerised programs for estimates of alignment, such programs are prone to error rates and lack precision (e.g., Green & Sun, 2021). These limitations likely explain why some research found adult-child grammatical alignment to be at approximately chance level (Healey et al., 2014). Thus, manual coding of parent-child interactions may capture linguistic alignment more accurately. A further advantage of manual coding is that, unlike computerised programs, it allows for alignment to be estimated within triadic interactions, as opposed to only dyadic. Considering family systems theory (Minuchin, 1985), a manual approach can offer additional insights regarding how the presence of an additional caregiver may influence parent-child linguistic alignment. Such findings may be particularly relevant given experimental evidence which suggests that during triadic adult-adult-child conversations conversational partners (both children and adults) tend to align with the less competent interlocutor (Cai et al., 2021).

The Present Study

The present study aims to contribute to the child language research base through a number of research aims. First, the study examines trajectories of parent-child type of alignment from toddlerhood (two-years-old) through to preschool years (three- to four-years-old) within triadic interactions. Second, the study examines whether parent-child linguistic alignment during triadic interaction explains unique variation across longitudinal links between parent language input during toddlerhood and the preschool years (inclusive of traditional predictors such as quantity and diversity of parent language) and child language outcomes during the first years of formal schooling (eight to nine years). Given the limited research on different types of alignment, the hypothesis regarding trajectories of parent-child linguistic alignment from two- to four-years old remains exploratory (hypothesis 1). However, the study hypothesises that parent-child alignment from two- to four-years-old will positively relate to children's language diversity (vocabulary), complexity (MLU and verbs per utterance), verbal comprehension, and literacy skills (reading and spelling) at eight- to nine-years old, beyond parent language quality and complexity (vocabulary and MLU; hypothesis 2).

Method

Participants

Participants were 26 Irish mother-father-child triads (10 male and 16 female children). Data in the present study are part of a larger longitudinal study at Trinity College Dublin. Families participated when children were in toddlerhood (M_{age}=24.28 months, SD=1.45), preschool years (M_{age}=43.13 months, SD=7.15) and middle childhood (M_{age}=8.58 years, SD=.26). In toddlerhood, fathers' age ranged from 29 to 55 years (M=36.92, SD=5.61) and mothers' age ranged from 30 to 48 years (M=35.77, SD=4.93 Families were well educated, with 80.80% of mothers and 69.20% of fathers having a bachelor's degree or higher.

Procedure

Ethical approval was obtained from the School of Psychology Ethics Committee at Trinity College Dublin. During toddlerhood and preschool years mothers and fathers provided informed written consent, whereas in middle childhood consent was obtained from mothers, fathers and teachers and informed assent was obtained from children.

In toddlerhood and preschool years families participated in the study at the Infant and Child Research Lab, Trinity College Dublin. Parents provided demographic information and completed a battery of questionnaires about their child. Children subsequently underwent developmental assessment administered by a trained research assistant in the presence of one parent. Finally, families were presented with a gender-neutral toy-set and instructed to play as they normally would for a duration of five minutes as outlined in Chapter 4.

All interactions were video- and audio-recorded and subsequently transcribed with the CHAT (Codes for the Human Analysis of Transcripts) conventions of CHILDES (Child Language Data Exchange System; MacWhinney, 2000). A second transcriber verified the transcripts for accuracy of content.

In middle childhood families participated in the study via an online conferencing platform. Children's language skills were directly assessed via the verbal comprehension subscale of the WISC-IV (Wechsler, 2003). They were further presented with a wordless picture book (via screen sharing) and asked to compose a narrative based on the book illustrations. Children's narratives were transcribed with the CHAT conventions of CHILDES (MacWhinney, 2000) and analysed for language quality (vocabulary diversity) and complexity (mean length of utterance measured in morphemes and verbs per utterance). Finally, teachers were contacted with permission of the families and asked to provide children's reading and spelling scores on national standardised tests of performance.

Measures in Toddlerhood and Preschool Years

Linguistic Alignment

Linguistic alignment was coded on a turn-by-turn basis following Fernandez & Grimm's conventions (2014) that have previously been used to characterise semantic, syntactic, and lexical alignment between caregivers and children (see Misiek et al., 2020). For each type of alignment, only child alignment with mothers and fathers, and parental alignment with children (but not between mothers and fathers) was included in analysis.

Semantic Alignment

Transcripts were manually coded to capture parent-child conversational turns that contained semantically similar talk without necessarily producing similar syntactic structures or re-using another interlocutor's words. A turn was defined as an immediate semantically contingent response to a previous speaker's utterance within a five second window. The number of semantically connected turns for each speaker was calculated as a proportion of the total number of the respective speaker's turn. An example of semantic alignment from this study is presented in Table 3.2.

Table 2.2

Example of Semantic Alignment.

Speaker	Utterance	Description
Child:	why does it stick together?	Paternal semantically aligned
Father:	because they (a)re magnets.	response to child utterance.

Lexical Alignment

The CHIP command (Sokolov & MacWhinney, 1990) of CLAN was used to compute the proportion of father, mother, and child utterances which contained at least one word from the previous speaker's utterance. This calculation produces three measures, namely the proportion of exact, expanded, and reduced repetitions. The three indices were combined to create an overall measure of lexical alignment.

CHIP allows for comparison of lexicality across utterances by assigning a 'source' utterance using the code '+b' and a 'response' utterance using the code '+c'. As such, computations were limited to lexical alignment between children and mothers (via the command ‘CHIP +bCHI +cMOT’ for maternal alignment with child and ‘CHIP +bMOT +cCHI’ for child alignment with mother), and children and fathers (via the command ‘CHIP +bCHI +cFAT’ for paternal alignment with child and ‘CHIP +bFAT +cCHI’ for child alignment with father) only. Any mother-father alignment was omitted. Examples of the three types of repetition used to calculate lexical alignment from transcripts in this study are presented in Table 2.3.

Table 2.3

Examples of Exact, Expanded and Reduced Repetitions.

Speaker	Utterance	Description
Child: Mother:	why are they shaking? why are they shaking?	Maternal exact repetition of child utterance.
Child: Father:	monkey. where does the monkey live?	Paternal expanded repetition of child utterance.
Child: Mother: Child:	why are the boy and girl not standing up properly in their seats? (be)cause they (a)re silly people. silly people.	Child’s reduced repetition of maternal utterance.

Syntactic Alignment

The Morphological Analysis algorithm (MOR) of CLAN (MacWhinney, 2000) was used to generate Part of Speech (PoS) ngrams for each conversational partner. To calculate syntactic alignment, the number of PoS ngrams that each conversational partner re-used from the previous interlocutor’s utterance were manually coded and calculated as a proportion of each speaker’s total number of ngrams. An example of syntactic alignment from the transcripts used in this study is presented in Table 2.4.

Table 2.4

Example of Syntactic Alignment.

Speaker	Utterance		Description
Child:	over preposition	there. adverb	Maternal syntactic alignment to child utterance

Mother:	yes let (u)s	(u)s put it	Over Preposition	there. adverb	via the use of two ngrams (preposition, adverb).

Measures in Middle Childhood

Child Language Quality and Complexity. Children's language quality and complexity were calculated from transcripts of their narratives of a wordless picture book entitled 'David Goes to School' by David Shannon. The book is advertised as appropriate for use with children aged four to eight years. A PDF of the book used in this study can be accessed at https://issuu.com/conicam/docs/wpb. The book consists of 17 pages featuring a young protagonist who engages in a series of activities at school.

Child language quality and complexity were calculated via the KIDEVAL command of CLAN which produces 41 indices of language lexicality, morphology, and syntax. For the purposes of this study, children's vocabulary diversity (VOCD) was used as a measure of language quality and their mean length of utterance (MLU) in morphemes and number of verbs per utterance were used as measures of language complexity.

Child Verbal Comprehension. The verbal comprehension index (VCI) was used as a composite measure of children's expressive and receptive vocabularies, their ability to identify similarities between concepts, and their general knowledge. The VCI was assessed using the 'similarities', 'vocabulary', and 'comprehension' subscales of the WISC-IV (Wechsler, 2003). The scales consist of 44, 68, and 42 items respectively. Children were awarded a score of '0', '1' or '2' for each item based on response quality, with higher scores reflecting better verbal skills. Raw scores for each subscale were converted into scaled scores which were then summed and standardised to provide an overall index of verbal comprehension.

Child Literacy. Children's reading and spelling skills were used as a measure of child literacy as assessed via teacher report of child performance on the Drumcondra Reading and Spelling tests. The Drumcondra tests are a set of standardised national assessments administered to children in schools in Ireland. Scores between 80 and 89 indicate 'low average' performance, between 90 and 109 indicate 'average' performance, between 110 and 119 indicate 'high-average' performance and between 120 and 130 indicate 'above-average' performance.

Confounders

Parent Language Quality and Complexity. The KIDEVAL command of CLAN was used to compute measures of maternal and paternal vocabulary diversity (VOCD) and MLU in morphemes during interaction in toddlerhood and preschool years. Mothers' and fathers' VOCD scores were combined to produce an overall score of parental language quality whereas their MLU scores were averaged to produce an overall score of parental language complexity.

Analytic Strategy

First, a series of descriptive analyses was performed. Second, two sets of two-way ANOVA analyses were performed to examine the effect of parent gender (mothers and fathers) and timepoint (toddlerhood and preschool years) on semantic, syntactic, and lexical alignment (1) between mother and father alignment with child and (2) child alignment with mothers compared to child alignment with fathers. Finally, partial correlations were performed to examine associations between mothers', fathers', and children's linguistic alignment during triadic interaction in toddlerhood and preschool years and children's language quality and complexity, verbal comprehension, and literacy skills in middle childhood, controlling for parental vocabulary and MLU. Given the multiple comparisons performed, the alpha value against which correlations were compared was adjusted using Maier and Lakens et al.'s JustifyAlpha R package (Maier & Lakens, 2022). The package minimises the risk of Type I and Type II error based on sample size, the effect size of interest and an analytic power function. Accordingly, all correlations in this study were compared against the corrected alpha value of .04.

Results

Linguistic Alignment in Toddlerhood and Preschool Years

Descriptive statistics for maternal, paternal, and child semantic, lexical, and syntactic alignment in toddlerhood and preschool years are presented in Table 2.5.

Table 2.5

Descriptive Statistics for Mothers', Fathers', and Children's Semantic, Lexical and Syntactic Alignment During Interaction in Toddlerhood and Preschool Years.

	Mother-Child Alignment				**Father-Child Alignment**			
	Toddlerhood		Preschool Years		Toddlerhood		Preschool Years	
	M (SD)	Range	M (SD)	Range	M (SD)	Range	M (SD)	Range
Exposure Variables								
Linguistic Alignment								
Semantic								
Parent Alignment	.15 (.10)	0 - .37	.29 (.14)	.13 - .67	.14 (.09)	0 - .36	.26 (.12)	.10 - .54
Child Alignment	.50 (.27)	0 – 1	.56 (.16)	.31 - .88	.50 (.26)	0 – 1	.53 (.16)	.24 - .93
Lexical								
Parent Alignment	.06 (.05)	0 - .17	.04 (.03)	0 - .10	.03 (.04)	0 - .10	.04 (.02)	0 - .10
Child Alignment	.07 (.05)	0 - .20	.05 (.03)	0 - .12	.06 (.04)	0 - .17	.05 (.03)	0 - .12
Syntactic								
Parent Alignment	.07 (.12)	0 - .50	.03 (.02)	0 - .08	.06 (.05)	.01 - .20	.06 (.06)	0 - .27
Child Alignment	.09 (.09)	.01 - .49	.57 (.28)	.06 - .97	.10 (.14)	0 - .75	.52 (.31)	.08 - .98
Measures Used to Calculate Alignment								
Semantic (Frequencies)								
Parental Conceptually Related Utt	9.96 (7.16)	0 – 30	32.31 (19.25)	7 – 90	5.77 (3.92)	0 – 17	18.70 (10.68)	3 – 39
Child Conceptually Related Utt	7.27 (7.34)	0 – 30	28.88 (14.27)	5 – 66	4.38 (4.11)	0 – 15	15.27 (8.45)	4 – 43
Lexical (Proportions)								
Parental Exact Repetitions	.01 (.02)	0 - .10	.01 (.01)	0 - .04	.02 (.03)	0 - .10	.01 (.01)	0 - .03
Parental Expanded Repetitions	.002 (.01)	0 - .06	.004 (.01)	0 - .03	.001 (.004)	0 - .02	.01 (.01)	0 - .04
Parental Reduced Repetitions	.05 (.05)	0 - .17	.02 (.01)	0 - .07	.01 (.02)	0 - .06	.02 (.02)	0 - .08
Child Exact Repetitions	.03 (.03)	0 - .14	.01 (.02)	0 - .06	.04 (.03)	0 - .11	.02 (.01)	0 - .06
Child Expanded Repetitions	.03 (.03)	0 - .09	.02 (.01)	0 - .06	.02 (.02)	0 - .08	.02 (.01)	0 - .06
Child Reduced Repetitions	.004 (.01)	0 - .02	.02 (.02)	0 - .06	.002 (.01)	0 - .03	.02 (.02)	0 - .06
Syntactic (Frequencies)								

Parental Repeated Ngrams	10.31 (6.08)	1 – 20	25.31 (14.02)	1 – 48	10.11 (6.32)	0 – 20	23.46 (16.02)	2 – 49
Child Repeated Ngrams	8.92 (6.57)	0 – 20	24.73 (13.52)	4 – 50	6.04 (6.05)	0 – 19	26.42 (15.65)	1 – 49
Confounders								
Parent Language Quality (VOCD)	30.81 (6.34)	14.09 – 40.30	47.52 (8.54)	32.36 – 64.12	27.96 (8.58)	8.51 – 50.38	45.87 (7.35)	27.95 – 59.65
Parent Language Complexity ($MLU_{morphemes}$)	4.60 (.89)	3.04 – 7.04	5.71 (.74)	4.50 – 7.40	4.25 (1.07)	2.80 – 6.56	5.14 (.93)	2.69 – 7.65
	Middle Childhood							
	M (SD)		Range					
Outcome Variables								
Language Quality								
VOCD	40.52 (11.22)		16.08 – 55.78					
Language Complexity								
$MLU_{morphemes}$	9.04 (2.58)		4.25 – 13.01					
Verbs/utterance	1.36 (.51)		.60 – 2.78					
Verbal Comprehension								
WISC	39.11 (9.13)		18 – 52					
Literacy								
Reading	114.92 (11.21)		94 – 130					
Spelling	110.12 (10.69)		92 - 129					

Note. Utt = utterances; Proportions rather than frequencies are provided for measures used to calculate lexical alignment as these were not manually calculated but computed by CHIP.

ANOVA analyses examining the effects of parent gender and timepoint on maternal versus paternal linguistic alignment with children, and on child linguistic alignment with mothers versus alignment with fathers are presented in Table 2.6.

Mother vs Father Alignment with Child

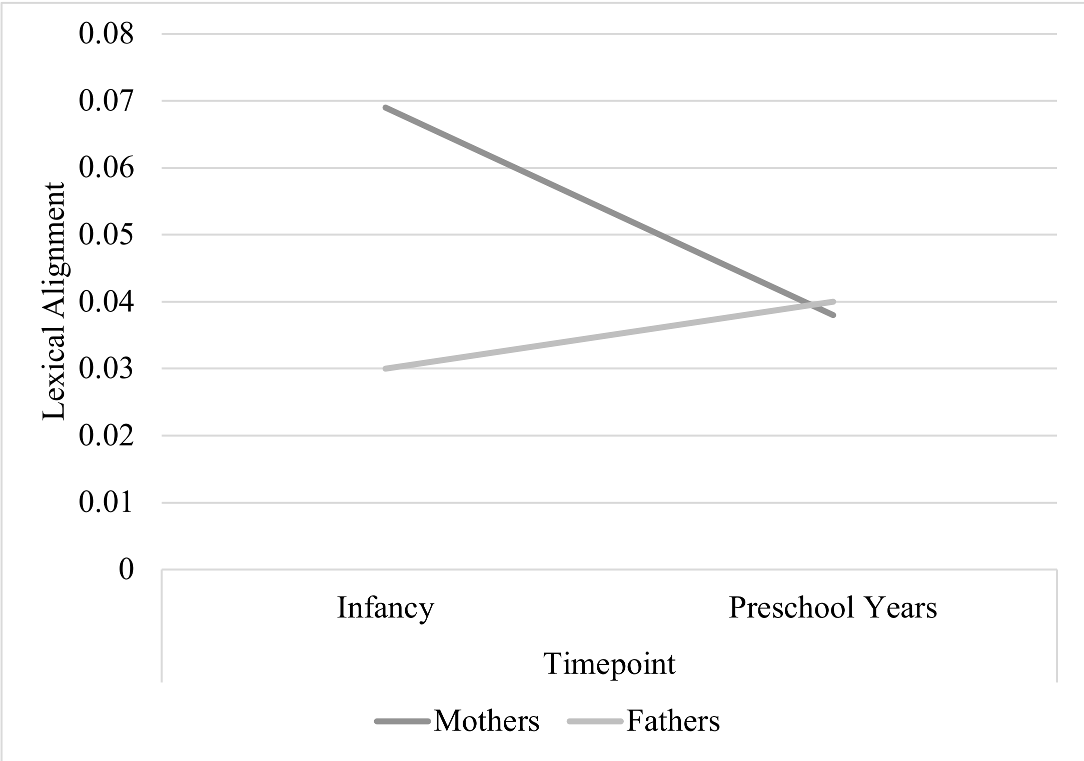
There was no statistically significant interaction between the effect of parent gender and timepoint on parents' semantic alignment with children. There was however a significant main effect of timepoint, but not parent gender, on parents' semantic alignment with children such that both mothers and fathers increased their semantic alignment over time.

There was a statistically significant interaction between parent gender and timepoint on mothers' and fathers' lexical alignment with children, as well as a main effect of parent gender. As illustrated in Figure 3.1, during toddlerhood mothers engaged in more lexical alignment with children than fathers, but by the preschool years maternal and paternal lexical alignment appeared to converge.

Finally, there were no statistically significant interaction or main effects of parent gender and timepoint on mothers' and fathers' syntactic alignment with children.

Figure 3.1.

Interaction Effect Between Parent Gender and Timepoint on Mothers' and Fathers' Lexical Alignment



Child Alignment with Mothers vs Child Alignment with Fathers

There were no statistically significant interactions or main effects of parent gender and timepoint on children's semantic or lexical alignment with mothers and fathers. Similarly, there was no statistically significant interaction between parent gender and timepoint on children's syntactic alignment with parents. However, there was a statistically significant main effect of timepoint, but not parent gender, on children's syntactic alignment such that children increased their syntactic alignment with both mothers and fathers from toddlerhood to preschool years.

Links between Mother, Father, and Child Linguistic Alignment in Toddlerhood and Preschool Years and Child Language Outcomes in Middle Childhood

Partial correlations between linguistic alignment in toddlerhood and child outcomes in middle childhood are presented in Table 2.7. Results indicate that, controlling for parental language quality and complexity during triadic interaction, only child semantic alignment with fathers in toddlerhood related positively with child verbal comprehension in middle childhood.

Partial correlations between linguistic alignment in preschool years and child outcomes in middle childhood are presented in Table 2.8. Controlling for parental language quality and complexity, maternal semantic alignment was significantly positively related to child spelling skills whereas paternal lexical alignment was negatively related to child spelling skills. Moreover, the combined proportion of maternal and paternal lexical alignment during preschool years was similarly negatively linked with child spelling skills.

In contrast, children's lexical alignment with mothers was significantly positively related to their language complexity (MLU and verbs per utterance). Finally, paternal, but not maternal or child, syntactic alignment was significantly positively related to child language quality (VOCD) and complexity (MLU and verbs per utterance) in middle childhood. However the combined proportion of maternal and paternal syntactic alignment was also positively linked with child language complexity (MLU and verbs per utterance) with larger effect sizes.

Table 2.6
Effects of Parent Gender and Timepoint on Mother, Father, and Child Semantic, Lexical and Syntactic Alignment.

	Mother vs Father Alignment with Child				**Child-Mother vs Child-Father Alignment**			
	M_D	F value	p value	η^2	M_D	F value	p value	η^2
Semantic Alignment								
Parent Gender x Timepoint		.35	.55	.004		.19	.67	.002
Parent Gender	.02	1.03	.31	.01	.02	.12	.73	.001
Timepoint	.13	32.87	<.001	.25	.05	1.29	.26	.01
Lexical Alignment								
Parent Gender x Timepoint		9.19	.003	.08		.09	.77	.001
Parent Gender	.02	7.24	.01	.07	<.001	.001	.98	<.001
Timepoint	.01	2.33	.13	.02	.01	1.94	.17	.02
Syntactic Alignment								
Parent Gender x Timepoint		1.73	.19	.02		.39	.53	.004
Parent Gender	.02	.87	.35	.01	.01	.10	.75	.001
Timepoint	.02	1.73	.19	.02	.45	105.32	<.001	.51

Table 2.7

Partial Correlations between Mother, Father, and Child Linguistic Alignment in Toddlerhood and Child Language Outcomes in Middle Childhood.

	Language Quality	**Language Complexity**		**Verbal Comprehension**	**Literacy**	
	VOCD	**MLU**	**Verbs/Utterance**	**WISC**	**Reading**	**Spelling**
Semantic						
Maternal Alignment	.35	.41	.26	.18	-.42	-.19
Paternal Alignment	-.06	.11	-.06	-.19	-.38	-.15
Total Parental Alignment	**.30**	**.31**	**.14**	**-.01**	**-.39**	**-.13**
Child Alignment with Mother	-.03	-.12	-.26	-.31	.16	.07
Child Alignment with Father	.29	.14	-.06	**.54***	.13	.21
Lexical						
Maternal Alignment	.05	.19	.15	-.06	-.02	.04
Paternal Alignment	-.03	-.32	-.28	-.37	.27	.22
Total Parental Alignment	**.01**	**-.10**	**-.10**	**-.34**	**.13**	**.16**
Child Alignment with Mother	-.02	.15	.04	.34	-.17	-.01
Child Alignment with Father	-.25	-.03	-.11	-.17	-.14	-.07
Syntactic						
Maternal Alignment	-.39	-.18	-.09	.05	-.16	-.09
Paternal Alignment	.03	.12	.03	-.37	-.02	.13
Total Parental Alignment	**-.40**	**-.09**	**-.06**	**-.09**	**-.13**	**-.02**
Child Alignment with Mother	-.004	-.06	.05	.04	-.18	-.10
Child Alignment with Father	-.15	-.06	.05	.04	-.22	-.19

Note. Correlations between linguistic alignment and child language outcomes control for parental VOCD and MLU in toddlerhood; *p<.04

Table 2.8

Partial Correlations between Mother, Father, and Child Linguistic Alignment in Preschool Years and Child Language Outcomes in Middle Childhood.

	Language Quality	**Language Complexity**		**Verbal Comprehension**	**Literacy**	
	VOCD	**MLU**	**Verbs/Utterance**	**WISC**	**Reading**	**Spelling**
Semantic						
Maternal Alignment	-.02	-.12	-.18	-.15	.38	**.42***
Paternal Alignment	-.25	-.05	-.06	-.36	.11	.003
Total Parental Alignment	**-.15**	**-.10**	**-.15**	**-.29**	**.30**	**.27**
Child Alignment with Mother	.07	-.23	-.30	-.30	.02	.01
Child Alignment with Father	.08	.02	-.10	.11	.17	.18
Lexical						
Maternal Alignment	.06	.18	.22	.08	-.26	-.34
Paternal Alignment	-.30	.14	.07	-.002	-.24	**-.41***
Total Parental Alignment	**-.14**	**.21**	**.19**	**.05**	**-.33**	**-.49***
Child Alignment with Mother	.28	**.43***	**.40***	.01	.16	.17
Child Alignment with Father	.17	.38	.37	.02	.16	.19
Syntactic						
Maternal Alignment	.09	-.19	.25	.21	.07	-.14
Paternal Alignment	**.44***	**.49***	**.53***	.09	-.05	.08
Total Parental Alignment	**.37**	**.52***	**.58***	**.16**	**-.07**	**.02**
Child Alignment with Mother	.06	-.13	.14	-.26	.09	.11

Child Alignment with Father	-.01	.04	.14	.16	.23	.16

Note. Correlations between linguistic alignment and child language outcomes control for parental VOCD and MLU in preschool years; *p<.04.

No other significant links were observed between parent and child linguistic alignment and any child language outcomes.

Discussion

Parent language input is universally recognised as fundamental for child language development (Rowe & Weisleder, 2020). While a wealth of empirical data supports the predictive association between parent and child language, it has been recently theorised that not only language quantity, quality and complexity foster language growth but also the extent to which parents' linguistic input aligns with children's concurrent language abilities (Fusaroli et al., 2021; 2023). Parent-child linguistic alignment, by definition, can only occur in response to child vocalisations and is therefore responsive and contingent on child language. Thus, linguistic alignment, in addition to quantity and quality of parental speech may represent a key mechanism by which child language development is promoted. Accordingly, the present study examined how mothers, fathers, and children engage in semantic, lexical, and syntactic alignment during triadic interaction in toddlerhood and preschool years. The study further examined how this linguistic alignment between parents and children relates to child language outcomes in middle childhood.

Mother-Child and Father-Child Linguistic Alignment in Toddlerhood and Preschool Years

While the research base on linguistic alignment is gathering momentum, few studies have examined children's alignment to parents (see Fusaroli et al., 2023 and Misiek & Fourtassi, 2022 for exceptions), and none have included both mothers and fathers. The present study is therefore among the first to illustrate that maternal, paternal and child linguistic alignment is dynamic and varies across development. The study found mothers and fathers to engage in comparable proportions of semantic and syntactic alignment with children during both toddlerhood and preschool years. The existing research base on maternal and paternal conversational behaviour with children is mixed, with some studies reporting differences (e.g., Rowe et al. 2004) while others find mothers and fathers to be similar (e.g., Conica et al., 2020). However, as the number of studies inclusive of both mothers and fathers accumulate, it is increasingly apparent that parents are more similar than different with respect to their interactive styles with children. The present study coheres with this growing research base and suggests that both mothers and fathers can be sensitive to their child's vocalisations and align their verbal input accordingly.

The study further found that both parents demonstrated greater levels of semantic alignment with children during preschool years compared to toddlerhood. This increase in alignment likely reflects parental fine-tuning of language in accordance with children's more sophisticated language skills. That is, as children become more proficient conversational partners, greater linguistic alignment likely reflects children's production of more linguistic material with which parents can align. Equipped with better language skills children are more capable of maintaining conversation by contributing meaningfully related speech and consequently affording parents increased opportunities to produce semantically aligned responses.

While broadly similar in terms of semantic and syntactic alignment, there was a significant interaction effect of parent gender and timepoint on mothers' and fathers' lexical alignment. Namely, while mothers' lexical alignment was significantly greater than that of fathers during toddlerhood, by preschool years maternal and paternal levels of lexical alignment appeared to converge. The initial disparity in parental lexical alignment in toddlerhood is contrary to prior research which found mothers and fathers to engage in similar levels of repetition of their two-year-olds' utterances, a proxy of lexical alignment (Conica et al., 2020). It is noteworthy that both studies included relatively small sample sizes and therefore restrict the extent to which an inference regarding similarities or differences between parental lexical alignment can be made.

Nonetheless, the difference between mothers' and fathers' lexical alignment observed in this study accords with family systems theory (Minuchin, 1985). Specifically, the triadic context within which participants were observed may reflect parents' tendency to assume complementary roles during interaction with children. It is therefore possible that parents are fine-tuned to their child's language and adjust their re-use of linguistic features to provide children with optimal levels of alignment. Future studies can further clarify whether such complementary mechanisms are at play by including comparative observations of mother-child and father-child linguistic alignment during dyadic and triadic interaction.

Crucially, this study found that children aligned aspects of their language in similar proportions with both parents suggesting that both mothers and fathers can co-create a linguistic synchrony with their child. As such, this study contributes to the growing research base which increasingly identifies more similarities than differences between maternal and paternal parenting behaviour (Rowe et al., 2004) and highlights the importance of including both mothers and fathers in research with children.

The study further found that children engaged in significantly more syntactic alignment during preschool years than they did during toddlerhood. These findings align with recent evidence which similarly found children's semantic, and also lexical and syntactic, alignment to increase from three to five years of age (Fusaroli et al., 2023). The greater child syntactic alignment likely reflects their increased capacity to produce more complex sentences and is coherent with evidence which indicates that children undergo significant grammatical development including morphological and syntactic growth, between the ages of three to five years (Bavelier & Neville, 2002).

The present study therefore presents three main observations pertaining to mothers', fathers' and children's linguistic alignment in triadic interaction during the years preceding formal education. First, parents are largely comparable in terms of their semantic and syntactic alignment with children, and both increase their semantic alignment over time which likely corresponds with children's developing language skills. Second, parents may engage in complementary lexical alignment by adjusting their repetition of child utterances, arguably to prevent over- or under-stimulation of children's lexicality. Finally, children align with both mothers and fathers to a similar extent and are increasingly syntactically aligned with parents during preschool years compared to toddlerhood. The increase in syntactic but not semantic or lexical alignment may reflect children's increased ability to adopt and re-use features of their interlocuter's language in more complex ways, beyond mere repetition (i.e., lexical alignment) or following a parent's lead (i.e., semantic alignment).

Links between Mother, Father, and Child Linguistic Alignment in Toddlerhood and Preschool Years and Child Language Outcomes in Middle Childhood

The present study found that during toddlerhood, only child semantic alignment with fathers, but not mothers, related positively with their verbal comprehension in middle childhood. This finding suggests that semantically connected child responses to paternal utterances, that arguably sustain ongoing conversation, are beneficial for children's later verbal comprehension as indexed by their abilities to identify similarities between concepts and their general knowledge.

Although maternal linguistic alignment in toddlerhood did not relate with any child outcomes, by preschool years, mothers' semantic alignment was positively linked with children’s spelling skills. These results may reflect the importance of attuning language input in accordance with children’s growing linguistic competence. That is, during the initial stages of learning to spell, children depend on one-to-one phoneme-grapheme mapping (van Rijthoven et al., 2021). However, once children successfully master this phonetic strategy, they need to be exposed to more orthographically complex words, a phase during which children must learn spelling inconsistencies in order to become competent spellers (Ehri, 2000; Treiman, 2018). To achieve this spelling competence children must connect specific knowledge of orthographic and morphological patterns to their already assimilated semantic representations such that they can invoke analogies of familiar words to spell novel, unfamiliar words (Allen, 2019; Treiman et al., 1994). Thus, findings of this study are in concert with existing evidence which suggests that high quality levels of orthographic, phonological as well as semantic representations are conducive to better child spelling skills (Perfetti, 2007).

In contrast, paternal lexical alignment, as well as the combined proportion of maternal and paternal lexical alignment, during preschool years were negatively linked with child spelling. This negative association, although unexpected, may be understood upon further scrutiny into the type of lexical alignment parents engaged in, namely exact, expanded, or reduced repetition of child utterances. In the present study, the lowest proportion of repetition among both mothers and fathers was expanded repetition. Yet, evidence suggests that this type of repetition appears to be more important for child language growth compared to exact or reduced repetitions (Snow, 2014), especially during preschool years when children have the ability to use language in more sophisticated ways. Hence, the higher use of reduced or exactly repeated utterances observed in this study may have lacked semantic variation, an aspect of linguistic input that is important for child spelling skills (van Rijthoven et al., 2021) and may therefore account for the negative association. This hypothesis coheres with the positive link between maternal semantic alignment during preschool years and child spelling skills in middle childhood. Future, sufficiently powered studies, can further examine how various types of parental lexical alignment relate to children's spelling skills.

Findings further suggest that children's lexical alignment with mothers was positively linked with their language complexity. This finding accords with previous research which found child word repetition between the ages of three to four to relate positively with their grammatical competence (Dispaldro et al., 2009). This study therefore contributes to the growing research base which promotes parent repetition (Conica et al., 2020; Che et al., 2018), and suggests that not only parents, but also children should be provided with ample opportunities to repeat, and therefore lexically align with their conversational partners.

Finally, paternal, but not maternal or child, syntactic alignment was positively linked with children's language quality and complexity. This finding is consistent with data which demonstrates a strong correlation between children's syntax and vocabulary development (Hoff et al., 2018; Lidz et al., 2017). As the syntactic bootstrapping hypothesis (Landau & Gleitman, 1985; Naigles, 1990) suggests, children who are exposed to unfamiliar words in a sentence can infer word meanings by drawing on features of sentence syntax. For instance, preschool children can determine whether an unfamiliar word is a singular noun (e.g., nep) or a proper name noun (e.g., Nep) based on whether the determiner 'a' is present and whether a novel word is a verb (e.g., nepping) based on whether it succeeds a noun and contains the affix 'ing' (Spencer & Schuele, 2012). Children can further determine whether a new word is a verb or a noun by considering where the word appears in a sentence (Gleitman & Gleitman, 1992).

Indeed, recent evidence suggests that teachers' syntax is uniquely linked with pre-schoolers and kindergartners' vocabulary growth (Farrow et al., 2020). Findings of this study similarly show that caregivers' syntactic alignment can positively impact child vocabulary, even during the years before formal education.

The link between paternal syntactic alignment and children's language complexity is particularly noteworthy given that syntax has been theorised to be important for verb learning as most verbs are frequently not accompanied by a referent or gesture (Gleitman & Gleitman, 1992). The lack of a significant association between maternal syntactic alignment and child language outcomes is likely due to the low power of the present study which restricted the ability to identify potentially small effect sizes. This is particularly plausible given that this study found evidence for a positive relation between the combined proportion of maternal and paternal syntactic alignment and child language complexity. It is noteworthy that these associations remained significant even after controlling for parent vocabulary and MLU. Accordingly, findings suggest that not only parent language quality or complexity, but also the alignment of syntactic properties in accordance with children's own syntax and arguably their evolving language skills, promotes child language.

Overall, findings suggest that semantic, lexical, and syntactic alignment between children and their parents, differentially relate to children's language outcomes during different periods of development. While this study found no evidence for associations between parental alignment in toddlerhood and child language, children's own semantic alignment with fathers related to *macro*-linguistic outcomes, such as their verbal comprehension in middle childhood. During preschool years however, linguistic alignment between children and parents showed associations with *micro*-linguistic child outcomes in middle childhood. Specifically, maternal semantic alignment related positively with child spelling whereas paternal and overall parental syntactic alignment was positively linked with child language quality (VOCD) and complexity (MLU and verbs per utterance). Children's lexical alignment during preschool years was similarly positively linked with their language complexity in middle childhood. These findings highlight the importance of exposing and engaging children in varied language alignment throughout the preschool years as this interactive mechanism has potential implications for a range of child language outcomes.

Findings of the present study further point to compensatory, and likely complementary, processes between maternal and paternal linguistic alignment. While the negative link between paternal lexical alignment in preschool years and child spelling skills was likely buffered by maternal semantic alignment, it is noteworthy that different types of parent alignment related to different child language outcomes also suggesting complementary parenting. More specifically, mother semantic alignment was positively linked with child spelling whereas father syntactic alignment related positively with child language complexity. Thus, maternal and paternal linguistic alignment may play distinct roles in promoting child language and early parenting interventions may usefully be tailored accordingly.

Limitations

The most salient limitation of the present study is the small sample size which severely restricted the scope of this study. First, it resulted in a low study power and therefore limited its potential to identify a host of potential small effects. Therefore, the possibility that non-significant associations observed in this study do not necessarily represent a true lack of effects, but rather significant associations beyond this study's ability to identify them, cannot be eliminated and these relations should be subjected to future research inquiry. Second, it limited the manner in which the data could be analysed as well as the number of variables that could be tested for their predictive, mediatory, or confounding value. Second, it underpowered the study to find additional possible associations between linguistic alignment and child language outcomes. This is particularly likely considering the numerous marginally significant associations observed. One advantage of the small sample size is that it permitted manual coding of linguistic alignment, therefore allowing for the examination of dyadic interaction within a triadic family context, and hence accounting for the dynamic transactional influences inherent in family systems.

Another limitation is that participants were largely homogenous, consisting of White, middle-class, well-educated families. Thus, the generalisability of findings is constrained and future research inclusive of more diverse participants from a range of cultures is imperative. For instance, some evidence suggests that linguistic alignment may play a more prominent role in languages with reduced consonant pronunciation (Trecca et al., 2021). Elsewhere, among cultures with limited direct language interaction with children, lack of linguistic alignment does not appear to be consequential for child language (Casillas et al., 2020).

Finally, findings may have been influenced by the setting within which families interacted. While structured interaction is frequently used, and highly informative, in research, there is a need for future studies to consider how settings may place specific demands on participant behaviour. Some evidence, albeit from adult-adult conversations, suggests that alignment tends to be greater during less restricted activities (Dideriksen et al., 2022a; 2022b). It is therefore important to recognise that activity context may similarly influence parent-child conversation.

Conclusion

Despite limitations, the present study provides support for the importance of attuned early conversations between caregivers and children. Moreover, the differential, possibly compensatory and complementary, associations observed in this study strongly motivate future research to examine how linguistic alignment during various developmental periods relate to child language growth. Such an approach bears tremendous implications for parent education, childhood practitioners, and early interventions which may be tailored to ensure optimal child development. The effects of such an exercise would extend beyond early childhood considering that children with better developed language skills tend to excel academically, both during the transition to school and throughout their academic careers.

Study 2. Children's Literacy and Numeracy Skills

Findings of the systematic review indicated that tparental language not only influences child language and literacy skills, but also benefits children's numeracy development. This effect has been attributed to the symbolic representation skills necessary for abstract reasoning such as letter-sound and number-symbol correspondence foundational for language and numeracy respectively. However, a relatively less examined aspect of language input, but one that similarly invokes abstract reasoning, in relation to both literacy and numeracy is parental use of decontextualised language. Decontextualised language refers to talk that requires cognitive abstraction and transcends the here-and-now including talk about the past or future, pretend talk, or cause-and-effect statements. Based on theoretical arguments which attest to the relevance of decontextualised talk to child literacy and numeracy, the second study of this chapter first described maternal, paternal, and children's use of decontextualised language during toddlerhood and preschool years. The study further explored associations between the use of decontextualised language in toddlerhood and preschool years and children's literacy and numeracy skills in middle childhood.

Talk Outside the Box: Parents' Decontextualised Language During Preschool Years Relates to Child Numeracy and Literacy Skills in Middle Childhood

Abstract

Children's literacy and numeracy skills are fundamental for early academic performance and later academic success, mental health, and employment prospects in adulthood. Given that parents play a key role in promoting child development, identifying early parenting behaviors that predict literacy and numeracy skills is a research imperative. Emerging evidence suggests that parental use of decontextualized language—talk that requires cognitive abstraction and transcends the here and now—predicts children's literacy skills. However, its relation to numeracy remains underex plored. Accordingly, the current study examined how decontextualised language during interaction with children during toddlerhood (T1) and preschool years (T2) relates to child literacy and numeracy in middle childhood (T3). Participants were 26 Irish mother–father–child triads (16 female children). At T1 and T2, participants engaged in 5-min interactions that were coded for decontextualised language. At T3, child literacy and numeracy were assessed using the Wechsler Intelligence Scale for Children–Fourth Edition and teacher report of child scores on national standardized tests. Controlling for child age and contextualized utterances, child reading in middle childhood was negatively related to maternal and child decontextualised language in toddlerhood but was positively related to decontextualised language during preschool years, suggesting that the benefits of decontextualised language may become apparent later in development. Mothers', fathers', and children's decontextualised language during preschool years was also positively linked with child numeracy in middle childhood. Thus, embedding decontextualised language in conversation with children may have positive domain-specific and cross-domain effects on children's literacy and numeracy performance. Findings provide incentive for future research to examine relations between decontextualised language and children's school performance across a wider range of developmental domains.

Keywords: decontextualiosed language, literacy, numeracy, toddlerhood, preschool years, middle childhood

Introduction

Children's early literacy and numeracy skills are central to their initial learning aptitude and continuous academic achievement (Hulme et al., 2012). Children with well-developed literacy and numeracy skills are adequately equipped to engage in decoding and reading comprehension, and to produce written material which forms the basis of formal academic assessment (Bowyer-Crane et al., 2008). Literacy and numeracy difficulties in contrast impede children's ability to learn and engage with the wider academic environment with profound enduring consequences through to adulthood. Children who lack these skills during primary school are more likely to drop out, experience unemployment, live in poverty, be incarcerated, and have poorer mental and physical health later in life (Reynolds et al., 2010). Poor literacy and numeracy skills are further associated with truancy, social exclusion, and substance abuse problems (Reynolds et al., 2010). Crucially, despite formal schooling, children with poor literacy and numeracy skills during preschool fail to catch up with their more academically skilled counterparts during later school years (Aunola et al., 2004).

Such persistent literacy and numeracy difficulties bear tremendous implications for educational, health and economic outcomes not only for each child individually but also at a national level (Fiester, 2010). It is therefore imperative to promote children's literacy and numeracy development early in childhood such that they embark on their academic journeys poised to succeed.

Parent Language Input and Children's Early Literacy and Numeracy Skills

Parent language input is one of the strongest predictors of children's literacy and numeracy development (Braham et al., 2018). Both quality and quantity of child-directed speech (CDS) during the first years of life can positively predict children's language and emergent literacy skills above and beyond parental education, socioeconomic status and race or ethnicity (Huttenlocher et al., 2010; Rowe, 2012). Children whose caregivers produce more words exhibit more diverse vocabularies, better language processing skills and greater literacy skills (Zimmerman et al., 2009). Parental vocabulary diversity has also been linked with toddlers' vocabulary growth (Huttenlocher et al., 2010) and later vocabulary size, even after accounting for quantity of parental speech (Rowe, 2012). Further evidence indicates that among four- and five-year-olds, parents who engage in greater proportions of complex speech have children who also produce more complex speech both at home and at school (Huttenlocher et al., 2002).

Parents' CDS also plays a critical role for children's numeracy development. Theoretically, children depend on language to develop the conceptual understanding needed to comprehend the abstract symbols of mathematics (Moses & Cobb, 2001). For instance, a well-developed vocabulary is necessary for understanding math terminology (Purpura et al., 2011). Additionally, precise representations of numbers, which are the basis of formal math, cannot exist independently of language (Spaepen et al., 2011). Along these lines, parental use of 'math talk', particularly their use of numbers larger than 10 have been related to children's math skills, above and beyond parents' overall speech (Elliott et al., 2017).

Parental Use of Decontextualised Language and Child Literacy and Numeracy Skills

Emerging evidence suggests that parent use of decontextualised language, talk that requires cognitive abstraction and transcends the here-and-now, may play an important role in preparing children for school (Ribner et al., 2020). Decontextualised language includes talk about the past and future, pretend talk, and explanatory talk that makes logical connections between concrete objects and events. Given that this type of language is lexically and grammatically more complex than other CDS (i.e., features more unique words, connectives, elaborated noun phrases; Demir et al., 2015), and contains the type of academic language that children require upon school entry (e.g., cause-effect statements, narratives; Uccelli et al., 2019), it is becoming increasingly scrutinised as a potentially influential precursor of child academic performance. Embedding this type of language during parent-child conversation has proven important for children's vocabulary growth, narrative skills, reading comprehension and children's own use of decontextualised talk above and beyond socioeconomic status, child language skills, and total number of utterances directed at children (Demir et al., 2015; Rowe, 2012).

However, the relation between decontextualised talk and numeracy skills remains underexplored despite theoretical arguments which motivate an examination of this association. For instance, akin to word learning, whereby children must create symbolic representations of abstract concepts, understanding early math concepts requires children to represent words in numbers (i.e., 'three' equates to '3') and numbers in words (i.e., '3' equates to 'three'). Drawing on Peirce's semiotic theory, the use of decontextualised language could prove a useful means of enabling children "to create analogies (structure mappings) across two or more complex wholes, based on similar functional roles" (Tomasello, 2005, p.4). In other words, it may promote children's understanding of how particular words or signs work to convey meaning.

In addition, decontextualised language may foster children's pattern detecting skills, inferential thinking and enable them to make comparisons, all of which are foundational for later numeracy competence (e.g., Flynn et al., 2020; Fyfe et al., 2015). For instance, four-year-olds exposed to abstract labels of a series of objects (e.g., A-B-A-B) performed better on pattern abstraction problems than did children exposed to concrete labels (e.g., blue-red-blue-red; Fyfe et al., 2015). These data endorse the hypothesis that language which challenges children to reflect, reason and draw inferences among abstract concepts may benefit numeracy development to a greater extent than language which solely focuses on perceptually available features (Fyfe et al., 2015). This hypothesis is further corroborated by recent research which found that maternal distancing language (i.e., language that extends beyond the here-and-now) during shared book reading episodes with five-year-old children related to children's literacy and numeracy skills both concurrently and longitudinally one year later (Ribner et al., 2020).

The Present Study

The present study aims to contribute to the research base on early predictors of child academic success through the following research aims: (1) to measure mothers', fathers', and children's decontextualised language during triadic interaction in toddlerhood and preschool years; and (2) to examine links between mothers', fathers', and children's use of decontextualised language in toddlerhood and preschool years with children's literacy and numeracy skills during middle childhood. The use of triadic interaction is grounded in family systems theory (FST) which recognises the family unit as a "complex integrated whole" (Minuchin, 1988, p.8) within which the interactive pattern of each family member influences, and is influenced by, all other family members (Cox & Paley, 1997). FST thus underscores the importance of studying children's interactions with one parent in the context of their interactions with the other parent (Minuchin, 1985). While extant research on dyadic interactions has produced significant insight pertaining to child development, exclusive focus on dyadic interaction obscures the influence of family level, triadic, processes on child development. The present study is thus guided by an FST perspective and proposes that studying children within the wider triadic family context may contribute to a more comprehensive understanding of the dynamic environment in which children develop.

Given the scarce research base on decontextualised language with this age group, and the lack of research on fathers' use of decontextualised language, the study does not make any hypotheses regarding the prevalence of each participant's decontextualised language during interaction. However, the study hypothesizes that higher levels of mother, father, and child decontextualised language during toddlerhood and preschool years will relate positively with children's literacy and numeracy during middle childhood.

Materials and Methods

Participants

Participants were 26 Irish mother-father-child triads recruited as part of a larger longitudinal study at Trinity College Dublin. Data were collected when children (16 female and 10 male) were infants (T_1), pre-schoolers (T_2), and during middle childhood (T_3). At T_1 children ranged in age from 22.17 to 27.13 months (M=24.28, SD=1.45), at T_2 children ranged in age from 34.60 to 54.40 months (M=43.18, SD=7.16) and T_3 children ranged in age from 7.67 to 9 years (M=8.58, SD=.27). At T_1 mothers' mean age was 35.77 years (SD=4.93) and fathers' mean age was 36.92 years (SD=5.607). Families were well educated, with 80.80% of mothers and 69.20% of fathers having a bachelor's degree or higher.

Procedure

Ethical approval was obtained from the School of Psychology Research Ethics Committee at Trinity College Dublin. At T_1 and T_2 families participated in the study in a research laboratory at Trinity College Dublin. Parents completed a battery of questionnaires about their child and provided demographic information. Children also underwent developmental assessment in the presence of one parent. Mothers, fathers, and their child were subsequently invited to participate in five-minute structured interactions during which they were provided with a gender-neutral toy and encouraged to play as they normally would. All interactions were recorded with indoor AXIS Q6035 PTZ Dome Network cameras and a professionally calibrated Beyerdynamic MPC66 v SW 12–84 V microphone.

Recorded interactions were transcribed with the CHAT (Codes for the Human Analysis of Transcripts) conventions of CHILDES (Child Language Data Exchange System; MacWhinney, 2000). Each transcript was verified by a second researcher to confirm accuracy of content.

At T_3 children's literacy and numeracy skills were directly assessed via an online conferencing platform (i.e., Microsoft Teams, Zoom). In addition, teachers reported children's literacy and numeracy scores on national standardised assessments.

Measures

Decontextualised Language

All mother, father and child utterances were coded as either decontextualised or contextualised according to Rowe's (2012) coding scheme. A full description of the coding scheme along with examples is provided in Table 3.1.

To establish inter-rater reliability, 20% of the transcripts were coded by a second researcher and disagreements were discussed until a criterion of > 90% agreement was achieved.

Table 3.1

Description of Coding Scheme Used to Code for Decontextualised Language.

Decontextualised Language		
Type	**Definition**	**Examples**
Narrative	Talk that references events that happened in the past or will happen in the future.	"Remember when we saw a giraffe like this one at the zoo?" "Maybe when we finish here, we

		can stop by Smyths (toy shop) and buy a similar toy."
Explanation	Talk that makes a logical connection between concrete objects, events, or conclusions, as well as predictions.	"You have to connect the magnets at opposite ends otherwise they will not stick together."
Pretend	Talk that makes an object represent something else, attributes thoughts, actions, or feelings to inanimate objects, enacts typical scripts or routines of everyday events, and assumes or assigns roles or personas.	"Rapunzel is very frightened that the evil witch will get her." "Oh, I think the boy is driving to his office like Daddy does."
	Contextualised Language	
Type	**Definition**	**Examples**
Conversation	Verbal remarks that are conversational in nature and did not meet the criteria for any other category.	"Uh oh"; "Yeah"; "Oh, dear"; "Yay!"
Description	Description or label of what is going on or what something is, excluding formal definitions (which would be coded as decontextualized— explanation).	"Yeah, well look there are green steps as well." "Does that look like the picture?"
Questions	Contextualized utterances with the intonation of a question, which included *wh*-questions, yes/no questions, and one-word questions.	"What's this?" "Do you want to make something else?" "Would you like a drink?"

Note. The definitions used for the decontextualized input categories are from the coding scheme developed by Rowe (2012). Examples provided are from the transcripts used in this study.

Child Literacy Skills

Verbal Comprehension. Children were administered the Similarities, Vocabulary and Comprehension subscales of the WISC-IV (Wechsler, 2003) via an online conferencing platform. The Similarities subscale requires children to explain how two objects or concepts are alike and measures children's verbal abstract reasoning. Sample items include '*In what way are first and last alike?*'. The

Vocabulary subscale requires children to give verbal definitions of a series of words. Sample items include '*What does transparent mean?*'. The Comprehension subscale requires children to respond orally to a series of questions relating to practical and social understanding. Sample items include '*Why do doctors take additional courses after practicing medicine for a while?*'. Responses are scored on a scale from '0' to '2', with higher scores reflecting better performance. Raw scores for each subscale were converted to standard scores. The three subscales are combined to give an overall score of verbal comprehension.

Reading and Spelling. Children's reading and spelling were assessed via the Drumcondra Reading and Spelling tests which are standardised national assessments administered to children in schools in Ireland. Scores between 80 and 89 indicate 'low average' performance, between 90 and 109 indicate 'average' performance, between 110 and 119 indicate 'high-average' performance and between 120 and 130 indicate 'above-average' performance.

Child Numeracy Skills

Arithmetic. The Arithmetic subscale of the WISC-IV was administered to children via an online conferencing platform. The scale required children to provide answers to a series of verbally administered math application problems and measures children's number reasoning, short term memory and attention. Children are awarded a score of '1' for correct answers and a score of '0' for incorrect answers. All raw scores were converted to standard scores.

Math. Children's math skills were assessed via the Sigma-T test which is a standardised national assessment administered to children in schools in Ireland. Scores between 80 and 89 indicate 'low average' performance, between 90 and 109 indicate ‘average’ performance, between 110 and 119 indicate ‘high-average’ performance and between 120 and 130 indicate ‘above-average’ performance.

Statistical Approach

First, a series of descriptive and correlational analyses were performed. Second, analysis of variance (ANOVA) was conducted to examine differences in decontextualised language as a function of participant (mother, father, or child) and timepoint (toddlerhood or preschool years). Third, regression analyses were performed to examine associations between mother, father, and child decontextualised language during triadic interaction in toddlerhood and preschool years and child literacy and numeracy outcomes during middle childhood. All models controlled for child age and contextualised language.

Results

Descriptive statistics for all study variables are presented in Table 3.2. Zero-order correlations between study variables are presented in Tables 1 and 2 in Appendix B. ANOVA indicated no statistically significant interaction between the effect of participant (mother, father, or child) and timepoint (toddlerhood or preschool years) on decontextualised language ($F(2, 150) = 1.27$, $p = .29$). There were however significant main effects of participant ($F(2, 150) = 4.19$, $p = .02$) and timepoint ($F(1, 150) = 16.38$, $p < .001$) on decontextualised language. Post-hoc Tukey HSD tests indicated that mothers produced a significantly greater number of decontextualised utterances than fathers (M_D=6.88, SD = 2.70, p = .03) and children (M_D=6.48, SD = 2.70, p = .04). There was no statistically significant difference between fathers’ and children’s number of decontextualised utterances (M_D=.40, SD = 2.70, p = .99).

With regards to timepoint, both mothers and children produced a significantly greater number of decontextualised utterances during preschool years than toddlerhood

(M_D=11.81, SD = 24.89, p = .03 mothers; M_D=11.19, SD = 17.27, p = .01 children). There was no statistically significant difference in fathers' decontextualised utterances from toddlerhood to preschool years (M_D=3.96, SD = 14.10, p = .17).

Table 3.2

Descriptive Statistics for Mothers', Fathers', and Children's Contextualised and Decontextualised Language During Triadic Interaction in Toddlerhood and Preschool Years.

	Toddlerhood		**Preschool Years**				
	***M* (*SD*)**	**Min-Max**	***M* (*SD*)**	**Min-Max**	***t*-value**	***p*-value**	**Cohen's *d***
Expoure Variables							
Mothers							
Total Utterances	75.85 (21.62)	42-119	127.81 (41.72)	14-200	6.37	<.001	41.63
Contextualised Utterances	68.19 (20.90)	35-109	108.35 (37.98)	14-196	5.18	<.001	39.52
Decontextualised Utterances	7.65 (5.31)	0-23	19.46 (24.32)	0-99	2.31	.03	26.03
Narrative	5.77 (4.34)	0-19	4.12 (4.41)	0-22	2.09	.05	4.04
Explanation	.46 (.76)	0-2	2.38 (2.21)	0-9	4.72	<.001	2.08
Pretend	1.46 (2.39)	0-8	12.96 (23.76)	0-95	2.39	.03	24.54
Fathers							
Total Utterances	52.38 (21.05)	12-111	89.31 (37.78)	26-166	4.94	<.001	14.32
Contextualised Utterances	47.69 (20.56)	12-107	80.65 (37.40)	22-162	4.32	<.001	38.88
Decontextualised Utterances	4.69 (5.22)	0-23	8.65 (13.10)	0-57	1.41	.17	14.32
Narrative	3.04 (3.43)	0-14	2.15 (2.44)	0-10	1.31	.20	3.43
Explanation	.12 (.33)	0-1	1.12 (1.56)	0-6	3.05	.01	1.67
Pretend	1.54 (3.22)	0-14	5.38 (11.76)	0-50	1.53	.14	12.83
Mothers and Fathers							
Total Utterances	128.23 (32.52)	72 – 206	217.12 (45.05)	130 – 316	9.58	<.001	47.31
Contextualised Utterances	115 (32.52)	62 – 194	189 (45.51)	92 – 284	7.22	<.001	51.64
Decontextualised Utterances	12.35 (8.81)	0 – 34	28.12 (35.34)	3 – 134	2.09	.02	38.47
Narrative	8.81 (6.20)	0 – 25	6.27 (5.51)	0 – 27	2.05	.03	6.32
Explanation	.58 (.95)	0 – 3	3.50 (2.67)	0 – 9	5.25	<.001	2.84
Pretend	3 (5.20)	0 – 22	18.35 (34.16)	0 – 122	2.18	.01	35.87
Children							
Total Utterances	29.69 (14.92)	7-62	88.38 (24.27)	45-139	10.75	<.001	27.85
Contextualised Utterances	27.96 (14.55)	6-62	77.20 (25.28)	14-118	7.90	<.001	30.62

Decontextualised Utterances	1.73 (2.71)	0-10	12.92 (17.06)	0-61	3.10	.01	18.02
Narrative	.92 (1.44)	0-5	2.12 (2.83)	0-11	1.89	.07	3.21
Explanation	0	0	.42 (.86)	0-3	2.52	.02	.86
Pretend	.81 (1.79)	0-8	9.50 (16.30)	0-60	2.64	.01	16.79

	Middle Childhood	
	M (SD)	Min-Max
Outcome Variables		
Literacy		
Verbal comprehension	39.11 (9.13)	18 – 52
Reading	114.92 (11.21)	94 – 130
Spelling	110.12 (10.69)	92 - 129
Numeracy		
Arithmetic	11.27 (3.37)	4 – 17
Math	107 (10.64)	90 - 126

Decontextualised Language in Toddlerhood and Preschool Years and Child Literacy and Numeracy during Middle Childhood

Toddlerhood

Controlling for child age and participants' contextualised language, mothers' decontextualised language in toddlerhood was only significantly negatively associated with child reading in middle childhood (β=-.51, p=.01, R^2=.34, F=3.57, p=.03). Similarly, children's DL in toddlerhood was significantly negatively linked with reading skills in middle childhood (β=-.60, p=.002, R^2=.41, F=4.92, p=.01). Fathers' decontextualised language during toddlerhood was not significantly linked with any child outcomes. Analysis of the effect of combined maternal and paternal decontextualised language during toddlerhood similarly showed no significant associations with child literacy and numeracy skills in middle childhood. Full regression models are presented in Tables 3-6 in Appendix B.

Preschool Years

Controlling for child age and contextualised language, both mothers' and fathers' decontextualised language during preschool years were significantly positively linked with child maths performance in middle childhood (β=.18, p=.05, R^2=.35, F=3.18, p=.04 mothers; β=.16, p=.03, R^2=.41, F=4.25, p=.02 fathers) but not with any other child outcomes. Moreover, although the overall models examining associations between combined maternal and paternal DL and child spelling and maths, but not verbal comprehension, arithmetic or reading, were statistically significant the effect of parental decontextualised language within the model failed to reach significance (β=.22, p=.34, R^2=.36, F=3.40, p=.04 for spelling; β=.26, p=.24, R^2=.42, F=4.35, p=.02). However, children's use of decontextualised language during preschool years was significantly positively linked with reading (β=.31, p=.03, R^2=.36, F=3.15, p=.05), spelling (β=.33, p=.02, R^2=.43, F=4.27, p=.02), and maths skills (β=.28, p=.04, R^2=.42, F=3.15, p=.05), but not with verbal comprehension or arithmetic scores. Full regression models are presented in Tables 7-10 in Appendix B.

Discussion

The use of decontextualised language during interaction with children has been convincingly theorised as a useful means of preparing children for their formal academic experience. Accordingly, this study examined variation in maternal, paternal and child use of decontextualised language during triadic interaction in toddlerhood and preschool years and how this use of decontextualised language relates to child literacy and numeracy in middle childhood.

Results suggest that throughout toddlerhood and preschool years mothers produce significantly higher levels of decontextualised language than fathers during triadic interaction. This finding is noteworthy given that fathers have elsewhere been described as more challenging conversational partners than mothers due to their higher use of *wh*-questions (e.g., Leech et al., 2013). Findings of this study however suggest that mothers appear to challenge and encourage children to think beyond the here-and-now to a higher degree than fathers. These results therefore tentatively suggest that like fathers, mothers can challenge children, albeit through different, and possibly complementary, mechanisms.

Findings further indicate that mothers' decontextualised language in toddlerhood was significantly negatively related to child reading skills in middle childhood. Considering the transactional nature of parent-child relationships (Sameroff, 2009) and parents' tendency to adapt their behaviour in accordance with children's abilities, also known as the fine-tuning hypothesis (Snow, 1989) this association likely reflects mothers' adjustment to children's developing language skills. This fine-tuning perspective may also explain the negative association between children's own use of decontextualised language in toddlerhood and their reading skills in middle childhood. That is, mothers of children with less developed overall language skills may have been producing higher levels of decontextualised language and possibly eliciting more decontextualised language from children in real time, as a means of promoting child language development. This hypothesis is supported by the positive correlation between mothers' and children's decontextualised language in real time during toddlerhood, and by the subsequent positive association between the significantly higher levels of maternal and child decontextualised language in preschool years and child reading skills in middle childhood. The increase in maternal decontextualised language over time observed in this study aligns with existing research which similarly reports that mothers' use of decontextualised language during interaction with children at home increases rapidly from 14 to 42 months (Rowe, 2012). Thus, it is likely that the positive effects of embedding decontextualised language in conversation with children become apparent later in development.

Alternatively, the greater syntactic and lexical complexity of decontextualised language than that of contextualised language (Brinchmann et al., 2023; Rowe & Snow, 2020) may exceed children's ability to benefit from it as early as toddlerhood, and its positive influence on language skills may only become apparent later in development. In fact, existing research that attests to the importance of decontextualised language to child language proficiency primarily focuses on the preschool years (e.g., Brinchmann et al., 2023; Uccelli et al., 2019). For instance, decontextualised language during preschool years has been found to predict children's academic language proficiency during middle school (Uccelli et al., 2019). Findings of this study similarly suggest that decontextualised language during preschool years may positively influence children's reading skills during middle childhood.'

It is noteworthy that fathers' decontextualised language during toddlerhood did not show any significant associations with children's literacy or numeracy outcomes in middle childhood. In accordance with FST (Minuchin, 1985), within triadic contexts the presence of an additional partner alters the dynamics of an interaction and evidence suggests that fathers' behaviour is more susceptible to influence by the presence of mothers than vice versa (e.g., Goeke-Morey & Cummings, 2007). Findings of this study align with this perspective, and similarly indicate that fathers engage in significantly less decontextualised language than mothers, which likely accounts for the non-significant associations observed.

Moreover, this study found no evidence for a compound effect of the overall maternal and paternal decontextualised language in toddlerhood on child literacy and numeracy skills in middle childhood. Although this observation may reflect a unique effect of maternal decontextualised language on these skills, it is possible that these associations failed to reach significance due to the low power of the study. Thus, whether there are indeed measurable differences between maternal and paternal interactive styles and their effects on child skills remains a testable hypothesis for future, better powered studies.

Results further indicate that mothers', fathers', and children's own use of decontextualised language during preschool years significantly positively relate to children's math performance during middle childhood**.** This study therefore contributes to the incipient evidence base which also suggests a link between decontextualised language and children's numeracy skills (e.g., Ribner et al., 2020). Thus, decontextualised language emerges as a promising conversational device that may enable children to understand ordinality and cardinality, and to engage in inferential thinking, pattern-detecting and comparison making, which subsequently benefit children's numeracy skills (Flynn et al., 2020). To date, only one study has examined the effects of decontextualised language on children's numeracy and found that, controlling for children's earlier pre-academic skills and mothers' overall language input, maternal distancing language during reading interaction with five-year-olds positively related with children's literacy and numeracy skills at both five- and six-years-old (Ribner et al., 2020). Compounded by findings of this study, this emerging research base propounds decontextualised language as a potentially useful strategy for preparing children for school with cascading effects on multiple domains of child development. Moreover, these results encourage future research to examine the potential benefits of decontextualised language to children's achievement across a wider range of school subjects. It is likely that the effects of language that involves inferential thinking, drawing connections and abstract reasoning may cascade onto other academic domains such as science and art.

Finally, it must be noted that children's decontextualised language during preschool years demonstrated both domain-specific effects on their reading and spelling skills and cross-domain effects on math performance. Thus, a further interpretation, and one that warrants future investigation, is that parental decontextualised language contributes to children's academic outcomes through increases in children's own decontextualised language. In fact, this hypothesis aligns with Peirce's semiotic theory and suggests that to engage in conversation that extends beyond the immediate physical environment children must develop signs and representations for concepts that are not readily observable. Equipped with these skills children are more likely poised to perform better in reading and spelling (i.e., sound-to-letter correspondence, decoding and encoding words), as well as numeracy domains (i.e., understanding that numbers represent quantities).

However, in line with observations in toddlerhood, the combined effect of maternal and paternal decontextualised language in preschool years did not relate significantly with child outcomes in middle childhood. As previously highlighted, this finding arguably occurred as a function of low power and represents a salient limitation of the present study.

It is also noteworthy that in this study decontextualised language did not relate significantly with children's outcomes as measured by the verbal comprehension and arithmetic subscales of the WISC-IV. This finding may be attributed to the remote circumstances under which the instrument was administered. Due to variation in internet speed, visual acuity of presented materials may have been reduced thereby interfering with child performance. Additionally, the remote environment may have limited the extent to which the researcher could establish rapport with children which could have also had an impact on child performance.

Alternatively, it may be that the WISC and standardised tests of achievement used in this study capture distinct aspects of children's literacy and numeracy skills. While the verbal comprehension index reflects children's abilities to draw similarities between objects, provide definitions and demonstrate social understanding, the reading and spelling tests more readily reflect children's abilities to engage in abstract thinking and create representations for abstract concepts. Similarly, it has been suggested that the arithmetic subscale of the WISC is a measure of concentration and working memory as opposed to numeracy skills (Karzmark, 2009). Thus, the significant effects of decontextualised language on child reading and math, and the null effects on WISC scores observed in this study are theoretically coherent.

Limitations

Findings of this study must be considered in relation to several caveats. First, the sample size was small and homogenous. Participants were White, well-educated and, as indicated by scores on tests of achievement, children were mainly 'high-average' performers. Thus, the generalisability of these findings to alternative populations is limited. In addition, the small sample size restricted the inclusion of additional covariates, such as parental verbal IQ and socioeconomic status, which likely contribute to the observed results. Due to the small sample size, the study was also underpowered to identify additional potential associations between decontextualised language and child literacy and numeracy skills. Thus, the extent to which the use of decontextualised language in toddlerhood relates to these child outcomes, as well as whether maternal and paternal decontextualised language exert unique, similar or compound effects on these competencies should be further scrutinised in the context of larger, more strongly powered studies.

Despite its drawbacks, the small sample size permitted manual micro-coding and hence an in-depth description of parent and child use of decontextualised language. Moreover, while existing studies have characterised decontextualised language during lengthy at-home interactions involving book-reading and mealtime activities (e.g., Rowe, 2012; Uccelli et al., 2019), the present study demonstrates that even short five-minute interactions can capture aspects of language typical of parent-child interactions. Nevertheless, the possible influence of the structured setting imposed on interactions in this study must be acknowledged. Therefore, future research inclusive of both structured and free-play interactions may provide additional insight into parental use of decontextualised language and clarify similarities or differences between mothers' and fathers' decontextualised language across settings.

Second, the correlational design of this study does not allow for an inference of the direction of effects. Thus, it remains possible that more precocious children elicited greater levels of parental decontextualised language. Third, while the use of triadic interaction in this study is a strength as it acknowledges families as systems and accounts for the transactional nature of interactions, it does not provide any insight as to how decontextualised language is used in dyadic interaction. Thus, future research should explore how parents embed this type of language in both dyadic and triadic contexts.

Finally, it remains possible that the use of decontextualised language may serve as a proxy for parental cognitive support and scaffolding more broadly. Parents who engage in more decontextualised talk may also frequently teach children math concepts, produce more math talk and engage children in more conversation through higher-order inferential questions. These in turn may influence children's numeracy and literacy skills. However, by controlling for the total number of parents' contextualised utterances, the risk that alternative aspects of parent language may influence the observed results is somewhat mitigated.

Conclusion

Findings suggest that parents' and children's use of decontextualised language throughout preschool years may not only exert positive domain-specific effects on children's literacy skills but also positive cross-domain effects on children's numeracy skills during the first years of formal schooling. These findings provide incentive for future research to consider ways in which parental use of decontextualised language might relate to child performance on a wider range of school subjects. The positive associations further confer potential value for the design of interventions, curricula, and early childhood programs. The school curricula require children to understand and elaborate on abstract concepts; however children vary widely in their abilities to do so. Parents and early childhood practitioners should be informed about the merit of cognitively stimulating conversations that challenge children to engage in inferential thinking and reason beyond the perceptually available environment. Engaging children in decontextualised talk may scaffold their abilities to reason about and discuss invisible, non-present, and abstract concepts, and to use language as its own context which in turn supports children's readiness for school and early academic performance.

Study 3. Children’s Cognitive Skills

While theory of how aspects of parent-child interaction as ‘proximal processes’ relate to child cognitive development acknowledges children’s own role in their development, most empirical data have primarily focused on parental behaviour such as scaffolding and cognitive stimulation. A less studied aspect of parent-child interaction in relation to cognition and to EF in particular and one that warrants further investigation, is conversational turn-taking. Although a seemingly effortless process, conversational turn-taking is cognitively demanding as it depends on a set of complex skills. The fluency of conversational exchanges rests on a dynamic temporal structure wherein interlocutors must monitor each other’s incoming turn, predict the end of another speaker’s turn, and plan a response. Moreover, successful turn-taking also requires speakers to establish shared intentionality via back-and-forth exchanges that maintain the topic of discussion. Due to the need to maintain temporal and semantic contingency, conversational turn-taking has been described as a cognitively scaffolding mechanism with implications for children’s EF. Accordingly, the third study in this chapter examined how mother-father-child contingent turn taking in toddlerhood and preschool years related to child executive functioning in middle childhood.

Contingent Conversations Between Toddlers and Parents Relate to Child Executive Functioning in Middle Childhood

Abstract

Executive function (EF) refers to a set of higher order cognitive processes that allow children to store and manipulate information in mind, switch from one task to another and inhibit dominant impulses. These skills have proven instrumental to children's early academic performance. During the first years of life before formal education parents play a critical role in preparing children for school. Thus, identifying parenting practices that promote child EF is an important research goal. Accordingly, this study examined how contingent conversational turns exchanged within 26 Irish mother-father-child triads (16 female) during toddlerhood (T1) and preschool years (T2) relate to child EF during middle childhood (T3). At T1 and T2 conversational turns were coded from transcribed structured play triadic interactions. At T3 child EF was measured via performance on the Flanker Fish and Hearts and Flower tasks and direct assessment of the WISC. Findings indicate that mothers and fathers engaged in similar proportions of conversational turns with children during toddlerhood and preschool years. Both mothers' and fathers' conversational turns, during toddlerhood, but not preschool years, related negatively with child EF in middle childhood. Arguably, parents were increasing their conversational turns in response to children's developing EF. This interpretation accords with the finding that children's conversational turns with fathers during toddlerhood was positively linked with their EF in middle childhood. Thus, toddlerhood may be an optimal period for promoting EF and fathers could play a particularly important role in the development of these skills. Findings bear implications for early childhood intervention, parent education and research stimulation.

Keywords: conversational turns, executive function, toddlerhood, preschool years, middle childhood, longitudinal

Introduction

As children transition into formal education, they face new behavioural challenges and cognitive demands. Before they can even begin achieving educational gains, children must first demonstrate an ability to function appropriately in a scholastic environment. Children must consciously control their behaviour, exchange attentional resources between cognitive and behavioural tasks and retain and reorganise information in mind (Anderson, 2002; Blair, 2002; Blair & Razza, 2007; Diamond & Lee, 2011; Samuels et al., 2016). More specifically, children must possess a selection of higher order cognitive skills collectively known as executive function (EF; Diamond, 2020).

Executive Function and Early Academic Performance

EF is an umbrella term used to denote a set of neurocognitive processes implicated in goal-directed thought, emotion, and action (Shonkoff & Phillips, 2000) and includes inhibitory control, cognitive flexibility and working memory (Diamond, 2020). Inhibitory control refers to the ability to suppress automatic, dominant impulses; cognitive flexibility (also known as set-shifting) denotes the flexible switching from one mental task to another; and working memory represents the capacity to hold and manipulate information in mind (Diamond, 2020)

EF has long been recognised as an essential precursor of child math and literacy performance (Blair & Razza, 2007; Gathercole & Pickering, 2000; Lan et al., 2011; McClelland et al., 2007) and overall academic achievement (e.g., Cortés Pascual et al., 2019; Jacob & Parkinson, 2015). In fact, a review of the research base on school readiness convincingly argues that EF may be as important, if not more so, for early academic performance than general intelligence (see Blair & Raver, 2015).

Theoretically, to benefit from learning opportunities children must be capable of attending to learning material, withstanding distraction, and persisting with challenging activities (Blair & Raver, 2015; McClelland et al., 2015). As children master these competencies, they further depend on EF for early numeracy and literacy performance (Blair et al., 2007; Rosenberg-Lee et al., 2011). Early math concepts include cardinality, ordinality, seriation, matching, classification, and patterning. To understand and engage in these activities children must be able to flexibly switch their attention between numerical elements (i.e., cognitive flexibility), suppress previously learned rules as they switch from procedural to conceptual problem-solving (i.e., inhibitory control), and retain and operate on stored information to solve math word problems (i.e., working memory; Bull & Lee, 2014).

Early literacy performance similarly places demand on children's executive functioning. For instance, phonemic awareness development requires children to identify individual units of sound and meaning. Similarly, cognitive flexibility and working memory foster children's spelling skills as these competencies allow them to store multiple letter-sound correspondence representations while inhibitory control allows for the suppression of one representation over another (e.g., in letter combinations such as 'gn' and 'kn').

Empirical data attest to the importance of children's EF to academic performance. EF has been shown to positively predict child reading and math achievement in kindergarten and first grade (Blair & Razza, 2007; Espy et al., 2008). Working memory and cognitive flexibility have been found to uniquely predict early math achievement even after controlling for reading ability and IQ (Bull & Scerif, 2001). Further, EF has been linked with math and reading skills, above and beyond general mental ability (Clark et al., 2010; Espy et al., 2004), baseline academic skills

(McClelland et al., 2007), social emotional competence and effortful control (Blair & Razza, 2007).

Given that EF undergoes the most rapid development during the preschool years (Zelazo & Ulrich, 2011) – a time during which parents arguably exert the greatest influence on child development – an extensive body of research has examined how variation in parenting behaviour relates to child EF. This research base suggests that parent linguistic diversity, verbal scaffolding, praise, encouragement, and chaos at two-years-old uniquely predict child EF at four-years-old (Hughes & Ensor, 2009). Maternal mind-mindedness, sensitivity and autonomy support from 12 to 15 months have also been positively linked with child EF at 26 months (Bernier et al., 2010). Thus, early parenting behaviour is seen as crucial to the growth and development of child EF.

Conversational Turns and Executive Function

A relatively less studied aspect of parent-child interaction in relation to children's EF, and one that warrants further research, is conversational turn-taking (see Carolus et al., 2023 for an exception). Although a seemingly effortless process, conversational turn-taking is cognitively demanding as it depends on a set of complex skills. First, the fluency of conversational exchanges rests on a dynamic temporal structure wherein interlocutors must monitor each other's incoming turn, predict the end of another speaker's turn, and plan a response (Casillas, 2014; Sacks et al., 1978). Notably, latencies between the end of one speaker's turn and another's response are generally too short to allow response planning after the end of a turn (see Nguyen et al., 2022 for a systematic review). It follows that interactional partners are attuned to turn transitions such that they can anticipate the ends of turns and begin planning a response before their interlocutor finishes speaking.

Second, successful turn-taking also requires speakers to establish shared intentionality via back-and-forth exchanges that maintain the topic of discussion. Thus, speakers must monitor, interpret, and contribute to a joint focus of attention. Due to this temporal and semantic contingency, conversational turn-taking has been described as a cognitive scaffolding mechanism (Stivers et al., 2009).

Theoretically, this cognitive scaffolding mechanism presents implications for children's EF. For instance, the temporal contingency aspect of turn-taking requires children to plan an appropriately timed response (i.e., working memory) and to refrain from speaking until the previous interlocutor has finished their turn (i.e., inhibitory control). The semantic contingency aspect however requires children to monitor and adapt to the changing subject of a conversation (i.e., cognitive flexibility: Merz et al., 2017; Raver, 1996) and to store information about interactive partners' motivations and expectations (i.e., working memory: Hofmann et al., 2012).

Emerging evidence supports the association between conversational turns and child EF. For instance, contingent conversations between caregivers and their 2-year-olds showed positive links with children's EF at 4.5-years-old via child language abilities at 3-years-old (Masek et al., 2022). More recently, mothers' disruptive conversational turns with three-year-old children were linked with higher child inhibitory control nine months later (Carolus et al., 2023). The authors speculated that disruptive utterances may in fact promote children's inhibitory skills insofar as children must supress their response following a parental interruption to allow the parent to speak.

The research base on conversational turn-taking and children's EF development is scant and any conclusion regarding the predictive influence of such contingent conversation would be premature. Nevertheless, continuous effort towards understanding the potential association between conversational turns and child EF is theoretically motivated. Further, while the developmental field recognises the importance of conversational turns to child development more broadly, most studies thus far have primarily focused on the frequency of conversational turns via the use of language collection tools such as Language ENvironment Analysis (LENA: Ganek & Eriks-Brophy, 2018; Gilkerson et al., 2017). However, comparative analyses of manually- versus LENA-coded CT indicate that LENA substantially overestimates conversational turn counts and is prone to high error rates due to multiple participants, speech from other children and noise from electronic media (Ferjan Ramirez et al., 2023).

Research that has included manually coded conversational turns primarily explored how caregivers respond to children's focus of attention and has neglected to examine the contingency of children's own conversational turns (Carolus et al., 2022). However, given the overlap between the demands of successful turn-taking and EF this is a salient omission. Arguably, children invoke, and thus refine, their EF skills as they engage in turn-taking and as such this interactive aspect of their behaviour may represent an important mechanism of EF development.

Finally, although paternal contribution to child development is increasingly recognised, the research base on fathers' turn-taking behaviour and child outcomes is small. Some evidence suggests that fathers' conversational turns during interaction with two-year-olds do not show concurrent links with child cognitive skills (Kelly et al., 2022). However, the potential longitudinal association between fathers' conversational turns during preschool years and child EF during the first formal school years remains underexplored.

The Present Study

To advance the research base on early parenting and child EF the present study undertakes two central aims: (1) to describe mothers', fathers', and children's conversational turn-taking behaviour during triadic interaction in toddlerhood and during preschool years; and, (2) to examine associations between mothers', fathers', and children's conversational turns in toddlerhood and preschool years and children's EF during middle childhood. Given the dearth of research inclusive of both mothers and fathers particularly as they engage in triadic interaction, hypotheses regarding the proportions of each participant's conversational turns are exploratory. However, the study hypothesises that children who engage in greater proportions of contingent conversational turns, and whose parents similarly engage in higher proportions of contingent conversational turns, will display better inhibitory control, cognitive flexibility and working memory during middle childhood.

Method

Participants

Participants were 26 Irish mother-father-child triads. Data in the present study are part of a larger longitudinal study at Trinity College Dublin. Families participated when children were infants (T1), pre-schoolers (T2) and subsequently during middle childhood (T3). Children's (10 male and 16 female) age ranged from 22.17 to 27.13 months (*M*=24.282, *SD*=1.453) at T1, from 34.60 to 54.40 months (*M*=43.130, *SD*=7.155) at T2 and from 7.67 to 9 years at T3 (*M*=8.583, *SD*=.267). At T1, fathers were aged between 29 and 55 years (*M*=36.923, *SD*=5.607) whereas mothers were aged between 30 and 48 years (*M*=35.769, *SD*=4.934). Families were well educated, with 80.80% of mothers and 69.20% of fathers having a bachelor's degree or higher.

Procedure

In toddlerhood and preschool years families visited a child-friendly laboratory at Trinity College Dublin. Parents responded to a series of questionnaires pertaining to their child and family functioning. Children were subsequently developmentally assessed by a trained research assistant.

Mothers, fathers, and children were then presented with a toy-set and instructed to play as they normally would for a duration of five minutes. All interactions were recorded and subsequently transcribed verbatim in accordance with the CHAT (Codes for the Human Analysis of Transcripts) conventions of CHILDES (Child Language Data Exchange System; MacWhinney, 2000). Transcripts were checked by a second researcher to verify accuracy.

During middle childhood children's EF was assessed based on their performance on a series of computerised tasks as well as via direct assessment using the Wechsler Intelligence Scale for Children (WISC-IV; Wechsler, 2004) through an online conferencing platform. To facilitate performance, children were given remote control of the researcher's computer such that they could engage with the tasks.

Measures

Conversational Turns

A conversational turn was defined as one speaker's vocalisation followed by another speaker. Given the triadic structure of interactions in this study, turns were manually coded to include only parental utterances directed at children (but not between each other) and child utterances directed at mothers and fathers. Conversational turns during which parents responded to child vocalisations, and children responded to parent vocalisations were subsequently manually coded for temporal and semantic contingency and calculated as a proportion of each participant's total number of turns.

A response was coded as temporally contingent if it occurred within five seconds of the offset of the prior speaker's vocalisation, as calculated from timestamped audio-linked transcripts. Responses that overlapped with the previous speaker's vocalisation (i.e., turns which began before the prior speaker finished vocalising) were considered temporally contingent. In instances where speakers produced more than one response within the five-second timeframe, all responsive utterances were counted as part of the temporally contingent turn.

All temporally contingent turns were further coded as semantically and temporally contingent (STC) if they were conceptually related to a previous speaker's utterance. Turns that were temporally contingent but did not relate conceptually to a pervious speaker's utterance were coded as non-semantically contingent (NSC). Inaudible or unintelligible utterances were excluded. Only STC turns were included in analyses. Examples of STC and NSC turns are presented in Table 4.1.

Table 4.1

Excerpt with Examples of Semantically and Temporally Contingent Conversational Turns from This Study.

Speaker	Conversational Turn	Contingency of Turn
Mother:	Rapunzel Rapunzel let down your hair.	NSC
Child:	the wicked witch is coming to get her.	STC
Mother:	oh no is she coming to get Rapunzel?	STC
Mother:	ah [=! screaming].	NSC
Mother:	okay off she goes.	NSC
Child:	off the witch goes.	STC

Father:	still have some more trees.	NSC
Mother	oh no poor Rapunzel.	NC
Mother	who (i)s going to rescue her?	NC
Child:	nobody.	STC
Mother:	maybe her friend in the car?	STC
Child:	yeah her friend.	STC
Mother:	hello Rapunzel jump in.	STC

Note. STC = semantically and temporally contingent; NSC = temporally but non-semantically contingent; NC = non-temporally and non-semantically contingent.

All transcripts were coded by the first author. To establish inter-rater reliability, 20% of randomly selected transcripts were coded by two of the authors, and disagreements were discussed until a kappa value of >.90 was achieved.

Executive Function

Inhibitory Control. The Flanker fish task (Schonert-Reichl et al., 2015) was used to measure children's inhibitory control using Inquisit Millisecond software (www.millisecond.com). The task requires children to focus on one target stimulus while ignoring distracting stimuli. The stimuli (a series of fish facing either left or right) are presented on a computer screen in three block types. The first type contains a series of blue fish, and children must respond by pressing a key based on the direction of the target fish while ignoring the peripheral fish. The second type contains a series of pink fish and children must respond based on the direction of the peripheral fish while ignoring the centred fish. Both blocks include congruent and incongruent trials. Finally, the third type is a mixed block which includes both blue fish (with the instruction to focus on the centred fish) and pink fish (with the instruction to focus on the peripheral fish). During the mixed trial children must hold both rules in mind and respond accordingly. Children were permitted up to three practice sessions to ensure they understood the task demands. The experimental trials were then presented in 8 blocks each consisting of 10 trials with a 1-minute break between blocks. During each trial, a fixation cross was first presented on a computer screen for a duration of 450ms, followed by a stimulus which was presented for up to 3000ms. Children's average accuracy (i.e., the proportion of correct responses) and reaction time (RT) in milliseconds (ms) were used as indices of inhibitory control.

The flanker task is a widely used measure of inhibitory control (Fan et al., 2003; Mullane et al., 2009). It is considered a valid measure of activity in the anterior cingulate cortex, a brain region responsible for inhibitory control and conflict monitoring (Fan et al., 2003). The task has also demonstrated sensitivity to differences in inhibitory control among children with and without ADHD (see Mullane, 2009 for a systematic review).

Cognitive Flexibility. The Hearts and Flowers task (Davidson et al., 2006) was used to assess children's cognitive flexibility via Inquisit Millisecond software (www.millisecond.com). The task requires children to press a button on the same side of a screen when an image of a heart is presented and a button on the opposite side of the screen when an image of a flower is presented. Images are presented in blocks consisting of hearts only, flowers only and a mixture of both. Children completed three practice trials to ensure they understood the task instruction. Practice trials were followed by 12 heart trials, 12 flower trials and 33 mixed trials. Stimuli were presented on screen for up to 2500ms, depending on whether a child responded. Inter-stimuli intervals lasted 1000ms.

Children's accuracy scores (i.e., proportion of correct responses) and RT in ms on the flowers only block reflects inhibitory control while their accuracy and RT on the mixed block (hearts and flowers) is used as a measure of cognitive flexibility. The HF has demonstrated sensitivity to improvements in four- to five-year-old children's EF following the Tools of the Mind preschool program (Diamond et al., 2007).

Working Memory. The digit span (forward and backward) and letter-number sequencing tasks of the WISC-IV (Wechsler, 2004) were used to measure children's working memory. The digit span task requires children to repeat a sequence of numbers as heard and in reverse order. Sequences are presented in increasing length starting with two numbers. Children were given two practice trials and testing continued until children failed to respond correctly on two consecutive trials of a given sequence. The letter-number sequencing task requires children to repeat a series of numbers and letters in ascending and alphabetical order. Raw scores were converted into scaled scores and were subsequently summed and converted into standard scores to yield an overall index of working memory.

Analytic Approach

A series of descriptive analyses were performed to describe the data. Next, mean level differences between mothers' and fathers' semantically contingent conversational turns were examined as well as differences between mothers', fathers', and children's conversational turns from toddlerhood to preschool years. Finally, a series of partial correlations were performed to explore links between mothers', fathers', and children's contingent conversational turns in toddlerhood and preschool years and children's inhibitory control, cognitive flexibility, and working memory in middle childhood, controlling for child age.

Results

Descriptive statistics of all study variables are presented in Table 4.2. Mothers, fathers, and children engaged in significantly more contingent turns in preschool years than during toddlerhood (t (25) = 4.26, p < .001 mothers; t (25) = 3.88, p < .001 fathers; t (25) = 3.15, p < .001 children). During both toddlerhood and preschool years mothers and fathers engaged in similar proportions of contingent turns (t (25) = .47, p = .64 toddlerhood; t (25) = 1.40, p = .18 preschool years). Finally, children engaged in comparable proportions of contingent turns with mothers and fathers (t (25) = .09, p = .93 toddlerhood; t (25) = 1.11, p =.28 preschool years).

Table 4.2

Descriptive Statistics for Mothers', Fathers', and Children's Proportions of Contingent Conversational Turns During Triadic Interaction in Toddlerhood and Preschool Years.

	Toddlerhood		**Preschool Years**		***t*-value**	***p* value**	**Cohen's *d***
	M (SD)	**Range**	**M (SD)**	**Range**			
Semantically and Temporally Contingent							
Maternal Turns	.15 (.10)	.00 - .37	.29 (.14)	.13 - .67	4.26	<.001	.17
Paternal Turns	.14 (.09)	.00 - .36	.26 (.12)	.10 - .54	3.88	<.001	.15
Child-M Turns	.50 (.26)	.00 – 1	.56 (.16)	.31 - .88	1.22	.12	.28
Child-F Turns	.50 (.26)	.00 – 1	.53 (.16)	.24 - .93	.70	.25	.29
Total Child Turns	.43 (.16)	.19 - .77	.54 (.15)	.33 - .88	3.15	.001	.19
Temporally but Non-Semantically Contingent							
Maternal Turns	.85 (.10)	.63 – 1	.71 (.14)	.33 – .87	4.26	<.001	.17
Paternal Turns	.86 (.09)	.64 – 1	.74 (.12)	.46 - .90	3.88	<.001	.15
Child-M Turns	.50 (.27)	0 – 1	.44 (.16)	.12 – 69	1.22	.12	.28
Child-F Turns	.50 (.26)	0 – 1	.47 (.16)	.07 - .76	.70	.25	.29
Total Child Turns	.57 (.16)	.23 - .81	.46 (.15)	.12 - .67	3.15	.002	.19

Note. Child-M = child turns with mothers; Child-F = child turns with fathers.

Longitudinal Links Between Contingent Turn-Taking in Toddlerhood and Preschool and Child Executive Function in Middle Childhood

Partial correlations, controlling for child age, between mothers', fathers', and children's contingent turns during triadic interaction in toddlerhood and preschool years and children's inhibitory control, cognitive flexibility and working memory during middle childhood are presented in Table 4.3.

Both mothers' and fathers' proportions of contingent conversational turns during toddlerhood were significantly negatively related to children's working memory in middle childhood. Fathers' contingent conversational turns during toddlerhood were also negatively linked with children's cognitive flexibility accuracy scores. However, children's contingent conversational turns with fathers, but not mothers, during toddlerhood were positively linked with their cognitive flexibility, specifically with RT and working memory.

In contrast, neither mothers', fathers', nor children's conversational turns during preschool years showed any significant links with EF in middle childhood.

Table 4.3

Partial Correlations Between Mothers', Fathers', and Children's Contingent Conversational Turns in Toddlerhood and Preschool Years and Child Executive Function in Middle Childhood.

	Inhibitory Control		**Cognitive Flexibility**		**Working Memory**
	Accuracy	RT	Accuracy	RT	
Toddlerhood					
Maternal Turns	-.23	-.01	.04	.10	**-.48***
Paternal Turns	-.06	.12	**-.43***	-.16	**-.42***

Child Turns with Mother	.30	.05	.23	-.11	.09
Child Turns with Father	.13	.10	.21	**.42***	.10
Total Child Turns	.25	.05	.22	.32	.11
Preschool Years					
Maternal Turns	.09	.17	.17	-.09	-.04
Paternal Turns	.26	.19	-.15	-.14	-.22
Child Turns with Mother	.15	.37	-.19	.17	-.24
Child Turns with Father	.32	.42[†]	-.16	.10	-.27
Total Child Turns	.20	.33	-.14	.10	-.21

Note. Correlations between conversational turns and child executive function control for child age; [†]<.10, *p<.05

Discussion

The present study aimed to characterise conversational turns behaviour between mothers, fathers, and children during triadic interaction in toddlerhood and preschool years. The study further aimed to examine associations between conversational turns during these triadic interactions and children's inhibitory control, cognitive flexibility and working memory in middle childhood. In doing so, the study contributes to the developmental field which emphasises the role of parent-child conversational turns to child EF development (King et al., 2021; Masek et al., 2021, 2022; Salmon et al., 2016) through several strengths. First, this study goes beyond examining mere frequency of parent-child conversational turns and explores how the semantic contingency of conversational turns may also relate to child EF. The frequency of conversational turns does not necessarily equate with successful, fluent conversation and as such may only provide partial insight pertaining to the role of this conversational mechanism for children's EF. Conversely, semantic contingency necessitates speakers to maintain focus on a shared topic, to retain previously discussed information and arguably to refrain from changing the subject. These requisites are likely to impose greater cognitive demands and hypothetically promote children's EF skills.

Second, the study explores conversational turns behaviour between children with both mothers and fathers. While research has largely redressed the earlier predominant focus on the mother-child relationship, fathers are still not sufficiently represented in research despite evidence that they are just as important to child development as mothers (Cabrera et al., 2018). This study therefore provides novel insight with regards to the role of conversational turns between children and parents. Moreover, by examining conversational turns behaviour during triadic interaction the study allows and accounts for the interactive and dynamic influence of each family subsystem on child development.

Finally, most prior inquiry into the role of conversational turns to child development has predominantly measured *parental* conversational turns, frequently framed as an index of responsiveness, without consideration of how *children* participate in this behaviour. Yet children are not passive recipients of parenting behaviour, and the types of behavioural and cognitive tasks that they engage in during interaction with parents are likely to have implications for their own growth and development. Given that conversational turn-taking is a particularly challenging process (Stivers et al., 2019), examining how children's participation in such back-and-forth exchanges relates to EF outcomes is warranted.

Contingency of Mother, Father and Child Conversational Turns during Toddlerhood and Preschool Years

Findings indicate that mothers, fathers, and children engaged in significantly more contingent conversational turns during preschool years compared to toddlerhood.

This result is likely as a function of growth in children's language skills. That is, as children become more competent language users, they are more likely to maintain the topic of a conversation and more likely to elicit semantically related responses from their conversational partners.

Results further indicate that mothers and fathers engaged in similar proportions of conversational turns and children likewise engaged in comparable proportions of contingent conversational turns with mothers and with fathers during both toddlerhood and preschool years. These results are noteworthy considering prior research which found that, compared to fathers, mothers tend to produce more utterances that are contingent on children's vocalisations during dyadic interaction at two-years-old (Kelly et al., 2022). While neither study compared parental turn-taking behaviour during both dyadic and triadic interaction, findings of this study may allude to a co-ordination and balancing of maternal and paternal conversational turns, such as to "*limit excessive or overlapping stimulations of the child*" (Frascarolo-Moutinot et al. 2020, p.99).

Findings further align with the growing research base which suggests that mothers and fathers are largely similar with respect to their linguistic behaviour such as their language quantity, complexity, diversity (Rowe et al., 2004) and repetition (Conica et al., 2020). Although preliminary, the findings of this study suggest that both mothers and fathers are sensitive and responsive to their children's communicative bids, both can follow their child's lead by continuing meaningful conversation, and both can maintain their child's interest by eliciting conceptually related child speech. Nevertheless, the research base on maternal and paternal turn-taking behaviour is scarce. Therefore, future, larger and better powered studies have the potential to significantly contribute to the mothering and fathering research base and to the long-standing debate pertaining to similarities and differences between mothers' and fathers' parenting behaviour.

Links Between Mother, Father, and Child Conversational Turns During Toddlerhood and Preschool Years and Child Executive Function in Middle Childhood

Results indicate that both maternal and paternal contingent conversational turns during toddlerhood related negatively with children's working memory while paternal conversational turns were further negatively linked with children's cognitive flexibility. These findings therefore fail to support the study hypothesis. While the correlational design restricts an inference regarding the direction of effects, it is possible that parents were adapting their conversational turns in response to children's developing EF skills. Children experience a rapid growth in EF during the first years of life (Zelazo & Ulrich, 2011) and as such toddlerhood represents a fertile developmental period during which parents can scaffold these skills. This hypothesis is supported by the positive relation between children's engagement in contingent turns with fathers during toddlerhood and their cognitive flexibility and working memory in middle childhood. Maintaining fluid conversation requires children to recognise the importance of shared attention to social interaction, to retain previously discussed information in mind and to flexibly adapt to their interlocutor's topic of interest. Thus, it may not only be the frequency with which children contribute to conversation but rather their opportunity to produce utterances that are meaningfully related to their interlocutor's previous turn that benefits EF.

Crucially, these findings also point to the benefits of engaging in serve-and-return interactions with fathers in particular and highlight the value of including both parents when conducting research with children. The need for greater father representation in developmental research is evinced by accruing studies which consistently highlight fathers' importance to child cognitive development. For instance, responsive, didactic paternal behaviour at 24 months has been found to benefit children's cognitive outcomes (Shannon et al., 2009). Systematic review findings from 40 studies further highlight the importance of paternal involvement to child cognitive development (Rollè et al., 2019). The present study aligns with this research base and advocates for continuous effort to include both mothers and fathers in research with children. Such a shift from a matricentric emphasis on parenting to one inclusive of both parenting styles may not only prove instrumental for early childhood interventions but may also have implications for theories of child development.

While the inclusion of both mothers and fathers in this study allowed for a unique association between father-child conversational turns and child EF to emerge, the null effect from semantically contingent exchanges between children and mothers on their EF is contrary to the study hypothesis. While the present study did not include qualitative measures of language, these may have provided additional insight into the disparate results observed for mothers and fathers. For instance, compared to mothers, fathers tend to use more questions and directive speech (Hallers-Haalboom et al., 2017), aspects of language which arguably interact with contingent turn-taking to promote cognitive growth. Questions, and in particular *wh*-questions (e.g., why, when, where?) not only elicit semantically contingent responses from children but also require them to think about cause-and-effect and to recall information, cognitive processes that map directly onto EF. Similarly, directive speech instructs children to follow a request which may well require them to invoke cognitive flexibility skills to switch from one task to another and inhibitory control to refrain from engaging in an activity other than the one directed towards. Thus, future studies could usefully examine whether and how qualitative aspects of paternal and maternal language interact to promote children's cognitive development.

Unexpectedly, the present study did not identify any significant links between turn-taking during preschool years and child EF outcomes in middle childhood. However, these findings are in concert with existing evidence which similarly found no link between maternal and paternal contingent turns with 24-month-olds and concurrent child cognitive skills (Kelly et al., 2022). It should be noted however that the null results observed do not necessarily indicate that contingent conversational turns during preschool does not influence child EF, but rather highlight several study limitations and hence areas for future research directions. First, the sample size was small and hence underpowered to identify potential, smaller-sized effects. This is particularly likely given the marginally significant link observed between children's contingent turns with fathers during preschool years and their inhibitory control in middle childhood. Further, while the small sample size allowed for manual coding of conversational turns and hence obviated the limitations associated with language coding tools, it nevertheless restricted the type and number of analyses that could be performed.

Second, the methods of EF data collection may have skewed children's performance scores. The circumstances which necessitated sharing and remote controlling of keys for task completion may not have accurately represented, and likely inflated, children's RT scores. Moreover, EF outcomes were collected during a lengthier episode during which children engaged in a larger number of cognitively demanding tasks that may have dampened their EF performance. Therefore, future studies that assess children's executive functioning in person, at intervals dispersed such as to minimise fatigue and allow optimal child performance can further elucidate potential links between conversational turns during the years preceding formal schooling and children's later EF. Limitations notwithstanding, the present study tentatively suggests that toddlerhood may represent an opportune time during which contingent conversations between children and parents can scaffold their EF.

Conclusion

The present study attests to the importance of engaging children in back-and-forth meaningfully related conversation for their cognitive development. This type of interaction during which parents communicate *with* the child rather than *at* the child may teach children to flexibly adjust to new topics of conversation, maintain and contribute to their interlocutor's focus of attention and to store and retrieve previously discussed information. Moreover, fathers may play a particularly important role with respect to the growth of these executive processes and continuous inquiry into their role on child EF development is strongly encouraged. Thus, there is scope for parenting interventions to promote contingent conversations during the preschool period which have the potential to boost EF and hence to prime children to learn and perform well during the transition to formal school. An early positive school start increases the likelihood that children will continue to succeed throughout their academic careers and will be less likely to require remedial education during later school years. Altogether, findings of this study not only highlight the importance of promoting early parent-child contingent conversation but also provide incentive for ongoing research efforts to examine more refined aspects of conversational turns as precursors of child EF, and to actively encourage both maternal and paternal participation in research.

Study 4. Children's Social-Emotional Difficulties

The semantic connectedness between conversational turns that parents and children engage in also have theoretical relevance to children's socioemotional competence. Arguably, meaningfully connected back-and-forth exchanges are foundational for pragmatic and social development; turn-taking not only requires children to interpret their interlocutor's language input but also to develop self-regulatory skills such as attending to incoming speech, awaiting their turn, and inhibiting disruptive impulses. Therefore, with the aim of examining the role of this process to children's socioemotional outcomes, the fourth study in this chapter examined how connected conversational turns in toddlerhood and preschool years during triadic mother-father-child interaction related to children's socioemotional difficulties in middle childhood.

Conversational Turn-Taking with Mothers and Fathers in Toddlerhood and Preschool Years Relates to Fewer Child Socioemotional Difficulties During the First School Years

Abstract

This study examined whether the quality of conversational turns between children and their parents during triadic interaction in toddlerhood (T1; *M*=24.28 months, *SD*=1.45) and preschool years (T2; *M*=43.13 months, *SD*=7.16) relates to fewer socioemotional difficulties during the first years of formal school (T3; *M*=8.58 years; *SD*.27). Participants were 26 Irish mothers (M_{age}=35.769, SD=4.934), fathers (M_{age}=36.923, SD=5.607), and their child (16 female). At T1 and T2 participants engaged in 5-minute structured triadic interactions in a child friendly laboratory. All interactions were transcribed, and conversational turns were coded manually for semantic connectedness. At T3 parents and teachers reported children's socioemotional difficulties using the Strengths and Difficulties Questionnaire. Controlling for child age, partial correlations indicated that children may differentially benefit from different aspects of conversational turns at different stages of development. Specifically, semantic connectedness between turns may play a more salient role in toddlerhood compared to preschool years. Further, while mothers and fathers engaged in similar conversational turns interactive styles, they differentially related to child outcomes. Children's socioemotional difficulties appeared to benefit from mothers' incoming semantically related turns. However, with fathers it was children's opportunity to respond contingently to paternal utterances that related with fewer socioemotional difficulties. Findings suggest that interactive experiences which offer children the opportunity to contribute to ongoing conversation may buffer against children's socioemotional difficulties, and conceivably foster early academic performance.

Keywords: conversational turns, socioemotional difficulties, toddlerhood, preschool, middle childhood, longitudinal

Introduction

International research, policy, and practice consistently emphasise the importance of a positive school start (Dockett et al., 2014), yet many children begin their academic journey without the requisite socioemotional competencies that allow successful learning (Sloan et al., 2022). These children have difficulty following instruction, awaiting their turn, raising their hand, and working independently and with others (Sloan et al., 2022). Such poor socioemotional skills inhibit children's ability to focus, attend to, devote resources to, and engage with the academic environment, and ultimately impede learning (Denham et al., 2015). Children with socioemotional deficits also receive less instruction from teachers, less positive feedback (Denham & Brown, 2010) and are less likely to develop positive rapports with peers (Curby et al., 2015) and teachers (Portilla et al., 2014) all of which further interfere with learning.

Crucially, socioemotional difficulties during kindergarten can contribute to immediate and longitudinal academic and social problems (Duncan et al., 2007). Poor early achievement results in persistent academic difficulties, school drop-out, juvenile delinquency, substance abuse, poor employment prospects and poor mental health (Duncan et al., 2007). Even more concerning is that children who experience socioemotional difficulties early in education are unlikely to catch up with their more successful counterparts (McClealland et al., 2007). In fact, these children may fall further behind and experience a larger number of poor outcomes later in life (McClealland et al., 2007). Hence, identifying sources of variation in children's early socioemotional development bears implications for children's initial transition to school, continuous academic performance, and later success in life.

Early Parent-Child Interaction and Child Socioemotional Development

The importance of early parent-infant interaction to child development has been convincingly demonstrated (Lieberman et al., 2005). Such interactions have been typically studied in terms of how broad dimensions of parenting such as warmth, affect, and responsiveness (Harrist & Waugh, 2002) relate to child outcomes. While informative, this approach inherently assumes a more active role on the parent's behalf and neglects children's agency in their own development. However, a comprehensive understanding of how early parent-child interaction shapes child socioemotional outcomes necessitates acknowledgement that both parent and child actively participate and dynamically influence early interactions and ultimately child outcomes (Feldman, 2007; Lunkenheimer et al., 2020).

Interactional Synchrony, Conversational Turns and Child Socioemotional Skills

Increasingly, research demonstrates that interactions characterised by back-and-forth exchanges during which parents and children synchronise their behaviour are beneficial for child socioemotional growth (Harrist & Waugh, 2002). Parent-child synchrony is an interaction pattern during which behavioural and biological states between interactive partners are co-ordinated frequently through contingent responsiveness and social reciprocity (Feldman, 2012). Parent-child synchrony is evident from as early as three months of age (Van Puyvelde et al., 2013) and is reportedly implicated in children's attachment development (Leclère et al., 2014), emotion-specific empathy and empathic understanding from infancy through to adulthood (Yaniv et al., 2021). Both cross-sectional and longitudinal evidence attests to the importance of parent-child behavioural synchrony for children's self-control, empathy, behavioural development, moral internalisation, and communicative competence (Feldman, 2007, 2012; Kochanska et al., 2008).

One type of interactional synchrony that has been less studied in relation to child socioemotional development is conversational turn-taking. However, there are compelling arguments that make this relationship worthy of further inquiry. Through the opportunity to engage in conversational turns children learn that they can contribute to, and influence, an ongoing interaction. Turn-taking not only requires children to interpret their interlocutor's language input but also to develop self-regulatory skills such as attending to incoming speech, awaiting their turn, and inhibiting disruptive impulses. In line with Tronick's Mutual Regulation Model, when interactional partners respond to infants' communicative behaviours, the resulting give and take interaction sets the stage for children's development of self-regulation skills (Diaz et al., 2019). Empirical data similarly suggests that interactive play during which parent and child mutually contribute to the interaction is associated with better child self-regulation and compliance (Kochanska et al., 2008) and fewer internalising and externalising behaviours (Bogels & Phares, 2008).

Recent inquiry into the neural underpinnings of parent-child synchrony during *in vivo* interaction (e.g., Nguyen et al., 2021; Quiñones-Camacho et al., 2021; Reindl et al., 2018) further motivates the exploration of conversational turn-taking as a mechanism facilitative of socioemotional development. For instance, conversational turns between mothers and their pre-schoolers was related with higher neural synchrony in the prefrontal cortex (PFC; Nguyen et al., 2021). This neural synchrony in the PFC has elsewhere been linked with better emotion regulation among five- to nine-year-old children (Reindl et al., 2018) and greater decreases in internalising behaviours across 18 months among four- to five-year-old children (Quiñones-Camacho et al., 2021).

Moreover, turn-taking requires interlocutors to multitask speech comprehension and production (Sigman & Dehaene, 2005) meaning that successful turn-taking invokes the quick time sharing of cognitive resources (e.g., Levinson, 2016). That is, listeners are monitoring and predicting their interlocutor's upcoming speech and planning a response during the middle of an incoming turn. It follows that interactional partners can only devote resources to comprehension during the early stages of a turn (Garrod & Pickering, 2015). As a result, interlocutors tend to rely on pragmatic heuristics to infer each other's messages (Thompson & Couper-Kuhlen, 2005). This use of pragmatic cues may represent a further mechanism through which children's socioemotional competencies develop. Indeed, it has been suggested that synchronous properties of interactions, such as those of turn-taking, prepare infants to engage in complex social acts and promote children's future ability to navigate relationships (Feldman, 2007).

The limited empirical research on conversational turns and socioemotional development demonstrates that the quantity of conversational turns with mothers at 18 months is uniquely associated with child socioemotional skills at 30 months (Gómez & Strasser, 2021). Other evidence suggests that the number of maternal semantically connected turns rather than the sheer number of turns at two-years-old are related to children's social understanding at three- and four-years-old (Ensor & Hughes, 2008). It remains unknown, however, whether conversational turns experienced early in life continue to influence children's socioemotional skills during their first years of formal school.

Moreover, while fathers are increasingly recognised for their influence on children's socioemotional skills their role has been frequently characterised in terms of play and physicality and described as distinct from that of mothers (see Amodia-Bidakowska et al., 2020). However, while some differences between maternal and paternal behaviours have been reported, mothers and fathers are also known to display similarities. Thus, to expand the literature on child socioemotional competence it is important to include both mothers and fathers in research and recognise that fathers' parenting role extends beyond that of a physical playmate.

The Present Study

The present study has two research aims. First, the study aims to characterise conversational turns between children, their mother and father during triadic interaction in toddlerhood and preschool years. The focus on triadic interaction represents a strength of the study as it acknowledges the importance of considering families as systems and studying father-child relationships in the context of mother-child relationships and *vice versa* (Lamb, 2010).

Second, the study aims to examine associations between mother-father-child conversational turns during toddlerhood and preschool years and children's socioemotional difficulties as reported by parents and teachers during middle childhood. The study hypothesises that children who experience more semantically contingent conversational turns, and arguably experience more synchronised interactions, with mothers and fathers during toddlerhood and preschool years will display fewer socioemotional difficulties during middle childhood.

Method

Participants

Participants in this study were 26 Irish mother-father-child triads. Data in the present study are part of a larger study at Trinity College Dublin. Data collection occurred when children were toddlers (T1), pre-schoolers (T2) and subsequently during middle childhood (T3). Children (10 male and 16 female) ranged in age from 22.17 to 27.13 months (M=24.282, SD=1.453) at T1, from 34.60 to 54.40 months (M=43.130, SD=7.155) at T2 and from 7.67 to 9 years at T3 (M=8.583, SD=.267). At T1, fathers' age ranged from 29 to 55 years (M=36.923, SD=5.607) whereas mothers' age ranged from 30 to 48 years (M=35.769, SD=4.934). Families were well educated, with 80.80% of mothers and 69.20% of fathers having a bachelor's degree or higher.

Procedure

Ethical approval was obtained from the School of Psychology Research Ethics Committee at Trinity College Dublin. At T1 and T2 the study was undertaken at the Infant and Child Research Lab at Trinity College Dublin. Parents provided demographic information and completed a battery of questionnaires about their child. Children were subsequently developmentally assessed by a trained research assistant in the presence of one parent. Next, mothers, fathers and their children were invited to participate in structured play sessions. Families were presented with a gender-neutral toy-set and instructed to play together as they normally would for five minutes.

All interactions were transcribed with the CHAT (Codes for the Human Analysis of Transcripts) conventions of CHILDES (Child Language Data Exchange System; MacWhinney, 2000). Transcripts were verified by a second researcher to confirm accuracy of content.

At T3 parents and teachers completed the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) via the online platform Qualtrics.

Measures

Conversational Turns

Conversational turns were manually coded according to Ensor and Hughes's conventions (2008). A conversational turns was defined as a speaker's vocalisation immediately followed by another speaker within five seconds. Each conversational turns was subsequently coded as connected if it related semantically to the previous interlocutor's turn. Only utterances exchanged between parents and children (but not between mothers and fathers) were included.

Socioemotional Difficulties

Children's socioemotional development was assessed via parent and teacher report on the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) at T3. Parents and teachers responded to a series of questions regarding the child's behaviour during the previous six months on a three-point scale ranging from 0 (not true) to 2 (certainly true). Items were combined to yield three subscales, namely prosocial behaviour, externalising behaviour, and internalising behaviour. The internalising and externalising subscales are subsequently combined to give an overall score of child socioemotional difficulties (α=.75 parents; α=.82 teachers). Higher scores reflect higher levels of socioemotional difficulties.

Analyses

All statistical analyses were performed using SPSS Version 28. First a series of descriptive and correlational analyses were performed. Second, partial correlations were performed to examine associations between quality of mothers', fathers', and children's CT during toddlerhood and preschool years and child socioemotional outcomes in middle childhood while controlling for child age.

Results

Descriptive statistics are presented in Table 5.1 and correlational analyses are presented in Tables 1 and 2 in Appendix C.

Table 5.1

Descriptive Statistics for Mothers', Fathers', and Children's Proportions of Semantically Connected Conversational Turns During Triadic Interaction in Toddlerhood and Preschool Years.

	Toddlerhood		Preschool Years				
	M (SD)	**Min-Max**	**M (SD)**	**Min-Max**	***t*-value**	***p*-value**	**Cohen's *d***
Semantically Connected Turns							

Maternal	.15 (.10)	.00 - .37	.29 (.14)	.13 - .67	4.26	<.001	.17
Paternal	.14 (.09)	.00 - .36	.26 (.12)	.10 - .54	3.88	<.001	.15
Child with M	.50 (.26)	.00 – 1	.56 (.16)	.31 - .88	1.22	.12	.28
Child with F	.50 (.26)	.00 – 1	.53 (.16)	.24 - .93	.70	.25	.29
Total Child Turns	.43 (.16)	.19 - .77	.54 (.15)	.33 - .88	3.15	.001	.19
Total Turns							
Maternal	55.46 (19.71)	34 – 109	111.46 (34.74)	14 - 161	6.96	<.001	32.95
Paternal	45.27 (19.66)	10 – 92	74.50 (34.68)	26 – 156	4.76	<.001	31.29
Child with M	14.27 (9.58)	1 – 41	51.38 (21.73)	12 – 106	8.26	<.001	22.92
Child with F	8.08 (5.28)	0 – 19	30 (15.09)	6 – 66	6.71	<.001	16.66
Total Child Turns	22.35 (12.20)	6 – 45	81.38 (20.54)	43 – 132	11.91	<.001	25.27

Note. M = mothers; F = fathers.

Mother, Father and Child Semantically Connected Turns

Mothers and fathers engaged in comparable proportions of semantically connected turns with children during both toddlerhood (t (25) = .47, p = .32) and preschool years (t (25) = 1.39, p = .09). Likewise, children engaged in similar proportions of semantically connected turns with both mothers and fathers during toddlerhood ((t (25) = .09, p = .46) and preschool years ((t (25) = 1.11, p = .14).

Conversational Turns During Preschool Years and Child Socioemotional Outcomes in Middle Childhood

Partial correlations between mothers', fathers' and children's semantically connected conversational turns during toddlerhood and preschool years and child socioemotional outcomes in middle childhood controlling for child age are presented in Table 5.2. Findings indicate that mothers', but not fathers', semantically contingent turns during toddlerhood were linked with fewer parent-reported socioemotional difficulties in middle childhood. However, children's turns that were semantically contingent on paternal, but not maternal, utterances were linked with fewer parent-reported socioemotional difficulties in middle childhood.

Table 5.2
Partial Correlations Between Mothers', Fathers', and Quality of Turn in Toddlerhood and Preschool Years and Child Socioemotional Difficulties in Middle Childhood.

	Outcomes Related to Turns in Toddlerhood		**Outcomes Related to Turns in Preschool Years**	
	Parent Report	**Teacher Report**	**Parent Report**	**Teacher Report**
Semantically Connected Turns				
Maternal	**-.67****	.12	.29	-.22
Paternal	-.32	.41†	.38	-.02
Child Turns with Mother	-.41†	-.18	.33	-.13
Child Turns with Father	**-.55***	.10	.21	-.26
Total Child Turns	**-.54***	-.08	-.11	.22
Total Number of Turns				
Maternal	-.41†	.09	.22	**-.51***
Paternal	-.05	.16	.02	-.13
Child Turns with Mother	-.04†	.02	.31	-.35
Child Turns with Father	**-.46***	.42†	.20	-.23
Total Child Turns	**-.48***	.19	.35	-.50*

Note. Correlations between CT in infancy and preschool and child socioemotional outcomes control for child age in toddlerhood and preschool years respectively; †<.10, *p<.05; **p<.01

Discussion

While synchronous parent-child interactions positively influence children's social and emotional skills (e.g., Harrist & Waugh, 2002), synchrony in the form of conversational turns has rarely been examined as a mechanism that may explain additional variance in children's socioemotional development. Thus, to further understand how conversational turns may relate to children's social development, this study first characterised maternal, paternal and child semantically contingent conversational turns in toddlerhood and preschool years during triadic interaction. The study also explored how conversational turns in toddlerhood and preschool years during interaction related to child socioemotional difficulties during middle childhood.

Conversational Turns During Toddlerhood and Preschool Years and Child Socioemotional Outcomes During Middle Childhood

Mothers and fathers in this study displayed comparable turn-taking styles with respect to the proportions of semantically contingent turns that they engaged in with children. These findings suggest that both mothers and fathers can display responsiveness and sensitivity towards their child as indicated by acknowledgement of child contribution to the interaction and maintenance of the child's focus of attention. Hence, while mothers' and fathers' interactive styles have been previously described as distinct, the present study contributes to the research base which suggests that despite some differences, mothers and fathers are largely similar in their parenting behaviours (see Kuppens & Ceulemans, 2019).

The study further found that only maternal, but not paternal, connected turns during toddlerhood were significantly associated with fewer parent-reported socioemotional difficulties during middle childhood. These findings align with existing research which similarly found semantic connectedness between mother-child turns, rather than the total number of turns, at two-years-old to be predictive of children's socioemotional functioning at three- and four-years-old (Ensor & Hughes, 2008). Arguably, semantically contingent responses validate a child's thoughts and feelings and may therefore promote better child emotional regulation. Effective communication and emotional regulation fostered by semantically contingent turns can in turn lead to a decrease in behavioural problems. Arguably, children who feel understood and supported are less likely to act out or engage in disruptive behaviours. Further, responsive interactions can build a sense of trust and attachment between parents and children; children feel secure when they receive consistent, meaningful responses from their caregivers. This secure attachment can serve as a protective factor against socioemotional difficulties, such as anxiety or behavioural misconduct.

In contrast, mothers' and fathers' connected turns during preschool years did not relate significantly with child socioemotional problems in middle childhood. It is possible that during toddlerhood children are still in the early stages of language acquisition and may rely on more salient aspects of conversational turns such as semantic connectedness for socioemotional growth. By preschool years children may have the requisite skills to use language for socioemotional growth in more sophisticated ways such as attending to, and assimilating, labels, and mental state references. These types of references may have featured in parental non-semantically connected turns and although coded as non-contingent, such turns may still have elicited behavioural responses from children and likely contain linguistic content that supports children's socioemotional development.

Alternatively, the null effects during preschool years may be attributable to how child socioemotional skills were operationalised in this study, namely in terms of emotional and behavioural difficulties. Evidence demonstrates that children display misbehaviour such as biting, hitting, and throwing tantrums from the ages of 12 to 24 months following which this behaviour declines (Alink et al., 2006; Tremblay et al., 2004). This developmental window may represent a fertile period during which conversational turns can serve to buffer against such behavioural outbursts. Conversely, during preschool years, as children outgrow mis-behavioural tendencies, conversational turn-taking may promote alternative aspects of socioemotional competence, and this represents a promising avenue for future research.

It is noteworthy that fathers' connected turns during both toddlerhood and preschool years were not significantly linked with child socioemotional outcomes in middle childhood. These null results may be due to the small sample size which underpowered the study. Alternatively, fathers and mothers may promote child socioemotional development through different mechanisms. Fathers are known to foster children's socioemotional growth through their physical and playful interactive style (StGeorge & Freeman, 2017). Compared to mothers, fathers show higher levels of physicality such as energising tactile stimulation, vigorous limb movement and rough-and-tumble play during interaction with children (Paquette, et al., 2003; StGeorge & Freeman, 2017). Fathers more often stimulate children by exciting, surprising, and arousing them (Paquette, 2004). This quality of interaction between father and child is thought to foster the development of the 'father-child activation relationship' (Paquette, 2004). Arguably, through this relationship, fathers give children the opportunity to explore within the confines of safety (Grossmann et al., 2002; Majdandžić, de Vente & Bögels, 2016; Paquette & Bigras, 2010;) and hence promote children's socioemotional development (Bretherton, 2010; Grossman et al., 2002; Whipple et al., 2009).

It is noteworthy however that children's own engagement in connected turns with both parents combined, as well as the proportion of connected conversational turns with fathers, but not mothers, during toddlerhood related with fewer parent-reported socioemotional difficulties in middle childhood. Although tentative, these findings suggest that the opportunity to engage in conversational turns with fathers early in life may uniquely benefit child socioemotional growth. As mentioned above, fathers have already been characterised as unique contributors to child socioemotional development through their challenging playful behaviour (see Amodia-Bidakowska et al., 2020). This study further suggests that fathers may also protect against child socioemotional problems by successfully engaging children in conversation.

However, the total frequency of children's turns (irrespective of semantic connectedness) with fathers, as well as with both parents combined, during toddlerhood also related with fewer socioemotional difficulties in middle childhood, further attesting to a potentially unique role of fathers in buffering against child socioemotional problems. It is noteworthy that only the frequency of child turns, irrespective of semantically connected turns, during preschool years with both mothers and fathers combined, related with fewer child socioemotional difficulties in middle childhood. Arguably, pre-schoolers are less dependent on parental language during interaction (i.e., repeating or adopting, and therefore semantically aligning with, parental interpretations of child feelings and emotions) and may in fact lower their risk of developing socioemotional difficulties by initiating novel conversations independently such as by verbalising their internal states. This study therefore suggests that semantically aligned conversations play a prominent role in toddlerhood whereas as children progress through to preschool years, increased child autonomy and hence increased opportunities to participate verbally in interaction may protect against social and emotional difficulties.

Overall, this study contributes three key findings to the parenting and child socioemotional development research base. First, despite documented differences with regards to maternal and paternal parenting behaviour, this study suggests that mothers and fathers can engage in comparable interactive styles with respect to their quality of turn taking with children. Second, giving children the opportunity to engage in turn-taking prior to school entry can support the positive development of socioemotional skills that are necessary for successful academic functioning. Moreover, different aspects of conversational turns may differentially benefit children's social skills at different times in development emphasising the importance of diversifying children's opportunities to engage in a range of conversational turns. Finally, although based on a small sample size and correlational analysis, engaging in conversational turns with fathers in particular, may uniquely foster child socioemotional development. Findings of this study bear implications for caregivers and early childhood interventions as they suggest that promoting cost-effective, simple back and forth conversation could play an important role in preparing children socially for school.

Limitations

The results of the present study must be considered in the context of several limitations. First, participants were largely homogenous – parents were well educated, and all participants were White. Thus, the extent to which these findings generalise to other populations is limited. Second, the sample size was relatively small and therefore the study was only powered to detect large effects. Future studies with larger sample sizes may identify additional smaller-sized effects from conversational turns on child socioemotional development. Larger sample sizes will also facilitate the inclusion of more potential confounders and additional relevant predictor variables.

Finally, despite the longitudinal nature of this study, reverse causality remains a possibility as children with greater socioemotional skills are likely to differentially engage in conversational turns compared to children with fewer social competencies. Therefore, the findings of this study can only be described as correlational.

Conclusion

The present study provides preliminary findings which suggest that giving children the opportunity to engage in conversational turns in the years preceding formal schooling may buffer against socioemotional difficulties during their early academic careers. Communication with multiple interlocutors requires children to sustain attention, attend to social cues, await their turn, inhibit impulses, and infer meaning, skills which transferred to a scholastic environment allow children to behave in socially appropriate ways. These findings are promising as they suggest that conversational turns in early childhood, which have been elsewhere linked with language and cognitive outcomes (e.g., Beiting et al., 2022), are also implicated in child socioemotional development. As such, this interactive aspect of parent-child communication represents a prime target for early childhood interventions as promoting turn-taking can have cascading effects on multiple child outcomes. Moreover, given that turn taking is the only characteristic that is universal across all languages (Sacks et al., 1974) it emerges as a particularly important process worthy of further research.

Chapter 6

Indirect Effects of Parenting on Children's Early Academic Performance

In addition to direct mechanisms of influence, the systematic review also highlighted how parenting practices influence child development indirectly such as via the home learning environment (HLE) and shared-reading practices. The present chapter therefore reports upon two studies of the HLE and children's school readiness and early academic performance based on secondary data analysis. The first includes nationally representative cohort data whereas the second is based on a small-scale experimental design.

Study 1. The Home Learning Environment

The HLE has been extensively studied and as indicated by the review represents the largest area of research focus with regards to its role in preparing children for school. Studies in this area have primarily operationalised the HLE as a global construct and only recently have scholars highlighted its multidimensionality. Rooted in this developing, more nuanced approach at examining the HLE, the fifth study in this thesis employed structural equation modelling of Growing Up in Ireland (GUI) data to examine how the formal literacy (e.g., teaching the alphabet) and numeracy (e.g., teaching counting) as well as the informal literacy (e.g., reading to child) and numeracy (e.g., playing board games) environment at three years related to child vocabulary, pragmatic language, literacy and numeracy and prosocial behaviour at five- and nine-years-old.

Domain-Specific and Cross-Domain Effects of the Home Literacy and Numeracy Environment at Three Years on Children's Academic Competencies at Five and Nine Years

Abstract

This study examined whether children's formal and informal home literacy (HLE) and home numeracy (HNE) environments at three-years-old demonstrated domain-specific, and cross-domain effects on children's academic performance at five- and nine-years-old. Participants were 7110 children (49.4% male; 84.4% Irish), recruited between 2007-2008 in Ireland. Structural equation modelling revealed that only the informal HLE and HNE demonstrated both domain-specific and cross-domain positive effects on children's language and numeracy outcomes but not on prosocial behaviour, at five- and nine-years-old. Effect sizes ranged from small (β=.020) to moderate (β=.209). These results suggest that even casual cognitively stimulating activities that do not directly focus on active teaching may benefit children's educational outcomes. Findings bear implications for cost-effective interventions with far reaching, and enduring, effects across multiple child outcomes.

Keywords: home literacy environment, home numeracy environment, early academic performance, longitudinal, language outcomes, social-emotional competencies

Introduction

Upon entry into the formal school system children's cognitive and social skills are important not only for immediate adjustment and performance but also for their subsequent academic trajectories (Duncan et al., 2007; LeFevre et al., 2010). In accordance with the '*skill begets skill*' assumption (Cunha & Heckman, 2007), children can capitalise upon rudimentary skills to engage with the school environment, to further refine their skills, and ultimately enter a perpetual cycle of academic achievement. However, approximately 25% of American children begin school without the necessary skills and, as a result, begin their academic journeys at a disadvantage (Isaacs, 2012). This figure is even larger in the UK, with teachers reporting that approximately half of the children who begin school lack the skills expected by the academic environment (Kindred Squared, 2021). Conversely, in Ireland, although teachers believe that children do not necessarily require basic numeracy and literacy skills upon school entry, they express concerns that children lack the necessary social, emotional, and self-management skills such as regulating emotions and making friends (Sloan et al., 2022). Given that children's individual differences in school performance are apparent as early as school entry, it is important to identify which aspects of children's early environments - prior to any formal schooling - might account for this variability.

The Early Home Learning Environment and Academic Performance

As Vygotsky's (1978) sociocultural theory suggests, children develop within social interactions with more experienced counterparts, who encourage and aid children's acquisition of skills beyond what they could achieve independently. In the context of this theoretical framework, examining how early aspects of children's home learning environment may promote their academic competencies can provide important insight into how caregivers can prepare children for school.

The home learning environment refers to the quality and quantity of cognitively stimulating resources and activities that promote children's learning. Broad indices of the home learning environment (including numeracy, literacy, painting and drawing activities) have been consistently linked with children's literacy and numeracy skills (e.g., Melhuish et al., 2008; Niklas and Schneider, 2017). Although several studies suggest that the home learning environment should be operationalised as a global measure (e.g., Baker, 2015; Dearing et al., 2012; Melhuish et al., 2008) there is compelling evidence to indicate that children's early learning environments may be better understood in terms of the home literacy (HLE) and numeracy (HNE) environment (e.g., Anders et al., 2012; Napoli & Purpura, 2018; Skwarchuk et al., 2014).

The Home Literacy Environment.

The HLE refers to language related cognitively stimulating activities and resources such as teaching letters, shared book reading and provision of children's books (Sénéchal & LeFevre, 2002). The HLE may influence children's academic outcomes through two distinct pathways (e.g., Sénéchal & LeFevre, 2002; Sénéchal, 2006). First, children may be exposed to *formal learning experiences*. Specifically, parents may engage in didactic behaviours such as teaching children to recognise letters and read words. Second, children may be exposed to *informal learning experiences*. These include experiences that are not explicitly oriented towards teaching, but nonetheless result in children's acquisition of literacy and numeracy skills. Such activities may include shared reading and providing access to children's books.

The distinction between the formal and informal HLE may have practical implications given that these aspects of children's early environments may promote different skills. For example, teaching literacy at home at two-years-old has been linked with children's emergent literacy at five-years-old whereas shared reading has been linked with children's vocabulary at five years-old and reading development from 8- to 15-years-old (Torppa et al., 2022). Similarly, teaching children to read during preschool has been found to predict children's emergent literacy skills during primary school whereas shared reading has been linked with children's oral language skills (Silinskas et al., 2020). However, both teaching children to read and engaging in shared reading during preschool have been linked with children's early letter knowledge during primary school (Silinskas et al., 2020). The formal HLE has also been linked with children's alphabet knowledge (Sénéchal, 2006) and reading performance throughout the early school years (Hood et al., 2008; Sénéchal, 2006; Sénéchal & LeFevre, 2002). In contrast, the informal HLE such as shared book reading has been linked directly with children's vocabulary knowledge at six years (Sénéchal, 2006; Sénéchal & LeFevre, 2002) and indirectly (through vocabulary mediation) with reading skills in 2nd (Hood et al., 2008), 3rd (Sénéchal & LeFevre, 2002) and 4th (Sénéchal, 2006) grade. Similarly, shared reading at one- to two-years-old has been linked with academic achievement at 8- to 11-years-old (Brown et al., 2022). Furthermore, meta-analytic evidence from 16 intervention studies aimed at promoting dialogic reading (e.g., highlighting words, emphasising sounds, asking questions during shared book reading) indicate that children whose parents received the intervention displayed greater vocabulary growth compared to their counterparts whose parents engaged in 'reading-as-usual' (Mol et al., 2008). Notably, larger effect sizes were observed among younger children (aged two- to three-years-old) suggesting that the home learning environment may differentially influence child outcomes across different stages of development. These differential associations between the formal and informal HLE with child outcomes bear implications for early interventions which could be tailored according to children's needs.

The Home Numeracy Environment

The HNE refers to activities such as teaching numbers, shapes (LeFevre et al., 2010), spatial skills, measurement, and patterning skills (e.g., Purpura et al., 2020) and may be similarly operationalised in terms of formal and informal learning experiences. The formal HNE may include teaching children to count, recognise numbers and calculate simple sums. In contrast, the informal HNE may include number games and numeracy-oriented activities that are inherent in daily tasks such as cooking (Skwarchuk et al., 2014). Compared to the HLE, findings regarding the formal and informal HNE have been less consistent (for a meta-analysis see Daucourt et al., 2021).

Formal aspects of the HNE such as frequently teaching children simple sums at four years has been found to predict better performance on arithmetic tasks and growth in non-symbolic and symbolic number comparison at five years (Susperreguy et al., 2020). However, other studies found no evidence for a statistically significant association between formal numeracy activities and children's math skills (Blevins-Knabe et al., 2000). Similarly, formal numeracy activities such as counting and performing elementary calculations were not statistically significantly related to math skills among five- and six-year-old children (DeKeyser, 2020). These inconsistent findings may be attributed to the differential operationalisation of the formal HNE across studies and the type of numeracy activities examined. For instance, a recent systematic review of 37 studies focusing on the HNE found that complex, but not basic, formal home numeracy activities were associated with better numeracy skills in children (Mutaf-Yildiz et al., 2020). This finding aligns with Vygotsky's sociocultural learning theory which posits that children's skills develop during interactions with more experienced social partners. However, such interactions can only promote children's skill development if children's interactional partners operate within their zones of proximal development (ZPD) and appropriately challenge them to develop more complex skills. Thus, teaching children basic numeracy skills such as counting may promote numeracy skills in young children who are only beginning to encounter numerical concepts. However, such activities may no longer be relevant to older children who have already mastered basic numeracy skills and are more likely to benefit from more complex numeracy activities.

In addition to the formal HNE, the informal HNE, albeit less studied (Mutaf-Yildiz et al., 2020), may also positively influence children's numeracy skills. In fact, some evidence suggests that the informal HNE may show stronger links with children's math skills than the formal HNE (Dunst et al., 2017). It is likely that the casual nature of informal numeracy activities may allow parents to introduce more complex mathematical concepts than they would feel comfortable teaching in a formal environment (e.g., Daucourt et al., 2021). As such, parents may be more likely to operate within children's ZPD and to scaffold children's numeracy skills during informal numeracy activities. This assumption is corroborated by findings which show that informal numeracy activities such as playing dice and number games at the start of kindergarten are linked with children's math skills (e.g., complex sums and subtraction tasks, calculating coins, completing patterns, and solving geometry tasks) both concurrently and at the end of 1st grade, controlling for children's IQ (Niklas & Schneider, 2014). Playing number board games has been identified as a particularly strong predictor of children's numeracy skills (Benavides-Varela et al., 2016; Ramani & Siegler, 2011). In fact, playing board games with children, who have no experience with such games at home, results in significant growth in children's early numeracy skills (Ramani & Siegler, 2011).

Similarly, engaging in art activities such as colouring and drawing may positively contribute to children's math skills. For instance, individual differences in children's drawing skills at four-years-old have been linked with children's math ability at 12-years-old (Malanchini, 2016). Arguably, art can represent a means through which children learn about patterns, shapes, sizes, and perspectives (Dooley et al., 2014). Moreover, giving children opportunities to play with modelling compounds such as '*play-doh*' can enhance children's understanding of conservation (Piaget, 1965), for instance, how specific quantities can change shape (Dooley et al., 2014).

It is noteworthy that although a distinction has been made between the formal and informal HNE there is no consensus regarding how best to operationalise children's early numeracy environments. While some evidence supports studying the HNE in terms of formal and informal activities (e.g., Manolitsis et al., 2013), other findings favour a bifactor conceptualisation consisting of one general numeracy factor, one direct and indirect numeracy factor and one spatial activities factor (Purpura et al., 2020). The various ways in which the HNE has been measured may explain the variability of research findings and highlight the need for further efforts towards the development of a robust HNE model**.**

Domain-Specific and Cross-Domain Effects of the HLE and HNE

Although there is wide support for domain-specific effects of the HLE and HNE (e.g., Lehrl, 2020), evidence is emerging to suggest cross-domain effects also. This is not surprising given that children's literacy and numeracy skills are associated (Purpura et al., 2011). That is, children who struggle with literacy skills tend to also have difficulties with numeracy skills and *vice versa* (Light & DeFries, 1995). It follows that promoting one domain of child development may have transferable effects on other domains of development. This conjecture is supported by findings which show that formal literacy activities can predict math skills just as well as formal numeracy activities (Manolitsis et al., 2013). Likewise, the HLE, comprising formal and informal activities, has been identified as a stronger predictor of numerical skills than a measure of formal and informal numeracy activities (Anders et al., 2012). It is likely that HLE activities such as shared reading may also involve enumerating items in books, identifying patterns and assessing characteristics such as size and depth, all of which may promote children's numeracy development.

Cross-domain effects have also been documented with regards to the HNE. For instance, some evidence suggests that the HNE might be a stronger predictor of children's language outcomes than the HLE (Napoli & Purpura, 2018). Arguably, this association stems from the complex verbal interactions inherent in numeracy activities. It is likely that parents invoke verbal explanations to scaffold children's numeracy development which in turn benefits children's vocabulary (Napoli & Purpura, 2018). Math talk may also represent one form of decontextualised talk which is a known predictor of child language development (Ebert et al., 2020).

Moreover, aspects of the HLE may influence children's academic performance by fostering *non-academic* skills which are nevertheless necessary for optimal school performance. Specifically, the early HLE has been found to influence children's socio-emotional competencies at 12 months (O'Farrelly et al., 2018), at four years (Bierman et al., 2015) and at eight years (Rose et al., 2018). From a Vygtoskian perspective, practices such as shared book reading provide an opportune infrastructure within which parents can expand the boundaries of children's ZPD by encouraging them to undergo various social and emotional experiences through the perspectives of book protagonists.

As a result, children may experience growth in their own socio-emotional skills and engage in prosocial behaviour such as cooperating and comforting peers (e.g., Aram et al., 2017). Indeed, some evidence suggests that shared book reading is directly linked with children's socio-emotional outcomes (Kozak & Recchia, 2019).

However, it is also plausible that the HLE influences children's socio-emotional outcomes through language development. Shared book reading may promote children's ability to articulate emotions which in turn may benefit socio-emotional development (Rose et al., 2018). In accordance with this hypothesis, some findings suggest that children's language competence at three years predicts children's co-operation, self-regulation, and aggressiveness at seven years (Rose et al., 2016). Similarly, the HLE of three-year-old German children was found to predict children's language abilities six months later which subsequently predicted children's socio-emotional skills (e.g., adequate display of shame and pride, ability to play alone and behavioural difficulties) as reported by teachers a further six months later (Wirth et al., 2021).

Similarly, the informal HNE may also contribute to children's socioemotional development. Activities such as board games, card games and cooking all require children to follow instructions and adhere to rules which theoretically may foster children's social skills. Numeracy related games in particular necessitate turn-taking and may evoke competitiveness thereby providing children with opportunities to experience failure and success, to learn how to self-regulate and engage in prosocial behaviours.

The Present Study

The present study examines timing-specific associations between the home learning environment at three years and children's school performance at five- and nine-years-old, thereby capturing the time-period during which children transition to formal schooling. The first research aim is to examine domain-specific associations between the early home learning environment comprising both formal and informal HLE and children's language skills at five and nine years and between the formal and informal HNE and children's numeracy skills at five and nine years. The second research aim is to examine cross-domain associations between the formal and informal HLE and children's numeracy and one aspect of socioemotional skills, namely prosocial behaviour, and between the formal and informal HNE and children's language and prosocial behaviour at five and nine years. The study includes parent report, teacher report, and direct assessments of child performance and therefore minimises the possibility of common method variance. The study further includes relevant control variables such as family socioeconomic status, primary caregiver education, child gender, child baseline language skills, preschool attendance and whether English is the child's first language.

This study hypothesises that: both the formal and informal HLE at three years will demonstrate direct domain-specific links with children's language skills at five and nine years (hypothesis 1a) and indirect domain-specific links with children's language skills at nine years through language, numeracy, and prosocial behaviour at five years (hypothesis 1b); both the formal and informal HNE at three years will show direct domain-specific links with children's numeracy skills at five and nine years (hypothesis 2a) and indirect domain-specific associations with children's numeracy skills at nine years through language, numeracy and prosocial behaviour at five years (hypothesis 2b).

Further, based on evidence that formal and informal literacy activities are important precursors of children's language outcomes (e.g., Sénéchal, 2006; Sénéchal & LeFevre, 2002) but also of socioemotional development (e.g., Rose et al., 2018), and that numeracy activities are important not only for math-related outcomes but also for language outcomes (e.g., Manolitsis et al., 2013), it is hypothesised that: both the formal and informal HLE will demonstrate direct cross-domain associations with children's numeracy and prosocial behaviour at five and nine years (hypothesis 3a) and indirect cross-domain associations with children's numeracy and prosocial behaviour at nine years through academic competencies at five years (hypothesis 3b); both the formal and informal HNE will demonstrate direct cross-domain associations with children's language skills at both five and nine years; but only the informal HNE will show direct cross-domain links with children's prosocial behaviour at five and nine years (hypothesis 4a) as informal activities such as board and card games may promote social development through teaching children self-regulation, rule-following, and turn-taking skills. Given the lack of theoretical and empirical evidence, the formal HNE is not expected to relate to children's prosocial behaviour. Lastly, the study hypothesises that: both the formal and informal HNE will show indirect cross-domain associations with children's language and prosocial behaviour at nine years through academic competencies at five years (hypothesis 4b).

Method

Transparency and Openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study, and we follow Journal Article Reporting Standards (JARS; Kazak, 2018). As per Irish Social Science Data Archive (ISSDA) regulations, data cannot be made publicly available and may only be accessed by researchers indicated on the Growing Up in Ireland data request form. Data were analysed using STATA, version 17. This study's design and its analysis were not pre-registered.

Participants

Participants in the present study are part of the Growing Up in Ireland (GUI) study, a large representative cohort study of children in Ireland. Ethical approval for this study was obtained from the Research Ethics Committee convened by the Department of Children and Youth Affairs. Full details of the GUI study design and data collection methodology have been described elsewhere (Quail et al., 2019). In brief, 11,134 children born between December 2007 and May 2008, along with their primary and secondary caregivers were recruited from the Republic of Ireland Child Benefit Register (Quail et al., 2019). Data collection occurred when children were aged nine months, three years (n = 9073), five years (n = 9001), seven to eight years (n = 5344) and nine years (n = 8032). The present study uses data that were collected when children were three, five and nine years old. Participants who did not participate at all three timepoints were not included in this study (n = 1891). Data were weighted to statistically adjust for systematic non-response and attrition based on the most recent census (detailed dataset of the entire population in Ireland carried out by the Central Statistics Office) and Child Benefit Register (a universal monthly social welfare payment to families with children in Ireland). This statistical adjustment accounts for any differences (e.g., in terms of education, social class) between the true population and sample that participated in the study. Minimum information loss algorithm was used to generate the weighting scheme.

In addition, 262 participants were excluded from analysis due to a diagnosed speech or language problem. The final sample consisted of 7110 primary caregivers and their children. All primary caregivers were the child’s parent (98.5% = mothers; 1.5% = fathers). Participant demographic information is presented in Table 6.1.

Table 6.1
Descriptive Statistics of Demographic Variables at Three Years.

	Mean (SD) or %	N
Primary Caregiver Age		
Years	30.16 (5.79)	7110
Marital Status		
Married/Co-habiting	75.1%	5339
Married and separated	2.2%	155
Divorced/widowed	1.3%	89
Never married	20.8%	1481
Unknown	1.2%	92
Primary Caregiver Education		
No Qualification	20.6%	1464
Technical/Vocational Qualification	14.3%	1025
Non-Degree	22.8%	1624
University Degree	24.2%	1720
Postgraduate	17.4%	1199
Doctorate	1.1%	78
Household Socioeconomic Status		
Professional	19%	1348
Managerial	34.4%	2445
Non-manual	16.6%	1180
Skilled/Unskilled manual	8.8%	629
Never worked/unknown	7.8	553
Child Sex		
Male	49.4%	3510
Language		
English not first language	7.3%	519
Preschool Attendance		
Yes	68.7%	4888
No	2.8%	200
Missing	28.4%	2022
Primary Caregiver Ethnicity		
Irish	84.4%	6002
Other White	10.8%	765
African or other Black	2.3%	164
Chinese or other Asian	2%	145
Other (including mixed)	.5%	32

Measures

The Home Learning Environment at Three Years

The home learning environment was measured using parent report on a home learning environment scale (see Table 1 in Appendix D). On a scale from ‘0’ to ‘7’ parents indicated the number of days per week during which they engaged in cognitively stimulating activities with children. In addition, parents reported the number of children's books present in the home.

Formal Home Literacy Environment (HLE).

Two items from the home learning environment scale, namely the frequency with which parents taught children the alphabet and songs, poems, or rhymes, were used to create a latent formal HLE variable within a structural equation modelling (SEM) framework. Factor loadings were .608 and .590 respectively (CFI = .986, TLI = .957, RMSEA = .030, SRMR = .018).

Informal Home Literacy Environment (HLE).

Two items from the home learning environment scale, namely the frequency with which parents read to children and the number of books present in the home were used as indicators of the informal HLE. The number of books was categorised as a dichotomous variable which assessed whether participants had less or more than 30 children's books in the house.

Formal Home Numeracy Environment (HNE).

One item from the home learning environment scale, namely the frequency with which parents taught children numbers and counting, was used as an index of children's formal HNE.

Informal Home Numeracy Environment (HNE).

Two items from the home learning environment scale, namely the frequency with which parents played games (e.g., board games, card games, jigsaw puzzles etc.) and engaged in art activities (e.g., painting, drawing etc.), were used to create a latent informal HNE variable. Factor loadings were .595 and .502 respectively (CFI = .986, TLI = .957, RMSEA = .030, SRMR = .018).

Academic Competencies at Five Years

Vocabulary. Children's expressive vocabulary was assessed directly by an interviewer in the home using the *Naming Vocabulary* scale of the British Abilities Scales (Elliott et al., 1996). Children were shown pictures of various objects and asked to verbally name them. Assessment continued until a child erred on five consecutive trials. Higher scores indicate more developed vocabularies.

Pragmatic Language Skills. Children's pragmatic language skills were assessed via teacher report on the Achievement Scales from the UK Millennium Cohort Study. Specifically, teachers responded to nine 'yes' or 'no' questions that included items such as "*Initiates communication with others, displaying greater confidence in more informal contexts*", "*Uses language to imagine and to recreate roles and experiences*", and "*Uses talk to organise, sequence and clarify thinking, ideas, feelings, and events; explores the meanings and sounds of new words*". The nine items were combined to create an overall 'Language for Communication and Thinking' score (α = .88). Scores ranged from 3 (indicating 3 or less) to 9 with higher scores indicating better pragmatic language skills.

Literacy and Numeracy Skills. Children's numeracy and literacy skills were assessed via teacher report on the Achievement Scales from the UK Millennium Cohort Study. With regards to numeracy, teachers responded to nine 'yes' or 'no' questions that included items such as "*Uses developing mathematical ideas and methods to solve practical problems*" and "*Recognises, counts, orders, writes, and uses numbers up to 20*". The nine items were combined to create an overall '*Numeracy*' score (α = .76). With regards to literacy, teacher report on two scales composed of nine items, namely

'Linking Sounds and Letters' and '*Child Reading*' were combined to form a latent literacy score. Items for '*Linking Sounds and Letters*' included '*Uses phonic knowledge to read simple and regular words*', '*Attempts to read more complex words, using phonic knowledge*' and '*Uses knowledge of letters, sounds and words when reading and writing independently*' (α = .85). Items for '*Child Reading*' included '*Shows an understanding of the elements of stories, such as main character, sequence of events, and openings*', '*Shows an understanding of how information can be found in non-fiction texts to answer questions about where, who, why, and how'* and '*Reads books of own choice with some fluency and accuracy*' (α = .77). Scores ranged from 3 (indicating 3 or less) to 9 with higher scores indicating better literacy and numeracy skills. Factor loadings for linking sounds and letters and child reading were .805 and .877 respectively (CFI = .986, TLI = .957, RMSEA = .030, SRMR = .018).

Prosocial Behaviour. Children's prosocial behaviour was obtained from teacher ratings on the Prosocial Behaviour subscale from the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997). The subscale consists of five questions regarding the child's prosocial behaviour over the past six months and are rated on a three-point scale ranging from 0 ('not true') to 2 ('certainly true'). Higher scores indicate greater levels of prosocial behaviour (α =0.81).

Academic Competencies at Nine Years

Vocabulary. Children's vocabulary was directly assessed by an interviewer using the Drumcondra Primary Reading Test – Revised (DPRT-R). The DPRT-R is a standardised test administered to children in Ireland in 2nd (eight- to nine-years-old), 4th (10- to 11-years-old) and 6th (12- to 13-years-old) class annually. The test consists of 40 multiple choice items aimed at assessing children's understanding of word meanings. Sample items include asking children to select the corresponding synonym for the underlined word in ‘The children reached the end of the road’. Response options include ‘A. crossed’, ‘B. arrived at’, ‘C. looked for’, ‘D. saw’. Each correct answer is awarded a score of ‘1’ and all final scores are summed to provide an overall score of child vocabulary. The DPT-R has high reliability with KR_{20}= .93. The vocabulary measure demonstrated modest test-retest reliability (r (7,108) = .382, p < .001).

Literacy and Numeracy Skills. Children’s literacy and numeracy skills were assessed via teacher report of children’s competence relative to developmental counterparts at nine years. Reading and writing scores were used to create a latent literacy skills variable. Factor loadings for reading and writing in English were .856 and .845 respectively (CFI = .986, TLI = .957, RMSEA = .030, SRMR = .018). Test-retest reliabilities for literacy and numeracy were r (7,108) = .733, p <.001 and r (7,108) = .745, p <.001 respectively.

Prosocial Behaviour. Children’s prosocial behaviour was obtained from teacher ratings on the five-item Prosocial Behaviour subscale from the Strengths and Difficulties Questionnaire (SDQ; α = .80; Goodman, 1997; r (7,108) = .277, p <.001).

Covariates

The study also adjusted for a number of covariates including family socioeconomic status, primary caregiver education, child sex, child baseline language skills (measured using the Naming Vocabulary subscale of the British Abilities Scale; Elliott et al., 1996), preschool attendance, child non-singleton status as well as whether English was the child’s first language.

Statistical Approach

First data were analysed for normality. Results revealed skewness and kurtosis values within ± 2 for all study variables, indicating normal univariate distribution (George & Mallery, 2010). Second, a series of descriptive and correlational analyses were performed using SPSS 26. Next, a SEM was modelled to address the research questions (see Figure 1 in Appendix D).

The model controlled for family socioeconomic status, primary caregiver education, child gender, child baseline language skills, preschool attendance, child non-singleton status as well as whether English was the child's first language. Correlations of residual variances of all academic competencies at five and nine years were also performed to account for overlap between variables. Indirect paths were estimated post-hoc using the KHB command (Karlson & Holm, 2011). The KHB command disentangles each mediator's contribution to the indirect effect, net of covariates. All indirect paths were tested, regardless of whether there was a significant main effect to allow potential suppressor effects to be identified. Model fit was assessed using Hu and Bentler's (2009) criteria including RMSEA <.05, SRMR <.08, and CFI and TLI values >.90. Given the multiple comparisons performed, to minimise both Type I and Type II error rates, Laken and colleagues' (2018) approach was employed to calculate an alpha level of 0.02. All paths were consequently tested against this new *p*-value.

Missing Data

As is common in longitudinal research, there was some missing data due to attrition and non-response. Analyses of missingness patterns using Little's MCAR test indicated that data were missing completely at random (MCAR), $\chi^2(9) = 9.323$, $p = .408$. Given that complete case analysis is an appropriate and robust approach for data that is MCAR (Von Hippel, 2007), only participants who took part in the study at three, five and nine-years-old were included. Among these, at three-years-old, there were .10% missing cases for the HLE. At five-years-old, there were .60% missing cases for child vocabulary, 6.00% missing cases for pragmatic language, 6.50% missing cases for numeracy, 17.50% missing cases for literacy, and 5.70% missing cases for prosocial behaviour. At nine-years-old, there were 2.50% missing cases for vocabulary, 9.10% missing cases for numeracy, 8.90% missing cases for literacy, and 8.50% missing cases for prosocial behaviour.

There were no differences between participants whose data were and whose were not available at all three timepoints in terms of primary caregiver education $\chi^2(5) = 14.319$, $p = .216$. However, participants who did not have data at all three timepoints were more likely to be of lower socioeconomic class $\chi^2(4) = 15.956$, $p = .026$ and less likely to have children enrolled in preschool education $\chi^2(1) = 8.391$, $p = .004$. Full Information Maximum Likelihood (FIML) was used to estimate the missing values via the 'mlmv' command in STATA.

Results

Descriptive statistics are presented in Table 2 in Appendix D. Pearson's correlations between all study variables are presented in Tables 3 and 4 in Appendix D.

Domain-Specific Associations Between the Formal and Informal HLE and HNE and Child Academic Competencies at Five and Nine Years Old

Factor loadings for latent variables, direct effects from the formal and informal HLE and HNE to child competencies at five and nine years are presented in Table 6.2. Similarly, indirect effects from the formal and informal HLE and HNE to child competencies at nine years through child competencies at five years are presented in Table 6.2.

Table 6.2

Standardised β Coefficients for Direct and Indirect Effects from the Formal and Informal HLE and HNE at Three Years to Child Competencies at Five and Nine Years.

Latent Variable Factor Loadings	**β**	***p*-value**		
ABCs → formal HLE	.608	<.001		
Songs, poems, rhymes → formal HLE	.590	<.001		
Board games → informal HNE	.595	<.001		
Art → informal HNE	.502	<.001		
Linking sounds and letters at five years → literacy skills at 5 years	.804	<.001		
Child Reading at five years → literacy skills at 5 years	.877	<.001		
Reading in English at nine years → literacy skills at 9 years	.856	<.001		
Writing in English at nine years → literacy skills at 9 years	.845	<.001		
Direct Effects	**β**	***p*-value**	**95% Bootstrapped Confidence Intervals**	R^2
Academic Competencies at 5 Years				
<u>Literacy Skills</u>				.126
Formal HLE → literacy skills at 5 years	-.235	.039	[-.599, -.076]	
Informal HLE → literacy skills at 5 years	.077	.003	[-.022, -.080]	
Number of books → literacy skills at 5 years	-.002	.945	[-.151, .030]	
Formal HNE → literacy skills at 5 years	.098	.114	[.008, .169]	
Informal HNE → literacy skills at 5 years	.209	.011	[.008, .387]	
<u>Vocabulary</u>				.285
Formal HLE → vocabulary at 5 years	.014	.850	[-1.434, 2.026]	
Informal HLE → vocabulary at 5 years	.016	.429	[-.104, .452]	
Number of books → vocabulary at 5 years	.052	.018	[.087, 1.44]	
Formal HNE → vocabulary at 5 years	.022	.549	[-.320, .719]	
Informal HNE → vocabulary at 5 years	.024	.643	[-.626, 1.756]	
<u>Pragmatic Language</u>				.097
Formal HLE → pragmatic language at 5 years	-.160	.144	[-.785, -.066]	
Informal HLE → pragmatic language at 5 years	060	.008	[.019, .104]	

Number of books → pragmatic language at 5 years	-.009	.740	[-.140, 102]	
Formal HNE → pragmatic language at 5 years	.050	.362	[-.013, .187]	
Informal HNE → pragmatic language at 5 years	.190	.017	[.136, .629]	
<u>Prosocial Behaviour</u>				.048
Formal HLE → prosocial behaviour at 5 years	.005	.954	[-.279, .283]	
Informal HLE → prosocial behaviour at 5 years	-.002	.940	[-.051, .048]	
Number of books → prosocial behaviour at 5 years	.020	.389	[-.060, .115]	
Informal HNE → prosocial behaviour at 5 years	.032	.583	[-.106, .239]	
<u>Numeracy Skills</u>				.057
Formal HLE → numeracy skills at 5 years	-.110	.290	[-.479, .014]	
Informal HLE → numeracy skills at 5 years	.074	.003	[-.132, .034]	
Number of books → numeracy skills at 5 years	.001	.981	[-.019, .055]	
Formal HNE → numeracy skills at 5 years	.054	.305	[-.018, .118]	
Informal HNE → numeracy skills at 5 years	.105	.186	[.037, .318]	
Academic Competencies at 9 Years				
<u>Literacy Skills</u>				.208
Formal HLE → literacy skills at 9 years	-.107	.429	[-.229, .037]	
Informal HLE → literacy skills at 9 years	.051	.012	[.003, .023]	
Number of books → literacy skills at 9 years	.035	.107	[-.001, .032]	
Formal HNE → literacy skills at 9 years	.046	.515	[-.012, .064]	
Informal HNE → literacy skills at 9 years	.088	.346	[-.007, .139]	
<u>Vocabulary</u>				.301
Formal HLE → vocabulary at 9 years	-.080	.454	[-.375, .071]	
Informal HLE → vocabulary at 9 years	.056	.001	[.016, .043]	
Number of books → vocabulary at 9 years	.052	.008	[.006, .073]	
Formal HNE → vocabulary at 9 years	.022	.688	[-.023, .105]	
Informal HNE → vocabulary at 9 years	.027	.686	[-.059, .103]	
<u>Prosocial Behaviour</u>				.122
Formal HLE → prosocial behaviour at 9 years	-.011	.914	[-.347, .323]	
Informal HLE → prosocial behaviour at 9 years	-.011	.605	[-.037, .048]	
Number of books → prosocial behaviour at 9 years	-.006	.812	[-.144, .061]	
Informal HNE → prosocial behaviour at 9 years	.035	.626	[-.151, .206]	

Numeracy Skills				.137	
Formal HLE → numeracy skills at 9 years	-.141	.139	[-.178, .010]		
Informal HLE → numeracy skills at 9 years	.030	.126	[-.009, .014]		
Number of books → numeracy skills at 9 years	.012	.545	[-.007, .031]		
Formal HNE → numeracy skills at 9 years	.066	.191	[.004, .051]		
Informal HNE → numeracy skills at 9 years	.085	.226	[-.001, .120]		
Indirect Effects	**β**	***p*-value**	**95% Bootstrapped Confidence Intervals**		**Proportion of Effect Explained**
Literacy Skills					
Indirect Effect from Formal HLE to Literacy Skills at 9 Years	.009	.065	[-.001, .017]		
Indirect Effect from Informal HLE to Literacy Skills at 9 Years	.025	.001	[.018, .029]	.290	
Informal HLE → literacy skills at 5 years→ literacy skills at 9 years	.009	<.001	[.006, .011]		29.28%
Informal HLE → pragmatic language at 5 years→ literacy skills at 9 years	.004	<.001	[.003, .006]		1.48%
Informal HLE → numeracy skills at 5 years→ literacy skills at 9 years	.005	<.001	[.003, .007]		14.68%
Indirect Effect from Number of Books to Literacy Skills at 9 Years	.004	.623	[-.005, .009]		
Indirect Effect from Formal HNE to Literacy Skills at 9 Years	.029	.104	[-.001, .014]		
Indirect Effect from Informal HNE to Literacy Skills at 9 Years	.063	.005	[.045, .064]	.260	
Informal HNE → literacy skills at 5 years→ literacy skills at 9 years	.023	<.001	[.019, .027]		42.72%
Vocabulary					
Indirect Effect from Formal HLE to Vocabulary at 9 Years	-.064	.089	[-.108, .008]		
Indirect Effect from Informal HLE to Vocabulary at 9 Years	.027	.002	[.033, .058]	.290	
Informal HLE → literacy skills at 5 years→ vocabulary at 9 years	.018	<.001	[.005, .011]		37.94%
Informal HLE → pragmatic language at 5 years→ vocabulary at 9 years	.008	<.001	[.005, .011]		4.26%
Informal HLE → numeracy skills at 5 years→ vocabulary at 9 years	.008	<.001	[.005, .012]		12.15%
Indirect Effect from Number of Books to Vocabulary at 9 Years	.010	.288	[-.008, .027]		
Indirect Effect from Formal HNE to Vocabulary at 9 Years	.034	.119	[-.004, .036]		
Indirect Effect from Informal HNE to Vocabulary at 9 Years	.074	.015	[.051, .096]	.280	
Informal HNE → literacy skills at 5 years→ vocabulary at 9 years	.052	<.001	[.043, .063]		70.28%
prosocial behaviour Skills					
Indirect Effect from Formal HLE to prosocial behaviour at 9 Years	-.007	.726	[-.078, .055]		

Indirect Effect from Informal HLE to prosocial behaviour at 9 Years	.003	.660	[-.009, .015]		
Indirect Effect from Number of Books to prosocial behaviour s at 9 Years	.004	.507	[-.015, .029]		
Indirect Effect from Formal HNE to prosocial behaviour at 9 Years	.001	.959	[-.021, .022]		
Indirect Effect from Informal HNE to prosocial behaviour at 9 Years	.016	.240	[-.016, .055]		
<u>Numeracy Skills</u>					
Indirect Effect from Formal HLE to Numeracy Skills at 9 Years	-.044	.069	[-.040, .002]		
Indirect Effect from Informal HLE to Numeracy Skills at 9 Years	.020	.001	[.008, .023]	.180	
Informal HLE → literacy skills at 5 years→ numeracy skills at 9 years	.008	<.001	[.006, .101]		38.35%
Informal HLE → pragmatic language at 5 years→ numeracy skills at 9 years	.004	<.001	[.002, .005]		1.08%
Informal HLE → numeracy skills at 5 years→ numeracy skills at 9 years	.007	<.001	[.004, .009]		34.08%
Indirect Effect from Number of Books to Numeracy Skills at 9 Years	.003	.641	[-.005, .008]		
Indirect Effect from Formal HNE to Numeracy Skills at 9 Years	.021	.125	[-.002, .012]		
Indirect Effect from Informal HNE to Numeracy Skills at 9 Years	.044	.014	[.028, .056]	.140	
Informal HNE → literacy skills at 5 years→ numeracy skills at 9 years	.021	<.001	[.016, .025]		49.80%
Goodness of Fit Indices					
RMSEA	.030				
CFI	.986				
TLI	.957				
SRMR	.018				

Note. For indirect effects, only child competencies at five years that emerged as significant mediators are reported.

Formal and Informal HLE

Results indicate that the formal HLE did not show significant domain-specific associations with children's literacy skills at either five or nine years. In contrast, with regards to the informal HLE, shared reading showed significant positive direct domain-specific associations with children's literacy (β = .077, p = .003) and pragmatic language (β = .060, p = .008), whereas the number of books in the house was linked with children's vocabulary (β = .052, p = .018) at five years old.

Similarly, shared reading showed significant positive direct associations with children's literacy skills (β = .051, p = .012) and vocabulary (β = .056, p = .001), whereas number of books was directly positively related only with child vocabulary (β = .052, p = .008) at nine-years-old (hypothesis 1a).

In addition, shared reading showed significant positive indirect associations with children's literacy skills at nine years (β = .025, p = .001) through literacy skills (β = .09, p < .001), pragmatic language (β = .004, p <.001) and numeracy skills (β = .005, p <.001) at five years. As illustrated in Table 6.2, literacy skills explained 29.28% of the indirect effect, pragmatic language explained 1.48% and numeracy skills explained 14.68%. There were significant positive indirect associations between the informal HLE and children's vocabulary at nine years (β = .027, p =.002) through literacy skills (β = .018, p <.001), pragmatic language (β = .008, p <.001) and numeracy skills (β = .008, p <.001) at five years. Literacy skills explained 37.94% of the indirect effect, pragmatic language explained 4.26% and numeracy skills explained 12.15% of the indirect effect (hypothesis 1b).

Formal and Informal HNE

There was no evidence for statistically significant domain-specific associations between either the formal or informal HNE and children's numeracy skills at either five or nine years (see Table 6.2; hypothesis 2a).

However, the informal HNE was indirectly associated with children's numeracy skills at nine years (β = .044, p = .014) through literacy skills (β = .021, p < .001). Literacy skills explained 49.80% of the indirect effect (hypothesis 2b).

Cross-Domain Associations Between the Formal and Informal HLE and HNE and Child Academic and Prosocial Behaviour at Five and Nine Years Old

Formal and Informal HLE

The formal HLE did not show any statistically significant cross-domain associations with children's numeracy or prosocial behaviour at either five or nine years. In contrast, the informal HLE showed significant cross-domain links with children's numeracy skills (β = .074, *p* = .003) at five years old.

There was no evidence for significant cross-domain direct associations between the informal HLE and children's prosocial behaviour and numeracy skills at either five or nine years (hypothesis 3a). However, the informal HLE showed significant positive indirect cross-domain associations with children's numeracy skills at nine years (β = .020, *p* = .001) through literacy skills (β = .008, *p* <.001 pragmatic language (β = .004, *p* <.001) and numeracy skills (β = .007, *p* <.001) skills. Literacy skills explained 38.35%, pragmatic language explained 1.08% and numeracy skills explained 34.08% of the indirect effect (hypothesis 3b).

Formal and Informal HNE

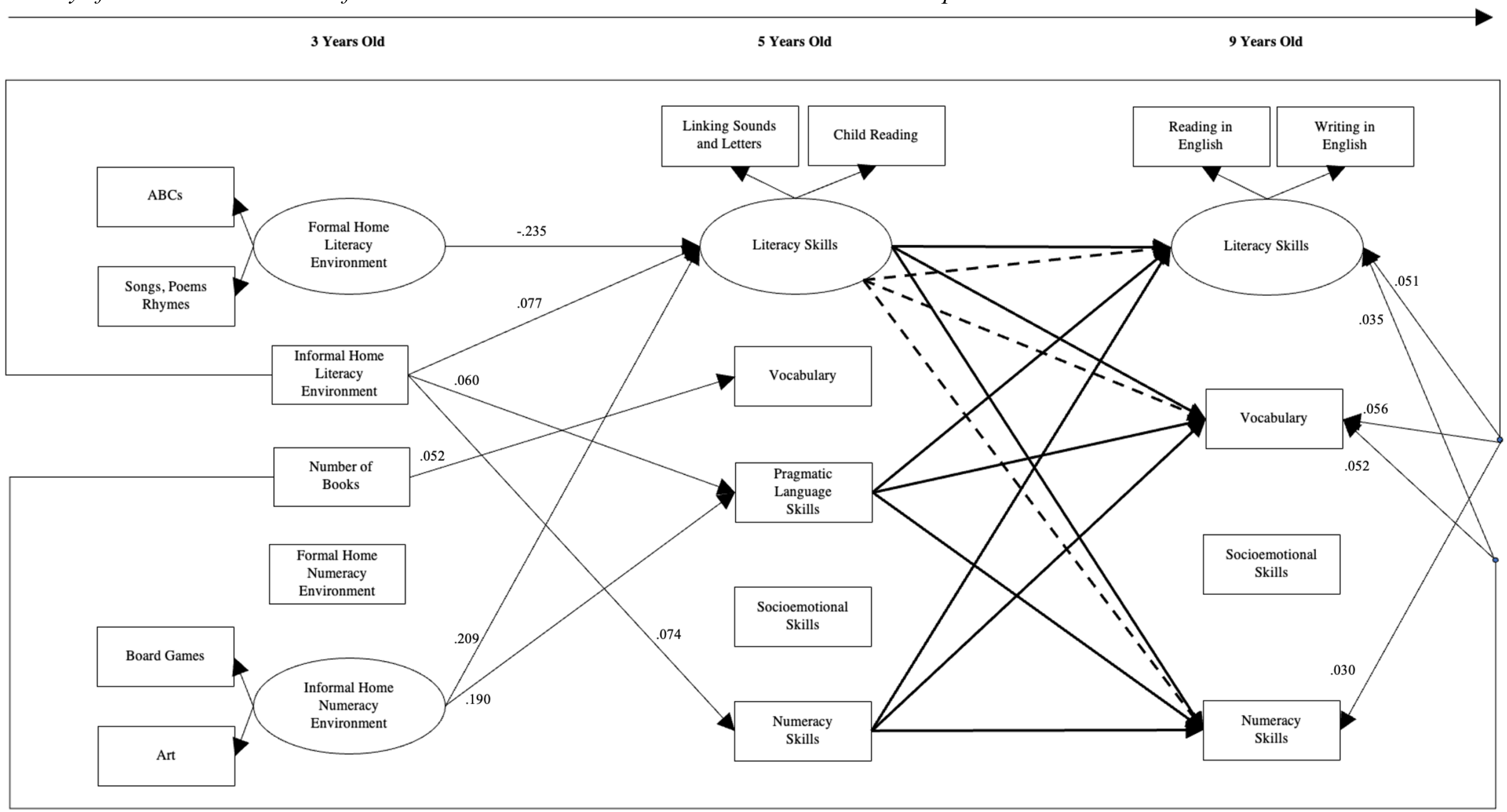
There was no evidence for statistically significant cross-domain associations between the formal HNE and children's language or prosocial behaviour at either five or nine years (see Table 6.2).

Conversely, the informal HNE was significantly positively associated with children's literacy skills ($\beta = .209$, $p = .011$) and pragmatic language ($\beta = .190$, $p = .017$) at five years. There were no significant direct cross-domain associations between the informal HNE and any child outcomes at nine years (hypothesis 4a).

However, there was evidence for significant positive indirect cross-domain links between the informal HNE and children's literacy skills at nine years ($\beta = .063$, $p = .005$) through literacy skills at five years ($\beta = .023$, $p < .001$) which explained 42.72% of the indirect effect. Similarly, the informal HNE was indirectly associated with children's vocabulary at nine years ($\beta = .074$, $p = .015$) through literacy skills ($\beta = .052$, $p < .001$) at five years. Literacy skills explained 70.28% of the observed effect (hypothesis 4b). The final model is presented in Figure 4.1.

Figure 4.1

Pathways from the Formal and Informal HLE and HNE at 3 Years to Child Academic Competencies at 5 and 9 Years



Note. Only significant direct and indirect paths from the formal and informal HLE and HNE are illustrated. Solid lines depict significant direct paths, solid bold lines indicate significant indirect paths from the informal HLE (through child competencies at five years), and dashed lines indicate significant indirect paths from the informal HNE (through child competencies at five years). The model adjusts for covariates. Strength of associations (β coefficients) are presented next to paths.

Discussion

Children's early academic competencies largely influence their academic trajectories (Duncan et al., 2007; LeFevre et al., 2010). Children who begin school with poorly developed literacy and numeracy skills are likely to lag behind throughout their academic journey (e.g., Hooper et al., 2010; Jordan et al., 2007). Accordingly, the present study aimed to explore how early aspects of children's home learning environment may foster their academic competencies during the first years of school through two research aims. First the study examined domain-specific effects between the formal and informal HLE and HNE at three years and child academic performance at five and nine years. The second research aim was to examine cross-domain effects between the formal and informal HLE and HNE at three years and children's academic and prosocial behaviour at five and nine years.

Domain-Specific Associations between the HLE and Children's Academic Competencies

Research has clearly highlighted the importance of the HLE during the preschool period (see Niklas et al., 2021 for an editorial). Participation in literacy and language activities (e.g., reading, reciting rhymes, access to books) with parents has been found to predict four-year-olds' print knowledge and interest in book reading one year later (Weigel et al., 2006). Similarly, among six-year-olds formal literacy activities (e.g., actively teaching children to read and write) predicted children's reading competence and reading motivation (Yeo et al., 2014). Paradoxically, in this study the formal HLE did not show any significant associations with children's literacy skills at either five or nine years. One possible explanation for this null result may be the complexity of the formal HLE activities assessed at three years. That is, while teaching children the alphabet and singing songs and rhymes might benefit toddlers who are less sophisticated language users, such activities may have limited influence on older children who can arguably read and write from the age of five onwards. It is therefore of relevance for future research to examine not only associations between the early HLE and child outcomes but also stability and change in the HLE over time. Such an approach can provide important insights into the types of HLE activities that most salient to children at different stages of development.

In contrast, the informal HLE demonstrated positive domain-specific associations with children's language skills at both five and nine years thereby partially supporting the first hypothesis. Specifically, the number of children's books at three years was associated with children's vocabulary whereas shared-book reading was associated with literacy skills and pragmatic language at five years. It is likely that shared reading represents interactive episodes whereby children actively participate in, rather than passively listen to, the book narrative. Thus, shared-reading may offer children the opportunity to experience turn-taking, to ask and answer questions and to explore various perspectives of book characters. These experiences in turn appear beneficial for children's development of vocabulary and language for thinking and communication during the preschool period.

Moreover, shared reading showed indirect links with children's literacy skills and vocabulary at nine years through pragmatic language, literacy, and numeracy skills at five years. In addition, both shared reading and number of children's books at three years were directly related to children's literacy skills and vocabulary at nine years independent of children's prior skills. It is likely that exposure to books and shared reading include activities such as letter recognition, rhyming and defining new words, all of which may promote children's language outcomes. These findings align with previous research which similarly found shared reading to be an important precursor of children’s vocabulary at six years (Sénéchal, 2006; Sénéchal & LeFevre, 2002) and of children’s reading skills in 2nd (Hood et al., 2008), 3rd (Sénéchal & LeFevre, 2002) and 4th (Sénéchal, 2006) grade.

The non-significant associations between the formal HLE and children’s language skills at nine years highlights an important limitation of the present study, namely that aspects of the HLE were only assessed when children were aged three. Consistent with Vygotsky’s sociocultural learning theory, teaching children the alphabet and songs, poems and rhymes during toddlerhood may operate within children’s ZPD and promote early language skills. However, such formal literacy activities may no longer challenge pre-schoolers who may benefit from more sophisticated aspects of the formal HLE such as actively learning how to read and write (e.g., Silinskas et al., 2020).

Domain-Specific Associations between the HNE and Children’s Academic Competencies

Existing research suggests that both the formal and informal HNE are meaningfully, albeit differentially, related with child outcomes (e.g., Skwarchuk et al., 2014; Zippert & Rittle-Johnson, 2020). In the present study, only the informal HNE was significantly linked with children’s numeracy skills at nine years through literacy skills at five years. Therefore, the hypotheses that both formal and informal HNE would demonstrate domain-specific associations with children’s numeracy skills were only partially supported. This finding is in concert with previous claims that informal aspects of the HNE, such as playing board games and engaging in art activities may play a positive role in children’s numeracy development (Benavides-Varela et al., 2016; Malanchini, 2016; Ramani & Siegler, 2011). Playing numerical games may require children to count, engage in iterative problem solving, recognise patterns, engage in spatial reasoning, and perform calculations to manage resources, all of which are likely to promote the development of numeracy skills. Similarly, children's math skills may grow as they explore patterns, shapes, sizes, and perspectives through art (e.g., Dooley et al., 2014). In addition, given that both math and art depend on patterns and relationships between objects, this aspect of the informal HNE may represent a useful activity that could foster children's early numeracy skills.

It is noteworthy that although the informal HNE showed significant domain-specific relations with children's numeracy skills at nine years, there was no evidence for a significant association at five years. This finding may be attributable to limitations with regards to the measures used to assess numeracy skills. Although in this study children's numeracy was assessed via teacher report of child numerical competence, it is likely that a more comprehensive assessment including children's problem-solving abilities, mathematical language, and spatial awareness (e.g., Purpura et al., 2020) may provide greater insight regarding the informal HNE and children's numeracy development.

Similarly, a more comprehensive measure of the formal HNE, beyond counting, may better capture the link between the early HNE and children's numeracy skills. It may be that activities such as teaching children sums, division and problem solving may push children to invoke the upper limits of their numerical abilities to a greater degree than counting and may therefore better explain potential relations between the formal HNE and children's numeracy skills.

Cross-Domain Associations between the HLE and Children's Academic and Prosocial Behaviour

Although the link between the HLE and children's language outcomes has been established (e.g., Kumschick et al., 2014; Mol et al., 2008; Sénéchal, 2015; Sénéchal &

Lefevre, 2014), growing evidence suggests that the influence of the early HLE may also extend to children's socioemotional development (Kumschick et al., 2014). However, findings have been less consistent among younger populations. Some studies suggest that the HLE can influence socioemotional competencies in children as young as 12 months old (O'Farrelly et al., 2018). However, other findings indicate that among two- to four-year-olds, shared book reading and a global measure of the HLE (e.g., frequency of reading, number of children's books, library visits) are not meaningful predictors of child socioemotional outcomes (Wirth et al., 2021). Similarly, in the present study, neither the formal nor the informal HLE showed significant associations with children's prosocial behaviour at either five or nine years. Therefore, the hypotheses that the formal and informal HLE would show cross-domain links with children's socioemotional skills were not supported. One possible explanation for these results is that socioemotional competencies were defined only in terms of teacher-reported prosocial behaviour and this measure may limit the extent to which children's socioemotional skills were captured. Socioemotional skills extend beyond prosociality and include abilities to adapt to different settings, establish boundaries and display appropriate emotional responses such as shame and pride. Therefore, more comprehensive assessments alongside observational measures might provide more accurate insight into children's socioemotional competencies (e.g., Wirth et al., 2021).

In addition, it has been suggested that the HLE is not only important for children's language and socioemotional development but may also relate to children's numeracy skills. For instance, formal literacy activities have been reported to impact children's numeracy skills to a similar degree as formal numeracy activities (Manolistis et al., 2013). There have also been suggestions that formal and informal aspects of the

HLE are stronger predictors of children's numeracy skills than formal and informal aspects of the HNE (Anders et al., 2012).

Similarly, in this study the informal, but not the formal, HLE was significantly positively directly linked with children's numeracy skills at five years and indirectly with numeracy skills at nine years through pragmatic language, literacy, and numeracy skills at five years. These results partially support the hypothesis that the formal and informal HLE would show cross-domain links with children's numeracy skills. This finding echoes previous research whereby the number of books in the home, and the frequency of shared reading was associated with children's math performance during the first months of kindergarten (Lahaie, 2008). It is likely, that in contrast to formal literacy activities, reading, like math activities, requires children to retrieve associations between symbolic and phonological concepts and therefore benefits both language and numeracy skills.

Alternatively, given that children's language skills at five years mediated the association between the informal HLE and numeracy skills at nine years, it may be that children with more developed language skills may be better equipped to participate in numeracy-related activities during preschool and as a result display better math performance during the early school years. These findings corroborate the claim that while early numeracy skills are important for later numeracy skills, language skills are also crucial (e.g., Yang et al., 2021). It is known that young children possess the ability to distinguish broad quantities (e.g., much, little), which later facilitates children's higher level numeracy skills (Butterworth, 2005). Language however allows children to link number words with quantities and therefore progress from a basic understanding of numeracy (e.g., 50 equates *much*) to a more refined one (e.g., 50 equates *fifty*). Furthermore, informal HLE activities such as shared reading may also incorporate enumeration, pattern recognition and engagement in math talk thereby providing a plausible mechanism through which the HLE may influence numeracy skills. Thus, the informal HLE may play a significant role in promoting children's early language skills which in turn contribute to children's later numeracy skills.

Cross-Domain Associations between the HNE and Children's Academic and Prosocial Behaviour

Growing evidence now suggests that the HNE is not only important for children's numeracy skills but may also positively influence literacy skills (Huntsinger et al., 2016). In fact, meta-analytic evidence suggests that early math skills predict children's reading skills just as well as early reading skills (Duncan et al., 2007**).** However, more recent evidence from younger populations indicates that playing structured games (e.g., board games, puzzles, and flash cards) with children aged 8 to 36 months is not predictive of children's vocabularies (Kartushina et al., in press).

In this study, the informal HNE demonstrated cross-domain direct relations with children's literacy skills and pragmatic language at five years. Crucially, these associations demonstrated the largest effect sizes providing some support for prior claims that the HNE might be a stronger predictor of children's language outcomes than the HLE (Napoli & Purpura, 2018). Moreover, the informal HNE also showed indirect relations with children's literacy skills and vocabulary at nine years through literacy skills at five years. These findings partially support the hypothesis suggesting cross-domain links between the HNE and child language outcomes. It is possible that engaging in informal numeracy activities such as playing card and board games promotes language skills in children such as initiating conversations with others and turn-taking, using language to imagine and recreate experiences, using talk to organise feelings, clarify ideas and explore meanings of new words. The lack of such an association among younger children (e.g., Kartushina et al., in press) further highlights that different aspects of the home learning environment may differentially relate to child outcomes across stages of development. These findings bear important implications for the development of developmentally appropriate interventions especially given prior suggestions that numeracy interventions may be beneficial to children's reading (Sarama et al., 2012).

It is possible that the effects of the informal HNE may extend beyond numeracy and language performance and also promote socioemotional development. For example, playing board games and card games may encourage children to adhere to social norms, engage in self-directed speech for self-regulation (e.g., Prizant & Wetherby, 1990) and interact appropriately with peers. Similarly, informal HNE activities may teach children to follow rules, inhibit strong impulses and remain on task, all of which are necessary for successful social functioning in an academic environment. However, in this study there was no evidence for a statistically significant association between the informal HLE and children's socioemotional development, in terms of prosocial behaviour. Thus, the hypothesis regarding the HNE and children's socioemotional skills was not supported. As discussed above, this finding might be attributed to how socioemotional skills were operationalised in this study and it is likely that observational measures might yield different results.

Overall, only the informal HLE and HNE demonstrated positive domain-specific effects and cross-domain effects with children's language and numeracy skills at five and nine years. However, these results should be interpreted with caution as the effect sizes identified in this study were of small to modest magnitude. Nevertheless, these findings suggest that even casual cognitively stimulating activities that do not directly focus on active teaching have demonstrable implications for children's educational outcomes. Moreover, there have been suggestions that informal literacy activities instil pleasure and appreciation of reading in children (Sénéchal, 2006) and informal numeracy activities lead children to associate math with entertainment and positive quality time with caregivers (e.g., Daucourt et al., 2021). Collectively these findings are promising for the development of cost-effective and easily implementable early childhood interventions.

Limitations

Although findings of the present study shed a positive light on the importance of early informal learning activities, a number of limitations must be acknowledged. First, the home learning environment was measured using parent report only. Moreover, constructs of the home learning environment were measured using a small number of items (ranging from one to two). Therefore, the extent to which children's formal and informal HNE and HLE were appropriately captured is limited. It would be useful for future research to assess children's early learning environment through alternative methods such as direct observation. Such an approach would allow additional, and potentially unexamined, aspects of the HLE and HNE to emerge. Second, children's home learning environment was only assessed when children were aged three. However, children continuously develop, acquire more complex skills and their ZPD changes accordingly. Hence, aspects of the home learning environment that may have promoted skill development at three years may differ from aspects of the home learning environment that may encourage skills development at five and nine years.

Third, socioemotional skills were assessed using a teacher reported measure of child prosocial behaviour. However, a more comprehensive understanding of how the home learning environment may influence child socioemotional skills may be obtained by multiple-item questionnaires complemented by direct assessment. Relatedly, given that all child outcomes were assessed using teacher report, it is possible that ceiling effects may have influenced the findings of this study. Future research should assess child outcomes using a multitude of measures to allow for greater variability to emerge and contribute greater insight into the relation between early learning environments and academic competencies. Fourth, although the study controls for children's baseline language skills, it does not account for bidirectional effects between other child individual characteristics and the home learning environment. It is likely that academically driven children are likely to elicit cognitively stimulating activities from parents which in turn may promote their later academic competencies (e.g., Sameroff, 2009).

Fifth, the extent to which these findings may generalise across orthographies is limited. For example, the effects of formal home learning activities tend to be significantly smaller across transparent orthographies (e.g., Finnish, Greek) compared to opaque orthographies (e.g., French, English; Manolitsis et al., 2013). Sixth, it should be noted that the effect sizes in the present study were of small magnitude, albeit comparable to existing research (e.g., Gibson et al., 2021). One possibility is that the large sample size may have increased the risk of Type I error which may account for the identification of weak effect sizes. Nevertheless, these findings provide promising suggestions that even recreational activities without explicit focus on math and literacy domains can partly contribute to children's academic competence.

Finally, despite the strengths of the longitudinal nature of the study, the analyses reported in the present paper are correlational. Thus, the possibility that confounders or reverse-causality may explain the observed effects cannot be fully eliminated.

Conclusion

Despite limitations, the present study tentatively suggests that children's early informal HLE and HNE play an important role for their later academic performance. Moreover, the positive influence of the early home learning environment appears to persist until children are nine years old. These findings point to the importance and the potential effectiveness of promoting cognitively stimulating environments early in life. In addition, the evidence for domain-specific but also cross-domain effects of the informal HLE and HNE bears important implications for early childhood interventions. Specifically, these findings provide incentive for future research to identify additional HLE and HNE activities that may show cross-domain effects. Such an exercise would facilitate the development of cost-effective interventions with far reaching effects across multiple child outcomes.

Study 2. Shared Book Reading

Akin to the wealth of research on the HLE, focus on the influence of shared book reading has also been extensive. However, while studies increasingly include fathers in child research, most insight with regards to shared reading and child development is informed by research with mothers. Further, although the developmental field has made advances in identifying mechanisms via which shared reading benefits children's language (e.g., engaging in dialogic reading whereby caregivers point to words, ask questions, and actively encourage child participation) there is scope for further development. For example, the textual and illustrative properties of books may differentially influence the quantity and quality of parents' language during shared reading activities and hence differentially relate to children's language outcomes. Based on this premise, it has been theorised that exposing children to a "varied diet" of book genre and type can have a distinct impact on children's language and early literacy skills. Thus, the final study of this thesis aimed to characterise paternal and child language use during a shared reading interaction with wordless and text-based picture books.

Father and Toddler Language During Shared Book Reading with Text-Based and Wordless Picture Books

Abstract

While the association between shared book reading (SBR) and child language development is well documented, there has been less focus on how book characteristics may differentially elicit parents' language input and hence differentially relate to children's language skills during this activity. Moreover, despite the positive and unique role that fathers have been shown to play for children's language, the father-child shared book reading evidence base is small. Accordingly, the present study examined variation in father and child language quantity, quality, complexity, and function during SBR with text-based and wordless picture books and explored associations between fathers' language and children's language during these episodes. Participants were 46 father-child dyads (20 females; Author, 2020). Fathers' mean age was 38.74 years (*SD*=5.74) and children's mean age was 37.89 months (*SD*=2.71). Findings indicate that fathers in the text-book condition produced significantly greater language quality, extended the topic more, and produced more conversational utterances but described and labelled pictures less than fathers in the wordless picture book condition. Fathers' language during both SBR episodes showed differential links with child language and may suggest that fathers were fine-tuning their language in accordance with their child's language skills (effect sizes ranged from r=.45 to r=.78). It is possible that variation in book content may encourage different types of learning with distinct effects on different domains of child language. Should future research replicate such differential relations, findings may inform caretakers and early childhood interventions with the aim of promoting children's books tailored to specific language areas of interest.

Keywords: shared book reading, text-based book, wordless picture book, father-child interaction, child language development

Introduction

Children's early language skills are fundamental to their school readiness (Fiorentino & Howe, 2004) and future academic performance (Hoff, 2013; Janus & Offord, 2007). Children who begin school with well-developed language skills are at increased likelihood of higher academic achievement, are more likely to pursue higher education and experience greater economic success during adulthood (Blanden, 2006). In contrast, children who enter school with poor language skills are at risk of academic failure (Tomblin, 2008), socioemotional and behavioural difficulties (Yew & O'Kearney, 2013) and poor employment prospects (Conti-Ramsden & Durkin, 2012). Yet approximately 10% of English children enter school with poor language skills (Norbury et al., 2016) and 25% of American children cannot read fluently in 4th grade placing them at risk for academic failure and school dropout (Alexander et al., 1997; Rathbun & Germin-Hausken, 2004). It is therefore crucial to promote children's language skills during the preschool years such that they arrive at school well equipped to succeed academically.

Shared Book Reading and Child Language Development

Children's language development begins in the early home environment primarily through interactive experiences with mothers and fathers (e.g., Cooksey & Fondell, 1996; Garrett-Peters et al., 2011; Kochanska et al., 2019). One such interactive experience with important implications for children's language development, and one that is amenable to intervention, is shared book reading (SBR; see Noble et al., 2019 for a meta-analysis). SBR has been linked with children's vocabulary (e.g., Elley, 1989; Farrant & Zubrick, 2012), phonological awareness (e.g., Lefebvre et al., 2011), print awareness (e.g., Justice & Ezell, 2000, 2004), conversational skills (e.g., Morrow, 1988; Reese, 1995) and grammatical development (e.g., Valdez-Menchaca & Whitehurst, 1992; Whitehurst et al., 1988). These skills in turn lay the foundation for language development (Adams, 1990; Bowman et al., 2001; Teale & Sulzby, 1986) and ultimately foster children's academic performance. Despite findings that SBR occupies only one to two percent of children's daily experiences (Soderstrom & Wittebolle, 2013) the quantity and quality of parents' language during SBR appears to exert unique and enduring effects on children's language outcomes. Indeed, analyses of sixteen-hour audio recordings in homes of three-year-old children indicate that parents produce more speech and engage in more conversational turns with their toddlers during reading compared to when they are engaged in non-reading activities (Gilkerson et al., 2017). Moreover, evidence suggests that parents use more complex language and more diverse vocabularies during SBR with 15- and 30-month-old children during SBR compared to other activities (Hansen et al., 2021). In addition, parents' interactive style during SBR appears to confer unique benefits to child language development. For instance, meta-analytic findings indicate that dialogic reading, whereby parents engage with their child, highlight words, emphasise sounds, ask questions and expand upon material within the book is positively related with child vocabulary, with stronger effects among two to three-year-olds compared to four- to five-year-olds (Mol et al., 2008).

One factor to be considered when examining the relationship between SBR and child language is the characteristics of the books that parents choose for this activity. The textual properties of books may differentially influence the quantity and quality of parents' language and hence differentially relate to children's language outcomes. There is evidence which attests to the importance of exposing children to a “varied diet” of book genre and type as each can have a distinct impact on children's language and early literacy skills (Pappas, 2006). For instance, alphabet and rhyming books can promote children's emergent literacy skills such as letter identification and phonological awareness (e.g., Murphy et al., 2022). Exposure to narrative books on the other hand is an effective means through which children can acquire comprehension strategies (Lynch & van den Broek, 2007). Even wordless picture books may confer unique advantages to language development as they facilitate discourse between caregiver and child. Comparisons of SBR with text-based and wordless picture books indicate that teachers ask more questions and more actively encourage child participation in narrative co-construction and children in turn produce more utterances during wordless picture book episodes (Schick et al., 2021).

Text-Based Book Reading

Children's text-based books may play an important role in promoting vocabulary development as parents produce more language input and more lexically diverse speech during SBR compared to other parent-child activities including toy-play, song singing, caregiving, and mealtime routines (Clemens & Kegel, 2021; Holme et al., 2022; Salo et al., 2016; Weizman & Snow, 2001). Children's books are also a valuable vocabulary source for children as they tend to contain larger proportions of unique word types compared to child-directed speech (CDS) of similar length (Montag et al., 2015). Recent analyses of children's books and CDS corpora indicate that in addition to more diverse words, children's books contain longer, more sophisticated, more lexically dense, and morphologically complex words compared to CDS (Dawson, 2021). Furthermore, nouns and adjectives were found to occur more frequently in children's books than pronouns which were more often encountered in CDS (Dawson, 2021). In addition, parental extra-textual talk during SBR with children aged between 14 and 58 months tends to be more complex, more lexically diverse, contains longer mean length of utterances and features a larger number of verbs (Demir-Lira et al., 2019) compared to CDS that occurs outside of SBR.

Moreover, text-based books may be particularly important for children's syntactic development. From a Vygotskian perspective (Vygotsky, 1978), text-based books may provide unique opportunities for parents to push the upper limits of children's syntactic abilities and hence promote language development. That is, compared to other parent-child interactions, parents produce significantly more complex sentences during SBR (Montag, 2019). Comparative analyses of syntactic constructions between best-selling children's books and CDS from corpus data suggest that CDS exposed children to greater proportions of questions whereas picture book text featured greater proportions of complex sentences (e.g., comprising at least two lexical verbs), and canonical sentence structures (e.g., subject-verb-object; Cameron-Faulkner & Noble, 2013). Exposure to complex sentence types is in turn strongly related with children's own understanding and production of such sentences longitudinally (Huttenlocher et al., 2002; Montag & MacDonald, 2015) but also in real time (e.g., Dale & Spivey, 2006; Moscoso del Prado Martín et al., 2020). Analyses of parent-child language corpora indicate that parents and children engage in syntactic co-ordination during ongoing conversation (Dale & Spivey, 2006; Moscoso del Prado Martín et al., 2020) and this process is also evident during SBR. Specifically, during conversations structured around the content of children's books both interactional partners tend to produce syntactic structures of similar complexity (Branigan et al., 2000). Thus, given that text-based children's books elicit more complex and sophisticated language, text based SBR may be an important facilitator of children's syntactic development and subsequent language outcomes.

Wordless Picture Book Reading

Although wordless picture books contain few or no words, they may also positively contribute to children's language outcomes. Wordless picture books often contain illustrations of low frequency words which promote child vocabulary development (Massaro, 2015; Montag et al., 2015). In line with Vygotsky's social learning theory (Vygotsky, 1978), attending to illustrations in picture books provides an ideal infrastructure within which parents can actively scaffold children's development by explaining novel concepts and encouraging children to participate in more sophisticated ways that they would independently be capable of (van Kleeck et al., 1997). Not only do wordless picture books increase the participation in the reading interaction (Beckett, 2012; Nikolajeva & Scott, 2001; Ramos & Ramos, 2011) but they also elicit greater child engagement in co-constructing meaning resulting in greater verbalisation from children (Graham, 1998; Nikolajeva & Scott, 2001; Nodelman, 1988). In fact, wordless picture books have been found to elicit a didactic reading style whereby caregivers encourage children to construct most of the narrative meaning (e.g., Chaparro-Moreno et al., 2017). This type of didactic reading has in turn been linked with children's receptive language skills (Schick, 2014). More recently, an intervention that promotes this type of reading with wordless picture books has been found to predict children's inferential and literal narrative comprehension abilities and vocabulary growth during the preschool year (Grolig et al., 2020).

Wordless picture books may also elicit more decontextualised talk which is a known predictor of child language (Rowe, 2012). For instance, research with children aged 51 months indicates that mothers engage in more decontextualised talk during story-telling episodes than during story-reading episodes (Curenton et al., 2008). This type of talk in turn encourages children to engage in higher order thinking such as reminiscing, imagining and thinking about abstract concepts that are outside the immediate environment, all of which relate to child language development (Rowe, 2013).

Father-Child Shared Book Reading

Although the evidence in favour of both text-based and wordless picture book SBR is compelling, the majority of studies have focused on mothers and children. A recent review focusing on parent-child language across different contexts including SBR found that 90% of caregiver participants were mothers (Holme et al., 2022). Thus, the extent to which SBR practices may or may not apply to fathers remains unknown. While there are similarities across maternal and paternal parenting behaviours (e.g., Cabrera et al., 2007; Fagan et al., 2014; Roggman, 2004) there are also documented differences (see Feldman & Shaw, 2021). Fathers tend to be more challenging interactional partners (Grossmann et al., 2002; Majdandžić et al., 2016), and notably, more challenging conversational partners (Rowe et al., 2004). Fathers tend to ask more *wh*-questions and more clarification requests (Rowe et al., 2004) both of which are linked with children's vocabulary development (Leech et al., 2013; Rowe et al., 2017). The limited research that has examined paternal language during SBR suggests that fathers positively and uniquely promote child language development (e.g., Baker et al., 2015). Moreover, compared to mothers, fathers tend to engage children more and to produce more extra-textual talk (Duursma, 2016). Fathers' use of questions during SBR has also been positively linked with children's vocabulary (Salo et al., 2016). However, the characteristics of fathers' language during text-based and wordless picture book SBR remain understudied.

The Present Study

Given the strong evidence in favour of SBR, the potential differential contribution of text-based and wordless picture book SBR to children's language development, and limited research with fathers, the present study aims to contribute to the research base through the following aims: (1a) to explore variation in father and child language quantity, quality and complexity during SBR with text-based and wordless picture books; (1b) to explore variation in the function of fathers' language (e.g., describing illustrations, extending the topic, behavioural directives) during SBR with text-based and wordless picture books; and (2) to explore associations between fathers' language and children's language during SBR with text-based and wordless picture books. The study proposes the following hypotheses: (1a) father and child quantity (number of utterances), complexity (mean length of utterance in morphemes, verbs per utterance and children's simple sentences), quality of language (vocabulary diversity**)** will vary across text-based and wordless picture book SBR interactions, (1b) fathers' language function will vary across text-based and wordless picture book SBR interactions, and (2) fathers' quantity, complexity, quality and function of language will be differentially associated with child language quantity, complexity, and quality during both text-based and wordless picture book SBR interactions.

Materials and Methods

Participants

Data used in this study is part of a larger project focused on father-child interaction undertaken at Trinity College Dublin (Kelly et al., 2020). Participants were 46 fathers and their typically developing child recruited through social media, flyers distributed to crèches and supermarkets, and snowballing. Children were aged 31 to 42 months (20 females; M=37.89, SD = 2.71) and fathers were aged 25 to 51 years (M = 38.74, SD = 5.74). All fathers were monolingual and resided in the family home. Fathers were well educated with 65.22% holding a bachelor's degree, 28.26% holding a master's degree and 2.17% holding a doctorate degree.

Procedure

Participants were invited into a child-friendly laboratory and randomly assigned to engage in SBR either with a wordless picture book (n=23) or with a text-based picture book (n=23). Participants in the wordless picture book condition read 'Hug' by Jez Alborough which features illustrations of jungle animals and only contains the word 'hug'. Participants in the text-based book condition read 'One Year with Kipper' by Mick Inkpen which features illustrations of two dogs undergoing various adventures throughout each month of the year and contains 419 words with approximately three to four sentences per page. Both books contained 16 pages and were considered appropriate for children aged two- to five-years old according to the publishers. All families indicated that they were unfamiliar with the books. Fathers were instructed to read with their child as they would normally read a new book at home. All interactions were audio-recorded and subsequently transcribed verbatim in accordance with conventions of CHILDES (Child Language Data Exchange System; MacWhinney, 2000). Each interaction was transcribed from the moment that participants opened the book to the moment that they closed the book or no longer engaged in book-related conversation. All transcripts were verified by a second transcriber to ensure accuracy of content.

Child verbal ability was also directly assessed using the receptive and expressive vocabulary subscales of the Bayley Scales of Infant Development (BSID-III; Bayley, 2006) by a trained researcher in the presence of their father.

Measures

Fathers' and children's language quantity, complexity, and quality during SBR were computed using the KIDEVAL command of the automated CLAN (Computerized Language ANalysis) program (MacWhinney, 2000). KIDEVAL is a language profiling command that automatically tracks the morphological, lexical, and syntactic properties of participants' language. Given that written language tends to be more complex than spoken language, all analyses were performed on paternal extra-textual talk only.

Language Quantity

Fathers' and children's language quantity was indexed by the total number of utterances produced during the SBR interaction. An utterance was defined as a continuous piece of speech beginning and ending with a clear pause, a self-interruption, or a change of speaker.

Language Complexity

Fathers' and children's language complexity was indexed by the Mean Length of Utterance (MLU) measured in morphemes and by the number of different verbs per utterance. Children's language complexity in terms of simple sentence formation was further indexed by proportion of child utterances which contained at least one subject and one verb.

Language Quality

Fathers' language quality was indexed by their vocabulary diversity (VOCD). VOCD analyses the probability of new vocabulary being introduced into speech samples resulting in a mathematical model of how Type/Token Ration (TTR) varies as a function of token size. This mathematical model is then compared with the empirical data in the transcript to yield a measure of vocabulary diversity. High quality language included utterances such as 'Froggies live in water and on land because they are amphibians'. Low quality language included utterances such as 'Look they start off like that and then they grow into that'.

Children's language quality was indexed by their Type/Token Ratio (TTR). TTR is measured by dividing the total number of different word types by the total number of word tokens. Thus, a higher TTR represents greater vocabulary diversity. While VOCD is a preferred index of language quality as it is less sensitive to variation in sample size (McKee et al., 2000), it cannot be computed on transcripts consisting of fewer than 50 word tokens, as was the case for children in this study.

Language Function

Fathers' talk during SBR interactions was further coded according to Demir-Lira and colleagues' (2019) conventions into five mutually exclusive categories applicable to both conditions, namely (1) labelling or describing a picture, (2) extending the topic, (3) behavioural directive, (4) conversational utterance, and (5) comments. Labelling or describing a picture included labels (e.g., 'That's a butterfly') and questions pertaining to the book (e.g., 'What does Kipper have in his hand?'). Extending the topic included utterances that related the content of the book to children's experiences (e.g., 'Remember we saw some little tadpoles when we were on holidays?' when attending to an illustration of tadpoles). Behavioural directives included utterances aimed to manage children's behaviour and direct their attention towards the book (e.g., 'Sit down'). Conversational utterances included requests for clarification (e.g., 'What?'), agreements and disagreements (e.g., 'That's right', 'Okay', 'No'). Comments included utterances regarding the book, the parent, or the child (e.g., 'Good boy', 'I like this book').

Fathers' Education

Fathers reported their highest level of education attained on a scale ranging from 1 (No formal education) to 8 (Doctorate).

Analytic Approach

First, a series of descriptive analyses were performed to explore fathers' and children's language during text-based and wordless picture book SBR, child verbal ability, and fathers' education. Second, independent samples *t*-tests were performed to compare paternal and child language during SBR with text-based and wordless picture books. Third, partial correlations were performed to examine associations between fathers' and children's language during SBR, controlling for child verbal ability.

Results

Descriptive Results

Table 7.1 presents the descriptive results of fathers' and children's language quantity, complexity, quality, and fathers' language function as well as reading episode duration during SBR with text-based and wordless picture books. Fathers in the text-based book condition did not differ significantly from fathers in the wordless picture book condition in terms of language quantity (t (44) = 1.50, p = .07) or complexity (t (44) = -1.38, p = .09 for MLU; t (44) = -.63, p =.06 for verbs). However, fathers in the text-based book condition displayed significantly greater language quality than fathers in the wordless picture book condition (t (44) = -10.42, p < .001).

Table 7.1
Descriptive and t-statistics for Fathers' and Children's Language During Shared Book Reading with Text-Based and Wordless Picture Books.

	Text-based book		**Wordless picture book**		***t*-value**	***p*-value**	**Cohen's *d***
	***M*/n (*SD*/%)**	**Range**	***M*/n (*SD*/%)**	**Range**			
Fathers' Education	5.61 (1.31)	3 – 7	5.74 (1.45)	2 – 8	-.32	.75	1.38
Primary	-	-	1 (4.3%)	-	-	-	-
Lower secondary	2 (8.7%)	-	-	-	-	-	-
Higher secondary	3 (13%)	-	5 (21.7%)	-	-	-	-
Diploma	4 (17.4%)	-	1 (4.3%)	-	-	-	-
Bachelor's degree	7 (30.4%)	-	8 (34.8%)	-	-	-	-
Postgraduate/Master	7 (30.4%)	-	7 30.4%)	-	-	-	-
Doctorate	-	-	1 (4.3%)	-	-	-	-
Fathers' Extratextual Language							
Quantity (# utterances)	105.30 (53.25)	31 – 226	118.26 (40.08)	66 – 205	1.50	.07	41.47
Complexity (MLU)	5.50 (.96)	3.67 – 7.68	5.18 (.66)	3.75 – 6.18	-1.38	.09	1.11
Complexity (verbs per utterance)	.97 (.17)	.65 – 1.39	.90 (.12)	.72 – 1.17	-.63	.06	.21
Quality (VOCD/TTR)	41.69 (5.81)	34.01 – 53.58	26.50 (4.76)	21.15 – 38.45	-10.42	<.001	6.99
Fathers' Language Function							
Describing the picture	57.74 (35.92)	19 – 167	76.39 (27.28)	41 – 134	3.21	.002	27.85
Extending the topic	9.74 (9.30)	0 – 37	2.83 (3.61)	0 – 11	-3.22	.002	10.31
Behavioural directives	5.57 (5.05)	0 – 18	5.39 (5.99)	0 – 25	-.17	.44	5.07
Comments	8.52 (6.24)	1 – 24	6.30 (5.45)	0 – 24	-1.43	.08	7.44
Conversational utterances	12.17 (8.34)	0 – 32	9.09 (5.94)	2 – 23	-6.95	<.001	8.35
Children's Language							
Quantity (# utterances)	34.13 (17.12)	11 – 68	50.30 (27.82)	9 – 115	-2.38	.02	23.10
Complexity (MLU)	2.77 (.64)	1.69 – 4.12	2.86 (.74)	1.73 – 4.77	-.46	.65	.69
Complexity (verbs per utterance)	.36 (.16)	.08 – .71	.36 (.14)	.11 – .59	-.09	.93	.15
Complexity (simple sentence)	.26 (.12)	.08 – .65	.26 (.12)	.09 – .46	.01	.50	.14
Quality (VOCD/TTR)	.56 (.15)	.23 – .87	.43 (.11)	.26 – .74	3.48	<.001	.13
Verbal ability	112.65 (8.09)	94 – 127	113.04 (9.72)	86 – 132	-.14	.45	13.50

With regards to language function, fathers in the wordless picture book condition produced a significantly larger number of utterances that described or labelled the pictures compared to fathers in the text-book condition (t (44) = 3.21, p = .002). In contrast, fathers in the text-book condition produced a significantly larger number of utterances that extended the topic (t (44) = -3.22, p = .002) and significantly more conversational utterances (t (44) = 6.95, p < .001) than fathers in the wordless picture book condition. There were no statistically significant differences between the number of behavioural directives produced by fathers in either condition (t (44) = -.17, p = .44).

As shown in Table 7.1, children in the text-based book condition produced significantly lower language quantity (t (44) = -2.38, p = .02) but greater language quality (t (44) = 3.48, p < .001) than children in the wordless picture book condition. There were no significant group differences between children's language complexity in terms of MLU, verbs or sentence complexity. Similarly, there were no significant group differences in terms of child verbal ability.

Associations between Fathers' Language and Children's Language during Shared Book Reading with Text-Based Picture Books

Partial correlations between fathers' language and children's language in SBR with the text-based picture book are presented in Table 7.2. Controlling for child verbal ability, fathers' language quantity was positively linked with children's language quantity (r = .58, p = .01) but negatively linked with children's language quality (r = -.59, p = .004) during text-based SBR. Father's language complexity was significantly positively linked with child language complexity, specifically with children's MLU (fathers' MLU: r = .54, p = .01; fathers' verbs: r = .51, p = .02), children's number of verbs per utterance (fathers' MLU: r =.59, p = .004; fathers' verbs: r = .53, p = .01), and children's simple sentences (fathers' MLU: r =.62, p = .002; fathers' verbs: r = .56,

$p = .01$). Conversely, fathers' language quality was not significantly linked with any child language outcomes.

In terms of fathers' language function, describing the picture was significantly negatively linked with child language quality ($r = -.60$, $p = .003$). Extending the topic and behavioural directives did not show significant associations with any child language outcomes. Fathers' use of comments was negatively related with child language complexity in terms of MLU ($r = -.46$, $p = .03$). Finally, fathers' conversational utterances were negatively related with child language quality ($r = -.61$, $p = .002$).

Associations between Fathers' Language and Children's Language during Shared Book Reading with Wordless Picture Books

Partial correlation between fathers' language and children's language in SBR with the wordless picture book are presented in Table 7.3. Controlling for child verbal ability, fathers' language quantity was positively linked with children's language quantity ($r = .78$, $p < .001$) but negatively linked with children's language quality ($r = -.52$, $p = .01$). Fathers' language complexity in terms of MLU was significantly positively linked with children's language quality ($r = .45$, $p = .04$). However, fathers' language complexity in terms of verbs was significantly negatively linked with children's language complexity as indexed by MLU ($r = -.53$, $p = .01$).

In terms of fathers' language function, describing the picture was positively linked only with child language quantity ($r = .61$, $p = .003$). Extending the topic was positively linked with child language quantity ($r = .53$, $p =.01$) but negatively linked with language complexity in terms of verbs per utterance ($r = -.47$, $p =.03$). Behavioural directives and comments did not relate significantly to any child outcomes. Fathers' conversational utterances were positively related with child language quantity (r = .72, p <.001) but negatively related with child language quality (r = -.60, p = .003).

Table 7.2

Bivariate Correlations Between Fathers' and Children's Language During Text-Based Shared Book Reading.

		(C) Quantity	(C) Complexity (MLU)	(C) Complexity (verbs)	(C) Complexity (simple sentence)	(C) Quality (TTR)
(F)	Quantity	.58**	.13	.34	.31	-.59**
(F)	Complexity (MLU)	-.10	.54**	.59**	.62**	-.20
(F)	Complexity (verbs)	-.19	.51*	.53**	.56**	-.12
(F)	Quality (VOCD)	.24	.17	.11	.23	-.01
(F)	Describing the picture	.38	.27	.37	.36	-.60**
(F)	Extending the topic	.29	-.02	.08	.17	-.10
(F)	Behavioural directives	-.12	-.42	-.27	-.20	.13
(F)	Comments	.43	-.46*	-.20	-.32	-.05
(F)	Conversational utterances	.42	.10	.32	.27	-.60**

Note. (C) = Child language; (F) = Father language; * p < .01; ** p < .05; All correlations control for child verbal ability.

Table 7.3

Bivariate Correlations Between Fathers' and Children's Language During Wordless Shared Book Reading.

		(C) Quantity	(C) Complexity (MLU)	(C) Complexity (verbs)	(C) Complexity (simple sentence)	(C) Quality (TTR)
(F)	Quantity	.78**	-.20	-.09	-.05	-.52*
(F)	Complexity (MLU)	-.19	-.31	-.41	-.40	.45*
(F)	Complexity (verbs)	-.10	-.53*	-.33	-.43	.21
(F)	Quality (VOCD)	.30	-.20	-.03	-.13	-.11
(F)	Describing the picture	.61**	-.23	-.17	-.15	-.40
(F)	Extending the topic	.53*	-.28	-.47*	-.28	-.13
(F)	Behavioural directives	.27	.01	.28	.26	-.17

(F)	Comments	.39	-.10	.20	.20	-.41
(F)	Conversational utterances	.72**	.11	.11	.23	-.60**

Note. (C) = Child language; (F) = Father language; * p < .01; ** p < .05; All correlations control for child verbal ability.

Discussion

SBR is a valuable parent-child activity with important implications for child language development (Noble et al., 2019). However, children’s books differ in textual, pictorial, and stylistic properties and this raises the question of how choice of book type may influence parents’ and children’s language as they interact with its narrative. Accordingly, the present study aimed to explore variation in fathers’ and children’s language quantity, complexity, and quality, as well as function of fathers’ language, during SBR with two different book types, namely text-based and wordless picture books. The study further explored associations between fathers’ language and children’s language during SBR with both text-based and wordless picture books.

Father and Child Language during Text-Based vs Wordless Picture Book Reading

Findings suggest that fathers in the text-based picture book condition produced significantly greater language quality but not quantity or complexity than fathers in the wordless picture book condition thereby lending partial support to hypothesis 1a. The higher quality of fathers’ language while reading text-based picture books accords with prior research. For instance, text-based children’s books are reported to contain more unique word types (Montag et al., 2015) which may have primed fathers to also produce more diverse extra-textual talk in this study.

It is noteworthy that there were no significant differences in terms of fathers’ language complexity across both groups. Existing evidence suggests that parents tend to produce more complex sentences (Cameron-Faulkner & Noble, 2013; Montag, 2019) and more verb types (Demir-Lira et al., 2019) during text-based SBR than they do in other types of parent-child interactions (Holme et al., 2022). While findings of the present study suggest that both text-based and wordless picture books elicit similar language complexity from fathers and may represent a strategic means of promoting children's syntactic development and vocabulary growth, this result may also be attributed to the high level of education of fathers in this study. Future studies inclusive of additional paternal CDS outside of SBR episodes can confirm whether fathers also produce more complex talk during wordless picture book shared reading, akin to their language during text-based shared reading (e.g., Cameron-Faulkner & Noble, 2013; Demir-Lira et al., 2019; Holme et al., 2022; Montag, 2019).

Similarly, there were no significant differences in terms of quantities of extra textual speech during text-based and wordless picture book SBR episodes. This finding deviates from evidence which suggests that wordless picture books are more likely to elicit greater participation from readers and arguably higher language input (Beckett, 2012; Nikolajeva & Scott, 2001; Ramos & Ramos, 2012). One possibility is that wordless picture books facilitate greater quantities of caregiver speech insofar as caregivers engage in didactic reading styles which may not necessarily have been the case in this study. Alternatively, lower quantities of caregiver language may correspond to higher quantities of child language. Perhaps fathers were in fact engaging in didactic reading by inviting children to verbally contribute to the reading interaction.

Analyses of the function of fathers' language indicate that fathers in the wordless picture book condition produced more labels and descriptive utterances, and more conversational utterances whereas fathers in the text-based condition tended to extend the topic more. These findings contrast existing research which suggests that mothers tend to engage in more decontextualised talk, and therefore extend the topic more, during storytelling, rather than story reading (e.g., Curenton et al., 2008). It is possible that there may be stylistic differences between maternal and paternal reading styles and future research is encouraged to examine narrative properties of SBR with both mothers and fathers. Alternatively, the theme of each book may have influenced the type of utterances produced by fathers. That is, the text-based book revolved around each month of the year, readily prompting utterances that extended the topic such as remembering birthdays and reminiscing about festive traditions (e.g., pumpkin carving for Halloween in October).

It is noteworthy that fathers produced similar numbers of behavioural directives and comments in both groups suggesting that these types of utterances may not necessarily relate to book style. Such talk may in fact represent parents' tendency to manage child behaviour (e.g., behavioural directives such as 'sit down') and praise children (e.g., comments such as 'good job') in general.

With regards to children's language, findings indicate that children in the wordless picture book condition produced significantly greater quantities of language than children in the text-based condition. Similar findings have been observed during SBR with wordless picture books among teachers and four-year-old children (Chaparro-Moreno et al., 2017). Compared to text-based SBR, teachers more often prompted children's participation via questions and feedback loops during wordless picture book SBR which resulted in greater verbalisation from children (Chaparro-Moreno et al., 2017). Collectively these findings lend support to claims that wordless picture books can facilitate children's participation in co-constructing meaning and therefore foster higher quantities of child language production (e.g., Graham, 1998; Nikolajeva & Scott, 2001; Nodelman, 1988).

In terms of children's language complexity, although children in the text-based condition were expected to outperform children in the wordless picture book condition (e.g., Cameron-Faulkner & Noble, 2013; Huttenlocher et al., 2002; Montag & MacDonald, 2015), there were no significant group differences observed. One potential explanation may be that children in this study were too young to have acquired adequate syntactic skills. Children typically do not successfully master the grammar and syntax of their language until the age of five years (Hoff, 2009). Therefore, it may be useful to examine how variation in book properties may influence associations between paternal language and child language complexity among older children, particularly as they approach school age.

Children's language quality was significantly greater in the text-based picture book condition which aligns with prior suggestions that text-based books contain and elicit more unique word types and more illustrations of those word types compared to other CDS (Massaro, 2015; Montag et al., 2015). Thus, these findings suggest that during toddlerhood, text-based picture books can play an important role in introducing novel words and promoting child vocabulary growth.

Links between Father and Child Language during Text-Based and Wordless Picture Book Reading

The present study further hypothesised that the quantity, complexity, quality, and function of fathers' language would positively relate to children's language quantity, complexity, and quality. Fathers' quantity of language was positively linked with children's quantity of language in both conditions thereby lending some support to the second hypothesis. Given the cross-sectional design of the study, it can only be inferred that SBR with both types of books provides a platform wherein both children and fathers mutually elicit each other's verbal contribution to the interaction. This finding may also reflect an interactional synchrony between father and child akin to that observed in mother-child dialogue (e.g., Dale & Spivey, 2006; del Prado Martín et al., 2020).

Surprisingly, fathers' language quantity was negatively linked with children's language quality in both groups. Thus, fathers of children who exhibited smaller vocabularies during the SBR episode produced greater quantities of speech. Although the cross-sectional and correlational design does not permit causal inference, it is possible that fathers produced more speech in response to their children's vocabulary knowledge as a means of providing children with opportunities to hear and acquire new words.

Fathers' language complexity (MLU and verbs) was positively linked with children's language complexity (MLU, verbs, and sentence complexity) in the text-based book condition. This finding accords with claims that children who are exposed to more complex sentences tend to exhibit greater comprehension and production of such sentences (Huttenlocher et al., 2002; Montag & MacDonald, 2015). Thus, it appears that SBR with text-based books which contain both illustrations and written text may provide a means through which children may begin acquiring syntactic skills.

In contrast, in the wordless picture book condition, fathers' complexity in terms of verbs per utterance was negatively linked with children's MLU. This finding is unexpected as parental verbal diversity is a known predictor of children's syntactic and grammatical development (Hsu et al., 2017). It is possible, although speculative, that fathers may have been producing greater verb diversity, and therefore modelling greater syntactic diversity, to promote their child's developing language skills. This type of fine-tuning mechanism has elsewhere been demonstrated among two- to five-year old children and their caregivers (e.g., Fusaroli et al., 2021) and is directly grounded in the fine-tuning hypothesis (Snow, 1989). Future studies can further clarify such a possible mechanism by employing longitudinal designs and assessing father-child reading behaviours at regular intervals over time.

Finally, fathers' language quality was not significantly linked with child language outcomes in either condition. This finding diverges from existing evidence which suggests that both teachers and children display greater lexical diversity during wordless picture book episodes (Chaparro-Moreno et al., 2017). Similarly, text-based books are known to readily allow parents to gesture towards, and label written words thereby positively contributing to vocabulary development (Tomasello & Todd, 1983). It is possible that the small sample size in the present study may have limited the study's power to detect an association between father language quality and child language outcomes.

Fathers' language function similarly displayed differential associations with child language outcomes. Describing and labelling pictures was negatively linked with child language quality in the text-based condition. Given that father and child language was measured in real time, it is possible that fathers were fine-tuning their language and producing more descriptive utterances as a means to promote their child's vocabulary growth. This conjecture is consistent with the finding that fathers in the text-based book condition displayed more diverse vocabularies than fathers in the wordless picture book condition and further suggests that while exposing children to a rich vocabulary may be beneficial, the manner in which such a vocabulary is presented (e.g., labelling, describing) during shared reading episodes may play a more important role.

In the wordless picture book condition however, describing was positively linked with child language quantity, suggesting that this type of talk may represent a means of inviting children to contribute to the SBR interaction. It is likely that in the absence of text children may undertake a more active role in co-constructing meaning rather than relying on their father to interpret written material.

It is noteworthy that although fathers in the text-based condition extended the topic more, these types of utterances were not significantly linked with any child outcomes in the respective condition. These findings align with recent data which similarly found no evidence for an association between parents' abstract language and preschool children's vocabulary (Muhinyi & Rowland, 2023). As the authors suggested, and consistent with the fine-tuning hypothesis, this type of language may benefit child language insofar as it aligns with children's concurrent language skills. Thus, future experimental studies may manipulate the complexity of parental abstract and decontextualised language to further explore how this type of talk relates to child language.

In contrast, extending the topic was positively linked with child language quantity in the wordless picture book condition. Extending a topic may take different forms, ranging from asking questions about the past which necessitate a child response, to inferential utterances which may not necessarily evoke a child verbalisation. Thus, future research could usefully examine variation in how different books may facilitate different topic-extending utterances and how these may relate to child outcomes.

Extending the topic in the wordless picture book condition was also negatively related to child language complexity in terms of verbs. Although unexpected, this finding may similarly suggest a linguistic alignment process at work. That is, extending a topic evokes abstract, frequently decontextualised language from speakers which entails switching between tenses and hypotheticals and is therefore syntactically more complex (Curenton et al., 2008; Demir et al., 2015). Thus, fathers may have been using opportunities to extend the topic as a strategy to demonstrate and promote their child's verb language complexity.

Fathers' use of behavioural directives did not significantly relate with any child language outcomes in either condition. Given that imperatives tend to be brief and contain little new information (e.g., Hoff, 2009) they may not necessarily promote children's language development. This finding accords with extant research which similarly found no significant relations between directive speech such as parental use of imperatives (e.g., *let it go; don't touch that*) which serves the function of guiding, prohibiting, or controlling a child's and child language development (e.g., Hoff-Ginsberg, 1985).

Fathers' use of comments was negatively linked with child language complexity in terms of MLU in the text-based condition only. This negative association may be attributed to the length of paternal comments, which were generally one-to-three-word utterances, frequently followed by child repetitions of those utterances, thereby corresponding to shorter MLUs.

Finally conversational utterances were negatively linked with child language quality in both groups. This finding is unexpected as conversational utterances included clarification requests and *wh*-questions which are a known strategy of promoting child language development especially among fathers (e.g., Leech et al, 2013). However, the direction of effects in the present study is unknown, and thus it remains possible that fathers were increasing their conversational utterances as a function of their child's growing vocabulary. Future research may examine whether such linguistic alignment occurs during SBR, and how it relates to child language growth by employing longitudinal designs.

Overall, findings suggest that SBR with both text-based and wordless picture books can influence child language outcomes, albeit by eliciting and targeting different aspects of language. In this study, aspects of paternal language more frequently related to child language complexity during the text-based condition, whereas during the wordless picture book condition fathers' language more often related to child language quantity. These findings attest to the importance of exposing children to variety of book genres (e.g., Poppas, 2006), as each may confer unique and distinct benefits on children's language growth.

Limitations

The findings of this study must be interpreted with reference to several limitations. First, participants in this study were well educated which limits the extent to which these findings may generalise to less educated, lower income families. This may partially explain the positive relations between father and child language of medium to large effect size in both text-based and wordless picture book SBR episodes. Thus, a future research avenue would be to explore paternal and child language performance in less educated, and even illiterate communities wherein book type may differentially elicit parent and child language.

Second, the sample size in this study was relatively small, thus, any observed effects must be interpreted with caution. However, the small sample size permitted in-depth analysis of the type of utterances that fathers produced during SBR with and without text. Nevertheless, a useful future exercise would be to explore variation in father and child behaviour within larger sample sizes which would also allow for the adjustment of other relevant variables. For example, fathers' education, socioeconomic status, verbal IQ, and children's IQ may also be important covariates of the observed findings in this study. This study also did not control for children's general language abilities and the possibility that fathers were responding to their child's linguistic competence cannot be eliminated. Similarly, a larger variety of books may allow for more insightful findings. For instance, the wordless picture book used in this study represented jungle animals and may have posed constraints on the extent to which both fathers and children could produce lexically diverse speech. It is likely that illustrations of more complex concepts may yield different results.

Third, the study used a between-subjects design and hence the possibility that individual differences may have influenced the observed associations cannot be eliminated. Future studies focusing on SBR with varied books should employ within-subjects designs to offset this limitation. Further, to strengthen the claim that SBR is a strategic practice for promoting diverse aspects of child language, future studies should include additional measures of non-book related CDS to allow for comparative analyses.

Fourth, although this study focuses on toddlerhood which is a critical period of rapid language development, a more comprehensive understanding of how textual differences across children's books influence child language prior to school entrance would require the inclusion of participants with a wider age range. It is likely that wordless picture books may favour SBR interactions with infants while text-based books may be more beneficial during the preschool year(s). Exploring SBR with children of various ages may allow researchers to identify the developmental stage during which children may transition from benefitting from certain types of books over others, and therefore when parents should introduce novel books to the SBR interaction.

Fifth, while this study suggests that SBR with fathers is an important experience of toddlerhood with positive implications for children's language, the omission of mothers did not allow for comparative analyses. Thus, an important future step would be to compare mothers' and fathers' speech during SBR with text-based and wordless picture books to allow similarities or differences between maternal and paternal reading styles to emerge.

Conclusion

Despite limitations, the study suggests that like mothers, fathers may also influence children's linguistic performance during episodes of SBR. In this study, the text-based picture book elicited greater paternal language quality, more language that extended the topic, and more conversational utterances. In contrast, the wordless picture book elicited more labelling and descriptive utterances. Thus, different book types may be useful in eliciting distinct aspects of paternal language input during father-child interaction. This is a promising finding given recent evidence that, compared to mothers, fathers of two- to six-year-old children produced shorter utterances, less focused speech and were overall less talkative (Kokkinaki, 2019). The study further found that children's language quantity was greater in the wordless picture book condition whereas their language quality was greater in the text-based condition. Moreover, fathers' language with both book types showed differential links with children's language quantity, complexity, and quality. It is therefore possible that variation in book content may encourage different types of learning with distinct effects on different domains of child language. Should future studies confirm such differential associations, findings may be used to inform interventions with the aim of promoting children's books that are tailored to language areas of interest.

Chapter 7

General Discussion

The transition to formal education is a pivotal milestone in a child's life. The foundation laid during these early years significantly influences a child's academic success and overall wellbeing throughout their academic career and beyond. Children who adapt well to their educational environment and who can engage with, and learn from, the school curriculum tend to excel throughout their academic careers, experience better employment prospects in adulthood and display better mental and physical health later in life (Brooks-Gunn, 2003; Reynolds, 2010). Conversely, children who struggle at the beginning of school tend to perform worse academically and this achievement gap persists throughout the school years. Therefore, ensuring that children possess the necessary skills to learn and perform well early in their academic journeys has become a prime goal for policymakers, researchers, educators, and caregivers alike.

While child development is influenced by an array of factors, during the formative years prior to school entry parents tend to exert the strongest and most enduring influence. Their role in providing the optimal balance of challenge and support as well as cognitively stimulating home environments that afford learning opportunities is instrumental for a child's school readiness and their scope to thrive both socially and academically. In this context, parents emerge as essential partners in ensuring that children transition into school poised to succeed.

The course of action therefore seems clear: parents should be encouraged to engage in the types of parenting practices that are conducive to school readiness and early academic achievement. However, there are several conceptual and methodological considerations that render this exercise more challenging than it appears. First, there is no agreed upon definition of school readiness and hence the types of child skills that should be prioritised are under debate. Teachers argue that social skills are most important as these allow children to behave adequately in a school environment, interact appropriately with educators and peers and ultimately to engage with learning material (Rimm-Kaufman, 2004). Parents, on the other hand, tend to emphasise cognitive skills such as literacy and numeracy on the premise that learning is cumulative; children depend on foundational competencies to learn and acquire more complex skills (Rimm-Kaufman, 2004). Yet the types of skills that are used to ascertain a child's school readiness bear implications for their academic experience as these can not only label a child as above or below average, but also dictate where program application, intervention implementation and funding allocation is required.

In addition to *what* outcomes are assessed, *how* these outcomes are measured must also be considered. Child school readiness can only be promoted insofar as all parties involved in a child's education are included in research efforts. Empirical studies on school readiness and early achievement must include information from a variety of measures ranging from parent and teacher report, each of whom can provide unique and valuable information about a child's functioning across time and contexts, to direct assessment and child performance which produce comparative data.

Given the importance of school readiness and early academic performance, coupled with the persistent challenge of how best to operationalise and subsequently foster it, the present thesis aimed to contribute to, and advance, the early childhood education research field through a number of aims. First, a systematic review of the current research base on parenting practices and child school readiness was undertaken which allowed for (1) a synthesis of how school readiness has been operationalised and assessed within the field, and (2) an understanding of the types of parenting practices that have demonstrated a longitudinal association with early child academic performance. Second, based on findings of the systematic review a series of individual studies were undertaken to examine how aspects of parent-child interaction that have been less studied throughout the literature (e.g., the use of abstract language, linguistic alignment), in addition to the HLE, relate longitudinally to indices of child school readiness.

The current chapter therefore first summarises and discusses findings of the systematic review conducted. Next, studies which examined aspects of parent-child interaction and child early academic performance (direct mechanisms of parenting influence), followed by studies which explored links between the HLE and child school readiness and early academic performance (indirect mechanisms of influence) are discussed. Finally, the chapter discusses the theoretical and practical implications of the findings presented in this thesis.

Summary of Findings

Findings of the systematic review, which included 79 studies, revealed that children's school readiness is primarily measured in terms of child language, literacy, numeracy, cognition, socioemotional and behavioural competence and by global measures of school readiness. These findings suggest that despite discrepancies in outcomes considered most relevant for early educational achievement by parents and teachers, both academic and non-academic competencies emerge as important for child school readiness.

Findings of the review indicated that a smaller proportion of studies also examined children's mastery motivation, task orientation and persistence, approaches to learning, preacademic work habits, experience of loneliness and even daily living skills as indices of school readiness. Arguably, children who demonstrate flexibility and easily adapt to novel tasks and environments, who are self-motivated and independent, are likely to better assimilate new information, agreeably engage with peers, elicit positive feedback from teachers and consequently enter a perpetuating cycle of academic success. Therefore, in addition to highlighting children's cognitive and social skills, future studies should expand the range of outcomes to be evaluated as reflective of school readiness.

The review further indicated that parental influence on child school readiness occurs either directly via parent-child interaction or indirectly through the HLE and involvement in early childhood education. The most commonly studied aspect of parent-child interaction in relation to school readiness was parental sensitivity such as responsiveness, supportiveness and attachment, followed by cognitive stimulation such as language use, joint attention and scaffolding, while a smaller proportion of studies studied a combination of both.

The largest proportion of studies in the review focused on the HLE which was primarily organised in terms of literacy and numeracy and shared reading activities and only 2.5% of studies examined parent involvement in ECE such as parent-teacher communication and volunteering in the Head Start Program. It is noteworthy that for each parenting practice examined, studies produced mixed findings with some reporting significant associations while others were not significantly related with child outcomes. Therefore, while there has been a wealth of research with parents and children on school readiness, there are still gaps in our understanding of the links between early parenting practices and later academic performance and therefore scope for continued research efforts.

Moreover, although parental child-directed speech is one of the most studied aspects of parent-child interaction, there has been little research attention focused on truly interactive linguistic features. Accordingly, this thesis examined how aspects of parent-child interaction, which are theoretically important for child academic success but have been empirically studied less often, relate to child competencies that are reflective of early academic performance. Specifically, the thesis examined how linguistic alignment, an interlocutor's tendency to adjust their language structures to mirror those of their conversational partner's, is associated with child language skills. The thesis further examined how the use of decontextualised language (i.e., abstract talk that challenges children as it extends beyond the immediate observable environment) relates to child literacy and numeracy skills. Next the thesis explored how semantically contingent conversational turn-taking, behaviour that is responsive and dependent on child participation in interaction, is associated with child cognitive and socioemotional competencies.

In addition to interactive behaviours, based on the nationally representative GUI cohort data, the thesis examined how formal and informal HLE activities predict child language, literacy, numeracy, and socioemotional skills. Moreover, given the lower paternal compared to maternal representation in the child development research field, the thesis further examined linguistic patterns during father-child shared book reading, established as an important element of the HLE, and how these patterns relate to child language performance in real time.

Parent-Child Interaction and Child Early Academic Performance

Developmental psychology has long emphasised the role of social interaction to child development (Vygotsky, 1978). Learning and development stem from opportunities to act on, or rather interact with, the surrounding environment. A comprehensive understanding of how early parent-child interaction relates to child academic performance must therefore include not just parenting behaviour in isolation but acknowledge parent-child social dynamics and the influence that children's own behaviour and individual differences bring to the process of parenting.

Child Language Development

Considering the role that social reciprocity plays in child development, Study 1 in Chapter 5 went beyond examining the type of language that parents use in interaction with children, and explored how both parents and children align linguistically with each other (i.e., re-use and/or expand upon each others' utterances and sentence structures) during toddlerhood and preschool years. The study subsequently examined how this alignment between parents and children relates to child language in middle childhood. Findings indicated that both mothers and fathers aligned with children to a similar extent. These results tentatively suggest that both parents can display linguistic sensitivity (i.e., by re-using a child's language a caregiver is necessarily responding contingently) and cognitive stimulation (i.e., caregivers can introduce novel words in similar sentence structures which in turn offers children opportunities to infer word meanings) and hence that both mothers and fathers can fine-tune their language to complement their children's evolving language skills.

The study also found that children aligned their language to that of their mothers and fathers in similar proportions. It therefore appears that both mothers and fathers can co-create interactional synchrony with their child. As such, these observations lend themselves to the growing evidence base which highlights more similar than different parent-child processes between mothers and fathers (Rowe et al., 2004).

Longitudinally, linguistic alignment was dynamically linked with child outcomes.

For instance, only child semantic alignment with fathers, but not mothers, during toddlerhood related positively with children's verbal comprehension in middle childhood. It therefore appears that responding to, and therefore maintaining conversation with, fathers is positively linked with children's later abilities to recognise similarities between concepts and their general knowledge.

By preschool years, paternal syntactic alignment was positively linked with children's language quality and complexity further highlighting the positive role that fathers play in children's language development. There was also some evidence to suggest that parents engaged in complementary alignment. Specifically, while paternal lexical alignment during preschool years was negatively linked with child spelling skills, maternal semantic alignment showed positive links with these child skills in middle childhood. This finding highlights the importance of studying child development in the context of the family unit. Complementary parenting cannot be captured by an exclusive focus on dyads and sources of influence on child development cannot be reduced to the sum of behaviours across familial dyads.

Not only parent, but also child, alignment in preschool years emerged as important for their language development. Specifically, children's lexical alignment with mothers during preschool years was positively linked with their language complexity in middle childhood. These findings are in concert with previous research which highlights the importance of repetition early in development (Conica et al., 2020; Che et al., 2018) and suggest that parents may be successfully modelling verbal behaviour (as indicated by child imitation, or repetition, of parental utterances) which in turn benefits children's language skills. Overall, these findings suggest that different child language outcomes may benefit from different types of alignment at different stages of development and that mothers and fathers may play unique roles in promoting these skills.

Child Literacy and Numeracy Skills

The benefits of parent linguistic behaviour extend beyond child language and appear to also promote child literacy and numeracy skills. Linguistic input assists children in constructing semiotic representations for both words and numerical symbols and math concepts. This process facilitates the association of novel information with prior mental representations and arguably fosters both literacy and numeracy development (Duval, 2006). One such relatively underexplored verbal mechanism that has been recently proposed as beneficial to child numeracy skills is decontextualised language.

Therefore, Study 2 in Chapter 5 examined maternal, paternal, and children's use of decontextualised language during toddlerhood and preschool years. The study further explored associations between the use of decontextualised language in toddlerhood and preschool years and children's literacy and numeracy skills in middle childhood. Findings indicated that maternal and child decontextualised language during toddlerhood related negatively to children's reading scores in middle childhood; however, their decontextualised language in preschool years showed positive links with children's reading scores in middle childhood. These findings suggest that the benefits of decontextualised language, an arguably challenging type of language for young children, may become apparent later in development.

Mothers', fathers', and children's decontextualised language during preschool years was also positively linked with child numeracy in middle childhood. Arguably the abstract nature of decontextualised language, akin to the use of symbols like "+", "-", "=", and variables (e.g., x, y) which represent mathematical operations and relationships in a way that is independent of any specific numbers or real-world situations, bears implications for children's numeracy development. The study therefore suggests that embedding decontextualised language in conversation with children may have positive domain-specific and cross-domain effects on children's literacy and numeracy performance.

Child Cognitive Skills

As indicated by the systematic review, diverse parenting behaviours, ranging from sensitivity to cognitive stimulation, play an important role in children's cognitive development. A somewhat less examined parent-child interactive behaviour that has recently been proposed as facilitative of cognitive development, specifically of EF, is contingent conversational turn-taking. Therefore, Study 3 in Chapter 5 examined how mother-father-child contingent turn-taking in toddlerhood and preschool years related to child executive functioning in middle childhood. The study found that mothers and fathers engaged in comparable proportions of conversational turns with their child and that children similarly engaged in commensurate levels of conversational turns with both parents. Considering the triadic context within which families were observed, these findings likely allude to the transactional nature of intra-familial relationships during which each member's behaviour is influenced by all other interactive partners. As a result of these proximal processes, participants may have been adjusting their behaviour to allow each member to equally respond and contribute to conversation to facilitate a balanced and synchronised interaction.

Longitudinally, mothers' and fathers' contingent turns during toddlerhood were negatively linked with child EF. One possible interpretation, and one that aligns with the recognition that parenting is not unidirectional but is in fact influenced by children's individual differences (Sameroff, 2009), is that parents were engaging in greater proportions of conversational turns in response to their child's developing cognitive competencies. During the first years of life children's EF undergoes rapid development (Diamond, 2020), and hence toddlerhood is an optimal period during which parents can shape these skills. This interpretation is particularly likely given that children's own opportunities to engage in contingent turns with fathers, but not mothers, during toddlerhood showed positive relations with their EF in middle childhood.

This unique effect observed with fathers but not mothers may reflect the systemic nature of families; it is possible that parents negotiate and assume distinct (but arguably complementary) roles during joint interaction with their child. Alternatively, contingent turn-taking with fathers may interact with additional paternal behaviours to influence EF development. Fathers are described as more challenging conversational partners than mothers, primarily due to their greater use of *wh*-questions (Rowe et al., 2017). This linguistic mechanism may mediate the association between turn-taking and child EF given that *wh*-questions require children to consider the query, retrieve relevant information and formulate a response. Future studies with sufficiently large sample sizes could address this hypothesis, as well as examine additional linguistic devices that may operate in concert with turn-taking to promote child EF.

Contrary to the study hypotheses, the study did not identify any significant links between conversational turns during preschool years and child EF in middle childhood. One possible explanation is that effect sizes for the link between turn-taking in preschool years and EF may have been smaller than those observed in toddlerhood and too small to be identified given the study sample size. A second potential explanation relates to the rapid expansion of child EF skills during the years preceding formal school; child EF may benefit from distinct parenting practices at different periods of development. Further, although EF develops from early infancy, and rapidly so until school entry, the rate at which each EF component develops tends to differ (Diamond, 2013), and hence the type of parenting that benefits each component may also differ across development.

Child Socioemotional Skills

Synchronous parent-child interactions which consist of back-and-forth exchanges characterised by contingent responsiveness and social reciprocity are also proposed as beneficial to children's socioemotional development (Harrist & Waugh, 2002; Feldman, 2007, 2012; Kochanska et al., 2008). A small evidence base shows that the frequency of conversational turns at 18 months (Gómez & Strasser, 2021) and semantic connectedness of turns at 2 years old (Ensor & Hughes, 2008) positively predict child socioemotional skills. Study 4 in Chapter 5 of the thesis similarly found that mothers', but not fathers', semantically connected turns during toddlerhood were associated with fewer teacher-reported socioemotional difficulties in middle childhood. Moreover, the study found that children's semantically connected turns with both mothers and fathers were associated with fewer parent-reported socioemotional difficulties.

These findings align with previous evidence which found that conversational turn-taking was linked with fewer child internalising and externalising difficulties (Bogels & Phares, 2008). Arguably, the fluency of turns requires children to inhibit disruptive tendencies, listen actively, consider another perspective, and allow interactional partners to finish speaking, all of which may in turn foster socioemotional development. Collectively, these findings attest to the importance of providing young children with opportunities to engage in meaningfully related conversation, which requires attention to social cues and impulse inhibition, as these may protect against socioemotional problems.

Contrary to expectations, mother-father-child semantically contingent turns in preschool years were not significantly linked with child socioemotional skills in middle childhood. It is possible that semantic connectedness may play a stronger role against socioemotional difficulties during toddlerhood, as children tend to experience a sharp increase in externalising behaviour from the ages 12 to 24 months, following which this behaviour subsides (Alink et al., 2006; Tremblay et al., 2004). It is therefore likely that semantically connected turns during preschool could benefit alternative socioemotional outcomes, and this hypothesis represents a promising avenue for future investigation.

Collectively the findings discussed above converge on three conclusions. First, 'parenting' does not entail just the parent, but is in fact a transactional process that consists of a synergy between all members of an interaction, including the second parent and most importantly the child. Aspects of parent-child interaction are conducive to positive child outcomes insofar as behaviours are attuned to children's developmental needs. In other words, proximal processes must operate within children's ZPD (e.g., the possibility that parents were increasing contingent turns in response to child EF in Study 3 Chapter 5). Moreover, given the systemic nature of families, child development may benefit most when mothers and fathers coordinate and complement each other's behaviour to ensure children are not over- or under-stimulated (e.g., the likelihood that parents were engaging in complementary linguistic alignment in Study 1 Chapter 5).

Second, child development is complex and dynamic, and their skills and competencies may benefit from different aspects of parent-child interaction throughout development. The acquisition of more refined, sophisticated competencies must be accompanied by adjustments in parenting practices that result in "progressively more complex" interactions (Bronfenbrenner & Morris, 1998, p.996). Although the studies presented in this thesis thus far are based on a small sample size and correlational designs, they provide incentive for future research to examine whether specific parenting behaviours are more or less influential at different times of development (e.g., associations between contingent turn-taking in toddlerhood but not preschool years with child socioemotional skills in middle childhood in Study 4 Chapter 5). Such an exercise bears promising implications for the development of targeted, effective interventions.

Third, with equal relevance to the development of interventions, aspects of parent-child interaction do not only exert domain-specific effects but rather cross-domain, cascading effects on a range of child outcomes. For instance, decontextualised language which has been previously linked to child language was found to also relate to child literacy and numeracy in the present thesis. Similarly, the contingency of parent-child conversational turns was found to relate to both child EF and socioemotional skills. These findings warrant further inquiry into associations between parenting practices and additional child outcomes as they offer potential for the development of cost-effective interventions which bear implications for children's early school performance, and later academic achievement, sociodemographic and health outcomes.

The Home Learning Environment and Child School Readiness and Early Academic Performance

One of the most exhaustively researched parenting practices with a strong influence on child academic performance is the HLE. Empirical and intervention studies consistently and convincingly highlight the positive impact of providing children with learning opportunities via educational materials (e.g., books, toys) and cognitively stimulating activities (e.g., shared reading, library visits; Fanti & Henrich, 2010; McCarty et al., 2005; Melhuish et al., 2008). Therefore, Study 1 in Chapter 6 in the current thesis aimed to examine how the formal and informal home literacy and home numeracy environments at three-years-old related to child academic and social outcomes at five and nine years old. Findings indicated that only the informal home literacy and numeracy environments demonstrated significant domain-specific and cross-domain associations with child language and numeracy, but not socioemotional skills. The null effects observed for the formal learning environments, and for child socioemotional outcomes are likely attributable to methodological limitations such as the operationalisation of the HLE construct (e.g., a single item to represent the formal numeracy environment) and ceiling effects associated with teacher report of child social skills.

While future studies with more comprehensive HLE measures can provide useful information regarding the influence of formal learning activities on child school readiness and early performance, this study is nevertheless significant to the parenting and child education field. First, it suggests that informal, entertaining, cognitively stimulating activities that do not actively focus on teaching can benefit children's academic outcomes. These findings are promising in relation to the Family Investment Model (Haveman & Wolfe, 1995) especially in the context of low SES wherein parents must frequently prioritise alternative responsibilities at the expense of quality time with children. Findings of this study would suggest that parents can provide a cognitively stimulating environment for their children by engaging them in informal, routine activities, such as cooking. Moreover, given that both domain-specific and cross-domain associations were identified, this study bears implications for the development of cost-effective interventions which have the potential to influence multiple child outcomes.

Just as the HLE has been widely researched, so too has the practice of shared book reading. The importance of not only exposing children to a wide range of books but also engaging them with reading material (e.g., dialogic reading) has been firmly established (Mol et al., 2008). However, while the types of interactive behaviours that benefit child outcomes have been scrutinised, comparatively fewer studies have examined how textual and illustrative book characteristics may elicit specific behaviours. There is evidence that children should be exposed to a "varied diet" of book genre, as different book types may benefit distinct child skills (Pappas, 2006). Moreover, while studies increasingly include both mothers and fathers in research with children, most insight pertaining to the benefits of this activity stem from observations of mother-child reading interactions. However, it should not be assumed that fathers are replicas of mothers and that they engage in similar reading patterns, or that their shared-reading behaviour relates to child outcomes in similar ways to that of mothers.

Accordingly, the final study of the present thesis first explored variation in father and their three-year-old child's language quantity, quality, and complexity during SBR with text-based and wordless picture books. Second, it explored variation in the function of fathers' language (e.g., describing illustrations, extending the topic, behavioural directives) during SBR with text-based and wordless picture books. Finally, it explored associations between fathers' language and children's language during SBR with text-based and wordless picture books. Findings indicated that paternal language performance differed across book conditions. Fathers produced greater language quality, more language that extended the topic, and more conversational utterances during the text-based reading episode. However, they produced more labelling and more descriptive language during the wordless picture book reading episode. Results also showed that children produced more speech during the wordless picture book episode and more diverse speech during the text-based condition. Interestingly, paternal language during both conditions was differentially associated with child language in real time suggesting that variation in book content may influence distinct child language outcomes. These findings bear significance for speech and language therapists, early childhood educators, caregivers, and targeted interventions.

Overall, our findings with regards to the HLE and child school readiness are promising. First, they highlight that immersing children in a cognitively stimulating environment does not necessarily have to be a financial burden. Informally challenging children to engage in numeracy (e.g., measuring ingredients while cooking, counting tiles on pavements while walking) and literacy (e.g., singing songs, rhymes) activities appears to be a cost-effective and successful means of promoting child school performance. Second, just like mothers, fathers can influence children's linguistic performance during shared reading and do so in diverse ways depending on the type of book they use. Fathers should therefore be encouraged to frequently engage in this activity as children are likely to experience additive benefits when both mothers and fathers are actively involved in their early learning environments.

Strengths of The Present Thesis

The present research features several important strengths. First, the study examined the role that not only mothers, but also fathers, play in preparing their child for formal education. With the continuously changing societal trends in terms of caregiving roles and increased paternal involvement in children's lives, it is imperative that research efforts keep up and include both fathers and mothers in studies of child developmental trajectories. Studies that have included fathers demonstrate that they can be as responsible, engaging, and sensitive as mothers, and just like mothers they can positively influence child development (Cabrera et al., 2007; Grossman et al., 2002). While the research base inclusive of fathers is growing, most studies tend to compare maternal and paternal behaviour during dyadic interactions with their child. This approach, while informative in some ways, neglects the systemic nature of families. Mother-child, father-child and mother-father relationships dynamically and transactionally influence each other. Examining how parents and children interact during triadic interaction in the present thesis therefore allowed for ecologically valid, naturalistic processes that occur between mothers, fathers, and children to emerge.

Second, the study employed a longitudinal, three-wave design. Tracking child development over time can provide important information about inter- and intra-individual variability in child skills and identify critical periods during which specific competencies emerge and therefore are most susceptible to environmental influence. Further, this type of study design identifies precursors of child outcomes and is therefore invaluable for the development of interventions aimed at promoting children's school readiness and early academic performance. In addition to determining precursors, longitudinal data facilitates the examination of mechanisms that underlie child development as well as associations between domains of development over time (Grammer et al., 2013).

Third, the study employed triangulation with regards to data collection and included observation, direct assessment, child performance, and parent and teacher report. Child development is multifaceted and dynamic and therefore the use of different measures allows for the identification of change over time within different domains of development across changing contexts. For instance, while directly assessed and performance-based measures provide the most objective data, only parents and teachers can report upon child behaviour along extended periods of time and across different environments thereby increasing the ecological validity of studies. Despite concerns associated with parent and teacher report, given that these were supplemented with additional assessments, measurement bias was reduced in this thesis and therefore phenomena under interest were likely objectively and accurately represented.

Fourth, the thesis includes analysis of representative, national cohort data. The large sample size of the GUI study included in this thesis allowed for the simultaneous analysis of multiple dependent and independent variables and for the testing of interrelationships among variables through structural equation modelling (SEM). Compared to alternative statistical approaches, SEM explicitly assesses, and accounts for, error variance parameters for both dependent and independent variables (Fan et al., 2016). Moreover, it allows for the identification of latent variables from observed variables which may otherwise go undetected. Further, SEM allowed for the testing of theoretical models against real world data and subsequent evaluation of the goodness-of-fit of models for the data. Crucially, analyses performed on the GUI data in this study addressed missing data via Full Information Maximum Likelihood (FIML) estimation, which is considered superior to listwise, pairwise or multiple imputation given that it uses all possible data points, “with all patterns subsequently being analysed into a multiple group design with appropriate constraints across groups” (Novikova et al., 2013, p.132). Accordingly, findings observed allowed for strong and convincing conclusions regarding the influence of the HLE on children’s language, literacy, numeracy, and socioemotional development.

Limitations and Future Directions

Notwithstanding the contributions of the present thesis to the parenting and child school performance research field, several limitations must be addressed. First, the studies based on primary data analysis were conducted in a laboratory environment with which families were at first not familiar. Accordingly, any behaviours observed may have been influenced by this novel context thereby threatening the ecological validity of the studies. Further, although considered sufficient (Kemppinen et al., 2005), observations of parent-child interactions were brief and may not have captured variation in proximal processes between parents and children that may occur over longer periods of time. Nevertheless, laboratory based observational methods of similar durations are commonly utilised in developmental research and have been demonstrated to facilitate detailed analysis of parent and child behaviours (Bingham et al., 2013).

Second, the studies based on primary data collection had low statistical power which poses several implications for the results observed and their interpretation. First, in the context of low power the likelihood of detecting a true effect, if it exists, is reduced. Therefore, even if there were real effects in the population, the studies in the present thesis may not have had sufficient sensitivity to identify them as statistically significant. Consequently the risk of making a Type II error was increased in the studies, namely failing to reject a false null hypothesis. It should therefore be emphasised that lack of statistical significance does not necessarily imply the absence of an effect and future research is encouraged to examine the effect of the maternal and paternal parenting practices outlined in this thesis on child school readiness and early academic performance within better powered studies. A further implication of low study power pertains to replicability of results. That is, low-powered studies tend to yield more variable results and this variability may be due to random sampling fluctuation rather than to meaningful group differences. Finally, non-significant results from low-powered studies may limit the generalisability of findings. Considering the lack of ability to detect effects in the population, it should be noted that findings may not be representative, and conclusions drawn from the present studies may not apply broadly.

In addition, while the findings based on the GUI data are representative of the Irish population, the generalisability of the findings from the primary data analysis studies is further restricted by the homogenous sample size. That is, participants were White, well educated, heterosexual and primarily in full time employment. It is likely that findings may differ in studies based on data collected in less socioeconomically advantaged populations and across different ethnicities and cultures. Therefore, future studies inclusive of more diverse samples are needed to increase the generalisability of findings.

Relatedly, families included in this research participated voluntarily. It has been recently demonstrated that self-selected participants display inherent biases in certain traits and characteristics (Yu et al., 2020) which further restricts the extent to which findings may generalise to the wider population. Nevertheless, self-selection is a conventional recruitment technique regarded as effective especially in research with child participants.

Additionally, owing to the small sample size, the sophistication of analyses was restricted as was the inclusion of other relevant covariates. While in the present thesis the large attrition rates are arguably due to the Covid-19 pandemic, future research with multiple waves of data collection and preferably conducted at more regular intervals can employ more robust statistical methods, such as latent growth curve modelling, to elucidate mechanisms of parenting influence and trajectories of child school readiness development.

Finally, the present thesis examined child school performance in terms of outcomes that have been most frequently assessed, and therefore perceived as most relevant, by the research literature. Yet as previously stated, it is possible that certain domains of development have been neglected by research focus, but they may nevertheless play a role in children's academic functioning. While literacy, numeracy and social skills are fundamental, so too may be a child's scientific, artistic, or even sporting inclination. If the school readiness literature is to advance, future research must adopt innovative approaches when conceptualising the construct.

Theoretical Implications

Findings of this study demonstrate the importance of recognising families as systems and understanding that child outcomes are rooted in the joint, interactive and complementary influence of interactions with mothers and fathers. While existing theory on mothering, and efforts towards developing theory on fathering have been invaluable, studying mother-child interaction in the absence of father-child interaction, and *vice versa*, can only provide a partial view of child development. As Minuchin (1985, p.2) stated, “if the individual is part of an organised family system, he or she is never truly independent and can only be understood in context”.

The shared influence of mothers and fathers on child development must further be considered in the context of Bronfenbrenner’s theoretical formula $\mathrm{D}_t = f_{(t-P)}\left(\mathrm{PE}_{(t-P)}\right)$ (Bronfenbrenner & Morris, 1998, 2006). That is, the study highlights that child outcomes (D) stem from processes (f), rather than static parent behaviours, that are co-constructed by both parents and children (P) during interactive episodes. Familial relationships are transactional, such that child characteristics, parent-child dynamics, and contextual factors (E) reciprocally influence each other over time (t). It follows that parenting is a process of continual fine-tuning considering that child attributes and behaviours likely elicit distinct parental behaviour as children acquire and develop new skills; the types of parenting practices that may benefit children earlier in development may differ from those that may play a more critical role later in development. Thus, findings of this study directly mirror Bronfenbrenner’s theoretical formula.

It must further be noted that these processes as examined in this study are reflective of WEIRD populations. To advance theory development there is a need for future studies to be conducted across different cultural contexts. Such an exercise can highlight how cultural norms and values influence parent child interaction, and consequently uncover culturally specific practices that promote or hinder school readiness. In addition to its influence on parent-child interaction, the role that culture plays in determining school readiness should also be considered. The types of attributes valued in individualistic compared to collectivistic cultures differs. Thus, a child who is self-sufficient, self-motivated, and competitive may be perceived differently by teachers and peers in distinct cultures, may elicit different feedback and therefore experience different outcomes. Therefore, prospective approaches to operationalising, assessing, and promoting school readiness may need to be multiple, tailored according to cultural variations and either conceptualised as falling along spectra or completely distinct.

Practical Implications

Findings of this thesis also present implications for early childhood interventions, parenthood education, and policy development. First, of all the factors that influence early child development the quality of parent-child interaction is most modifiable and hence amenable to change. It therefore represents an ideal target for early intervention with tremendous capacity to curtail the achievement gap, particularly among families at risk such as those living in low SES households.

Second, findings can be used to provide parents and caregivers with educational information, for instance via workshops, parenting apps and online resources. It is essential that parents recognise and accept school readiness and early academic achievement as a fundamental prerequisite for children’s continued academic performance and success later in life. Practitioners and early childhood educators must be aware that some parents may not be sufficiently versed with regards to the value of a positive early school start. Hence, there is scope for customised training and information meetings to examine school expectations and present the optimal evidence-based practices for child school readiness and early academic performance. These can help raise awareness and facilitate efforts towards preparing children for school. Increased parental education may also reduce parenting stress which can further lead to more positive parent-child interactions, and consequently better child preparedness for school.

Moreover, findings can be used in policy development to promote school readiness and positive school performance. There is a need for active dialogue between policymakers, who have the means to implement change, and parents, practitioners and researchers who can provide the information to facilitate that change. Policymakers must remain aware of the latest developments in the educational field, including but not limited to challenges associated with school readiness initiatives and family experiences. Parents, practitioners, and researchers on the other hand must produce rigorous, accessible, and meaningful data that can inform prospective policies.

The persistent achievement gap, in spite of government policies and school readiness initiatives, points to a need to maximise the impact of policies. There is a need for thorough re-examination of policy effectiveness and subsequently better monitoring of the extent to which they are implemented and yield success. The importance of rigorous policy evaluation is directly tied to the need for improved school readiness assessment strategies. At present stakeholders invested in a child's school readiness diverge in their opinions of what constitutes readiness for formal education. Yet findings of this thesis demonstrate that numerous outcomes are considered to be reflective of this construct within the existent research field. Herein lies the issue with assessing school readiness globally and arguably why such assessments tend to have limited predictive validity. Thus, a cornerstone for the assessment of policy impact on school readiness and early scholastic performance is the development of appropriate measurement instruments.

Ultimately, the primary goal of policies and educational programs is to foster positive and enduring outcomes for parents and children. Thus, funding and resource investment must be allocated for policy development, implementation, and evaluation. In addition, there is also a need for efforts towards creating successful partnerships between policymakers, families and communities such that they can combine efforts to prepare children for formal education. A positive start during the transition to school is essentially a determining factor in a child's future life circumstances, a community's future adult citizen and ultimately in social mobility. Thus, funding for intervention development and execution, program delivery and continuous effort to foster relations between all parties involved is by all means a profitable investment.

Conclusion

Parenting, child development and school readiness are complex constructs that are influenced by myriad factors, and vary across culture, context, and time. Providing a comprehensive overview of the parent-child processes that promote early academic achievement is therefore a challenging task. The present thesis found that engaging children in cognitively stimulating behaviours (e.g., using and eliciting decontextualised language), that are attuned to children's real time competencies (e.g., aligning linguistically), and contingent on, or responsive to, children's own behaviour (e.g., contingent turn-taking) can all influence child early academic performance. More importantly, findings suggest that teaching must not necessarily be a tedious task and that even entertaining activities, such playing board games and engaging in shared reading with a varied genre of books can positively influence children's school readiness and early academic performance. These promising results illustrate that the achievement gap is not inevitable. Designing cost-effective interventions is feasible, parenting practices are tractable, and their influence can extend to influence multiple domains of child development. Therefore, ensuring that all children arrive at school equipped to perform well is not only aspirational but possible.

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Appendix A

Ethical Approval at Waves 1 and 2

COLÁISTE NA TRÍONÓIDE, BAILE ÁTHA CLIATH | TRINITY COLLEGE DUBLIN
Ollscoil Átha Cliath | The University of Dublin

F.A.O. Dr Jean Quigley and Dr Elizabeth Nixon

School of Psychology Research Ethics Committee

17th September 2014

The School of Psychology Research Ethics Committee has reviewed your application entitled "Parent-child interaction and child development outcomes", and I am pleased to inform you that it was approved.

Yours sincerely,

Richard Carson
Chair,
School of Psychology Research Ethics Committee

SCHOOL OF PSYCHOLOGY
Arás an Phiarsaigh
Trinity College
Dublin 2

Scoil na Síceolaíochta
Dámh na nEolaíochtaí Sóisialta agus Daonna,
Áras an Phiarsaigh, Coláiste na Tríonóide,
Baile Átha Cliath 2, Éire

School of Psychology
Faculty of Arts, Humanities and Social Sciences,
Áras an Phiarsaigh, Trinity College,
Dublin 2, Ireland

T +353 (0)1 896 1886
F +353 (0)1 671 2006
psychology@tcd.ie
www.psychology.tcd.ie

Ethical Approval at Wave 3

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

16/03/2021

Study Title: Parent-Infant Interaction and Child Development

Dear Elizabeth

I have reviewed the Data Protection Impact Assessment ('DPIA') and supporting documentation (Information Sheet for Parents, Consent Form for Parents, Information Sheet for Teachers, Consent Form for Teachers) in respect of this research study and am satisfied that the intended processing of personal data for the purposes of the study as described therein is in compliance with data protection legislation, specifically the EU General Data Protection Regulation 2016 ('GDPR'), Data Protection Acts 1988-2018 and Health Research Regulations 2018.

Please note that the completion of a DPIA is not a one-time exercise, but a continual process. If at any stage there are changes to the processing envisaged by this assessment please contact me.

Be advised that the Trinity College Data Protection Office may carry out a review to assess if the processing is being performed in accordance with the information provided.

I wish you the very best of luck with your research.

Sincerely,

____

Data Protection Officer

Secretary's Office,

Trinity College Dublin,

Dublin 2, Ireland.

Wave 1 and Wave 2 Parent Consent Form

Parent-Child Interaction: Consent form

I have read the information leaflet and I agree to take part in the study. I understand that this involves being observed and recorded as I interact with my child. I understand that the study will also involve some testing and assessment of my child. ☐

I understand that the information that the researcher collects will be confidential to the research team and used only for the purpose of the research. Any identifying information will be changed. ☐

I understand that I am free to withdraw from participation at any time, and take breaks for me and my child at any time during the study. However I also understand that I will not be able to retrieve my data once it becomes part of an analysis or report. ☐

I understand that if anything emerges during the lab visit that causes the researcher to be concerned about me or my child, the researcher will have an obligation to follow this up afterwards. ☐

Participant (Parent)'s Name(s) [Printed]
………………………………………………

Participant (Child)'s Name(s) [Printed]
………………………………………………

Participant's Signature(s) Date
……………………………… ………………….
…………………

Dr Jean Quigley quigleyj@tcd.ie 01 896 2697
Dr Elizabeth Nixon enixon@tcd.ie 01 896 2867

School of Psychology, Áras an Phiarsaigh, Trinity College, Dublin 2

Wave 3 Parent Consent Form

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

CONSENT FORM

Parent-Infant Interaction and Child Development

Site	Trinity College Dublin
Principal Investigator and Co-Investigators	Dr. Elizabeth Nixon & Dr. Jean Quigley, *Assistant Professors in Psychology,* Mirela Conica, *PhD Student*, School of Psychology, Trinity College Dublin
Data Controller	Trinity College Dublin
Data Protection Officer	Data Protection Officer Secretary's Office Trinity College Dublin Dublin 2

There are 4 sections in this form. Each section contains a number of statements. You are asked to write your initials in the box beside the statement if you agree. If you do not agree with a statement, please leave the box blank. The end of this form is for the researchers to complete.

If you have any questions, please don't hesitate to call or email the lead researchers – Elizabeth Nixon (enixon@tcd.ie) or Jean Quigley (quigleyj@tcd.ie). Thank you for participating.

GENERAL	**Initials**
I confirm I have read and understood the **Information Leaflet** for the above-named study. I have been given the contact details of the lead researcher to ask questions. Where I had questions, they have all been answered to my satisfaction.	
I understand that participating in this study **is entirely voluntary, and if I decide that we do not want to take part, we can stop taking part in this study at any time without giving a reason**.	
I understand that we **will not be paid for taking part in this study** and that there will be no direct benefits to us from taking part in the study.	

I know how to **contact the research team** if I need to.	
I agree to take part in this study with my child having been fully informed of the **risks, benefits and alternatives** which are set out in full in the information leaflet with which I have been provided.	
I agree that I and my child can be **contacted by researchers by email and phone** as part of this research study.	
I agree to be video-recorded playing with my child.	
I agree that the researchers can contact my child's school and teacher and ask him/her to complete questionnaires and provide information about my child. *Please provide us with the name of your child's teacher and the full address of your child's school:* Teacher name: ______________________________ School address: ______________________________ ______________________________ ______________________________	

DATA PROCESSING	**Initials**
I give my permission for my own and my child's data to be processed in line with the aims of the research study, as outlined in the information leaflet.	
I understand that I am entitled to access any data that is held about me or my child.	
I understand that **personal data will be collected and stored as part of this research project.** The consent forms, my contact data, the video-data, and the completed questionnaires will be stored separately from each other, and a unique study ID to which only the lead researchers have access will be used to link the different pieces of data.	
I understand that the personal information collected in the study will be kept **strictly confidential** and will only be made available to researchers who are part of the **study team**.	
I understand that the data may need to be deposited in an online repository as part of the publication process, that the data will be anonymised and that no information that could potentially identify me will be included.	

I understand that **confidentiality may be breached in circumstances in which**: 1. The research team has a strong belief or evidence exists that there is a serious risk of harm or danger to either the participant or another individual. This may relate to issues surrounding physical, emotional and/or sexual abuse, concerns for child protection, rape, self-harm, suicidal intent or criminal activity. 2. Disclosure is required as part of a legal process or Garda investigation. In such instances, information may be disclosed to significant others or appropriate third parties without permission being sought. Where possible, a full explanation will be given to the participant regarding the necessary procedures and also the intended actions that may need to be taken.	
I understand that **I can withdraw my permission for me/my child to take part in this study** at any time without giving a reason. I understand that in this case, the researchers will delete all information related to us and we will be removed from the study from that point on. Once something has been published or submitted as part of course work using my data, it will not be possible for that data to be withdrawn.	

RETENTION OF INFORMATION	
I understand that my data may be retained by the study team for seven years and that we may be contacted within the seven years about follow-up stages of the research.	

SHARING OF INFORMATION	
Data will not be shared with researchers outside of the study team. The data will only be used for research projects related to the goals of this study.	

Child Name (Block Capitals)

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Parent/Guardian Name (Block Capitals)   Parent/Guardian Signature   Date

MIRELA CONICA   Mirela Conica

Lead Researcher Name (Block Capitals)   Lead Researcher Signature   Date

To be completed by the Principal Investigator or nominee and retained by parent/guardian

I, the undersigned, have taken the time to fully explain to the above participant the nature and purpose of this study in a way that they could understand. I have explained the risks and possible benefits involved. I have invited them to ask questions on any aspect of the study that concerned them.

I have given a copy of the information leaflet and consent form to the participant with contacts of the study team.

Researcher name: Mirela Conica

Title and qualifications: PhD student

Signature: Mirela Conica
Date:

Tel: 0871255221

Email: infantresearch@tcd.ie

This sheet to be retained by guardian/parent of participant

Consent Form for Teachers

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Parent-Infant Interaction and Child Development

Site	Trinity College Dublin
Principal Investigator and Co-Investigators	Dr. Elizabeth Nixon & Dr. Jean Quigley, *Assistant Professors in Psychology,* Mirela Conica, *PhD Student*, School of Psychology, Trinity College Dublin
Data Controller	Trinity College Dublin
Data Protection Officer	Data Protection Officer Secretary's Office Trinity College Dublin Dublin 2

There are 4 sections in this form. Each section contains a number of statements. You are asked to write your initials in the box beside the statement if you agree. If you do not agree with a statement, please leave the box blank. The end of this form is for the researchers to complete.

If you have <u>any</u> questions, please don't hesitate to call or email the lead researchers – Elizabeth Nixon (enixon@tcd.ie) or Jean Quigley (quigleyj@tcd.ie). Thank you for participating.

GENERAL	**Initials**
I confirm I have read and understood the **Information Leaflet** for the above-named study. I have been given the contact details of the lead researcher to ask questions. Where I had questions, they have all been answered to my satisfaction.	
I understand that participating in this study **is entirely voluntary, and if I decide that I do not want to take part, I can stop taking part in this study at any time without giving a reason**.	
I understand that **I will not be paid for taking part in this study** and that there will be no direct benefits to me from taking part in the study.	

I know how to **contact the research team** if I need to.	
I agree to take part in this study having been fully informed of the **risks, benefits and alternatives** which are set out in full in the information leaflet with which I have been provided.	
I agree that I can be **contacted by researchers by email and phone** as part of this research study.	

DATA PROCESSING	**Initials**
I give my permission for my own data to be processed in line with the aims of the research study, as outlined in the information leaflet.	
I understand that I am entitled to access any data that is held about me, and that parents are entitled to access data that are held about their child.	
I understand that **personal data will be collected and stored as part of this research project.** The consent forms, my contact data, and the completed questionnaires will be stored separately from each other, and a unique study ID to which only the lead researchers have access will be used to link the different pieces of data.	
I understand that the personal information collected in the study will be kept **strictly confidentia**l and will only be made available to researchers who are part of the **study team**.	
I understand that the data may need to be deposited in an online repository as part of the publication process, that the data will be anonymised and that no information that could potentially identify me will be included.	
I understand that **confidentiality may be breached in circumstances in which**: 1. The research team has a strong belief or evidence exists that there is a serious risk of harm or danger to either the participant or another individual. This may relate to issues surrounding physical, emotional and/or sexual abuse, concerns for child protection, rape, self-harm, suicidal intent or criminal activity. 2. Disclosure is required as part of a legal process or Garda investigation. In such instances, information may be disclosed to significant others or appropriate third parties without permission being sought. Where possible, a full explanation will be given to the participant regarding the necessary procedures and also the intended actions that may need to be taken.	
I understand that **I can withdraw my permission to take part in this study** at any time without giving a reason. I understand that in this case, the researchers will delete all information provided by me and we will be removed from the study from	

that point on. Once something has been published or submitted as part of course work using my data, it will not be possible for that data to be withdrawn.	

RETENTION OF INFORMATION	
I understand that my data may be retained by the study team for seven years.	

SHARING OF INFORMATION	
Data will not be shared with researchers outside of the study team. The data will only be used for research projects related to the goals of this study.	

Child Name (Block Capitals)

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Teacher Name (Block Capitals) Teacher Signature Date

MIRELA CONICA Mirela Conica

-- --- -------------------

Lead Researcher Name (Block Capitals) Lead Researcher Signature Date

To be completed by the Principal Investigator or nominee and retained by parent/guardian

I, the undersigned, have taken the time to fully explain to the above participant the nature and purpose of this study in a way that they could understand. I have explained the risks and possible benefits involved. I have invited them to ask questions on any aspect of the study that concerned them.

I have given a copy of the information leaflet and consent form to the participant with contacts of the study team.

Researcher name: Mirela Conica

Title and qualifications: PhD student

Signature: Mirela Conica

Date:

Tel: 0871255221

Email: infantresearch@tcd.ie

This sheet to be retained by teacher of participant.

Appendix B

Table 1

Zero-Order Correlations Between Maternal, Paternal and Child Decontextualised Language During Triadic Interaction in Toddlerhood and Children's Literacy and Numeracy Skills in Middle Childhood.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Maternal CL	-																			
2	Maternal DL	.01	-																		
3	*Narrative Utt*	.01	.89**	-																	
4	*Explain Utt*	.31	.57**	.48*	-																
5	*Pretend Utt*	-.09	.44*	-.01	.08	-															
6	Paternal CL	.23	-.35	-.30	-.18	-.14	-														
7	Paternal DL	.01	.40*	.21	.20	.50**	-.03	-													
8	*Narrative Utt*	.22	.24	.26	.12	.05	.01	.77**	-												
9	*Explain Utt*	-.10	.30	.10	.42*	.39*	.19	.47*	.18	-											
10	*Pretend Utt*	-.21	.36	.06	.16	.72**	-.09	.75**	.17	.47*	-										
11	Child CL	-.02	-.05	.04	-.23	-.14	-.30	-.35	- .25	-.40*	-.26	-									
12	Child DL	-.10	.75**	.68**	.37	.31	-.38	.05	- .03	.26	.09	.05	-								
13	*Narrative Utt*	.06	.54**	.62**	.18	.01	-.28	.01	.04	.02	-.03	.11	.80**	-							
14	*Explain Utt*	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
15	*Pretend Utt*	-.21	.70**	.53**	.42*	.45*	-.34	.08	- .08	.38	.17	- .02	.87**	.40*	-	-					
16	Child VC	-.002	-.22	-.21	.15	-.17	.03	-.12	.01	-.09	-.20	.09	-.26	-.37	-	-.09	-				
17	Child Arithm	.13	-.22	-.17	.11	-.22	.15	-.11	.11	-.14	-.28	- .15	-.32	-.25	-	-.28	.72**	-			
18	Child Reading	.21	- .51**	-.31	-.06	-.57**	.19	-.28	- .06	-.44*	-.35	- .09	- .52**	-.32	-	-.51**	.38	.36	-		

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
19	Child Spelling	.13	-.46*	-.24	-.09	-.57**	.04	-.34	-.12	-.35	-.39*	-.05	-.37	-.18	-	-.41*	.44*	.30	.87**	-	
20	Child Maths	.01	-.42*	-.22	-.05	-.53**	.03	-.45*	-.32	-.38	-.35	-.03	-.31	-.12	-	-.37	.27	.26	.78**	.86**	-

Note. * p < .01; ** p < .05; CL = contextualised language; DL = decontextualised language, Utt = number of utterances; VC = verbal comprehension; Artim = arithmetic; Child Verbal Comprehension and Arithmetic skills were directly assessed using the WISC-IV. Child Reading, Spelling and Maths were obtained via teacher report of child performance on standardised national assessments (Drumcondra and Sigma-T tests respectively).

Table 2

Zero-Order Correlations Between Maternal, Paternal and Child Decontextualised Language During Triadic Interaction in Preschool Years and Children's Literacy and Numeracy Skills in Middle Childhood.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Maternal CL	-																			
2	Maternal DL	-.16	-																		
3	*Narrative Utt*	.02	.30	-																	
4	*Explain Utt*	.30	-.10	.15	-																
5	*Pretend Utt*	-.19	.98**	.11	-.22	-															
6	Paternal CL	-.27	-.37	-.21	-.11	-.33	-														
7	Paternal DL	-.18	.76**	-.001	-.21	.80**	-.15	-													
8	*Narrative Utt*	.05	.33	.23	.003	.29	-.12	.49*	-												
9	*Explain Utt*	-.29	-.20	-.14	.03	.01	.46*	.31	.35	-											
10	*Pretend Utt*	-.17	.78**	-.03	-.23	.83**	-.20	.97**	.29	.14	-										
11	Child CL	-.03	-.47*	-.06	-.16	-.46*	.21	-.58**	-.25	-.18	-.57**	-									
12	Child DL	-.24	.89**	.10	-.21	.90**	-.34	.82**	.26	-.03	.76**	-.46*	-								
13	*Narrative Utt*	.05	.28	.35	.22	.21	-.33	.07	-.04	-.18	.11	-.20	.35	-							
14	*Explain Utt*	-.18	-.13	-.17	-.24	-.08	-.02	-.05	-.15	-.07	-.02	.22	-.12	-.20	-						
15	*Pretend Utt*	-.27	.89**	.07	-.25	.92**	-.32	.86**	.30	.01	.89**	-.43*	.98**	.23	-.11	-					

16	Child VC	.05	-.09	-.19	.24	-.08	.01	-.06	.13	.06	-.10	-.35	.02	.23	-.13	-.03	-				
17	Child Arithm	<.01	-.19	-.24	.17	-.17	.21	-.04	.01	.05	-.06	-.38	-.08	.12	-.17	-.14	.72**	-			
18	Child Reading	-.14	.45*	-.01	-.04	.47*	-.28	.39 +	.15	.06	.39*	-.29	.59**	.45*	-.18	.52**	.38	.36	-		
19	Child Spelling	-.13	.50**	.04	.01	.50**	-.43*	.31	.03	-.06	.35	-.26	.59**	.46*	-.03	.52**	.44*	.30	87**	-	
20	Child Maths	-.30	.55**	.24	.07	.51**	-.32	.38 +	.01	.03	.41*	-.29	.60**	.57**	-.08	.53**	.27	.26	.78**	.96**	-

Note. * p < .01; ** p < .05; $^{+}$ p=.05; CL = contextualised language; DL = decontextualised language, Utt = number of utterances; VC = verbal comprehension; Artim = arithmetic; Child Verbal Comprehension and Arithmetic skills were directly assessed using the WISC-IV. Child Reading, Spelling and Maths were obtained via teacher report of child performance on standardised national assessments (Drumcondra and Sigma-T tests respectively).

Table 3
Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Mothers' Use of Decontextualised Language During Toddlerhood

	Child Verbal Comprehension				Child Arithmetic			
	B	β	p	Model Summary	B	β	p	Model Summary
Mothers' DL	-.32	-.20	.37	R^2= .11, F = .89, p = .46	-.12	-.19	.38	R^2= .07, F = .50, p = .69
Mothers' CL	-.01	-.03	.89		.02	.11	.60	
Child Age	-1.72	-.27	.20		-.28	-.12	.56	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Mothers' DL	-1.51	-.51	.01	R^2= .34, F = 3.57, p = .03	-.89	-.45	.03	R^2= .26, F = 2.41, p = .09
Mothers' CL	.12	.23	.22		.07	.15	.45	
Child Age	1.58	.21	.26		1.49	.21	.29	
	Child Maths							
	B	β	p	Model Summary				
Mothers' DL	-.80	-.41	.05	R^2= .18, F = 1.51, p = .24				
Mothers' CL	01	.01	.94					
Child Age	.90	.12	.54					

Note. DL = decontextualised language; CL = contextualised language.

Table 4
Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Fathers' Use of Decontextualised Language During Toddlerhood

	Child Verbal Comprehension				Child Arithmetic			
	B	β	p	Model Summary	B	β	p	Model Summary
Fathers' DL	.14	.06	.79	R^2= .08, F = .62, p = .61	.10	.12	.60	R^2= .04, F = .32, p = .81
Fathers' CL	-.02	-.05	.83		.02	.11	.63	
Child Age	-1.83	-.29	.19		-.28	-.12	.58	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Fathers' DL	-.56	-.19	.38	R^2= .12, F = .92, p = .45	-.73	-.26	.23	R^2= .10, F = .81, p = .50
Fathers' CL	.13	.24	.27		.04	.08	.71	
Child Age	1.86	.24	.26		1.60	.22	.31	
	Child Maths							
	B	β	p	Model Summary				
Fathers' DL	-1.28	-.45	.03	R^2= .22, F = 1.91, p = .16				
Fathers' CL	1.17	.16	.43					
Child Age	.03	.06	.78					

Note. DL = decontextualised language; CL = contextualised language.

Table 5
Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Mothers and Fathers' Use of Decontextualised Language During Toddlerhood

	Child Verbal Comprehension				Child Arithmetic			
	B	β	p	Model Summary	B	β	p	Model Summary
Parental DL	-.14	-.11	.57	R^2= .09, F = .70, p = .56	-.04	-.;08	.70	R^2= .04, F = .31, p = .82
Parental CL	-.02	-.06	.77		.01	.14	.55	
Child Age	-1.77	-.28	.20		-.25	-.11	.62	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Parental DL	-.61	-.42	.04	R^2= .28, F = 2.66, p = .07	-.57	-.42	.04	R^2= .23, F = 2.05, p = .14
Parental CL	.08	.24	.22		-.57	-.42	.04	
Child Age	1.87	.25	.21		1.61	.22	.27	
	Child Maths							
	B	β	p	Model Summary				
Parental DL	-.66	-.49	.01	R^2= .26, F = 2.42, p = .09				
Parental CL	-.01	-.03	.89					
Child Age	.99	.14	.45					

Note. DL = decontextualised language; CL = contextualised language.

Table 6
Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Children's Use of Decontextualised Language During Toddlerhood

	Child Verbal Comprehension				Child Arithmetic			
	B	β	p	Model Summary	B	β	p	Model Summary
Children's DL	-.88	-.26	.21	R^2= .15, F = 1.21, p = .33	-.42	-.35	.09	R^2= .19, F = 1.68, p = .20
Children's CL	.04	.06	.78		-.05	-.23	.26	
Child Age	-.15	-.24	.25		-.17	-.07	.72	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Children's DL	-2.43	-.60	.002	R^2= .41, F = 4.92, p = .01	-1.73	-.45	.03	R^2= .25, F = 2.33, p = .10
Children's CL	-.14	-.18	.30		-.10	-.14	.48	
Child Age	2.07	.27	.13		1.84	.25	.20	
	Child Maths							
	B	β	p	Model Summary				

Children's DL	-1.43	-.37	.08	R^2= .16, F = 1.29, p = .31
Children's CL	-.08	-.10	.62	
Child Age	1.24	.17	.41	

Note. DL = decontextualised language; CL = contextualised language.

Table 7

Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Mothers' Use of Decontextualised Language During Preschool Years

	Child Verbal Comprehension				Child Arithmetic			
	B	β	p	Model Summary	B	β	p	Model Summary
Mothers' DL	-.07	-.20	.44	R^2= .11, F = .71, p = .56	-.05	-.36	.15	R^2= .15, F = 1.08, p = .38
Mothers' CL	-.01	-.03	.88		-.01	-.13	.56	
Child Age	-.48	-.35	.18		-.16	-.33	.20	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Mothers' DL	.13	.32	.19	R^2= .22, F = 1.73, p = .20	.16	.39	.09	R^2= .33, F = 2.89, p = .06
Mothers' CL	-.01	-.02	.94		-.01	-.04	.83	
Child Age	-.34	-.23	.33		-.39	-.26	.24	
	Child Maths							
	B	β	p	Model Summary				
Mothers' DL	.18	.43	.05	R^2= .35, F = 3.18, p = .04				
Mothers' CL	-.03	-.08	.67					
Child Age	-.34	-.23	.31					

Note. DL = decontextualised language; CL = contextualised language

Table 9

Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Fathers' Use of Decontextualised Language During Preschool Years

	Child Verbal Comprehension				Child Arithmetic			
	B	β	p	Model Summary	B	β	p	Model Summary
Fathers' DL	-.09	-.13	.60	R^2= .09, F = .59, p = .63	-.02	-.09	.71	R^2= .09, F = .57, p = .65
Fathers' CL	.01	.02	.92		.02	.19	.41	
Child Age	-.42	-.31	.21		-.10	-.21	.39	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Fathers' DL	.18	.25	.28	R^2= .24, F = 1.93, p = .16	.09	.13	.54	R^2= .36, F = 3.42, p = .04
Fathers' CL	-.05	-.18	.39		-.11	-.37	.07	
Child Age	-.45	-.31	.18		-.62	-.42	.05	
	Child Maths							

	B	β	p	Model Summary
Fathers' DL	.16	.20	.03	R^2= .41, F = 4.25, p = .02
Fathers' CL	-.12	-.41	.04	
Child Age	-.57	-.38	.06	

Note. DL = decontextualised language; CL = contextualised language.

Table 9

Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Mothers' and Fathers' Use of Decontextualised Language During Preschool Years

	Child Verbal Comprehension				**Child Arithmetic**			
	B	β	p	Model Summary	B	β	p	Model Summary
Parental DL	-.05	-.21	.44	R^2= .11, F = .70, p = .56	-.03	-.30	.28	R^2= .10, F = .69, p = .57
Parental CL	-.01	-.06	.81		-.002	-.03	.91	
Child Age	-.48	-.35	.17		-.15	-.31	.23	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Parental DL	.08	.28	.27	R^2= .24, F = 1.88, p = .17	.06	.22	.34	R^2= .36, F = 3.40, p = .04
Parental CL	-.02	-.10	.65		-.07	-.29	.18	
Child Age	-.36	-.25	.29		-.48	-.32	.14	
	Child Maths							
	B	β	p	Model Summary				
Parental DL	.07	.26	.24	R^2= .42, F = 4.35, p = .02				
Parental CL	-.08	-.35	.09					
Child Age	-.43	-.29	.16					

Note. DL = decontextualised language; CL = contextualised language

Table 10

Multiple Regression Models for the Prediction of Child Literacy and Numeracy Outcomes by Children's Use of Decontextualised Language During Preschool Years

	Child Verbal Comprehension				**Child Arithmetic**			
	B	β	p	Model Summary	B	β	p	Model Summary
Children's DL	-.10	-.18	.49	R^2= .20, F = 1.38, p = .28	-.07	-.37	.15	R^2= .26, F = 2.00, p =.15

Children's CL	-.15	-.41	.12		-.07	-.50	.05	
Child Age	-.34	-.24	.31		-.12	-.25	.27	
	Child Reading				**Child Spelling**			
	B	β	p	Model Summary	B	β	p	Model Summary
Children's DL	.31	.53	.03	R^2= .36, F = 3.15, p = .05	.33	.56	.02	R^2= .43, F = 4.27, p = .02
Children's CL	.004	.01	.97		.03	.07	.76	
Child Age	-.25	-.17	.42		-.40	-.26	.19	
	Child Maths							
	B	β	p	Model Summary				
Children's DL	.28	.48	.04	R^2= .42, F = 4.14, p = .02				
Children's CL	-.05	-.12	.58					
Child Age	-.35	-.23	.25					

Note. DL = decontextualised language; CL = contextualised language.

Appendix C

Table 1
Zero-Order Correlations Between Maternal, Paternal and Child Conversational Turns During Toddlerhood.

		1	2	3	4	5	6	7	8
1	(M) Connect								
2	(M) Total	.86**	-						
3	(F) Connect	.04	.06	-					
4	(F) Total	.35	.05	.24	-				
5	(CM) Connect	-.15	.35	-.11	-.50*	-			
6	(CM) Total	-.19	.30	-.001	-.58**	.88**	-		
7	(CF) Connect	.06	.23	.27	-.11	.27	.36	-	
8	(CF) Total	-.03	.08	.53**	-.02	.12	.29	.83**	-

Note. M = mothers' turns; F = fathers' turns; CM = child turns with mothers; CF = child turns with fathers; *p<.05; **p<.0

Table 2
Zero-Order Correlations Between Maternal, Paternal and Child Conversational Turns During Preschool Years.

		1	2	3	4	5	6	7	8
1	(M) Connect	-							
2	(M) Total	.56**	-						
3	(F) Connect	-.24	-.46*	-					
4	(F) Total	-.47*	-.43*	.73**	-				
5	(CM) Connect	.82**	.46*	-.14	-.48*	-			
6	(CM) Total	.11	-.04	-.12	-.33	.22	-		
7	(CF) Connect	-.27	-.36	.79**	.66**	-.09	-.04	-	
8	(CF) Total	-.26	-.32	-.30	.19	-.21	-.25	-.03	-.14-

Note. M = mothers' turns; F = fathers' turns; C = child turns; CM = child turns with mothers; CF = child turns with fathers; *p<.05; **p<.0

Appendix D

Table 1

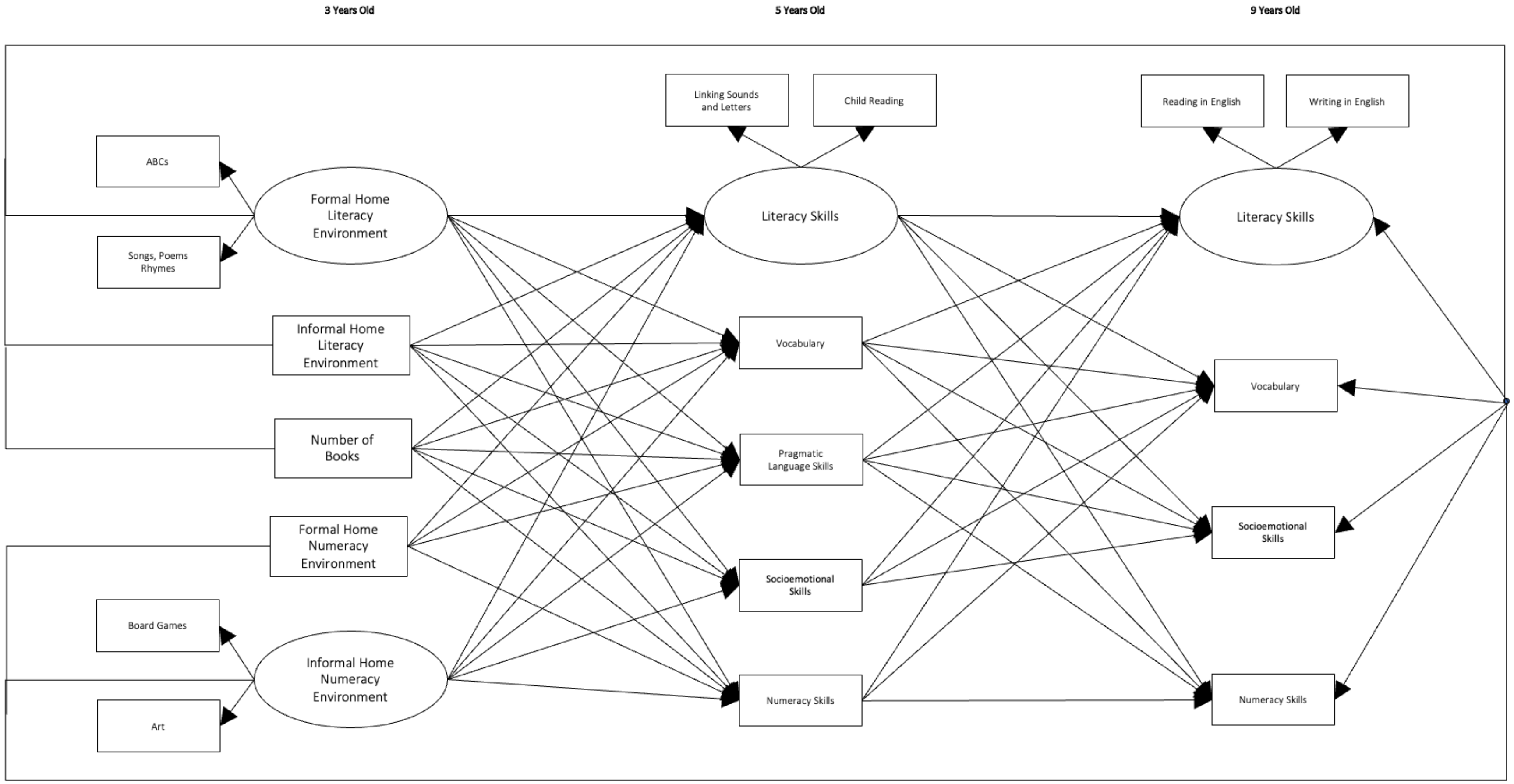
Individual Items from the Home Learning Environment Scale.

1.	ABCs	On how many days in an average week does anyone at home help <child> learn the ABC or alphabet?
2.	Songs, Poems, Rhymes	On how many days in an average week does anyone at home help <child> learn songs, poems, or nursery rhymes?
3.	Reading	On how many days in an average week does anyone at home read to <child>?
4.	Books	About how many children's books does <child> have access to in your home now, including any library books?
5.	Numbers, Counting	On how many days in an average week does anyone at home help <child> learn numbers or counting?
6.	Board Games	On how many days in an average week does anyone play games [board games, jigsaws, card games etc.) with <child>?
7.	Art	On how many days in an average week does <child> paint, draw, colour or play with play-doh at home?

Note. Scale reproduced from Murray and Colleagues' (2013) summary guide to wave 2 of the infant cohort of growing up in Ireland.

Figure 1

Theoretical Model for Pathways from the Formal and Informal HLE and HNE at Three Years Old to Child Outcomes at Five and Nine Years Old.



Note. Informal Home Literacy Environment = shared reading; Formal Home Numeracy Environment = teaching child numbers, counting. Number of Books is coded as a dichotomous variable (1 = less than 30 books and 2 = more than 30 books). The model adjusts for covariates.

Table 2

Descriptive Statistics of Study Variables.

	Mean (SD) or n (%)	Min	Max	Variance
Formal HLE				
ABCs	3.77 (2.38)	0	7	5.68
Songs, poems, rhymes	5.26 (1.99)	0	7	3.96
Informal HLE				
Reading	5.67 (1.92)	0	7	3.70
Number of books				
Less than 30	2920 (41.10%)	-	-	-
More than 30	4189 (58.90%)	-	-	-
Formal HNE				
Numbers	5.19 (1.96)	0	7	3.82
Informal HNE				
Board games	4.40 (2.19)	0	7	4.80
Art	5.02 (1.94)	0	7	3.76
Child Baseline Language				
Vocabulary at age 3	76.27 (19.10)	10	170	364.84
Academic Competencies at 5 Years				

Linking sounds and letters	7.86 (1.78)	3	9	3.70
Reading	7.67 (1.63)	3	9	2.65
Vocabulary	112.29 (17.19)	26	170	295.65
Pragmatic language skills	7.78 (1.92)	3	9	3.70
Socioemotional skills	7.94 (2.15)	0	10	4.61
Numeracy skills	7.78 (1.36)	3	9	1.86
Academic Competencies at 9 Years				
Reading in English	3.57 (.48)	3	4	.24
Writing in English	3.47 (.48)	3	4	.25
Vocabulary	.37(.89)	-2.94	2.41	.80
Socioemotional skills	8.23 (1.97)	0	10	3.89
Numeracy skills	3.53 (.50)	3	4	.25

Note. Linking sounds and letters, reading and numeracy were measured on a 7-point scale ranging from 3 (indicating 3 or less) to 9 with higher scores indicating better child performance within the respective domains; Linking sounds and letters and reading were combined to form a latent variable of literacy.

Table 3

Pearson's Correlations between Items of the Home Learning Environment Scale, Child Academic Competencies at Five Years and Covariates.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	ABCs	-																		
2	Songs, poems, rhymes	.37**	-																	
3	Reading	.19**	.27**	-																
4	Number of books	.01	.11**	.29**	-															
5	Numbers	.49**	.43**	.24**	.08**	-														
6	Board games	.26**	.28**	.27**	.15**	.25**	-													
7	Art	.20**	.26**	.17**	.10**	.24**	.32**	-												
8	Linking sounds and letters	.04**	.05**	.13**	.11**	.03*	.10**	.03**	-											
9	Child reading	.04**	05**	.13**	.11**	.03**	.11**	.05**	.72**	-										
10	Vocabulary	.06*	.08**	.19**	.18**	.07**	.09**	.01	.21**	.21**	-									
11	Pragmatic language	.01	.06**	.17**	.12**	.02	.11**	.04**	.43**	.47**	.26**	-								
12	Socioemotional	.01	.05**	.06**	.05**	.01	.06**	.05**	.20**	.22**	.11**	.41**	-							
13	Numeracy	.03**	.05**	.12**	.09**	.03**	.08**	.02	.59**	.62*	.15**	.36**	.18**	-						
14	Child Sex	.07**	.13**	.05**	.03*	.04**	.06**	.23**	.09**	.10**	.02**	.09***	.18**	.04**	-					
15	Baseline language	.06**	.11**	.23**	.20**	.06**	.11**	.09**	.18**	.19**	.50**	.23**	.12**	.15**	.12**	-				
16	First language	.002	-.05**	-.13**	-.13**	-.03*	-.01	.04**	-.06**	-.09**	-.40**	-.14**	-.06**	-.04**	.02	-.30**	-			
17	Family SES	.04**	-.003	-.20**	-.26**	.01	-.08**	.02	-.12**	-.11**	-.19**	-.19**	-.08**	-.11	.04**	.16**	.14**	-		

18	Parental education	-.02*	.03*	.26**	.28**	.01	.10**	.02	.09**	.09**	.13**	.14**	.03*	.09**	-.03*	-.19**	-.003	-.48**	-	
19	Preschool	.01	-.01	-.07**	-.05**	<.001	-.03	-.01	-.08**	-.07**	-.05**	-.05**	-.02	-.06**	.01	-.06	.04**	.14**	-.10**	-

Note. * Correlation is significant at the 0.05 level; ** correlation is significant at the 0.01 level; Items 1-3 and 5-7 represent the frequency with which parents reported engaging in these activities with children per week ranging from '0' to '7' days; Number of books was coded as a dummy variable where 1 = less than 30 books and 2 = more than 30 books; Vocabulary was measured using the *Naming Vocabulary* scale of the British Abilities Scales (Elliott et al., 1996). Higher scores indicate better vocabularies; Pragmatic language (α = .88) linking sounds and letters (α = .85), child reading (α = .77) and numeracy (α = .76) were measured by teacher report on the Achievement Scales from the UK Cohort Study; Socioemotional skills were obtained from teacher report on the prosocial subscale of the strengths and difficulties questionnaire (SDQ; α =0.81; Goodman, 1997). Higher scores indicate more prosocial behaviour; Child sex was coded as a dummy variable where 0 = male and 1 = female; First language was coded as a dummy variable where 0 = 'not English' and 1 = 'English'; Family SES was a categorical variable ranging from 1 = 'never worked' to 5 = 'professional'; Parent education was a categorical variable ranging from 1 = 'no qualification' to 6 = 'doctorate degree'; Preschool attendance was coded as a dummy variable where 1 = 'attended' and 2 = 'did not attend'.

Table 4

Pearson's Correlations between Items of the Home Learning Environment Scale, Child Academic Competencies at Nine Years and Covariates.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	ABCs	-																	
2	Songs, poems, rhymes	.37**	-																
3	Reading	.19**	.27**	-															
4	Number of books	.01	.11**	.29**	-														
5	Numbers	.49**	.43**	.24**	.08**	-													
6	Board games	.26**	.28**	.27**	.15**	.25**	-												
7	Art	.20**	.26**	.17**	.10**	.24**	.32**	-											
8	Reading in English	.01	.05**	.17**	.16**	.03*	.08**	.03**	-										
9	Writing in English	-.002	.03**	.14**	.15**	.02	.08**	.03**	.72**	-									
10	Vocabulary	.01	.06**	.21**	.20**	.03**	.09**	03**	.49**	.45**	-								
11	Socioemotional	.02	.04**	.04**	.05**	.01	.04**	.09**	.10**	.13**	.06**	-							
12	Numeracy	-.01	.002	.13**	.13**	.01	.06**	.01	.58**	.59**	.39**	.10**	-						
13	Child Sex	.07**	.13**	.05**	.03**	.04**	.06**	.23**	.03*	.05**	.02	.24**	-.07**	-					
14	Baseline language	.06**	.11**	.23**	.20**	.06**	.11**	.09**	.22**	.19**	.32**	.08**	.16**	.12**	-				
15	First language	.002	-.05**	-.13**	-.13**	-.03*	-.01	.04**	-.07**	-.05**	-.14**	-.04**	-.001	.02	-.30**	-			
16	Family SES	.04**	-.003	-.20**	-.26**	.01	-.08**	.02	-.21**	-.20**	-.24**	-.08**	-.21**	.04**	.16**	.14**	-		

17	Parental education	-.02*	.03*	.26**	.28**	.01	.10**	.02	.21**	.21**	.26**	.03*	.22**	-.03*	-.19**	-.003	-.48**	-	
18	Preschool	.01	-.01	-.07**	-.05*	<.01	-.03	-.01	-.04**	-.02	-.06**	-.02	-.05**	.01	-.06**	.04**	.14**	-.10**	-

Note. * Correlation is significant at the 0.05 level; ** correlation is significant at the 0.01 level; Items 1-3 and 5-7 represent the frequency with which parents reported engaging in these activities with children per week ranging from '0' to '7' days; Number of books was coded as a dummy variable where1 = less than 30 books and 2 = more than 30 books; reading and writing in English, and numeracy skills were reported by teachers on a 5-point scale where 1 = 'well below average' and 5 = 'well above average'; Vocabulary was measured using the Drumcondra Primary Reading Test – Revised (DPRT-R), a standardised test administered to school children annually in Ireland (KR_{20}= 93). Higher scores indicate better vocabularies; Socioemotional skills were obtained from teacher report on the prosocial subscale of the strengths and difficulties questionnaire (SDQ; α = .80; Goodman, 1997). Higher scores indicate more prosocial behaviour; Child sex was coded as a dummy variable where 0 = male and 1 = female; First language was coded as a dummy variable where 0 = 'not English' and 1 = 'English'; Family SES was a categorical variable ranging from 1 = 'never worked' to 5 = 'professional'; Parent education was a categorical variable ranging from 1 = 'no qualification' to 6 = 'doctorate degree'; Preschool attendance was coded as a dummy variable where 1 = 'attended' and 2 = 'did not attend'.