Father-Child Conversation and the Development of Executive Function during the

Preschool Period

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Declaration

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Linda Kelly

31st March 2020
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Summary

The present thesis sought to add to the body of research demonstrating the importance of the early father-child interactive environment for child executive function (EF) development. In particular, this thesis focussed on associations between fathers’ child-directed speech (CDS) and child EF. This research was carried out in the Trinity College Dublin Infant and Child Research Lab which uses observational methods to study naturalistic interactions between parents and children in order to investigate how patterns of interaction are associated with children’s development over time. Observation of parent-child interaction is a well-established approach to studying developmental processes in early childhood. This method allows researchers not only to investigate relationships between interactive patterns and child development over time, but also track the moment-to-moment processes by which parents and children shape each other’s behaviour as they interact. This research is embedded within a transactional model of child development which views the influence of parents and their children on one another as bidirectional (Sameroff, 2009).

The present research investigated how patterns of interaction between parents and their two-year-old children were longitudinally associated with child language and executive function development at ages three and four years. At age two years interactions between parents and child were captured in free play and structured play contexts, in both dyadic (one parent and child) and triadic (mother, father, child) settings. Father-child language variables were calculated from transcripts of these interactions. Child EF abilities were assessed via parental report at age two years and directly assessed at ages three and four years. Child language abilities were directly assessed at each wave of data collection.
The first chapter of the thesis presents an overview of the literature on parent-child interaction and the role of fathers in child development. This chapter emphasises that although fathers are underrepresented in research on parent-child interaction, studying father-child relations provides an enriched understanding of early interactive influences on child development. This chapter also introduces fathers’ CDS as an important contributor to child development. Chapter 2 outlines the development of EF during the preschool period with a particular focus on the interactive context in which this set of higher-order cognitive processes emerges.

The remainder of the thesis is divided into a number of separate studies. Chapter 3 provides a cross-sectional comparison of mothers’ and fathers’ CDS during structured and free play at child age two years. Longitudinal associations between fathers’ CDS at age two and child language and EF development at age three years were subsequently examined, controlling for mothers’ speech. Findings indicated that fathers’ CDS demonstrated unique associations with child language and EF development. Chapter 4 investigated longitudinal associations between fathers’ CDS measured at child age two years and child EF at age four years. Findings demonstrated an association between conversational turn-taking in father-child interaction and child EF. The dynamics of conversational turn-taking as well as the communicative functions of fathers’ speech were subsequently analysed in order to understand this association in greater depth.

Chapter 5 sought to investigate the association between conversational turn-taking and child EF among a new sample of three-year-old children and their fathers using an experimental design. Conversational turn-taking in father-child interaction was manipulated using a shared book-reading paradigm and the effect on EF was measured. Findings illustrated the effectiveness of manipulating father-child turn-taking during shared
book-reading however did not support an effect on child EF. In summary, this thesis provides an in-depth study of father-child interaction and highlights the importance of fathers’ CDS for child development. Chapter 6 discusses the implications of the findings of the thesis, details its limitations and provides directions for future research.
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List of Abbreviations

**ADS:** Adult-Directed Speech

**BRIEF-P:** Behaviour Rating Inventory of Executive Function, Preschool Version

**BSID-III:** Bayley Scales of Infant Development, 3rd Edition

**CDS:** Child-Directed Speech

**CES-D:** Centre for Epidemiological Studies - Depression Scale

**CHAT:** Codes for Human Analysis of Transcripts

**CLAN:** Computerised Language Analysis

**DCCS:** Dimensional Change Card Sort

**EF:** Executive Function

**MLT:** Mean Length of Turn

**MLU:** Mean Length of Utterance

**PSI:** Parenting Stress Index

**TRR:** Type-Token Ratio

**VOCD:** Vocabulary Diversity

**WAIS-IV:** Wechsler Adult Intelligence Scale, Fourth Edition

**WPPSI-IV:** Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition
Chapter 1

Part 1. The Importance of Parent-Child Interaction for Child Development

Developmental psychology is concerned with describing and explaining the psychological growth of an individual over the lifespan. Theory and research have long emphasised the important role of parents in shaping child developmental trajectories. Interactions between parent and child provide an important context for children’s development. Variation in the quality of these interactions has meaningful implications for child developmental trajectories and has therefore become a key focus of research. This research is framed by transactional models of development which emphasise the active role of the child in interaction and stresses the central role of the child in their own development. The aim of this review was to sketch the parent-child interaction literature in relation to leading theories in developmental psychology and to outline research demonstrating associations between key constructs in the field and child language, cognitive and social-emotional development. Finally, this review places the study of parent-child interaction within the larger context of influences on child development.

The largely postnatal trajectory of the child’s psychological development introduces a particular susceptibility to input from the environment, yet the processes by which proximal social factors influence this development are not yet fully understood. Infants spend most of their time with their parents and the parent-child relationship is therefore proposed to be one integral factor influencing child development (Bornstein, 2002). It is during early childhood - an important period for child cognitive, language, and social-emotional development, and a time when parents are largely responsible for providing the experiences to which their child is exposed - that parenting behaviours are theorised to be particularly influential (Bornstein, 2002). From an evolutionary standpoint
it has been suggested that the prolonged nature of human infancy facilitates infant development by necessarily increasing the child’s exposure to these parenting influences (Bjorklund, 2007). Bjorklund (2007) emphasises that compared with other species, the period of early childhood is one of intensive brain development, again highlighting the potential importance of environmental input such as parent-provided experiences to development. In terms of neuropsychological research, Hane and Fox (2006), for example, demonstrated that normative variations in caregiving behaviour influence the development of frontal brain regions in infancy.

Developmental research more generally supports the hypothesis that parenting affects development, and suggests that differences in parenting behaviours that fall within the normal range can have a significant impact on different aspects of children’s development (Bernier, Carlson & Whipple, 2010). A key approach of contemporary research is examining relationships between specific processes which take place in the context of parent-child interactions and the associations between these processes and child developmental trajectories. Current approaches are interested in studying how patterns of interaction between parents and their children may shape development over time. This research emphasises the role of the child in development by examining bidirectional associations between moment-by-moment behaviours of parent and child during interaction.

Historical Perspectives on Parent-Child Interaction Research

Two influential theoretical perspectives during the first half of the 20th century emphasised parents’ influence on child development and shaped the evolution of the study of parent-child interaction (Parke & Buriel, 1998). The behaviourist perspective stressed that patterns of reinforcement in a child’s environment underpin development whereas
psychodynamic theory was concerned with how internal conflict between the child’s biological drives and societal norms shaped personality. Subsequent research exploring the effects of parenting on children was framed by diverse theoretical and methodological perspectives with the common aim of defining and explaining the link between the parent-child relationship and child development (Henderson, 1981). The rise of social learning theory shifted focus from external reinforcement for learning whilst systems theory recognised the influence of multiple interacting social systems in shaping development (Parke & Buriel, 1998). Early models of parenting were unidirectional such that the role of the child in shaping parents’ behaviour was given little consideration (Darling & Steinberg, 1993). In order to better understand developmental processes, researchers began to employ observational methods of studying parent-child relations and child development, supplementing previous interview and questionnaire approaches (Maccoby & Martin, 1983).

Attachment theory focussed interest on the role of parents in child development at the level of the dyad (Parke & Buriel, 1998). The attachments that infants form to their caregivers are shaped through their interactive experiences and, according to Bowlby (1988), are integral to the development of the child. According to attachment theory, the child's early attachment relationships are important for forming internal working models of the self and others, upon which they model future relationships (Bowlby, 1969). Ainsworth classified infant patterns of attachment into secure, insecure and disorganised types (Ainsworth, Blehar, Waters & Wall, 1978). Infants described as “securely” attached use their attachment partner (usually a parent) for comfort and as a secure base from which to explore their environment (Ainsworth, 1969; Bowlby, 1969). Ainsworth (1979) posited that parental sensitivity is particularly important for the development of secure attachment.
Sensitive parents are alert to their infant’s behavioural and emotional signals, and respond to these cues appropriately and promptly during synchronised interactions with their children (Ainsworth et al., 1978). In particular caregivers’ responses to infant distress appear to support the development of internal working models of attachment which the child carries forward to future relationships (Isabella, Belsky & von Eye, 1989).

Bowlby’s theory of attachment combined hypotheses from evolutionary, biological, developmental and cognitive theories into one comprehensive model of child development whose hypotheses were amenable to empirical investigation (Bretherton, 1997). Research has demonstrated that early attachment relationships predict children’s later social functioning (e.g., Easterbrooks & Lamb, 1979; Fearon, Bakermans-Kranenburg, van IJzendoorn, Lapsley & Roisman, 2010; Groh, Roisman, van IJzendoorn, Bakermans-Kranenburg & Fearon, 2012; Sroufe, 2005). Furthermore, the methodology of attachment research emphasised the merit of naturalistic observations of parent-child interactions for understanding children’s early relationships.

Whilst attachment theory has endured over the past number of decades, some researchers claim that attachment theory is not extensive enough to explain why parent-child interaction is related to child developmental trajectories (Pleck, 2010a). It has been argued, for example, that a theory which focusses primarily on the attachment-related needs of the child of comfort and security is too narrow in its focus to explain a wide range of child outcomes (Hazan & Shaver, 1994). Furthermore, most attachment research has been carried out with infants and their mothers and the influence of other attachment figures is less clearly defined (Hazan & Shaver, 1994).
Towards a Transactional Model of Development

Early developmental theories of pioneers such as Skinner, Piaget, and Chomsky were considered individualist in their approaches to understanding children’s development. Processes such as learning and language were conceptualised as innate capacities unfolding within the individual infant, which the parent-child relationship perhaps moderated but was not an important source of influence in its own right (Bruner & Bornstein, 1989). Subsequent research investigating the role of parents examined how parenting styles affect child development (Baumrind, 1991). Contemporary research on child development, framed by social-interactionist frameworks, emphasises how variation in the quality of interactions between parents and their children contribute meaningfully to children’s development (Vygotsky, 1978). In recent decades the field has undergone a conceptual shift from considering only parenting factors towards a transactional model of child development which views the influence of child and environment as bidirectional (Sameroff, 2009). Transactional models propose that both the active environment and active child influence one another over time, emphasising that the interaction between parent and child is a crucial unit of analysis in the research (Bruner & Bornstein, 1989; Yurovsky, 2017). The literature primarily refers to the dyad of parent and infant and the impact each member of this pair has on the other during the course of interaction and over time (Bornstein & Tamis-LeMonda, 2010).

Newborn infants show an early propensity for social interaction and the behaviours of both infants and their parents are intent on promoting and maintaining proximity with one another (Bowlby, 1969). Before they learn to speak, infants engage in episodes of joint attention with their parents and communicate using behaviours such as vocalisations and facial expressions. These behaviours are highly contingent upon, and synchronised with,
those of their parents (Trevarthen & Aitken, 2001). Bateson (1979) termed these pre-linguistic interactions between infant and parents “proto-conversations”. Synchrony refers to the tendency of parents and infants to match affective states and is believed to play an important role in moderating infant arousal (Lester, Hoffman & Brazleton, 1985). The extent to which parents’ behaviours are contingent, timely and appropriate in relation to the child’s activity provides important cues for the young infant (Ainsworth et al., 1978; Bornstein & Tamis-LeMonda, 2010). Infants as young as five months old learn to associate their parents’ contingent behaviours to their ongoing activities, and can therefore begin to appreciate the social implications of their own behaviours (Goldstein, Schwade & Bornstein, 2009). Research has also demonstrated how child behaviours can affect the quality of parents’ responses. For instance, infant babbling displays communicative intent to parents, who respond using simplified child-directed speech (Elmlinger, Schwade, & Goldstein, 2019).

Not only do the behaviours of infants play an important role in shaping interactions with their parents, but so too do child characteristics such as temperament and developmental stage of the child (Belsky, 1984). Other research has examined how child factors such as age (e.g., Rowe, 2012) and gender (e.g., Mascaro, Rentscher, Hackett, Mehl, & Rilling, 2017) influence patterns of interaction between parent and child. Furthermore, different dimensions of parenting may be more or less salient to the child’s development depending on child characteristics and concurrent abilities (Landry, Smith, Swank & Miller-Loncar, 2000). Overall, theory and research emphasise that patterns of interaction within a dyad relate to later child developmental trajectories (O’Connor, 2002).
The Nature of Parent-Child Interaction

Whilst parent-child interaction is hypothesised to be an important context for child development, it is necessary to delineate the processes by which interaction influences development and to define the principal constructs and aspects of development under investigation. O’Connor (2002) emphasises that at present the field of developmental psychology lacks a "grand unifying theory of parent-child relationships" (p. 555). Much early research assumed that overall level of parental input and engagement broadly influenced children’s development (Wachs & Chan, 1986). This global approach overlooks however that parents may behave differently across different contexts and time (Holden & Miller, 1999). Contemporary research tends to align itself with the specificity principle described by Bornstein (2006). According to this approach, specific parent and child behaviours during interaction are measured and examined in relation to their impact at specific time points on specific aspects of children’s development. Research supports this approach, finding, for example, that parent behaviours which support language development differ from those which influence the development of play (e.g., Tamis-LeMonda & Bornstein, 1994). Furthermore, parent behaviours which support child language development at one developmental stage may be less salient at later stages (e.g., Landry et al., 2000; Rowe, 2012). Aside from framing the research in this manner, two approaches have been taken in the literature to characterise parent-child interactions.

The first approach organises the content of parent-child interaction into domains of engagement (Bornstein & Tamis-LeMonda, 2010). Bornstein (2006) proposed four core domains of parental engagement which encompass nurturant, material, didactic, and social caregiving. According to Bornstein and Tamis-LeMonda (2010), nurturant caregiving, attending to the infant’s physical and health needs, is rarely a major focus of research as
this domain shows minimal variation between families. Material caregiving, on the other hand, refers to the provision of stimulating objects such as toys and books. Didactic caregiving refers to the parent’s regulation of how the child interacts with these objects in their environment, for example, through creating opportunities for, and encouraging their child to learn. Lastly, social caregiving encompasses behaviours parents employ with the goal of engaging their infants in successful social exchanges. These domains, as well as the language used throughout these interactions, broadly encompass the content of parent-infant interaction, and whilst these classifications as such may be useful, in reality parenting activities are comprised of combinations of each (Bornstein & Tamis-LeMonda, 2010).

The second approach taken in the literature to describe the nature of parent-child interaction focusses on the quality of parent behaviours (Bornstein & Tamis-LeMonda, 2010). Whilst early research focussed on the content of engagement and amount of time spent with their infants, the quality of parenting behaviours during interaction has also been consistently highlighted as important for child development (e.g., Bernier, Calkins & Bell, 2016; NICHD Early Child Care Research Network, 2002; Rowe, 2012). Constructs of parenting quality such as warmth, sensitivity, autonomy support and control are central to current developmental research. These constructs are often measured along two main continuums in the literature and do not necessarily demonstrate covariance with each other. Warmth and sensitivity refer to parenting behaviours which are involved, responsive and synchronised with the child's behaviours and emotions, and demonstrate affection and enthusiasm (Baumrind, 1967). This dimension ranges from affectionate, warm, responsive parental caregiving to cold or unresponsive parenting.
The dimension of control ranges from autonomy supportive parenting to intrusive, demanding caregiving (Schaefer, 1959). Autonomy support refers to parents’ efforts to structure, guide and support their child’s activities and sense of independence, in contrast with intrusive and overstimulating parenting behaviours that direct or control the child’s activity (Grolnick & Ryan, 1989). Whilst it cannot be assumed that these dimensions of parenting comprehensively capture the phenomenological experience of parents and their infants during interaction (O’Connor, 2002), research has demonstrated that these constructs are predictive of child developmental trajectories.

As previously mentioned, the nature of the association between parenting influences and child development is guided by the principle of specificity. Another critical issue facing developmental researchers is the temporal nature of these patterns of associations. According to theories emphasising “sensitive periods”, the early experience of the child is uniquely critical for later outcomes (Bornstein, 1989). This differs from the “contemporary environment” model which posits that it is at later time points that experience exerts important influence over long-term child outcomes (Rutter, 1998). A cumulative model of effect on the other hand proposes that a combination of early and later parent-child experience accounts for child developmental outcomes (Collins, Maccoby, Steinberg, Hetherington & Bornstein, 2000). Returning to the transactional model of development discussed previously, child characteristics and behaviours play a role in determining their interactive environment and experiences, as well as how these are assimilated by the child and ultimately shape their developmental trajectory. Empirical evidence lends support to each of these models, thus it is important for researchers to clearly define the developmental variables of interest and the timeframe of the
investigation in order to effectively investigate the nature of the associations between parent-child interaction and child development (Bornstein & Tamis-LeMonda, 2010).

**Functions of Parent-Child Interaction**

The literature tends to focus on child development of language, cognitive, and social-emotional skills within the context of parent-child interaction. The goal of theory and research is to delineate how patterns of interaction between parent and child influence these domains of development. The role that parent-child interaction plays in the child’s development in these core domains is what Bornstein and Tamis-LeMonda (2010) refer to as the functions of interaction.

**Social-emotional development.** Interaction is central to the child’s evolving social-emotional competencies. Social-emotional development refers to the child’s emerging communication, emotion-regulation, and relationship skills. This aspect of child development influences the child’s interactional style and the quality of their interactions with others across time (Zeman, Cassano, Perry-Parrish & Stegall, 2006). As previously mentioned, from birth, infant and parents show a proclivity for interacting with each other. Parents are integral to their newborn’s emotional experience by providing stimulation through touch, vocalisations, and facial expression during interaction with their infants (Papoušek & Papoušek, 2002). Parent and child coordinate these behaviours and emotions and infants are sensitive to irregularities in these reciprocal exchanges. Infants display withdrawal following a period of non-responsiveness from the parent during the Still Face Paradigm, a classic procedure in developmental research (Tronick, Als, Adamson, Wise & Brazelton, 1978).

Parents contribute to infant social-emotional growth by assisting infants to reach heightened levels of arousal which they cannot do on their own, and by regulating this
arousal (Bornstein & Tamis-LeMonda, 2010). Parents initially act as external regulators of infant arousal and gradually these processes become internalised by the child. This enables the infant to tolerate higher states of arousal and supports their developing capacity for self-regulation (Bornstein & Manian, 2013), as well as encourages enjoyment in parent-child interactions (Bornstein & Tamis-LeMonda, 2010). Thompson (1994) defines emotion regulation as consisting of "the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals" (p. 27). This may include regulation of attention and motivation as well as emotions and physiological responses (Eisenberg & Spinrad, 2004; Tronick, 1989). Theory suggests that young children also assimilate the social expectations and norms conveyed to them through responsive interactions with their caregivers, and that these internal working models underpin the child’s future relationships (Grusec, Goodnow, & Kuczynski, 2000).

**Cognitive development.** Once largely explained by the unfolding of intra-individual processes (e.g., Piaget & Cook, 1952), social interaction is now widely conceived of as necessary for child learning and cognitive development (Bruner & Bornstein, 1989). The focus of current developmental research is on determining the specific patterns of parent-child interaction which are important for optimal child cognitive development. Research has demonstrated that cognitive stimulation, parents’ efforts to teach their children through specific activities and language, is associated with child cognitive development (NICHD Early Child Care Research Network, 2005). Other dimensions of parenting quality have demonstrated associations with child cognitive development, including parental warmth and sensitivity (Lugo-Gil & Tamis-LeMonda,
A large focus of recent developmental research has been on the development of executive function (EF) in preschool age children. EF refers to the set of higher-order cognitive skills associated with prefrontal brain regions which are necessary for conscious control over thought and behaviour (Carlson, Zelazo & Faja, 2013). Features of the interactive environment linked to EF development include responsiveness (Kochanska, Askan, Prisco & Adams, 2008), warmth (e.g., Kraybill & Bell, 2013), quality of attachment (Bernier, Deschênes & Matte-Gagné, 2012) and scaffolding (e.g., Bernier et al., 2010). Furthermore, effects are most likely bidirectional as increased capacity for self-regulation may further promote higher-quality parent-child interactions (Carlson, 2009).

The literature describing associations between parent-child interactive behaviours and child development of EF is discussed in greater detail in Chapter 2.

Another way in which parent-infant interaction is proposed to support child cognitive development is through its influence on infant language acquisition. Several studies suggest that associations between parenting quality and cognitive development are mediated by child verbal ability (e.g., Landry, Miller-Loncar, Smith & Swank, 2002; Lowe et al., 2014). Enriched parental language during interaction that provides the child with conceptual information that assists them to organise their thoughts and understand cause and effect is thought to promote cognitive development (Song, Spier & Tamis-LeMonda, 2014).

**Language development.** Seemingly effortlessly and without being explicitly taught, by age two years most children have made rapid strides in their mastery of language (Bornstein, 2002). The social environment is believed to not only motivate
infants to acquire language (Kuhl, 2007) but it is also within the context of parent-child interaction that infants are exposed both to parental speech input, as well as engaging in patterns of interactive behaviours, which may support language learning. Whilst theory emphasising the importance of social interaction for language acquisition has long been accepted (e.g., Vygotsky, 1962; Bruner, 1983), research is ongoing regarding which aspects of parental speech and interaction style are most important for child language development at different points in time.

Child-directed speech (CDS) refers to the simplified register parents instinctively use when interacting with young children. Research demonstrates that both the quantity and quality of CDS contribute to language development (Rowe, 2012; Rowe & Snow, 2019). In infancy, the prosodic features of CDS such as lengthening of syllables, pauses, and changes in pitch at phrasal boundaries are of particular importance for language development (Fisher & Tokura, 1996; Thiessen, Hill & Saffran, 2005). As the child’s linguistic skills develop, the lexical diversity and grammatical complexity of CDS propel children’s further language learning (Song et al., 2014). Not only is the quantity and quality of parental linguistic input during interaction important for the infant language learner, but so too are the interactional behaviours of parents. Parents who are sensitive, responsive and provide cognitive stimulation (for example, use varied and complex language/increase the level of difficulty according to child’s abilities), tend to have children with better linguistic skills compared to children of parents who are less responsive and more controlling (Matte-Gagné & Bernier, 2011; Rodriguez et al., 2009; Song et al., 2014).

Parents who respond contingently to their child’s ongoing focus or activity have infants who develop more sophisticated language earlier on (e.g., Landry et al., 1997;
Contingent responding refers to adults’ behaviour which immediately follows a child behaviour and relates to the child's current focus of attention (Roth, 1987). This process may help children to match labels to objects in the environment for instance (Tamis-LeMonda & Bornstein, 2002). Parent responsiveness in early infancy may also serve to convey the role of language as a social-communicative device to the infant (Tamis-LeMonda et al., 2001). Overall, it is important to understand infant language acquisition and development within the context of parent-child interaction (Tamis-LeMonda et al., 2001). For an in-depth discussion of child-directed speech see Chapter 1 Part 3.

**Parenting in Context**

The above discussion briefly sketches available research in support of the proposal that interactions between parent and child influence trajectories of child language, cognitive, and social-emotional development. It is important to recognise that these interactions do not take place in a vacuum and that there are many factors which may influence the content and quality of parent-child interaction. In other words, child development cannot be understood without reference to the context in which it is embedded (Bronfenbrenner & Morris, 2006).

**Bio-ecological model.** Consideration of the wide range of factors which may influence parent-child interaction is consistent with the bio-ecological model of human development (Bronfenbrenner & Morris, 2006). According to this framework, reciprocal interactions between the individual child and the environment shape the trajectory of their development. The bio-ecological model emphasises the role of proximal processes in shaping child development. Proximal processes refer to the patterns of interaction which occur in the context of the child’s immediate relationships, which become more complex
over time in response to the child's developing capacities (Bronfenbrenner & Morris, 2006). The child actively shapes the course of these interactions which are influenced by the child’s behaviours and characteristics.

These proximal processes are also shaped by wider contextual factors, which interact with one another to influence child development, as well as adapt over time. The economic resources of parents for example may exert distal influences on parent-infant interaction. Low socioeconomic status (SES) is associated with parenting stress and harsher parenting practices (McLoyd, 1998). The negative factors associated with low SES can reduce the parent’s capacity for consistent and sensitive parenting. Finally, parenting practices are also greatly influenced by culture, from affecting the role of the father in caregiving, to influencing parenting values and amount of time spent with children.

**Parenting process model.** Belsky (1984) outlined a process model of parenting which proposed that parenting quality was determined by multiple contextual factors. According to this model, parent characteristics including age, personality, sense of parenting competency, and attitudes towards parenting may influence parent-child interactions. As mentioned previously, child characteristics such as temperament, developmental stage, and regulatory skills may also influence parenting. Within the wider context of parenting influences, perceived social support from extended family, friends and neighbours may affect parenting by offering resources to parents such as emotional support, advice, guidance, and hands-on assistance (Belsky, 1984). These resources may reduce parenting stress and parents may in turn be more psychologically equipped to parent effectively, as well as be more available to their children.

Observations of infants’ interactions with parents experiencing psychological difficulties such as depression, for example, demonstrate that parenting is susceptible to the
psychological resources of the parent. Compared to non-depressed mothers, the interactive style of depressed mothers tends to be more intrusive, controlling, and less positive, and these mothers may respond less contingently to their infants and be less attentive to the infant’s emotional and behavioural cues (Dix & Meunier, 2009). When interacting with their depressed mothers infants often display emotional flatness, avert their gaze and are more passive (Dix, Meunier, Lusk & Perfect, 2012). Patterns of controlling or intrusive interactions may be ineffective in regulating infants’ emotions and have long-term effects on their development of self-regulation (Field, 1994). Infants of mothers with non-clinical levels of depression also demonstrate similar patterns of impaired emotion regulation (Vieites & Reeb-Sutherland, 2017).

Systems models highlight the importance of transactional processes in influencing child development and the importance of recognising the multiple contexts within which a child develops. The challenge facing researchers may be in determining a hierarchy of influences across the various interacting systems and time, on child development. These models can be applied in combination with other theories in order to capture more comprehensively the unique factors to which a child is exposed and how these experiences may influence development.

**Conclusion**

Parent-child interaction provides an important context for infant language, cognitive, and social-emotional development. Both parents and children are active participants in interaction, influencing each other’s behaviours and therefore shaping the trajectories of child development. These interactions between parent and child are also influenced by each participants’ own characteristics, as well as the wider family, economic, and cultural systems in which they are embedded. Current research is interested in
exploring and defining the elements of the child’s interactive environment (e.g., speech styles of mothers and fathers, responsive behaviours, sensitivity) and how the patterns of interaction between parents and their infants may contribute to child development.
Part 2. The Role of Fathers in Child Development

For most of its history the parenting literature has been primarily concerned with the influence of mothers on child development prompting Lamb (1975, p. 245) to refer to fathers as the “forgotten contributors to child development”. In response, fathering researchers began developing their own independent theories and researching fathers’ role in child development. This emerging literature was framed by the historical and cultural context of the time. The manner in which fathering has been conceptualised has evolved as fathers have become more involved in caregiving, from early studies which focussed on amount of father engagement and financial support, to current research which acknowledges that the quality of interactions with children is also important. Today, observational research measuring the quality of father-child interactions is considered the gold standard approach to understanding fathers’ roles in child development (Cabrera & Volling, 2019). As in the broader field of parenting research, there is no grand theory of fatherhood (Bronte-Tinkew, Carrano, Horowitz & Kinukawa, 2008) and research focusses on the different elements of the father-child interactive environment which support child development.

In light of the converging role of mothers and fathers in today’s society, as well as recognition of the influence of the complex system of influences within which a child develops, the parenting literature considers research on both mothers and fathers to provide a more comprehensive insight into the factors affecting child development (Lamb & Lewis, 2010). Research demonstrates the important and unique contribution of fathers to children’s language, cognitive and social-emotional development (e.g., Cabrera, Shannon & Tamis-LeMonda, 2007; Coley, Lewin-Bizan & Carrano, 2011; NICHD Early Child Care Research Network, 2004; Towe-Goodman et al., 2014). Scholars have proposed that
theories in developmental psychology developed within the context of the mother-child relationship may need to be reconsidered in light of the changing roles of both mother and father (Cabrera, Tamis-LeMonda, Bradley, Hofferth & Lamb, 2000). Integrating fathering research into the broader field of parenting however poses several challenges. The aim of this review is to outline the changing landscape of fathering research since its conception to the present day, to discuss theoretical issues in integrating this research within the wider parenting literature, and to summarise recent research emphasising the important role of fathers in child development.

**Changing Definitions of Fathering**

Like mothers, fathers are joyful at the birth of their newborns (Greenberg & Morris, 1974), are responsive to their infant’s cues (Ashbourne, Daly, & Brown, 2011; Parke & Sawin, 1976), alter their speech patterns when speaking with their children (Gergely, Faragó, Galambos, & Topál, 2017; Gleason, 1975), and develop attachment relationships to their infants (Lamb & Lewis, 2014). Research from neuroscience indicates that fathers may be biologically equipped for parenting, as similar to mothers, paternal caregiving displays its own neural system with associated hormones and neuropeptides (Rilling & Mascaro, 2017). Despite this propensity for caregiving, historical and cultural forces have greatly influenced the nature of fatherhood.

The role of the father in children’s lives has evolved from moral teacher during colonial times, to “breadwinner” or financial provider, and following the Depression and World War II the role became that of gender role model, primarily responsible for socialising masculinity in his sons (Lamb, 2010). The advancement of feminism in 1970s America spurred a new era of the “nurturant father” who was actively involved in caregiving (Lamb, 2010, p. 3). In other words, fathers were no longer viewed as important
solely for their financial contribution to their child’s lives or as role models but as involved
coparents (Cabrera et al., 2000). In Ireland specifically, several factors may be associated
with increased father involvement over the second half of the 20th century, including rising
numbers of women joining the work force, increased unemployment rates in the 1980s and
early 1990s, and like other western countries, changes in societal views of fathering
(McKeown, Ferguson, & Rooney, 1998).

Contemporary research acknowledges that fatherhood is not limited to narrow,
unidimensional definitions, and fathers’ multiple roles including moral guide, breadwinner,
care provider and play mate are now widely acknowledged (Lamb, 2010; Volling &
Cabrera, 2019). As definitions of fatherhood have changed, so too have conceptualisations
of how fathering should be measured and questions have emerged about the aspects of
paternal parenting which are important for child development. Today, consideration of the
different types of fathers such as those in same-gender parent families, non-resident
fathers, and fathers from different cultures, will further advance the field of fathering
research (Parke & Cookston, 2019a).

**Theoretical Viewpoints in Fathering Research**

Early parenting studies typically focussed on the mother’s influence on child
development, and key concepts in developmental psychology such as attachment theory
emphasised the role of the mother-child relationship in shaping child developmental
trajectories. This not only undermined the potential influence of other significant
interaction partners, such as fathers, but also reinforced dominant societal views of fathers’
limited and unidimensional role within the family. Precipitated by a parenting literature
which focussed solely on mothers, a template which did not necessarily capture the
experience of fathers’ parenting, fathering research emerged as a separate body of work
with its own unique constructs (Adamsons & Buehler, 2007). The brief history of empirical fathering research has also been shaped by governing societal views of fathers of the time. For instance, when fathers were viewed solely as gender role models, the major focus of the research was centred on the socialisation of masculinity in boys (Lamb, 2000). Whilst in past decades the role of fathers has received increased attention, a problem facing researchers today is integrating findings when various definitions of fathering have been utilised in the research (Ramchandani et al., 2012).

The focus of early conceptualisations of fatherhood was on involvement, referring to the amount of time spent with their child and fathers’ financial contribution to child care (Adamsons & Buehler, 2007). This focus was, in part, precipitated by the rise of single parent families. The fact that within families with absent fathers, children appeared to be doing less well developmentally led to the question of how fathers contribute to children’s well-being. Whilst early studies suggested that the absence of a male role model may adversely affect children’s development (Popenoe, 1996), evidence indicates that factors such as stress, both financial and emotional, in one-parent families and lack of support from a co-parent may diminish the quality of parent-child interaction in families (Kelly, 2012). Furthermore, exposure to conflict in the home and feelings of abandonment may also negatively impact children’s development (Lamb & Tamis-LeMonda, 2004). There is wide variability in how children fare following divorce and research has now evolved to produce a more nuanced picture of the range of factors which may influence children’s development in this context.

Progressing from simple measurements of father involvement, a significant advancement in the field of father research was provided by the framework of Lamb and colleagues (Lamb, Pleck, Charnov & Levine, 1987). The authors operationalised fathering
as comprising engagement (i.e., the amount of time spent in interaction with infant/child); responsibility (i.e., fulfilment of infant physical and childcare needs and involvement in key child-related decisions); and accessibility (i.e., the father’s availability to infant/child when not in direct interaction with them). These constructs of paternal involvement were conceptualised in acknowledgement of the father’s role in child development, which had not yet been reflected in the wider parenting literature (Pleck, 2012).

The framework of Lamb et al. (1987) however lacked clarity in terms of how the constructs should be measured and inconsistencies across studies made it difficult to interpret results (Pleck, 2010a). The component of father engagement received the widest attention from researchers, perhaps due to the ease with which it could be operationalised and measured, and the term was often used interchangeably with involvement (Pleck, 2012). These studies were often correlational and tended to lack consideration of the broader range of influences at play in children’s development (Lamb, 2000). For instance, many studies linking father involvement and child psychopathology measured only the residence status of fathers (Flouri, 2010). The framework did not refer to how qualitative features of father-child interaction may be important for child development (Adamsons & Buehler, 2007; Pleck, 2010a) and therefore the specific behaviours that fathers actually employ when interacting with their children were largely overlooked by this literature (Bronte-Tinkew et al., 2008).

Whilst early studies of father involvement were not framed by any particular theoretical framework, scholars called for theory underpinning why father involvement specifically influences child outcomes to be elucidated in order to guide further research (Marsiglio, Amato, Day & Lamb, 2000). Models such as attachment theory conceptualised in the broader field of parenting research were considered. Compared with mothers, father-
child attachment was proposed to serve unique functions. Paquette (2004) developed the concept of the activation relationship, referring to the father-child bond within which fathers encourage their child to explore the environment and take physical and social risks. This pattern of engagement may encourage confidence and risk-taking in unfamiliar situations so that children may be successful outside of the parent-child relationship. The activation relationship was considered to complement the role of the mother who provides a sense of security to the child.

Play was central to Paquette’s (2004) model of fathering. Fathers’ ‘rough and tumble play’ (RTP), patterns of physical play with their child, such as wrestling, tickling, and swinging the child, was the primary focus of the activation relationship theory (MacDonald & Parke, 1986). The high peaks of arousal during RTP were also hypothesised to assist children in developing social-emotional skills such as affect regulation and experience of interpreting emotional cues in others (Carson, Burks & Parke, 1993). Studies have shown that patterns of father-child play support child self-regulation development (e.g., Flanders, Leo, Paquette, Pihl, & Séguin, 2009; Flanders et al., 2010; St George, Fletcher, & Palazzi, 2017).

Research suggests however that although there may be quantitative and qualitative differences in mother-child and father-child play, there is little evidence to suggest this has any meaningful impact on children’s development and instead indicate that the play styles of mothers and fathers influence children similarly (Fagan, Day, Lamb and Cabrera, 2014; John, Halliburton & Humphrey, 2013). Recent research has demonstrated that both fathers and mothers engage in activation parenting (Volling, Stevenson, Safyer, Gonzalez, & Lee, 2019). Tamis-LeMonda (2004) argues that Paquette’s interpretation of father-play is overly simplistic and does not take into consideration the wider ecological framework within
which children develop. Many fathers today play a broader role than playmate to their children and may influence their development in a multitude of manners and contexts (Roggman, 2004). According to scholars, Paquette’s (2004) model is too narrow, is vague in its links to attachment theory and draws contrasts between mothers and fathers which are too extreme, and is therefore insufficient to comprehensively guide fathering research (Pleck, 2010a; Roggman, 2004).

Another theory which has widely been rejected is the essential father hypothesis (e.g., Blankenhorn, 1995), according to which the presence of a male parent plays a crucial role in child development. This theory was developed in the context of a society that viewed the father’s role in the family as that of gender role model for his children, particularly his sons, although contemporary proponents maintain that fathers’ parenting makes a unique and essential contribution to child developmental outcomes and adjustment more broadly (Silverstein & Auerbach, 1999). Silverstein and Auerbach (1999) suggested that support for the essential father hypothesis is inappropriately inferred based on oversimplified interpretations of empirical research and emphasised that it discriminates against diverse family types. Furthermore, father-child interactive behaviours shown to be important for children are evident in interactions between both mothers and fathers with their infant (Pleck, 2010b). Research suggests that children with two supportive parents may be at an advantage, and whilst having one supportive parent is sufficient for positive child outcomes, the gender of this parent is irrelevant (e.g., Ryan, Martin and Brooks-Gunn, 2006). Evidence also suggests that it is not the characteristics associated with being male that are important for children, rather parent-related characteristics are influential and that exposure to two parenting styles may also positively affect child development (Lamb, 2010).
A new framework conceptualised by Pleck (2010a) ultimately rejected these theories and offered a revision of the Lamb et al. (1987) model, which better acknowledged the multiple layers of father involvement. The core components of this revision operationalised father involvement along dimensions of fathers’ positive engagement activities with their child; warmth and responsiveness; control, as well as two auxiliary components, namely, indirect care and process responsibility. This revision emphasised the qualitative features of father-child interaction and took into account the potential mechanisms of father’s influences on child development, as well as the factors that may moderate this relationship (Pleck, 2012). This conceptualisation therefore allowed scholars to expand on the complex direct and indirect pathways of father influence on child development (Cabrera, Fitzgerald, Bradley & Roggman, 2014). This new model of father involvement was a better fit with the general field of parenting (Pleck, 2010a) and paralleled Belsky’s (1984) process model of parenting which emphasised the factors which influence parenting such as child and parent characteristics, and social context.

Current models of fathering emphasise taking an ecological approach and, in particular, highlight the importance of taking transactional processes between father and child into consideration (Cabrera et al., 2014). Research shaped by ecological models of development acknowledges the dynamic nature of father-child interaction and the importance of studying the influence of these proximal processes on child development at different points across the lifespan. Research on fathers today has advanced from measuring single binary dimensions of fathering such as absence or financial support, to investigating a wide range of fathering behaviours and the roles they play which may directly and indirectly affect multiple aspects of their child’s development (Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). Father-child interaction has therefore
become an important unit of analysis. This research shows that similar to mothers, fathers vary greatly in the quality of behaviours to which they expose their children (Leech, Salo, Rowe & Cabrera, 2013). Similar to the existing field of parenting research, a theory-driven domain-specific approach which examines the influence of particular father behaviours on specific child outcomes as well as the pathways of influence, has widely been adopted (Flouri, 2010).

**Challenges to Integrating Fields of Parenting and Fathering Research**

Fathering research has faced criticism for lacking coherence and clarity concerning the definition and measurement of its constructs across studies, and also in relation to how its findings can be integrated into the broader field of parenting (Fagan et al., 2014). Pleck (2012) emphasised the need to integrate unique constructs of fathering research conceptualised by Pleck (2010a) such as involvement, financial input, and social indirect care, with important dimensions developed in the parenting literature, as well as assessing fathers’ motivations for involvement in caregiving. This, he argued, would enrich the field of developmental psychology and broaden our insight into the range of influences on child development. There are however several difficulties to consider when attempting to integrate these two literatures.

As concepts within fathering research begin to resemble those studied within the broader parenting literature, scholars have highlighted several concerns. One major issue is that many parenting constructs were conceptualised and developed in the context of mother-child interaction and therefore may not be entirely appropriate to apply to the study of father-child interaction (Adamsons & Buehler, 2007; Lewis & Lamb, 2003; Paquette, 2004; Roggman, 2004). Questions emerge concerning whether paternal behaviours (e.g., sensitivity) manifest in the same way in father-child interaction as in mother-child
interaction (Cabrera et al., 2014), and if so whether this differs according to the developmental stage of the child (Adamsons & Buehler, 2007). Furthermore, the validity of many measures assessing these constructs has been demonstrated solely with mothers which makes it difficult to infer whether differences between mothering and fathering reported in the literature are valid or due to inaccurate measurement of paternal behaviours (Adamsons & Buehler, 2007). Measurement issues could partially explain inconsistencies in findings relating father-child interaction to child development (John et al., 2013). These concerns are important to consider when evaluating the research comparing mothers and fathers and studies investigating fathers’ influence on child development.

**The Influence of Fathers on Child Development**

In light of current conceptualisations of fatherhood and advances in methodology, a number of key questions have come to the fore. In terms of fathers’ influences on child development, researchers are interested in defining the behaviours that fathers and children demonstrate during interaction with one another and whether these are comparable or different to those displayed during mother-child interaction. The research also seeks to define the dimensions of fathering that are most important for specific child outcomes at specific developmental stages and if this differs to mothers, as well as the factors which shape how fathers interact with their children.

Research suggests that toddlerhood is characterised by an increase in father involvement in caregiving (e.g., Cabrera et al., 2007; NICHD Early Child Care Network, 2000) compared to early infancy. Despite developments in fathering research, there remains a paucity of research exploring the influence of fathers on their child’s development during this period (Ramchandani et al., 2012). Toddlerhood is a stage marked by rapid advances in many aspects of child development (Albright & Tamis-LeMonda,
2002), and given the increase in father involvement at this time, there is an impetus to fill this gap in the research (Harewood, Vallotton & Brophy-Herb, 2017). Meaningful features of fathers’ parenting may come to the fore during this period, and influence the course of future father-child interactions and child development (Bernier, Jarry-Boileau & Lacharité, 2014). This may be particularly true as toddlerhood is a period when parent-child interactions become more complex due to the child’s rapidly developing competencies (Shannon, Tamis-LeMonda & Cabrera, 2006), as they demonstrate more elaborate behaviours and a capacity for independence (Kwon, Jeon, Lewsader & Elicker, 2012). Studies of parent-child interaction at this age may therefore offer valuable insights into paternal interaction styles and the influence of paternal parenting on child development (Bernier et al., 2014).

Existing research suggests that fathers may exert a unique influence on many domains of child development including child language (e.g., Malin, Cabrera, & Rowe, 2014; Pancsofar & Vernon-Feagans, 2006; Tamis-LeMonda et al., 2004), cognitive (e.g., Baker & Vernon-Feagans, 2015; Coley et al., 2011; Harewood et al., 2017; Shannon, Tamis-LeMonda, London & Cabrera, 2002; Tamis-LeMonda et al., 2004) and social-emotional development (e.g., Ramchandani et al., 2012). A review of father involvement studies indicated that higher levels of father involvement was associated with positive effects on child development (Sarkadi, Kristiansson, Oberklaid & Bremberg, 2008). Recent studies demonstrate that the quality of father interaction may be of particular importance for children’s development, beyond the quantity of time spent (Kroll, Carson, Redshaw & Quigley, 2016; Opondo, Redshaw, Savage-McGlynn & Quigley, 2016). Whilst early research overlooked the qualitative features of father-child interactions, it may be these
characteristics that explain the benefits associated with increased paternal involvement (Easterbrooks & Goldberg, 1984; Lamb, 2010).

**Pathways of Paternal Influence**

A challenge facing researchers is to delineate the pathways of paternal influence and their relative importance for child development (Lamb, 2000). In the literature both direct and indirect pathways of fathers’ influence have been proposed, which may be more or less significant at particular developmental stages of the child (Cabrera et al., 2014). As mentioned previously, father involvement may indirectly influence child development through provision of material resources and economic support (Silverstein & Auerbach, 1999). Furthermore, research exploring indirect paternal influences suggest that fathers’ effects on mothers’ parenting behaviours have an important influence on child development over time (Tamis-LeMonda et al., 2004). Increased father involvement may, for example, reduce maternal parenting stress which has previously been linked to negative patterns of maternal parenting and may have negative implications for child development (Coley & Schindler, 2008).

As mentioned previously, the quality of specific paternal behaviours observed during father-child interaction has been demonstrated to directly affect specific domains of child development including language, cognitive and social-emotional outcomes (e.g., Tamis-LeMonda et al., 2004). High quality paternal behaviours may also have a buffering effect on child outcomes when maternal parenting is impaired (e.g., Ryan et al., 2006). In the case of maternal depression for example, father-child interaction may moderate the influence of associated negative maternal behaviours on their children (Cabrera et al., 2014). Lamb (2010) posits that it is necessary to examine both direct and indirect pathways of paternal influence on child development in order to build a clearer picture of when and
how fathers are important for child development. Approaches to understanding fathers’ role in child development must therefore adopt an ecological approach (Cabrera et al., 2014).

**Moderators of Fathering**

Cabrera et al. (2014) emphasised the importance of acknowledging the pathways of fathers’ influence on child development, as well as the factors that moderate this influence. As previously mentioned, cultural values and societal norms greatly influence father involvement (Cabrera et al., 2014) whilst at the more proximal level characteristics of the father, as well as characteristics and behaviours of the mother and child, are likely to affect the course of father-child interactions, and subsequently child development (Bronte-Tinkew et al., 2008).

**Relationship with coparent.** The quality of the marital relationship may have important implications on fathers’ involvement with their children. The literature describes that in cases of relationship breakdown, mothers may act as gatekeepers and control fathers’ access to their children (Schoppe-Sullivan, Brown, Cannon, Mangelsdorf & Sokolowski, 2008). Marital satisfaction on the other hand has been shown to promote positive father-child interactions (e.g., Bernier et al., 2014). In relation to coparenting, the father’s role in triadic interaction appears more susceptible to coparenting support than mothers’ (Palkovitz, Fagan & Hull, 2014). The authors suggest that influences on parent-child interaction may be non-symmetrical for mothers and fathers. For instance, several studies indicate that fathers’ interactions with their children may be affected by factors such as social support and relationship with spouse, which tend to affect mother-child interactions to a lesser extent (e.g., Belsky, Gilstrap & Rovone, 1984; Lamb & Elster, 1985).
Research has also suggested that fathers’ caregiving behaviour may be more susceptible to the pressures of family conflict than mothers’, referred to as the “fathering vulnerability” hypothesis (Cummings, Merrilees, & George, 2010). On the other hand, the quality of mothers’ and fathers’ parenting appears to be equally affected by other factors (e.g., sense of self-efficacy; Giallo, Treyvaud, Cooklin & Wade, 2013) and overall the evidence in favour of a fathering vulnerability is mixed (Stevenson, Volling, & Gonzalez, 2019). Overall the research suggests that there may be both similarities and differences in relation to the factors influencing mother-child and father-child interaction and emphasises the importance on taking an ecological approach to studying parent-child interaction.

**Child characteristics.** Whilst mothers tend to lead interactions with their children, it is primarily the infant that structures the course of interaction with their father, which may account, in part, for the fact that these interactions are less predictable in nature (John et al., 2013; Moore et al., 2013). Child gender may influence paternal caregiving, for instance, studies have suggested that fathers may encourage more emotional expression with girls compared to boys, parent more strictly with boys, and that advanced language skills in girls may encourage greater complexity of parent language in interactions with girls rather than boys (Conrade & Ho, 2001; Lindsey, Mize & Pettit, 1997; Vallotton & Ayoub, 2011). A recent study demonstrated that fathers used more analytical language with girls, engaged in more RTP with boys and that fathers’ patterns of brain activity showed different responses depending on child gender (Mascaro et al., 2017).

Research has also demonstrated how the child’s developing capacities, for instance, social-emotional (e.g., Flouri, Midouhas & Narayanan, 2015) and language skills (e.g., Quigley & Nixon, 2019; Schwab, Rowe, Cabrera, & Lew-Williams, 2018), can impact fathers’ behaviour. According to the transactional model of development, father and child
influence each other’s behaviours during interaction (Sameroff, 2009), which has become an important consideration for research in the field (e.g., Holmes & Huston, 2010; Jia, Kotila & Schoppe-Sullivan, 2012; Neece, Green & Baker, 2012).

**Father characteristics.** Individual characteristics of fathers may also influence paternal parenting. Research suggests for example that fathers’ cognitive resources may influence their capacity for autonomy supportive parenting (Meuwissen & Carlson, 2015). Other individual characteristics such as paternal psychological well-being have been associated with father-child interaction quality and child development. Recent research has found that new parents who experience lower levels of daily stressful experiences report a better relationship with their partner and closeness with their child (Feinberg, Jones, McDaniel, Liu, & Almeida, 2019). The literature also suggests that paternal depression increases the likelihood of children developing behavioural and emotional problems (e.g., Kvalevaag et al., 2013; Ramchandani et al., 2008). Similar to mothers, it is likely that depression in fathers affects child outcomes through its impact on the quality of paternal caregiving, which is characterised by higher frequencies of negative parenting behaviours and lower positive behaviours (Wilson & Durbin, 2010). Furthermore, paternal depression may have an indirect influence on child development by increasing marital conflict which may also affect maternal parenting (Barker, Iles, & Ramchandani, 2017).

**Similarities and Differences between Mother-Child and Father-Child Interaction**

The fathering literature emerged based on the premise that there may be qualitative differences between fathering and mothering (Adamsons & Buehler, 2007). Indeed research has shown that there may be both similarities and differences in the way mothers and fathers interact with their children (Moore et al., 2013), particularly with regard to communicative style and play behaviours (Lewis & Lamb, 2003). Studies have produced
inconsistent results however, both in terms of what interactive behaviours may be unique
to fathers and also how the behaviours of mothers and fathers during interaction may be
differentially significant for children’s development. For instance, there is some evidence
which suggests the influence of fathers’ behaviours may vary for boys and girls. Patterns of
associations between father-child interaction and child social-emotional development have
previously been found to be stronger for boys than girls, for instance (Ramchandani et al.,
2012). Boys’ language development may also be affected to a greater extent by paternal
parenting stress than that of girls (Harewood et al., 2017).

As previously mentioned, style of play is one aspect of parent-child interaction
which has received much attention in light of possible meaningful differences between
mothers and fathers (Fagan et al., 2014). It has been suggested that the stimulating nature
of father-play may make fathers’ influence on children more pronounced, regardless of
level of involvement (Lamb, Frodi, Hwang, & Frodi, 1983). Recent research has moved
beyond unidimensional characterisations of fathers’ play as rough-and-tumble and
considers how other aspects of father-child play (e.g., pretence) may support child
development (Cabrera, Karberg, Malin, & Aldoney, 2017). Findings from Cabrera and
colleagues (2017) indicated that parents’ use of pretend play is comparable between
mothers and fathers although it contributes in different ways to children’s development.
The authors demonstrated that father’s pretend play was associated with child receptive
language whereas mothers’ play was associated with child social-emotional skills. Again,
the importance of investigating specific parenting behaviours and their association with
specific aspects of child development at specific developmental stages is emphasised
(Cabrera et al., 2014).
Several scholars have hypothesized that fathers may play a unique role by acting as a “bridge” between the closely attuned interactive environment of the mother-child relationship and the unfamiliar outside world (Lamb & Lewis, 2010). This has been described above in relation to father-child play but has also been proposed by researchers studying child language development (Gleason, 1975). Whilst the body of research examining fathers’ language in interaction with their children is small compared to studies with mothers (Bingham, Kwon & Jeon, 2013), several studies suggest that although fathers and mothers produce the same quantity of speech and diversity of vocabulary (Harewood et al., 2017), the language used by fathers is often more imperative and therefore challenging for children (Leech et al., 2013; Rowe, Coker, & Pan, 2004). Furthermore, research has suggested that mothers and fathers may exert influence on different aspects of child language development (e.g., Pancsofar & Vernon-Feagans, 2006). The communicative style of fathers may encourage more child speech as well as necessitate greater reasoning by the children (Rowe, Leech, & Cabrera, 2017) whilst preparing them for interactions with others who are less attuned with the child’s communicative developmental level (Fagan & Iglesias, 2000). Differences and similarities in mothers’ and fathers’ CDS is discussed in greater detail in Chapter 1 Part 3.

Overall, investigations of the impact of parent gender on specific parenting behaviours are limited and have yielded inconsistent conclusions (Kwon, Bingham, Lewsader, Jeon & Elicker, 2013). Many studies report that mothers and fathers parent in ways that are more similar than different and that it is the quality of this parenting that is most important for children (Ryan et al., 2006; Tamis-LeMonda et al., 2004). A longitudinal study by Tamis-LeMonda et al. (2004) demonstrated no significant differences between mothers and fathers on key dimensions of parenting of warmth, sensitivity and
control. According to the ecological model of parent-child interaction proposed by Cabrera et al. (2014), the parenting styles of mothers and fathers function complementarily and synergistically to affect child development. Their influence on children may be additive in that both are contributing in important ways to development (Cabrera & Roggman, 2017). It is important to consider that although dimensions of parenting may be comparable across mothers and fathers, differences may emerge in terms of the timing, frequency and intensity with which each parent displays these behaviours (St George et al., 2017). In light of inconsistent findings across the literature, more research is needed to clarify the potential differences between mother-child and father-child interaction at different points in time, and whether these differences are significant for child development.

**Conclusion**

Historical and cultural advances have altered society’s view of fathers and the role they play in their children’s lives. Today fathers are involved interactive partners with their children who influence the course of their child’s development. The research on fathering evolved as a separate entity from the broader field of parenting research but as fathers’ and mothers’ roles in the family, as well as the behaviours they display become more similar, there is an impetus to integrate these two fields in order to advance our understanding of the wide range of factors influencing child development. A more comprehensive understanding of fathering and its effects on children is needed, especially in relation to delineating the aspects of fathering which affect particular domains of children’s psychological development. Investigating the ecological factors that shape these paternal interactive behaviours is also a key focus for future research. More broadly, if policy and interventions are to include greater emphasis on fathers, a clear presentation of the positive effects of paternal parenting on children needs to be made explicit (Sarkadi et al., 2008).
**Part 3. Child-Directed Speech in Father-Child Interaction**

Child-directed speech (CDS) refers to the patterns of speech that adult caregivers produce when interacting with young children. CDS differs from adult-directed speech (ADS) along several notable dimensions and has been documented in many languages and cultures (e.g., Broesch & Bryant, 2018; Fernald et al., 1989; Werker et al., 2007). CDS is an important communicative tool which parents use seemingly intuitively that serves a variety of important functions for the developing child. From parental speech directed at the prelinguistic infant to language input to the toddler who can string together short sentences, the form and functions of CDS adapt in tandem with the maturing capacities of the child. Research has focussed on how this special speech register contributes to child language and cognitive development in particular, but also how, as a tool of communication, it supports child social-emotional development. Whilst the majority of studies have focussed on maternal CDS, there is a body of literature which suggests that features of paternal CDS may also be important for the developing child. Finally, given the importance of CDS for children, it is important to understand the factors contributing to variation in parental speech input. The aim of this review is to provide an account of the role of CDS across early child development, to describe how different features of CDS become more or less salient to children at different stages of development, to emphasise the importance of fathers’ CDS for children’s development, and to give an overview of the literature on sources of variability in caregivers’ speech input to children.

CDS is characterised by its slow tempo, frequent pauses, heightened pitch, and exaggerated pitch contours (Cooper & Aslin, 1990). It contains frequent repetitions, simplified vocabulary and syntax, and the focus of conversation tends to be confined to a limited number of topics (Cameron-Faulkner, Lieven, & Tomasello, 2003). Interest in CDS
came to the fore during the 1970s, arising from a seminal paper by Snow (1972) which asserted that child language acquisition was not independent of the speech input from parents. This *interactionist* perspective maintained that variation in the child’s linguistic environment contributes in important ways to child language development. This diverged from the *nativist* perspective which asserted that language is an innate capacity and not dependent on speech input. This latter viewpoint was popular during the second half of the 20th century and therefore little attention had been paid previously to the features of the child’s early language environment.

Early CDS research was interested in characterising the speech to which children are exposed and how this special speech register supports child language learning. This research was aligned with sociocultural theories of language development which highlighted the importance of parent-child interaction for child development (e.g., Vygotsky, 1978). Early studies investigating how the child’s linguistic environment contributes to language development emphasised that the quantity of speech input was important for children’s vocabulary growth (e.g., Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Beyond the quantity of speech input, research subsequently turned to delineating how variation in the quality of specific features of CDS are important for child language as well as how the relative importance of these characteristics changes across early development (Rowe & Snow, 2019).

**The Form and Functions of CDS**

Research indicates that certain features of the child’s linguistic environment support their development at different points in time. Gilkerson and colleagues (2018) demonstrated that the quantity of language experienced by one-year-old children was predictive of their language proficiency ten years later (Gilkerson et al., 2018). For infants
it may also be the prosodic properties of CDS which are most important whilst for the child who has begun to produce words it may be its lexical and grammatical features. The pragmatic elements of parent-child language interactions may also serve important functions for the developing child.

**Prosodic properties of CDS.** Early CDS research focussed primarily on the acoustic features of adults’ speech to their infants. The prosodic properties of CDS differ notably from ADS and appear to be of particular salience to the prelinguistic infant. The acoustic features of parental speech rather than its linguistic content appear to serve some communicative purpose, such as conveying speaker intent or emotion (Fernald, 1993; Papoušek, Bornstein, Nuzzo, Papoušek, & Symmes, 1990) and attraction and regulation of infant attention (Fernald, 1985; Stern, Spieker, & MacKain, 1982; Werker & McLeod, 1989). Experimental evidence indicates that very young infants demonstrate a preference for CDS compared to ADS and that it is its intonational properties, and in particular the fundamental frequency (pitch) of parental speech, which appear to be driving this preference (e.g., Cooper & Aslin, 1990; Fernald & Kuhl, 1987). Into the second half of the infant’s first year, the frequent pauses, lengthening of syllables and pitch fluctuations of CDS may begin to provide infants with cues which support language learning specifically. Prosodic information contained in speech input may assist children in segmenting boundaries between words (Johnson & Jusczyk, 2001) and in learning grammar (Nelson, Hirsh-Pasek, Jusczyk, & Cassidy, 1989). According to the prosodic bootstrapping hypothesis, syntax is correlated with the acoustic properties of speech and therefore assists children in learning about the grammatical structure of language (Gleitman & Wanner, 1982).
**Lexical and syntactic properties of CDS.** Adults use shorter utterances and a restricted, simplified vocabulary with very young children compared to ADS (Henning, Striano, & Lieven, 2005; Snow, 1977). Words in parental speech input to very young children often take consonant-vowel-consonant (CVC) or consonant-vowel-consonant-vowel (CVCV) forms (Soderstrom, 2007). Mean length of utterance (MLU) is typically considered an index of language complexity, with shorter utterances perhaps indicating simpler grammatical structures (Soderstrom, 2007). A detailed analysis of maternal speech input during the infant’s first year of life demonstrated low variability in vocabulary and syntactic complexity, however, this input was rich in complex function words (pronouns, articles, conjunctions) and grammatically complete utterances (Genovese et al., 2019). The authors argued that CDS is therefore a “simplified but not simple register” which becomes more complex over time (p. 14).

Whilst simplified vocabulary and sentence structures in CDS might be useful to very young language learners, during toddlerhood parents’ increased lexical diversity, or number of novel words in parental input, and syntactic complexity are important features of CDS which support child language development (Hoff & Naigles, 2002; Hsu, Hadley, & Rispoli, 2017; Jones & Rowland, 2017; Pancsofar & Vernon-Feagans, 2010; Rowe, 2012). As previously mentioned, CDS is dynamic and its form and functions change as the child makes gains in linguistic proficiency (Snow, 1995). Parental utterances become longer and more complex in toddlerhood (Stern, Spieker, Barnett, & MacKain, 1983) and research has demonstrated that parents’ language complexity is associated with children’s own grammatical complexity (Huttenlocher, Vasilyeva, Cyerman, & Levine, 2002). By increasing the complexity of their speech according to the developmental capacities of their children, parents scaffold their child’s language learning.
Not only have specific features of CDS been documented to facilitate child language learning at specific points in development, but aspects of parental speech input such as language complexity and vocabulary diversity may also be associated with child cognitive development. Research has demonstrated bidirectional associations between the quantity and diversity of language input and child cognitive development across the preschool period (e.g., Landry et al., 2002; Song et al., 2014). According to Song and colleagues (2014), language supports children’s capacity to form categories, represent objects and reason. One important area of cognitive development during the preschool period is executive function (EF). A recent study demonstrated that maternal vocabulary diversity and language complexity were predictive of later child EF development (Daneri, Blair, Kuhn, & FLP Key Investigators, 2019). Associations between CDS and EF will be discussed in greater detail in Chapters 3 and 4.

**Interactive features of CDS.** For the preverbal infant, CDS may serve as a tool which facilitates emotional bonding between caregiver and child (Schachner & Hannon, 2011). Parents and infants engage in proto-conversations (Bateson, 1979), and respond contingently to one another’s behaviours in interaction with one another, demonstrating the early precursors to conversation and turn-taking. Recent research found that in early infancy parents alternate their speech with their infants’ speech-like vocalisations, whereas parental speech is more likely to overlap with infant cries (Yoo, Bowman, & Oller, 2018). These results indicate that during the first three months, parents are helping infants to learn about turn-taking. These bidirectional interactions between parents and children support child language, cognitive and social development (Gilkerson et al., 2017). Longitudinal research has demonstrated that controlling for quantity of input, more conversational turn-taking between parents and preschool aged children was associated with greater language
abilities 18 months later (Zimmerman et al, 2009). More back-and-forth language interactions between parents and children may help parents gauge the developmental capacities of their child and pitch the complexity of their language input within the bounds of the child’s zone of proximal development, maximising their learning potential (Vygotsky, 1978). It also gives children the opportunity to practice their emerging language skills. Work on conversational turn-taking places the child’s role in language exchanges to the fore of research.

Another interactive characteristic of CDS is use of repetition. Frequent repetition of words and phrases is an important characteristic of parental speech input (Snow, 1972), peaking when infants are half way through their first year of life and gradually declining in toddlerhood (Kaye, 1980; Stern et al., 1983). Research has demonstrated that six-month-old infants are attracted to speech containing repetition (McRoberts, McDonough, & Lakusta, 2009). Greater repetition in parental speech input in infancy is associated with greater vocabulary in toddlerhood (Che, Brooks, Alarcon, Yannaco, & Donnelly, 2017; Newman, Rowe, & Bernstein Ratner, 2016). Compared to middle childhood, two-year-olds are exposed to significantly more repetition in CDS (Snow, 1972). Experimental research demonstrates that two-year-olds learn novel words when they are repeated in successive phrases (Schwab & Lew-Williams, 2016a). Repetition indicates that the parent is following the child's lead and is a means through which parents scaffold conversation (Kilani-Schoch, Balčiunienė, Korecky-Kröll, Laaha, & Dressler, 2009). Parents also repeat their children’s utterances but recast what they have said to make it grammatically correct. Research suggests that parental feedback through recasting helps the child learn and avoid repeating their errors (Strapp & Federico, 2000).
Finally, research has highlighted the significance of parental utterances enriched with *wh*-questions for children’s development (e.g., Leech et al., 2013; Rowe et al., 2017). *Wh*-questions are considered challenging for children and may elicit children’s verbal reasoning skills. Two-year-olds who hear more *wh*-questions have greater vocabularies and produce more syntactically complex responses to this type of question (Rowe et al., 2017). These questions may also promote turn-taking in interactions between children and parents and therefore encourage child participation in conversation.

**Conceptual features of CDS.** In particular research has highlighted the significance of parental speech enriched with decontextualised language for children’s language development (e.g., Seven & Goldstein, 2019). Decontextualised language, talk which is independent from the immediate context, and for instance refers to a past or future event, is challenging for young children (Rowe, 2013). This form of speech input tends to expose children to different sentence structures and verb tenses. An intervention study demonstrated that increasing use of decontextualised language during shared book-reading led to greater back-and-forth conversation between fathers and their children (Seven & Goldstein, 2019). A longitudinal study by Rowe (2012) investigated the aspects of CDS which contributed to child vocabulary development across early childhood. Results demonstrated that at 18 months, quantity of parental input predicted child vocabulary at age two years, at 30 months vocabulary diversity predicted vocabulary at age three years, and at child age 42 months parental decontextualised language predicted child vocabulary one year later. This is one of the few longitudinal studies examining the effect of different features of CDS on child language development at different stages of development. Another longitudinal study demonstrated that parental decontextualised language used with
toddler language was associated with later language performance in adolescence (Uccelli, Demir-Lira, Rowe, Levine, & Goldin-Meadow, 2019).

**Fathers’ CDS**

Early characterisations of CDS were drawn from observations of mothers interacting with their children and CDS was often referred to as “motherese” in the literature during this period (e.g., Newport, Gleitman, & Gleitman, 1977). As this term suggests, much less attention has been paid to the forms and functions of fathers’ CDS. Overall the body of literature investigating the role of fathers’ CDS for child development is small and is mostly limited to findings drawn from shared-booking reading interactions. It was recently suggested that this gap in knowledge may indicate that the total effect of parental speech input on child language development may be underestimated in the literature (Schwab et al., 2018). Including fathers in research helps in the bid to document the full range of inputs to children’s early language environments (Tamis-LeMonda, Baumwell, & Cabrera, 2013). Studies comparing maternal and paternal CDS have however produced conflicting results. Regardless, fathers play an important role in their children’s development (Cabrera et al., 2014) and emerging evidence suggests that aspects of fathers’ CDS may have a unique impact on child development beyond the influence of maternal CDS.

A small number of early studies suggested that there may be important differences between mothers’ and fathers’ CDS. When evaluating this literature it is important to consider how the role of the father in the family has changed across time and how patterns of father-child interaction today may be characterised quite differently. Whilst historically fathers were viewed simply as breadwinners or rough-and-tumble play partners, today their role is acknowledged in research as being multi-faceted and their importance in providing
significant language experiences for their children is now recognised (Tamis-LeMonda et al., 2013). Early studies were particularly interested in delineating prosodic differences between maternal and paternal CDS. Several studies report similarities between mothers’ and fathers’ prosody when addressing their infants (e.g., Papoušek, Papoušek, & Haekel, 1987; Trehub, Unyk, Kamenetsky, & Hill, 1997), whilst other studies suggest that fathers do not modify their pitch range, or do so to a lesser extent than mothers (e.g., Fernald et al., 1989; O’Neill, Trainor, & Trehub, 2001). Warren-Leubecker and Bohannon (1984) found that mothers and fathers both display heightened pitch when addressing two-year-old children. According to this study, mothers also demonstrated this heightened pitch when addressing their five-year-old children, however, at this age fathers’ pitch was now indistinguishable from ADS.

Along with pitch modifications, both mothers and fathers produce shorter utterances and longer pauses in CDS compared to ADS (Fernald et al., 1989). Both parents also hyperarticulate their vowels in CDS, though mothers may do this to a greater extent when speaking with very young infants compared to fathers (Gergely et al., 2017). Collectively, research suggests that both fathers and mothers modify their speech when addressing their children at least into toddlerhood (Bergelson et al., 2019; Warren-Leubaker & Bohannon, 1984).

Results from a meta-analysis suggest that compared to mothers, fathers speak less overall to their infants but that this gap closes as children get older (Leaper, Anderson, & Sanders, 1998). As previously mentioned, toddlerhood is a period when complexity and diversity of language input becomes salient to child language development (Rowe, 2012). In a study comparing mothers’ and fathers’ CDS in a low-income sample, findings demonstrated that there were no differences in speech quantity, diversity, or complexity
addressed to two-year-olds (Rowe et al., 2004). Fathers did however ask more wh-questions and made more clarification requests than mothers. The literature has previously suggested that fathers’ speech may be less attuned to the developmental capacities of their children and therefore is more challenging. As mentioned in Chapter 1 Part 2, fathers’ were hypothesised to act as a bridge between the parent-child interactive environment and the more distal contexts with which a child interacts by preparing children for interactions with others who are less attuned to the child’s communicative skills (Fagan & Iglesias, 2000).

Whilst there may be few differences in fathers’ and mothers’ speech to their children, each may contribute to child development in unique ways. Fathers’ use of questions and repetition of child speech during book-reading is associated with child receptive and expressive language in toddlerhood (Teufl, Deichmann, Super, & Ahnert, 2019). Paternal repetition during book-reading and play with their two-year-olds predicted child vocabulary one year later (Schwab, et al., 2018). Fathers’ use of repetition with their toddlers is also associated with child vocabulary development, beyond the influence of mothers’ repetition (Conica, Nixon, & Quigley, 2020). A study comparing parents’ speech to their two-year-olds found that paternal, but not maternal, CDS predicted child expressive language ability one year later (Pancsofar & Vernon-Feagans, 2006). Another study compared mothers’ and fathers’ speech during a book-reading interaction, demonstrating that fathers engaged in more recasting of their child’s speech, posed more questions and provided more labels than mothers, and that these features of CDS were associated with child vocabulary (Malin et al., 2014).

Beyond the influence of maternal speech input during a book-reading task, fathers’ language complexity has been demonstrated to predict child vocabulary and problem-solving skills (Baker & Vernon-Feagans, 2015). Similarly, fathers’ vocabulary in this
context has been demonstrated to predict later child language abilities beyond the influence of mothers’ vocabulary (Pancsofar & Vernon-Feagans, 2010). A limitation of many of these studies has been the measurement of fathers’ language in one context (typically book-reading) only. It may be important to collect father-child language data from multiple contexts in order to build a comprehensive picture of children’s daily language experiences.

**Factors which Influence CDS**

The literature has consistently demonstrated the importance of mothers’ and fathers’ CDS for child development. Given wide variation in children’s early language development, it is of prime interest to researchers to delineate the factors which may shape this key aspect of parent-child interaction. Child development does not take place in a vacuum but is influenced by a host of proximal and distal factors which interact with one another to shape child developmental trajectories (Bronfenbrenner & Morris, 2006).

**Distal influences.** Broad ecological factors such as socioeconomic status (SES) and culture may influence the language children hear and engage with. These wider factors can have a cascading effect on proximal processes between parent and child (i.e., the patterns of reciprocal interactions over time).

**Socioeconomic status.** There is wide variation in the quantity and quality of parental language input to their children. A major focus of the literature has been investigating the influence of SES on children’s language environment. Maternal education for example is an important predictor of child language ability (McNally, McCrory, Quigley, & Murray, 2019). Widely publicised findings from Hart and Risley (1995) demonstrated that children from lower SES backgrounds were exposed to less language input on average than children from higher SES backgrounds. The results of this study are
commonly referred to as the ‘30 million word gap’ and findings also revealed that lower quantity of speech input was associated with poorer child linguistic ability. SES disparities can have enduring repercussions for child language development across childhood (e.g., Fernald, Marchman, & Weisleder, 2012; Pace, Luo, Hirsh-Pasek, & Golinkoff, 2017).

The existence of the ‘30 million word gap’ has however been challenged by some. Recent research suggests that rather than quantitative differences, it may be the qualitative features of CDS such as lexical diversity, complexity and turn-taking which mediate the association between SES and child language development (Gilkerson et al., 2017, 2018; Romeo et al., 2018; Schwab and Lew-Williams, 2016b), although this may depend on the developmental stage of the child (Romeo, 2019). Furthermore, there is wide variability in the quality of CDS within SES brackets which is masked by focussing solely on quantitative differences (Golinkoﬀ, Hoff, Rowe, Tamis-Lemonda, & Hirsh-Pasek, 2018; Kuchirko, 2017). A review of the literature indicated that children from lower SES backgrounds who are exposed to high quality speech input have better language skills compared to children exposed to poorer quality input (Schwab and Lew-Williams, 2016b).

Hoff (2003) demonstrated that parents’ vocabulary diversity and language complexity differed according to SES, with two-year-olds from higher SES backgrounds being exposed to higher quality linguistic input compared to their lower SES counterparts. Parents from lower SES backgrounds tend to use language which is more directive or prohibitive with children rather than language that is conversation-eliciting (Hart & Risley, 1995; Hoff, 2006). Rowe (2008) found that parents who produced more directive utterances during interaction with their two-year-olds used vocabulary that was less diverse than parents who were less directive. This study also demonstrated that the relationship between SES and CDS was mediated by parental beliefs about child development. It is
possible that parents may not be aware of the benefits of speaking with their children. Parenting interventions targeting parental knowledge of child language development however may not provide enduring results (e.g., Suskind et al., 2016).

A recent special issue on intervention research addressing the word gap (Walker & Carta, 2020) emphasises the importance of focussing on bidirectional interactions within the caregiver-child dyad during the first three years of life for children’s communication and language development (Adamson, Kaiser, Tamis-LeMonda, Owen, & Dimitrova, 2020; Ford, 2020). Parents of lower SES may have less time and resources for engaging in consistent and sensitive parenting and may be faced with a complex interaction of factors which serve to diminish the quality of parent-child interaction. It is also important to consider how systemic barriers may reduce the quality of parent-child language interactions and for intervention efforts to go beyond the level of the family and address wider structural issues facing parents from lower socioeconomic backgrounds (Ellwood-Lowe, Foushee, & Srinivasan, 2020; Kuchirko & Nayfeld, 2020).

Culture. Language learning is a culturally-specific process (Kuchirko & Nayfeld, 2019). It is important to consider that the majority of CDS research has been carried out in WEIRD (Western, educated, industrialised, rich and democratic) societies. Research on the word gap has been criticised for privileging the forms of interaction considered valuable for language-learning in Western societies without acknowledging cross-cultural differences (Kuchirko & Nayfeld, 2019). Cross-cultural research is interested in delineating the factors which support child language learning in societies where CDS is relatively rare and may offer important insights into how children acquire language more generally.
In terms of the wider cultural context that influences parent-child interaction, some research suggests that CDS is comparatively infrequent in different parts of the world, for example in Mayan communities, although speech directed at children appears to remain important for vocabulary development compared to non-directed speech (Casillas, Brown, & Levinson, 2019; Shneidman & Goldin-Meadow, 2012). A recent study demonstrated that fathers in a small island community in the South Pacific altered their speech when addressing children in different ways compared to North American fathers. They used higher pitch, whereas North American fathers did not and whilst North American fathers slowed down their rate of speech, fathers in this island community did not (Broesch & Bryant, 2018).

**Proximal influences.** Further to broad societal and cultural influences on CDS, characteristics of both parent and child may have important implications for parental speech and child language development.

**Parent characteristics.** Beyond SES and culture, it is important to consider how more proximal factors such as parenting stress and mood contribute to variability in CDS. The literature has documented a link between parental depression and child language development (e.g., Paulson, Keefe, & Leifeman, 2009) but there has been little focus on how depression impacts CDS specifically. Depressed mothers and fathers display reduced prosodic exaggeration compared to CDS typically produced by nondepressed parents (Kaplan, Bachorowski, Smoski, & Zinser, 2001; Kaplan, Sliter, & Burgess, 2007). As previously mentioned, pitch modifications in CDS may serve important functions for the developing child and reduced pitch variation in the CDS of depressed parents may therefore have negative implications for child language development (Kaplan, Bachorowski, Smoski, & Hudenko, 2002).
Beyond the prosodic features of parental language input, little research has examined how other aspects of CDS may be impacted by parental depression. The research does show that mothers with depression are less contingently responsive to their infants’ cues and capacities (Dix & Meunier, 2009), which may have implications for the quantity and quality of their CDS. Apart from depression, other factors which may influence the quality of parent-child interaction have not been examined extensively in relation to how they might impact CDS specifically. Fathers’ stress for instance may have implications for child cognitive and language development (Harewood et al., 2017) but no research has examined whether this may be accounted for through its influence on fathers’ CDS. Furthermore, little research has examined how these proximal factors may differentially influence the CDS of mothers and fathers.

**Child factors.** Child characteristics such as age and gender, as well as children’s behaviour during interaction may have important implications for the speech input to which they are exposed and their involvement in back-and-forth conversation.

**Age and gender.** One of the most important factors which shapes CDS is the child themselves. As discussed previously, parents adapt the form of their CDS according to child age (Rowe, 2012), although a review of the literature suggests this may be in response to the child’s developing language proficiency rather than chronological age (Saint-Georges et al., 2013). Associations between children’s scores on standardised language measures and parental CDS have been documented in the literature. For instance, fathers repeat words less often to children who have higher vocabularies (Schwab et al., 2018) and use more diverse vocabulary with children with greater language proficiency (Quigley & Nixon, 2019). At 24 months, a time when fathers’ pitch in CDS begins to resemble ADS, weaker child language abilities may drive continued use of this speech
modification (Quigley, Nixon & Lawson, 2019). Whereas previous research proposed that fathers are less attuned to children’s language proficiency than mothers, these findings suggest that fathers are sensitive to the language abilities of their children.

In relation to gender, girls tend to have more advanced linguistic skills compared to boys (Huttenlocher et al., 1991), which may have implications for parental speech input. One study found that pitch modifications were more exaggerated when speaking to infant girls compared to boys in Australian English, although the same effect was not observed in a Thai sample (Kitamura, Thanavishuth, Burnham, & Luksaneeyanawin, 2002). Research with preschool aged children suggests no differences in the quality of parental language input to boys and girls (Huttenlocher Vasilyeva, Waterfall, Vevea, & Hedges, 2007; Rowe, 2012).

*Dynamic behaviour during interaction.* According to the transactional model of development (Sameroff, 2009), children actively shape the behaviours of those with whom they are interacting. This includes relatively fixed factors such as child age and gender as well as more dynamic real-time factors such as vocalisations during interaction. One line of enquiry for research has therefore been to capture the real-time dynamics of CDS and characterise how parents and children coordinate their language with one another’s during the course of conversation. Previous research has demonstrated that mothers respond differentially according to the quality of infants’ prelinguistic vocalisations, for instance imitating their consonant-vowel sounds but not vowel-only sounds (Gros-Louis, Goldstein, West, & King, 2006). Infant vocalisations that are directed at objects are also associated with greater maternal responsiveness (Albert, Schwade, & Goldstein, 2018). Children who are very explorative may make more communicative bids in the form of gestures and
vocalisations, which may in turn elicit greater speech input from caregivers (Rowe & Goldin-Meadow, 2009).

Recent research comparing parental speech that was contingent and non-contingent to infant babbling found that parents simplified their lexicon and used shorter utterances in response to their infants’ vocalisations, indicating that infants evoke language from their parents that facilitates learning (Elmlinger et al., 2019). Longitudinal research indicates that parents’ contingent responses to their infant’s vocalisations and behaviour are associated with greater child vocabulary in toddlerhood (Donnellan, Bannard, McGillion, Slocombe, & Matthews, 2019). In toddlerhood, the complexity of CDS continues to be governed by child cues in real-time (Bohannon & Warren-Leubecker, 1985), for instance parental vocabulary diversity and use of repetition is sensitive to child speech during interaction (Conica et al., 2020; Quigley & Nixon, 2019). Corpora analyses also reveal that parent and child’s speech tends to be matched on measures of complexity during interaction (Dale & Spivey, 2006; Kunert, Fernández, & Zuidema, 2011; Sokolov, 1993).

**Sampling methods.** There is some evidence that the context within which interaction takes place can influence CDS, and that this might differ between mothers and fathers. Fathers and mothers may have different dispositions to engage with their children in certain contexts (Lewis & Gregory, 1987). Comparisons of mothers’ and fathers’ CDS are largely drawn from shared book-reading studies and may therefore underestimate the rich variety of speech to which children are exposed from day to day. One study which compared mothers’ and fathers’ language input across structured and free play settings with their toddlers found that both parents had higher mean length of utterance (an index of language complexity) during structured play, whereas both parents had higher type-token ratios (an index of vocabulary diversity) during free play (Kwon et al., 2013). Structured
play is goal-oriented and parents may use either directive or elaborative language in this context whereas free play may encourage more decontextualised speech as it is less tied to the here-and-now.

Another study comparing fathers’ CDS with their two-year-olds across book-reading and toy play paradigms demonstrated that fathers produced longer utterances during toy play whereas they used more diverse vocabulary and posed more questions during shared book-reading (Salo, Rowe, Leech, & Cabera, 2016). A recent study compared mothers’ CDS during book reading and toy-play across two sociocultural contexts, finding that mothers in a US sample produced more conversation-eliciting behaviours and used language which was more complex during free play whereas there were no significant differences between contexts in a German sample (Doering, Schluter, & Suchodoletz, 2019). The authors suggested that differences in child rearing beliefs and emphasis on early academic skill-building in the US may influence mothers’ CDS when playing with their children. Due to the small number of studies, it is difficult to draw conclusions regarding the role of interactive context in shaping the CDS of mothers and fathers and more research is needed across a variety of settings.

Toy type may also affect the quantity and quality of parent and child speech during play (Sosa, 2016), as well as parents’ responsiveness to their child’s vocalisations (Miller, Lossia, Suarez-Rivera, & Gros-Louis, 2017). Gender-stereotyped toys such as dolls and cars precipitate different quality language from parents, with longer and more complex utterances elicited during doll play (O’Brien & Nagle, 1987). As mothers and fathers typically demonstrate different proclivities towards playing with certain types of toys (Leaper, 2002), this may shape the language that children hear when interacting with either parent.
It is important to consider how other sampling methods may influence results. Research characterising CDS is based on observational research, corpora analyses and experimental studies. Corpora provide a rich source of data, which spans a range of languages, time-points, and adult-child as well as adult-adult conversations. The CHILDES database has a rich annotation system which allows for multifaceted analyses (MacWhinney, 2000). However, corpus data provides only samples of language and may not fully approximate the linguistic environment or abilities of interlocutors. Furthermore, the transcription method cannot completely capture the richness of interaction between speakers (MacWhinney, 1996). Lastly, different approaches are taken across corpora studies – some are derived from lab-based interactions whilst other recordings are taken in the home, some are taken between caregivers and their children whereas others are taken between unfamiliar adults and children (Cristia, 2013).

Another approach is using a small wearable recording device that produces day-long recordings and analyses of the child's linguistic environment in the home. The Language Environment Analysis (LENA) system, for instance, is a widely used tool for measuring day-long recordings. Comparisons of CDS measured using hour-long video recordings and using day-long recordings may reveal how representative certain methods are of presenting the features of CDS heard by children in daily life (Bergelson, Amatuni, Dailey, Koorathota, & Tor, 2018). However, the LENA system is limited to quantitative analyses of children's language environment (adult and child word counts and conversational turn counts). Furthermore, research evaluating LENA suggests that, compared to human coders, this system may miss more instances of speech and is less effective in tagging speakers correctly (Cristia et al., 2019). It is also important to consider how sampling methods influence comparability across different studies.
Conclusion

CDS is a dynamic feature of the parent-child communicative environment which is important for child development. Both parents and children are active participants in interaction, influencing each other’s behaviours and together shaping the course of conversation. Whilst the majority of research has been carried out with mothers, fathers’ speech input may contribute in unique and meaningful ways to their child’s development. Different aspects of CDS may support child development at specific points in time yet there is little research comparing how this may differ between mothers and fathers. There is a wide range of factors which may influence the quantity and quality of parental CDS and these factors may interact with one another and change over time. Again, research exploring individual differences in fathers’ CDS is limited. It is important to fill these gaps in order to gain a more comprehensive insight into the linguistic environment of the child and the range of inputs which help shape their development.
Chapter 2

Part 1. The Development of Executive Function during Early Childhood

The emergence of executive function (EF) as a construct in developmental psychology is relatively recent, with the past three decades witnessing a rapid growth in studies and theoretical accounts. A number of influential frameworks for understanding the structure of EF has been proposed in the literature, although considerable variation in its conceptualisation remains. Theoretical advances are further constrained by methodological limitations in the field. Despite challenges in studying EF, the construct as it has come to be understood has demonstrated consistent links with a wide range of long-term outcomes in children and adults. From a developmental perspective, researchers are interested in discerning the emergence of EF as a measurable construct and the processes by which EF evolves. As well as understanding the developmental trajectory of EF, researchers are interested in uncovering the factors that influence its development in order to explain the large individual differences observed in the EF performance of young children. With regard to sociocultural influences on EF development, research demonstrates the importance of the early parent-child interactive environment. The aim of this review is to provide a synthesis of recent conceptualisations and approaches to measuring EF during the preschool period, to sketch its developmental trajectory and outline research attempting to understand its precursors, and to highlight the importance of EF in predicting later developmental trajectories of the child.

The study of EF development is generally attributed to Luria (1966, 1980), who developed tasks which are still used in the field today. Within the past four decades renewed interest in the development of EF among preschool-aged children has grown rapidly (Müller & Kerns, 2015). Novel approaches to studying children’s EF have been
developed which have demonstrated important associations with children’s psychological
development. A precise definition of EF has however yet to be formalised in the literature.
New methods of examining the structure of EF may provide clarity which will inform
theoretical and methodological approaches to understanding EF in early childhood. This
review covers key theories and research on EF development and discusses issues which
may impede current knowledge in the field. In particular, this review will emphasise the
role of social interaction in child EF development.

**Defining Executive Function**

Early definitions of EF were developed from studies with brain lesion patients,
reflecting the abilities which were impaired following brain injury. Findings from cases
such as that of Phineas Gage, who after suffering frontal lobe damage demonstrated acute
dysfunction in behaviour regulation, led researchers to focus on areas of the prefrontal
cortex (PFC) as neural substrates of EF (Anderson & Reidy, 2012). The diversity of
deficits due to brain injury however mitigates against a coherent definition of EF.
Furthermore, developmental accounts of EF are important in order to achieve a
comprehensive understanding of the construct. Today, the EF literature can still be
considered to lack clarity. Definitions of EF across the literature have, for example, tended
to overlap with other abstract constructs such as self-regulation and effortful control (Fay-
Stammbach et al., 2014; Müller & Kerns, 2015). Inconsistent definitions of EF make it
difficult to compare and interpret findings across studies, hindering theoretical coherence
(Müller & Kerns, 2015).

Although there is little agreement over precise conceptualisations in the literature,
EF in childhood and adulthood generally refers to the set of interrelated higher-order
cognitive skills associated with prefrontal brain regions that are necessary for conscious
control over attention, thought, and behaviour (Carlson et al., 2013). There are three core skills which are typically referred to as constituting EF in adults, namely working memory, inhibitory control, and cognitive flexibility (Miyake et al., 2000). Luria (1966) proposed that EF is best understood within a hierarchical model according to which higher-order skills operate on lower level skills, exercising top-down control of thought and behaviour. Accordingly, EF facilitates engagement in goal-directed behaviour and supports adaptive problem-solving in novel and complex circumstances (Garon, Bryson & Smith, 2008). Elsewhere, EF has been referred to as “the cognitive toolkit of success” (Hendry, Jones, & Charman, 2016, p. 2).

**Why is EF Important?**

Across the lifespan, EF supports an individual’s capacity to thrive. EF permits individuals to meet goals, focus attention, delay gratification, learn, and solve problems (Diamond, 2013). In childhood, the development of EF supports independent learning, as children foster the skills to attend to task goals, plan strategies in order to problem-solve, inhibit non-goal related behaviours, as well as evaluate and adapt problem-solving behaviours if necessary (Landry et al., 2000). Another reason why interest in EF is increasing rapidly across disciplines such as developmental psychology, neuroscience, clinical and educational psychology, is that performance on EF task batteries predicts a wide range of psychological outcomes (Müller & Kerns, 2015), often beyond the influence of IQ (Zelazo, 2015). Meaningful variations in EF have been linked to individual differences in children’s development of theory of mind (e.g., Carlson & Moses, 2001), emotion regulation (e.g., Carlson & Wang, 2007), school readiness (e.g., Blair, 2002), and academic achievement (e.g., Biederman et al., 2004; Duncan, McClelland, & Acock, 2017;
Espy et al., 2004). Broadly, research suggests that EF is a critical component of children’s cognitive and emotional development (Bernier et al., 2010).

On the other hand, poor performance on child EF measures has been linked to child behavioural problems (e.g., Espy, Sheffield, Wiebe, Clark & Moehr, 2011; Kim, Nordling, Yoon, Boldt & Kochanska, 2012), financial instability, health issues, substance abuse and incarceration (Moffitt et al., 2011). Overall, research indicates that early individual differences in EF may predict a wide range of important trajectories. Difficulties with EF are also implicated in developmental disorders such as attention deficit/hyperactivity disorder (ADHD; Barkley, 1997) and autism spectrum disorder (Gardiner, Hutchison, Müller, Kerns & Iarocci, 2017). These findings demonstrate the importance of taking a developmental approach to understanding EF and how to best support its early development.

**Approaches to Studying EF**

Despite the increase in studies examining EF, the conceptualisation of this construct remains problematic. Debate within the field has primarily focussed on whether EF in early childhood is best defined as a unitary construct or whether it is better understood as comprising distinct processes (Carlson et al., 2013). An integrative framework proposed by Miyake and colleagues (2000), devised from research with adults, was particularly influential in early approaches to understanding EF in children (e.g., Garon et al., 2008). According to this model there are three core skills which constitute EF in adults, namely working memory, inhibitory control, and cognitive flexibility (Miyake et al., 2000). Briefly, working memory is essential for holding information in mind over a short delay and using it for further processing (Baddeley, 1992), whilst inhibitory control entails the suppression of automatic attentional or behavioural responses in favour of
effortful, counterintuitive ones (Garon et al., 2008). Cognitive flexibility or set shifting, builds upon the two prior components and refers to the ability to flexibly shift attention between one task - or aspects of a task - to another, according to a particular rule or goal (Diamond, 2013). There are however inconsistencies regarding the number and classification of skills comprising EF found across studies (e.g., Anderson, 2002; Fisk & Sharp, 2004).

From a developmental perspective, research suggests that EF may be better described as a unidimensional construct during the preschool period with the core skills described by Miyake and colleagues becoming discernible in later stages of development (Hughes, Ensr, Wilson & Graham, 2009; Wiebe et al., 2011; Willoughby, Blair, Wirth & Greenberg, 2010). A recent approach to delineating the components of EF has been the use of confirmatory factor analysis (CFA) on the performance of pre-schoolers on EF task batteries. However, these analyses have also produced divergent results. Research with preschool age children has tended to support either a one-factor or two-factor model of EF (e.g., Hughes et al., 2009; Karr et al., 2018; Miller, Giesbrecht, Müller, McInerney & Kerns, 2012; Schoemaker et al., 2012; Wiebe et al., 2011; Willoughby et al., 2010). A clear conceptualisation of EF has implications at both research and clinical levels in terms of the measures that are developed in order to assess EF performance, and how these results are interpreted and used to form intervention strategies (Gardiner et al., 2017). More longitudinal research using diverse samples is needed to confirm the factor structure of EF in early childhood.

Another approach to classifying EF in early childhood has been along the dimension of hot versus cool. An issue with regard to the ecological validity of typical EF assessments pertains to how well performance on laboratory-based EF tasks reflects real
life problem-solving (Ardila, 2008). Pursuit of goals is central to definitions of EF yet this is made largely redundant by performance-based measures of EF (Toplak, West & Stanovich, 2013). These lab-based tasks are typically assessed under emotionally-neutral conditions (Diamond, 2013). It has been suggested that comprehensive models of EF should not overlook the emotional and motivational aspects of goal-directed problem-solving (Carlson, 2003) and that conceptualising EF as varying along a continuum from “hot” to “cool” may be useful in circumventing this issue (Zelazo, Müller, Frye, & Marcovitch, 2003). Cool EF is measurable by cognitive tasks which are purported to elicit no emotional response in participants (Carlson & Wang, 2007), whilst hot EF is evoked by emotionally-laden assessments which elicit motivation, such as delay of gratification tasks which involve tangible rewards (Beck, Schaefer, Pang & Carlson, 2011).

Support for this distinction comes from lesion studies which suggest that performance on hot and cool tasks is associated with different regions of the prefrontal cortex (e.g., Eslinger, Flaherty-Craig, & Benton, 2004). Furthermore, research has demonstrated that individual differences in hot and cool EF predicts different domains of later child development. For instance, one study found that performance on hot EF tasks was associated with later behavioural outcomes whereas performance on cool EF tasks was predictive of child academic performance (Kim et al., 2012). Whilst the distinction between hot and cool EF offers an intriguing area for future research and theory, it poses challenges when designing tasks that are separated on this dimension, if they can be truly separated (Müller & Kerns, 2015). Deeper understanding of the relationship between cognition and emotion in child self-regulation is also needed (Carlson & Wang, 2007).
Issues with Measuring EF in Children

Theoretical progress in understanding EF development is limited by methodological challenges in the field (Anderson & Reidy, 2012). As previously mentioned, lab-based measures may lack ecological validity and give little insight into how children use EF in their day-to-day lives. Although “hot” EF tasks may be considered more representative of real world EF, attempts to design tasks separating hot and cool EF highlights the issue of task impurity, a problem often referred to in EF research.

Performance on EF task batteries is often dependent on not only EF but also the lower-order cognitive processes which EF regulates (Anderson, 2002), complicating the interpretation of findings. Many tasks place language demands on young children, for instance, which may influence performance on a given measure (Hughes & Graham, 2002). Verbal ability may also be central to EF performance. According to Vygotsky (1934/1962), language as a cultural instrument, is key to complex cognitive processing and is necessary for self-regulation of behaviour (Carlson et al., 2013). Child verbal ability has demonstrated consistent associations with EF performance (e.g., Carlson, Mandell & Williams, 2004; Carlson & Moses, 2001; Fuhs & Day, 2011) however, the mechanisms through which language promotes EF performance are not well understood (Matte-Gagné & Bernier, 2011).

With regard to CFAs, factors derived from such analyses are necessarily limited by the tasks included in the battery, which often differ between studies and demonstrate little agreement on what component of EF each is actually measuring (Miyake et al., 2000). This may explain inconsistent findings in the literature in relation to the number and composition of EF components (Carlson, 2003). Finally, low reliability of EF measures may also influence findings. For instance, a prerequisite of performance-based EF
measures is that they are novel, which creates problems with assessing test-retest reliability (Miyake et al., 2000). Furthermore, many task batteries are age-dependent such that tasks used with pre-schoolers, for example, may not be suitable for slightly older children, making comparisons across age groups difficult (Best & Miller, 2010). Lastly, studies often use wide age brackets which may mask subtle developmental changes in EF structure (Howard, Okely & Ellis, 2015).

**Developmental Trajectory of EF**

Despite conceptual and methodological challenges, a significant body of research has allowed researchers to sketch a coherent account of EF development in early childhood. It was long maintained that EF did not emerge until adolescence, however evidence now suggests that rudimentary EF begins to develop during the first year of life (Kraybill & Bell, 2013). Acknowledgement of the goal-directed activity of infants contributed to research regarding the emergence and development of EF (Anderson & Reidy, 2012) and infants’ emerging sense of agency is believed to motivate the development of cognitive control (Kopp, 1982). There are however few tasks to test emergent EF in infancy and toddlerhood (Garon et al., 2008). One popular measure is the A-not-B task (Espy, Kaufmann, McDiarmid & Glisky, 1999). In the first phase of the task infants observe an item being hidden at location A and are required to retrieve it during several trials. In the second phase infants view the object being hidden at a new location - location B - and must subsequently retrieve it. Infants under twelve months tend to perseverate in searching for the object at location A (Diamond, 1985). This perseveration is attributed to infants’ immature EF. Infant gaze and reaching are used to measure performance on this task, however, some studies have shown discrepancies in infants’
performance depending on which modality is assessed as well as biases to reach or gaze in a particular direction (e.g., Hofstadter & Reznick, 1996).

According to Garon and colleagues (2008), rudimentary EF skills develop in infancy and the preschool age marks a period of integration and coordination of these skills. It is well-documented that at approximately three years of age children’s EF skills begin undergoing rapid development (Garon et al., 2008; Montroy, Bowles, Skibbe, McClelland, & Morrison, 2008) and there has been a much greater emphasis on the development of executive processes during the preschool period (e.g., Carlson, 2005; Hughes & Ensor, 2005; Willoughby et al., 2010) compared to other stages of development in childhood. This has also precipitated the establishment of developmentally sensitive measures with which to assess EF among this age group (e.g., Willoughby et al., 2010; Carlson, 2005).

Between three and five years of age, children show age-related improvements in the number of items they can retain in memory (e.g., Carlson, 2005; Garon et al., 2008). Backward span tasks are frequently used for assessing an individual’s working memory ability. This task requires a sequence of numbers be stored and recalled in the reverse order to which they were presented (Davis & Pratt, 1995). Carlson (2005) demonstrated dramatic improvements in performance on a backwards digit span from ages three to four years and further improvements from ages four to five years. Carlson (2005) also demonstrated similar patterns of improvements in tasks designed to measure children’s inhibitory control. Longitudinal research has demonstrated that the length of time children were able to tolerate on delay of gratification tasks increased linearly between 22 - 56 months (Kochanska, Murray & Harlan, 2000; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). Carlson (2005) reported similar results from a cross-sectional study
among children aged two to four years. Three-year-olds struggle however with tasks
designed to measure cognitive flexibility and continue to show improvements in this skill
beyond age five years (Zelazo, 2006). Performance on EF tasks continues to improve in
school-age children and into adolescence and demonstrates subsequent decline in older
adults (Cepeda, Kramer, Gonzalez de Sather, 2001).

Functional neuroimaging studies help elucidate the associations between
maturation in certain regions of the brain and the development of EF. Whilst studies with
children are scarce due to the challenges associated with carrying out this type of research
with this age group (Anderson & Reidy, 2012), existing research suggests that myelination
and changes in white and grey matter volume underlie the development of higher-order
cognitive functions (Johnson, 2001). Furthermore, improvement in EF tasks in preschool
age children has demonstrated associations with increased activation in the inferior
prefrontal region of the brain (e.g., Moriguchi & Hiraki, 2011) as well as age-related
increases in activation of brain areas important for task performance and decreases in
activation of task-irrelevant brain regions, which is similar to adult patterns of brain
activity (e.g., Durston et al., 2006). Improvements in EF may therefore be related to
specialisation of function in specific regions of the brain and associated increased
efficiency of processing (Carlson, et al., 2013). It is also recognised that extensive
connections across the brain are necessary for PFC functioning (Heyder, Suchan & Daum,
2004), and that EF relies on circuitry across the brain (Blair, 2016). Finally, whilst brain
maturation may support EF development, it is important to recognise that psychological
processes such as EF cannot be reduced to activity in the prefrontal cortex (Müller &
Kerns, 2015).
Developmental Theories of EF

Developmental models are needed in order to establish a comprehensive theory of EF (Garon et al., 2008), as well as to understand normal trends in its development and inform intervention. A number of theoretical approaches to understanding EF and its development have been proposed in the literature. These developmental accounts attempt to explain why younger children have difficulties with EF tasks and the processes by which age-related improvement occurs. One EF task in particular, the Dimensional Change Card Sort (DCCS; Zelazo, 2006), has been the focus of these accounts. This task requires children to first sort cards according to a particular dimension (e.g., colour) and then switch to sorting the cards using a different dimension (e.g., shape). Three-year-old children have difficulty switching to the new rule and perseverate in sorting cards by the first dimension whilst by age four years the majority of children have mastered this ability (Zelazo, 2006).

Proponents of working memory accounts of EF (e.g., Engle, 2002; Morton & Munakata, 2002) postulate that development of working memory underpins improvement on EF tasks (Carlson et al., 2013). Morton and Munakata’s (2002) neural network model of EF development, for instance, emphasises the role of working memory in explaining why children perseverate on tasks such as the DCCS by drawing a distinction between latent memory traces in which preswitch rules are held, and active memory representations of the postswitch rule which must override the previously relevant rule. According to this model, prefrontal development underpins the strengthening of active memory representations necessary to overcome conflicting latent memory traces. Inhibition accounts (e.g., Dempster, 1992; Diamond, 2013), on the other hand, maintain that the development of inhibitory control underlies advances in EF. According to these accounts, young children’s perseveration is not due to an inability to remember the new rule, but rather an inability to
overcome the prepotent response built up in the preswitch phase (Carlson et al., 2013). Critics of this approach argue however that inhibition accounts do not sufficiently interpret how correct switching is achieved and have suggested combining working memory and inhibition accounts into an interactive framework (e.g., Roberts & Pennington, 1996).

An alternative approach is the cognitive control and complexity theory (CCC) proposed by Zelazo and colleagues (Frye, Zelazo, Burack, 1998; Zelazo & Frye, 1998), which is a functional account of EF that defines EF and its subfunctions in relation to the role they play in goal-directed problem-solving (Zelazo et al., 2003). The CCC account emphasises qualitative changes in how children can represent information and integrate complex, higher order rules as underlying success on EF tasks (Zelazo et al., 2003). With regard to the DCCS, young children can sort cards according to the preswitch dimension as well as understand the new rule, but their perseverance on postswitch trials is attributed to their inability to reflect on and unify incompatible elements of knowledge into one higher complexity rule system.

Müller & Kerns (2015) argue that these accounts are not comprehensive and often do not trace the development of EF outside of the preschool period. Furthermore, whilst these accounts differ in their explanations of how developmental change enables children to succeed on tasks such as the DCCS, little attention is paid to the quantitative advances in the basic skills underlying EF in explaining patterns of EF development. A review by Hendry and colleagues (2016) demonstrates how individual differences in infants’ capacities for selective attention, processing speed and self-regulation predict emergent EF in toddlerhood. More research examining the developmental foundations of EF is required (Müller & Kerns, 2015).
Contextual Influences on EF development

The approaches to EF discussed previously make little reference to contextual factors that may influence the developmental trajectory of EF (Müller & Kerns, 2015). Substantial individual differences in EF development are noted in the research, which is particularly evident in young children (Anderson & Reidy, 2012). Genetic approaches demonstrate that EF is highly heritable (e.g., Friedman et al., 2008), however evidence from cognitive training intervention studies attests to the malleability of child EF skills (e.g., Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008; Riggs, Greenberg, Kusché & Pentz, 2006; Thorell, Lindqvist, Bergman Nutley, Bohlin & Klingberg, 2009).

Consideration of the broad range of influences on child development is consistent with the bio-ecological model of human development (Bronfenbrenner & Morris, 2006), and researchers are interested in discerning the relative importance of different sources of influence on EF (Blair, 2016) as well as how the complex interactions between these factors may influence development (Fay-Stammbach et al., 2014). Socioeconomic status, for example, is a well-established risk factor for child EF development (Lawson, Hook, & Farah, 2017; St. John, Kibbe, & Tarullo, 2019). One major focus of recent research has been investigating the role of proximal factors such as interactions between parent and child, on child EF.

Parent-child interaction and child EF development. Due to the timeline of EF development, current research has shifted its focus to the role of proximal social factors, specifically the quality of parent-child interactions, in attempting to explicate observed individual differences in EF (Lewis & Carpendale, 2009). Research investigating the role of parent-child interaction in EF development draws influence from the writings of Vygotsky (1978) and Luria (1966, 1980), who emphasised the pivotal role of social
interaction in cognitive development. Due to the protracted nature of EF development, it is believed to be particularly susceptible to input from the early interactive environment (Bernier et al., 2010). Theoretically, parents initially serve as external regulators of the child’s thought and behaviour (Bernier et al., 2010), and directly support the internalisation of these skills through warm and sensitive parenting (Kochanska & Aksan, 1995). Furthermore, evidence suggests that high quality parenting affects child EF development by influencing brain development, particularly through regulating the child’s stress-response system (Blair et al., 2011). A more detailed account of specific parenting behaviours and the mechanisms through which parent-child interaction is proposed to facilitate EF development is provided in Chapter 2 Part 2.

A significant body of research indicates that the quality of parent-child interaction may predict child EF performance. Parental behaviours which have demonstrated associations with child EF development include responsiveness (e.g., Bernier et al., 2010; Kochanska et al., 2008), positive affect (e.g., Kraybill & Bell, 2013), scaffolding (e.g., Bibok et al., 2009; Hammond, Müller, Carpendale, Bibok & Liebermann Finestone, 2012; Hughes & Ensor, 2009) and child-directed speech (e.g., Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). On the other hand, evidence suggests that chaotic family structure and controlling behaviours are associated with poor EF outcomes (e.g., Hughes & Ensor, 2005). The relationship between SES and child EF may also be mediated by the quality of parent-child interaction (e.g., Daneri et al., 2019). Parents from lower SES households may face high levels of stress and lack the resources to provide consistent, high quality and responsive parenting to their children.

According to Belsky’s (1984) process model, child and parent characteristics are also likely to moderate parenting influences on child EF development. Different
dimensions of parenting may be important predictors of EF depending on the child’s developmental stage (Carlson, 2009). For instance, Landry and colleagues (2000) demonstrated that during toddlerhood, directive parental utterances supported cognitive development, whereas at age three years this type of utterance was negatively associated with child cognitive outcomes. In relation to parent characteristics, apart from being highly heritable, parental EF may also influence parenting behaviours and parents’ abilities to serve as external regulators of their child’s thought and behaviour, which in turn may influence the course of child EF development (Deater-Deckard, 2014).

In summary, research indicates that the child’s developing capacity for self-regulation is supported by parents who are responsive to their child’s cues and who provide opportunities for children to practice their emerging EF skills within a supportive environment (Carlson, 2009). The literature emphasises the importance of taking a broad range of influences on child EF into consideration. A task for future research is to further understand the role of fathers in supporting child EF development, as the majority of studies described above pertain to interactions between mother and child.

Conclusion

Despite the rapid increase in EF research, theoretical approaches to understanding the structure and development of EF remain incomplete in this relatively new field of study. Methodological challenges to studying EF may constrain progress in this regard. Regardless of theoretical and methodological limitations, research has documented consistent associations between early EF and diverse aspects of later psychological functioning. Research has demonstrated that proximal social factors may underpin wide individual differences seen in preschool-aged children. Findings emphasise that the quality
of parent-child interactions may play a key role in shaping the course of child EF development during the preschool period.
Part 2. The Influence of Parenting on Children’s Executive Function Development during the Preschool Period: A Narrative Review

Current research aims to elucidate the developmental timeline of EF during early childhood, as well as uncover the factors which shape its development. Given its protracted trajectory, EF development may be particularly susceptible to input from the environment (Garon et al., 2008). In light of the central role of parents in the lives of young children, the role of parent and child processes during interaction has become an important focus of the EF literature (Best & Miller, 2010). This research is framed by sociocultural theory, which emphasises the pivotal role of social interaction in the development of higher order cognitive functions (Luria, 1966, 1980; Vygotsky, 1978). The current review discusses associations between specific features of parent-child interaction and individual differences in child EF development during the preschool period. The mechanisms through which these aspects of parenting are proposed to support EF development are also outlined, as well as parent and child factors which may moderate these associations. Recent studies emphasising fathers’ contributions to child EF development are also discussed. Finally, limitations of past research are considered with an emphasis on future directions that may benefit the field of study.

The body of literature attesting to the role of parent-child interaction in child EF development during the preschool period continues to expand. A systematic review carried out by Fay-Stammbach and colleagues (2014) included 23 studies. The present review aims to add to this review by including studies published between 2014-2020 and will also refer to the key findings of studies included in the article by Fay-Stammbach and colleagues. Databases included in the search were PsychInfo, PsychArticles, ScienceDirect, and Web of Science. These databases were used to search the terms “executive function” and “parenting” and “preschool”. Similar to the review by Fay-
Stammbach and colleagues (2014), only studies which involved observational measurement of parenting behaviours, had child executive function as an outcome measure, and were drawn from typically-developing samples were included.

**The Influence of Parenting Quality on Child EF Development**

Both cognitive and affective aspects of parenting behaviours may be related to child EF development (Devine, Bignardi, & Hughes, 2016). Carlson (2003) proposed that three parenting behaviours in particular are likely to influence the development of child EF during the preschool period, namely, sensitivity, mind-mindedness, and scaffolding. Fay-Stammbach and colleagues (2014) operationalised parenting quality along four dimensions - sensitivity/responsiveness, scaffolding/autonomy-support, cognitive stimulation, and control. This review presents the findings of previous studies in relation to the dimensions of parenting proposed by Carlson (2003) and Fay-Stammbach and colleagues (2014), as well as recent findings pointing to the role of child-directed speech (CDS), and discusses how this research has contributed to current understanding of the development of child EF.

**Sensitivity.** Parental sensitivity refers to caregivers’ capacity to perceive and accurately interpret the behaviour of their child, and to respond appropriately and promptly to this behaviour (Ainsworth, Bell, & Stayton, 1971). According to attachment research, parents initially serve as external regulators of their infant’s affect and cognition (Bernier et al., 2010) and directly support the internalisation of self-regulation skills through warm and sensitive parenting (Kochanska & Aksan, 1995). The child’s experience of sensitive and responsive parenting creates a predictable environment which permits young children to form rudimentary rule-based expectations about interactions with others (Carlson, 2003). Furthermore, sensitive and responsive caregiving may contribute to the child’s emerging sense of their own impact on the world around them (Bernier et al., 2010),
perhaps furnishing them with an awareness of their own behaviour and capacity for regulation, as well as motivating young children to exert cognitive control over their behaviour (Kopp, 1982).

Finally, Carlson (2003) suggested that sensitive parenting may act as a buffer against environmental stress which is associated with deficits in EF. Physiological responses to stress, particularly hormonal reactions, can alter the synaptic activity in the prefrontal cortex, an area of the brain strongly associated with EF (Blair et al., 2011). Blair and colleagues (2011) demonstrated that among a sample of low-income mothers, lower levels of sensitivity and positive regard when interacting with their child at age seven, fifteen and twenty-four months were associated with lower child EF at age three years. This association was partially mediated by higher child salivary cortisol (a stress hormone) levels. Low SES is a well-established risk factor for deficits in child EF (Lawson et al., 2017; St. John et al., 2019). Other studies have found that higher parental sensitivity may support child EF development in high-risk samples (e.g., Merz, Landry, Montroy, & Williams, 2017; Sulik, Blair, Mills-Koonce, Berry, & Greenberg, 2015).

Longitudinal research has demonstrated associations between sensitive caregiving and child EF during the preschool period (e.g., Bernier et al., 2010; Frick, Forslund, & Brocki, 2019; Towe-Goodman et al., 2014). Several of these studies examined a range of parenting behaviours rather than the role of sensitivity on child EF in isolation and operationalisations of sensitivity have differed across studies. Bernier and colleagues (2010) compared the relative influence of parental sensitivity, scaffolding, and mind-mindedness on child EF. The authors measured maternal sensitivity using the Maternal Behaviour Q-Sort (Pederson & Moran, 1995) during interaction when their infants were 12-15 months old and found a modest significant association with child EF performance at
age 26 months. Another study compared maternal and paternal parenting quality using the adapted NICHD global rating scales (NICHD ECCRN, 1999), and demonstrated that mothers’ and fathers’ sensitive parenting (a composite of sensitivity/supportive presence, detachment/disengagement, stimulation of cognitive development, positive regard, and animation in interacting with the child) at 24 months was associated with child EF performance at age three years (Towe-Goodman et al., 2014). Finally, evidence from intervention studies supports the role of sensitive parenting for child EF development (Lunkenheimer et al., 2008; Landry et al., 2017), although a study by Merz and colleagues demonstrated limited effects of an intervention designed to increase parental sensitivity on child EF (Merz, Landry, Johnson, Williams, and Jung, 2016a).

**Intrusiveness.** Parental intrusiveness, defined as parenting behaviours which do not follow the child’s lead and are often accompanied by negative parental affect and overstimulation (Rhoades, Greenberg, Lanza, & Blair, 2011), may be associated with poorer child EF performance. Cuevas and colleagues (2014) demonstrated that maternal intrusiveness was associated with lower EF performance at child age three years. The authors found that intrusiveness and negative affect influenced child EF performance at 36 months but not at 24 months, suggesting that EF development may become more susceptible to the influence of negative parenting as children get older. In a study of high-risk children, the association between child EF and combinations of socioeconomic risk factors such as income and single parenthood, was partially mediated by maternal negative intrusiveness (Rhoades et al., 2011).

Research has however demonstrated cultural variation in the effects of parental intrusiveness on child EF. The study by Rhoades and colleagues (2011) for instance found a negative association between maternal intrusiveness and child EF among White families...
but not African American families in their high-risk sample. A more recent study however found that high maternal intrusiveness was associated with poorer EF among African American pre-schoolers (Holochwost, Volpe, Iruka, & Mills-Koonce, 2018). In a South Korean sample, no significant effect of intrusiveness on EF was observed (Lee, Baker, & Whitebread, 2018), suggesting in some cultures this style of parenting may be relatively normative and does not show the same negative pattern of influences on child development. Finally, a study comparing maternal and paternal intrusiveness demonstrated that children displayed more positive affect during intrusive interactions with fathers than mothers (Karberg, Cabrera, Malin, & Kuhns, 2019). These studies highlight the importance of considering child interpretations of parental behaviours during interaction and subsequent implications for children’s development.

**Mind-mindedness.** Parental mind-mindedness refers to parents’ tendency to verbally label and refer to their child’s mental states during interaction (Meins, 1997). Research has demonstrated that parents vary in the amount they infer and talk about their child’s likes and dislikes, their emotions, desires, thoughts and beliefs and the extent to which these comments are attuned to the child’s ongoing behaviour (e.g., Meins, Fernyhough, Fradley, & Tuckey, 2001). Mind-mindedness is considered to promote child conscious awareness of their own behaviours, the effects these behaviours have on the world around them, the effectiveness of their problem-solving strategies when attempting to achieve a particular goal, and therefore contribute to children’s conscious control over their behaviour (Bernier et al., 2010; Zelazo, 2004). Bernier and colleagues (2010) proposed that mental state talk becomes internalised by children, providing them with the verbal tools to reflect on and appraise their own behaviour.
Whilst the literature regarding mind-mindedness and child EF during the preschool period is relatively sparse, several studies suggest that this dimension of parental speech during interaction with their child promotes the development of higher order cognitive processes (Baptista et al., 2017; Bernier et al., 2010; Cheng, Lu, Archer, & Wang, 2018; Gagné, Bernier, & McMahon, 2018). One study demonstrated however that maternal emotion-focussed language was associated only with child inhibitory control on an emotion-themed EF task but not a purely cognitive task (Kahle, Grady, Miller, Lopez, & Hastings, 2017). Given the emphasis on emotions, it is possible that parental mind-mindedness may be particularly beneficial for the development of “hot” EF, although more research is needed to clarify the mechanisms through which mental-state talk supports child EF development.

**Scaffolding.** The most consistent finding across the literature is that the quality of parental scaffolding supports child EF development (Fay-Stammbach et al., 2014; Valcan, Davis, & Pino-Pasternak, 2018). Scaffolding, often used synonymously with autonomy support, refers to the processes by which caregivers support their child’s activity in order to successfully perform a task that is too challenging to complete alone (Wood, Bruner, & Ross, 1976). According to Wood and colleagues (1976), caregivers scaffold their child’s activity by recruiting or maintaining the child’s task-directed focus, organising the task into simpler individual components, emphasising features of the task which the child can use to problem-solve, and by demonstrating how to complete the task. In other words, scaffolding is purposeful behaviour carried out by the parents geared towards facilitating the goal-directed activity of the child (Hughes & Ensor, 2009). Scaffolding is elicited in problem-solving contexts, which, compared to other parenting behaviours, may directly support the child in scenarios requiring EF skills (Carlson, 2009).
Within a problem-solving context, parental scaffolding fulfils many of the roles of EF (Bibok et al., 2009) and has been described as external and auxiliary “other regulation” provided by caregivers to their children (Landry et al., 2002, p.16). Skills associated with EF such as planning and organising activity, evaluating the effectiveness or ineffectiveness of this activity, and maintaining focus on the goals of the task are partially or entirely fulfilled by the parent in scaffolding interactions (Freund, 1990). This affords children opportunities to practice and gradually internalise these skills (Bernier et al., 2012). Socio-cultural theory suggests that children are exposed to and learn the skills needed for independent functioning within the context of social interaction, and that these skills become gradually internalised by the child (Landry et al., 2002). Scaffolding interactions also provide experiences of successfully completing complex tasks, promoting a sense of self-efficacy and achievement which can contribute to positive attitudes towards future problem-solving (Bandura, 1977a).

A substantial number of cross-sectional studies (Bibok et al., 2009; Distefano, Galinsky, McClelland, Zelazo, & Carlson, 2018; Hopkins, Lavigne, Gouze, LeBailly, & Bryant, 2013; Meuwissen & Carlson, 2015; Schneider-Hassloff et al., 2016; Suor, Sturge-Apple, Davies, & Jones-Gordils, 2019) and longitudinal studies (e.g., Bernier et al., 2010; Bindman, Hindman, Bowles, & Morrison, 2013; Bindman, Pomerantz, & Roisman, 2015; Devine et al., 2016; Hammond et al., 2012; Hughes & Ensor, 2009; Hughes & Devine, 2017; Kahle et al., 2017; Marcisko et al., 2019; Matte-Gagné, Bernier, & Lalonde, 2015; Meuwissen & Carlson, 2018) have demonstrated that higher quality parental scaffolding is directly related to higher EF performance in preschool children. Bernier and colleagues (2010) demonstrated that scaffolding was the strongest predictor of child EF performance during the preschool period, compared with maternal sensitivity and mind-mindedness.
Other research has also shown that early autonomy support during infancy is of particular importance to EF development, whereas measures of maternal autonomy-support at preschool age did not predict concurrent child EF (Matte-Gagné et al., 2015). This may reflect the changing salience of particular parental behaviours at different stages of development. Cross-cultural research also supports a relationship between parental autonomy-support and child EF development (e.g., Cheng et al., 2018; Lee et al., 2018; Sun & Tang, 2017).

Studies investigating the relationship between this feature of parenting and child EF development have however differed in their operationalisation of scaffolding, particularly with regard to the inclusion of both verbal and physical components of scaffolding and the timing of these behaviours. A cross-sectional study by Bibok and colleagues (2009) concluded that it was variation in the timing of maternal scaffolding utterances with regards to the child’s task-directed behaviour that predicted child EF. The authors proposed that the timing of parental scaffolding utterances in relation to the child’s activity facilitates the internalisation of EF skills and enables the child to better relate their present activity to particular outcomes, therefore assisting them in associating correct behaviours to successful outcomes, or prompting them to switch their activity to a new behaviour when they are incorrect.

Furthermore, whilst many of these studies demonstrated a direct association between parental scaffolding and child EF development, other studies have demonstrated that the influence of parental scaffolding on child EF may be mediated by child verbal ability (Hammond et al., 2012; Landry et al., 2002; Matte-Gagné & Bernier, 2011). It has been suggested that increased language competency may assist child verbal representations of task challenges and possible solutions, and in this way support EF performance (Landry
et al., 2002). Vygotsky (1934/1962) also proposed that children’s use of private speech increases their proficiency for cognitive control. Hammond and colleagues (2012) found that child verbal ability mediated the influence of scaffolding measured at age two years on EF at age four years, whereas scaffolding measured at age three years exerted a direct influence on later child EF, indicating that the mechanisms by which parental scaffolding affects EF development may change over time. Matte-Gagné and Bernier (2011) demonstrated that verbal ability only mediated the relationship between maternal scaffolding and impulse control EF and not the relationship between scaffolding and working memory and set shifting. These results suggest that scaffolding may support the more cognitive components of EF. It is important to note that studies which have found that verbal ability mediates the effect of parental scaffolding on EF have tended to use verbal measures of scaffolding (Hughes & Devine, 2017).

According to social learning theory, children learn by observing, imitating and modelling the behaviours of others (Bandura, 1977b). Some experimental research has been conducted investigating the social transmission of EF behaviours. Moriguchi, Lee and Itakura (2007), using a modified version of the Dimensional Change Card Sort (DCCS) EF task, demonstrated that observing an adult complete this task prior to child testing had a significant effect on children’s subsequent performance. In one condition the adult researcher made purposeful errors when sorting the cards, yet expressed confidence in their activity. Children in this condition were more likely to commit sorting errors compared with the condition in which the model expressed uncertainty with her sorting choices, emphasising the role of social cues in explaining children’s subsequent performance. Similar findings have been reported using a range of EF tasks (e.g., Lewis and Carpendale, 2009; Moriguchi, 2012).
In a similar vein, Hughes and Ensor (2009) used a novel task (the six things task) in which children observed their mothers performing a task designed to measure maternal planning. Mothers were required to complete six tasks such as wrapping objects, and sorting items by colour, within six minutes and were not permitted to complete similar tasks consecutively. This task was coded for mothers’ tactical approaches to the tasks as well as for the time within which each was completed. The results demonstrated an association between maternal planning and child performance on EF tasks at age four years. The authors highlighted that whilst traditional emphases on parental scaffolding capture parent behaviour in a context of deliberate instruction, the imitative learning model may capture everyday parental behaviours that support EF development. Hughes and Ensor (2009) suggest that imitation of these behaviours related to problem-solving may build up children’s skills and support the development of EF.

**Control.** Parental controlling behaviours may also be elicited during joint problem-solving tasks. Control refers to the degree to which parents take over the task, intercede with an inappropriately high level of help or criticise the child’s attempts. High levels of parental control (i.e., the extent to which parents direct their child’s activity) may undermine the child’s attempts to problem-solve and diminish their emerging sense of volition and self-efficacy (Blair et al., 2011). Research has demonstrated that parents’ controlling behaviours and use of highly directive language is associated with poorer child EF (Bindman et al., 2013; Devine et al, 2016; Hughes & Devine, 2017; Meuwissen and Carlson, 2015). Directive or controlling interactions may limit children’s opportunities to practice and internalise emerging EF and have long-term consequences on the development of this set of cognitive skills.
**Cognitive stimulation.** Parental cognitive stimulation refers to parental activities during interaction which aim to teach or enhance a child’s cognitive skills (NICHD Early Child Care Research Network, 2005). This includes engaging children in educational activities and games, and reading to children, which provide opportunities for children to practice problem-solving and self-regulation skills (Clark et al., 2013). The Early Childhood Home Observation for Measurement of the Environment (EC-HOME; Caldwell & Bradley, 1984) scale for measuring parental cognitive stimulation includes items measuring parental language intended to promote child verbal ability and intellectual development such as teaching the alphabet and colours, parental modelling of behaviour, appropriate discipline, as well as features of the home learning environment such as number of books and educational toys in the home.

Clark and colleagues (2013) demonstrated that the quantity of parental language and cognitive stimulation was associated with greater child inhibition and cognitive flexibility. Other research has however demonstrated that the association between cognitive stimulation and child EF disappeared once verbal ability had been controlled for (Dilworth-Bart, 2012). Hughes and Devine (2017) recently demonstrated that parental scaffolding and control were specifically related to children’s EF development, and that quality of the home learning environment and parental language were associated with both child EF and verbal ability, indicating that these features of parenting may support children’s development more generally.

**Child-directed speech.** Recent research has focussed on the role of child directed speech (CDS) in supporting child EF development. As previously mentioned, several studies have demonstrated that associations between certain aspects of parenting and EF may be mediated by the child’s own language ability. Despite strong theoretical
associations between child language and EF (e.g., Vygotsky, 1934/1962; Zelazo et al., 2003), little research has examined the role of parental CDS and child EF development. A recent study demonstrated that maternal language diversity (i.e., the number of unique words spoken by the mother) during a book-reading task at 24 months and maternal language complexity (mothers’ mean length of utterance) at 36 months predicted child EF at 48 months (Daneri et al., 2019). The authors suggested that maternal language input may support child vocabulary, which previous research suggests is highly correlated with EF performance. Alternatively, Daneri and colleagues propose that greater exposure to the rules of language may support children’s performance on rule-based EF tasks. A study by Hughes and Devine (2017) however found a negative association between parental language complexity and child EF. More research on the role of CDS in child EF development is needed to clarify these divergent findings.

The Influence of Fathers on Child EF Development

Whilst the focus of the majority of studies included in the review carried out by Fay-Stammbach and colleagues (2014) outlined the associations between maternal parenting behaviours and child EF development, several recent studies have demonstrated that fathers may offer unique contributions to their young child’s emerging EF capabilities. Interest in the elements of the father-child interactive environment which support child development is particularly salient in light of the changing role of fathers, who today often spend as much time with their infants as mothers (Cabrera et al., 2000). The arousing and challenging patterns of interactions between fathers and their children in particular is hypothesised to provide unique opportunities for children to practice regulatory and problem-solving skills, and therefore support EF development (Grossman et al., 2002; Towe-Goodman et al., 2014).
Similar to findings drawn from mother-child dyads, a handful of studies indicate that fathers’ sensitivity (Towe-Goodman et al., 2014), autonomy support (Meuwissen & Carlson, 2018), control (Meuwissen & Carlson, 2015) and mind-mindedness (Gagné et al., 2018) are associated with child EF development during the preschool period. Several divergent points are however worth noting. As mentioned previously, Towe-Goodman and colleagues (2014) found that at age two years both mothers’ and fathers’ sensitivity uniquely contributed to child EF one year later. However, maternal sensitivity and not paternal sensitivity at child age seven months predicted later child EF, suggesting that aspects of fathers’ parenting may exert specific influences on child development at certain points in time. The authors suggested that the increased influence of fathers’ sensitivity may be associated with greater involvement of fathers during toddlerhood compared to infancy or may be due to the increased salience of fathers’ sensitivity during more challenging forms of play as children get older. This is one of the few studies to include a comparison between mothers’ and fathers’ parenting behaviours in relation to child EF development.

Two studies have investigated the role of paternal mind-mindedness in child EF development. Gagné and colleagues (2018) found a positive association between fathers’ mind-mindedness at age eighteen months and child EF at age three years. A study by Baptista and colleagues (2017) however demonstrated that maternal but not paternal mental-state talk at child age four years predicted child EF at age five years. The latter study measured mind-mindedness during a shared book-reading condition whereas Gagné and colleagues (2018) measured this behaviour during free-play which the authors considered may be more representative of how fathers and children interact with one another. Baptista and colleagues (2017) further noted that maternal mental-state talk
accounted for a small portion of variance in child EF and suggested it may be beneficial to examine a wider range of parenting behaviours produced by both mothers and fathers during interaction with children. Further research is needed to clarify the role of fathers in child EF development.

**Factors which Moderate the Effect of Parent-Child Interaction on EF**

As there is now a substantial number of studies supporting the association between quality of parenting and child EF development during the preschool period, research is beginning to elucidate the factors which may structure this association. This research highlights how broader socioeconomic factors may influence parenting and, in turn, affect child EF development. Research has also demonstrated how specific parent and child factors may moderate the association between parenting and child EF, emphasising the active role of children in shaping their own development.

**Socioeconomic status.** As previously mentioned, low SES is a risk factor for child deficits in EF. One pathway by which SES may influence child EF is through its effect on parenting. Parents from lower SES households may lack the resources and have less opportunities to provide consistent, high quality and responsive parenting to their children. These parents may, for instance, provide scaffolding which is less elaborative compared to parents from higher SES households (Kurkul & Corriveau, 2018), which may have implications for children’s developing EF. SES is complex and multidimensional and the pathways by which it affects child development likely involve many interacting factors.

**Child gender.** One line of research suggests that there may be gender differences in EF performance which favours girls during the preschool period (e.g., Carlson & Moses, 2001). There may also be subtle differences in behaviour when parents are interacting with boys and with girls, and these differences may be particularly pronounced among fathers.
(Mascaro et al., 2017). One study that directly investigated the relationship between child gender and parenting, and how this related to EF achievement, documented that lower parental sensitivity was related to poorer inhibitory control performance in boys but not girls, suggesting that boys may be more susceptible to lower levels of parental sensitivity than girls (Mileva-Seitz et al., 2015).

**Child temperament.** Several studies have found that the effect of parenting on child EF may be moderated by child temperament. Rochette and Bernier (2016) demonstrated that the developmental trajectory of impulse control of children with difficult temperaments was particularly susceptible to the influence of maternal parenting behaviours. Temperamentally difficult children exposed to lower levels of maternal sensitivity, cognitive stimulation, and positive affect and higher levels of hostility performed worse on an impulse control task compared to children with easy temperaments. On the other hand, temperamentally difficult children exposed to high levels of positive maternal behaviours and low levels of negative parenting performed better than children without a difficult temperament.

Conway and Stifter (2012) investigated the influence of maternal attention-maintaining and redirecting behaviours on child conflict (cognitive tasks) and delay (affective tasks) EF amongst children categorised as inhibited (i.e., children who are fearful of novelty) or exuberant (i.e., children who are novelty-seeking). The authors found that conflict and delay EF performance of children with inhibited temperaments only was negatively affected by maternal attention-redirecting behaviours whereas maternal attention-maintaining behaviours were positively associated with conflict EF performance of both inhibited and exuberant children. The authors suggested that inhibited children may display higher vigilance during novel situations and may therefore be particularly
susceptible to the negative effects of maternal attention-redirecting as this may overload their already aroused attention system. On the other hand, exuberant children are more impulsive and maternal attention-maintaining strategies may help them focus and resist urges in the face of temptation.

A recent cross-sectional study found that the association between maternal scaffolding and child EF was moderated by child surgency, such that children who were more impulsive and showed more positive affect had lower EF scores when mothers displayed lower quality scaffolding (Suor et al., 2019). It is possible children who demonstrate surgency temperament traits are more reliant on parental scaffolding supports. On the other hand, this study demonstrated that children with low negative emotionality had higher EF scores when mothers produced more effective discipline behaviours, as perhaps they were better able to internalise self-regulation skills than their counterparts who were high in negative emotionality.

Attachment style. A longitudinal study by Bernier and colleagues (2012) revealed that parent-child attachment status was better at accounting for variance in child EF performance at age three years than measures of parental sensitivity, scaffolding and mind-mindedness. The authors proposed that as attachment security is inferred from the child’s own behaviour, this may give a better insight into the child’s perceptions and interpretations of parental behaviours as well as overall parent-child relationship compared to measurements of parental behaviour. A study by Meuwissen and Englund (2015) demonstrated that maternal autonomy-supportive parenting influenced the EF development of securely but not insecurely attached children. The authors suggested that securely attached children were better able to internalise the appropriate skills needed for EF performance from interactions with their parents.
**Parental EF.** Although EF is considered highly heritable (Friedman et al., 2008), it has been suggested that genetic factors interact with the psychosocial environment to influence child development (e.g., De Bellis, 2001). Research has demonstrated that parents’ EF is associated with the quality of parenting behaviours. Several studies emphasise an association between parental EF and autonomy-supportive parenting, for instance, suggesting that parental EF may support skills associated with this type of parenting such as flexibility in approach, planning, and inhibiting the urge to intercede too quickly or too much (Distefano et al., 2018; Meuwissen & Carlson, 2015). Results from Obradović, and colleagues (2017) suggest that intervention targeting maternal EF may improve mothers’ capacity for autonomy-supportive parenting, and ultimately be beneficial for child EF development.

On the other hand, Hughes and Devine (2017) demonstrated that poorer parental EF was related to controlling, intrusive and criticising parenting behaviours. Cuevas and colleagues (2014) also demonstrated an association between maternal intrusiveness and maternal EF. In another study, strict parenting was associated with poorer parental EF, although was not related to children’s EF (Kao, Nayak, Doan, & Tarullo, 2018). In a South Korean sample however, no links between maternal EF and maternal scaffolding and intrusiveness were found (Lee et al., 2018).

**Limitations and Future Directions**

It is important to consider this research in light of conceptual and methodological issues in the fields of both EF and parenting theory and research. With regards to EF, whilst there is disagreement over the factor structure of EF in young childhood (Morra, Panesi, Traverso, & Usai, 2018), the majority of studies in this review used a unitary composite score to represent child EF. Several did however draw associations between
parenting and specific components of EF. In relation to the EF measures used in the research, there is a great variety used across the different studies, as well as within longitudinal studies, as due to the nature of EF development, different tasks are appropriate at different ages (Carlson, 2005). This, in addition to issues of task impurity, both complicates comparisons across studies and makes it difficult to chart developmental change (Best & Miller, 2010). Similarly, with regard to parenting, definitions and the operationalisation of parenting constructs vary across studies. This was briefly discussed in relation to the measurement of parental scaffolding. Furthermore, it has been suggested that as these constructs were developed in relation to maternal parenting, they may not fully capture the experience of paternal parenting (Adamsons & Buehler, 2007).

Whilst the research discussed in this review explored a wide range of parenting behaviours and their influence on child EF, many included just one dimension of parenting or collapsed several behaviours into composites of positive and negative parenting. There may be value in comparing multiple parenting behaviours in relation to child EF (Hughes & Devine, 2017). Furthermore, continued attention to the role of fathers is needed given recent research which suggests they may exert a unique influence on child EF. In fact it has been proposed that children who are exposed to different parenting styles from each caregiver may develop greater flexibility (Cabrera et al., 2000). Furthermore, it may be important to explore how parenting behaviours differ across contexts, as well as over time and how this impacts child EF development. Lastly, as well as capturing the interactive experience of the child, more detailed investigation into the factors that may moderate the effect of parenting and EF is warranted. Factors such as parenting stress and depression have not directly been explored in relation to child EF development during the preschool period.
Conclusion

There is now abundant evidence linking a wide range of parenting behaviours to child executive function development during the preschool period. The research suggests that dimensions of parenting such as sensitivity, scaffolding, cognitive stimulation, and child-directed speech support child development of EF. More research is needed to elucidate the unique and combined contributions of mothers and fathers to their child’s EF development. Furthermore, additional attention to the factors that moderate the influence of parenting on child EF is warranted. It is important to understand the antecedents of individual differences in young children’s EF given the relationship between early executive function and future aspects of child psychological development.
Chapter 3

Study 1. Mothers’ and Fathers’ Child-Directed Speech during Structured and Free Play

Abstract

Child-directed speech (CDS), the patterns of speech that adult caregivers produce when interacting with children, scaffolds children’s language learning and attunes to their communicative abilities. The purpose of this study was to compare mothers’ and fathers’ CDS during interaction with their two-year-old children and to explore parent and child characteristics which contribute to variance in parental CDS. Another goal was to investigate the context specificity of parental CDS as previous research suggests that interactive context may have important implications for parents’ and child’s behaviour.

Eighty two-year-olds (41 females; $M = 24.06$ months, $SD = 1.39$) and their biological mothers ($M = 35.03$ years, $SD = 4.14$) and fathers ($M = 36.5$ years, $SD = 5.06$) took part in the current study. Mother-child and father-child dyads engaged in a free play and structured play session. Transcripts of these interactions were analysed in order to measure parents’ vocabulary diversity (VOCD), language complexity (MLU), and balance in conversational turn-taking between parent and child (MLT ratio). Child language and cognitive skills were assessed using standardised measures and parental depression and stress levels were assessed via self-report questionnaires. Results indicated that mothers used more diverse vocabulary during play than fathers, and that both mothers and fathers produced more varied vocabulary during free play compared to structured play. Greater MLT ratio, an index of balance in conversational turn-taking, was also observed during free play compared to structured play. Child cognitive ability emerged as important in
contributing to variance in parent-child conversational balance, suggesting that children play a key role in shaping parents’ behaviours and, as such, are active in their own development.

**Introduction**

Research studying the influence of parents on child development in the context of parent-child interaction has traditionally focussed on the mother-child dyad. This research has consistently demonstrated that the quality of specific features of mother-child interactions has important implications for children’s development. Furthermore, these interactions are dynamic and can be influenced by a wide range of contextual, child, and parent factors. The literature now also recognises the complex ecology of father-child interactions and the importance of fathers in child development (Cabrera et al., 2014; Lamb & Lewis, 2010). Including both mothers and fathers in research is valuable in providing a closer approximation of the developing child’s environment and the range of factors which shape their development. Researchers are interested in exploring and defining the elements of the child’s interactive environment and how patterns of interaction between parents and their children contribute to child development. Parental language input to their children is a salient feature of parent-child interaction. Child-directed speech (CDS) is the particular form of language adults use when interacting with young children and has long-term influences on child language, cognitive and social-emotional development.

The majority of research characterising CDS has focussed on interactions between mothers and children. Recent research has however demonstrated that fathers’ speech input has important and unique implications for children’s language development (Bakers & Vernon-Feagans, 2015; Malin et al., 2014; Pancsofar & Vernon-Feagans, 2006; Pancsofar & Vernon-Feagans, 2010; Schwab, et al., 2018). A review of the literature provided in
Chapter 1 Part 3 indicated that mothers and fathers do not tend to differ significantly on measures of vocabulary diversity and language complexity during play with toddlers. This literature is small however and has yielded inconsistent findings. Furthermore, studies have differed in the context which is used to compare mothers’ and fathers’ CDS. As discussed in Chapter 1 Part 3, parental CDS may vary according to the context in which it is measured (e.g., Bingham et al., 2013; Doering et al., 2019; Gergely et al., 2017; Kwon et al., 2013; Salo et al., 2016). Inconsistent findings across studies warrant further research comparing mothers’ and fathers’ CDS and the role of interactive context on mothers’ and fathers’ speech.

There is a vast literature on the relationship between socioeconomic status (SES) and parental speech (Schwab & Lew-Williams, 2016b), however, there is little research investigating more proximal sources of variability in parents’ CDS, particularly in relation to fathers. As outlined in Chapter 1 Part 3, child characteristics such as gender and age, as well as child language and cognitive abilities, may influence parental CDS in important ways. This review also demonstrated that parent characteristics such as depression or stress may influence their speech input to children, yet there is little research on the effects of parental psychological well-being on parental speech during toddlerhood, particularly amongst fathers.

**The Current Study**

The aim of this study was to compare the lexical, syntactic and pragmatic features of mothers’ and fathers’ language produced during interaction with their two-year-old children across structured and free play. Whilst earlier research suggested that fathers’ language may differ from mothers’ due to disparities in time spent interacting with their children, more recent research suggests the CDS that mothers and fathers produce during
interaction with their toddlers is comparable (Pancsofar & Vernon-Feagans, 2006; Rowe et al., 2004). Similar to prior research, mothers’ and fathers’ vocabulary diversity and language complexity are not expected to differ widely. Several recent studies suggest that fathers ask more questions and seek more clarifications during interaction with their children compared to mothers (e.g., Rowe et al., 2004). Due to the conversation-eliciting nature of these types of utterances, a difference in conversational turn-taking in father-child and mother-child interaction may be expected.

This study also aimed to examine the effect of interactive context on CDS by comparing fathers’ and mothers’ speech during structured and free play. These different contexts may elicit specific qualities of parental speech input. For instance, due to the goal-oriented nature of structured play, parental speech in this context may be more directive and less conversation-eliciting compared to free play. In free play, on the other hand, more conversational back-and-forth between parent and child concerning the different stimuli and make-believe scenarios may be expected. Research suggests that parents are spending increasing amounts time in structured play with their young children with a view to preparing children for school (Hirsh-Pasek, Golinkoff, Berk, & Singer, 2009), yet there is little research examining parental language in this context.

Finally, this study aimed to determine how specific parent and child characteristics and competencies may influence parental language input. Whilst maternal education is perhaps the strongest predictor of child language development (McNally et al., 2019), there was little variation in this domain among the current sample in order to control for such effects. This study aimed to examine how proximal factors such as child age, gender, language and cognitive ability, as well as parent mood and stress may contribute to individual differences in parental speech input. Given recent findings that parents’ CDS is
related to child linguistic competencies, it was expected that child language and cognitive abilities would be positively associated with parents’ vocabulary diversity, language complexity, and conversational balance in parent-child interaction.

This study also sought to investigate associations between parent characteristics and CDS. Although parent depression affects parent responsiveness in interaction with their children, it is unclear whether parent mood or stress would have an effect on parents’ diversity of vocabulary, language complexity and conversational turn-taking. In summary, a complex interaction of factors may influence CDS and this may differ between mothers and fathers. This study aims to elucidate the child and parent factors which may contribute to variability in parental CDS, and extend previous research which has focussed primarily on the factors which influence maternal speech input to their children.

**Hypothesis 1.** In light of previous research, it was expected that there would be no significant differences between mothers and fathers on measures of vocabulary diversity and language complexity or conversational turn-taking in parent-child interaction.

**Hypothesis 2.** Due to the goal-oriented and stimulus-dependent nature of the structured play condition, it was expected that parents would produce more diverse vocabulary, more complex language, and that there would be greater conversational turn-taking between parent and child in free play compared to structured play. This pattern of findings was not expected to differ between mother-child and father-child interaction.

**Hypothesis 3.** Research indicates that parents adjust their CDS at different stages of child development. It was expected that child age would be associated with parental vocabulary diversity, language complexity and conversational turn-taking in parent-child interaction. Previous findings regarding child gender are less consistent but suggest that parental CDS during the preschool period is not affected by child gender. An association
between child gender and parental CDS was therefore not expected. Furthermore, this pattern of findings was not expected to differ between mothers and fathers.

**Hypothesis 4.** Previous research has demonstrated that child language competency is associated with parental CDS. It was expected that child language and cognitive abilities would be associated with parental vocabulary diversity, language complexity and conversational turn-taking in parent-child interaction. It was also expected that child language and cognitive abilities would explain age-related differences in parental CDS. Again, similar patterns of associations were expected to emerge in both mother-child and father-child interaction.

**Hypothesis 5.** Studies with infants suggest that parental depression influences the prosodic features of CDS. It was expected that parental depression would be associated with CDS during the preschool period. Specifically, it was expected that parents with higher scores on a mood assessment may speak less with their child which may be borne out in the language complexity and conversational turn-taking measures of both mothers and fathers. Given the absence of previous research on the relationship between parenting stress and CDS, no specific hypothesis was made regarding the features of CDS which may be associated with parental stress.

**Method**

**Participants**

Eighty children aged between 21 – 27 months (41 females; \( M = 24.06 \) months, \( SD = 1.39 \)) and their biological mothers and fathers were recruited to take part in the current study. Participants were recruited through social media, flyers distributed to crèches and supermarkets, and snowballing. Families comprised two parents (a mother and father) and their biological children. All participating families were White and classified as middle-
class. All children included in the current study were born full-term and were typically developing. Parents were monolingual, Irish-English speaking, and residing in the family home. Mothers were aged between 25 and 46 years ($M = 35.03$, $SD = 4.14$). Fathers were aged between 23 and 55 years ($M = 36.5$, $SD = 5.06$). All mothers had completed second-level education, 77.5% had a Bachelor degree, and 35% had a postgraduate qualification. 93.8% of fathers had completed second-level education, 63.8% had a Bachelor degree, and 22.5% had a postgraduate qualification.

**Procedure**

The study was conducted at an Infant and Child Research Lab based in a university setting with the approval of the relevant Research Ethics Committee. Informed consent was obtained from participants prior to commencement of testing. The lab visit consisted of a developmental assessment with the child and video-recorded observations of mother and child and father and child during free and structured play. In the structured play condition, dyads were presented with a magnetic puzzle board (of either fish or car design) which differed between the mother-child and father-child interactions. The task firstly required the child to use a magnetic stick attached to a string (similar to a fishing-rod) to pull out ten puzzle pieces, and secondly to replace these pieces back into the correct slots once all had been removed. The task was challenging for two-year olds to complete on their own and required parental input to be completed. In the free play condition, parent and child were presented with a box containing a variety of toys (ball, blocks, toy cars, Mr. Potato Head). The duration of the structured play condition was five minutes and the free play condition was ten minutes. In both conditions parents were instructed to play with their children as they would at home.
Interactions were video recorded using Mangold VideoSync Pro 1.5 and transcribed offline by trained research assistants using the Computerised Language Analysis (CLAN) software according to the Codes for Human Analysis of Transcripts (CHAT) conventions (MacWhinney, 2000). Information on family sociodemographic factors, child executive function, and parent mood and stress were collected via questionnaires completed by both parents. Parent verbal intelligence was directly assessed by a research assistant. The visit lasted approximately 2.5 - 3 hours in total and parents and child were offered breaks as needed. At the end of the visit, participants were debriefed and thanked for their time.

**Measures**

**The Bayley Scales of Infant and Toddler Development-Third Edition (BSID-III).** Child language ability was assessed by a trained research assistant using the receptive and expressive scales of the BSID-III. The receptive language scale assesses child vocabulary, understanding of grammar and tenses and knowledge of prepositions. The expressive scale assesses child ability to label objects, use different tenses of verbs and use prepositions. Child cognitive development was also directly assessed using the cognitive scale of the BSID-III. The cognitive scale assesses the child’s memory skills, ability to manipulate objects, and knowledge of concepts such as big and small. Child scaled scores on the cognitive, receptive and expressive scales were used in the present analyses. Child social-emotional skills were assessed using the parent-reported social-emotional scale. This scale assesses the child’s ability to understand cues from others and expression and regulation of emotions. Composite scores on the social-emotional scale were reported in the present analyses. The BSID-III are widely used to assess child development and have demonstrated acceptable levels of internal consistency, test-retest reliability, and concurrent validity (Bayley, 2006).
Behaviour Rating Inventory of Executive Function, Preschool Version (BRIEF-P). One parent completed the BRIEF-P, a 63-item parent-report questionnaire (Gioia, Espy, & Isquith, 2003). The BRIEF-P is considered an ecologically valid measure of child executive function performance in everyday contexts (Sherman & Brooks, 2010). The measure consists of five scales - Inhibit, Shift, Emotional Control, Working Memory, and Plan/Organise. The Global Executive Composite, which provides a summary index of the child’s overall EF abilities, was used in the present analyses. Higher scores on this composite indicate greater difficulties in EF.

Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV). Three verbal comprehension subscales – Vocabulary, Similarities and Information - of the WAIS-IV (Wechsler, 2008) were administered to each parent. Scaled scores on these subtests were combined to form the Verbal Comprehension Index which was used in the present analyses. The scale demonstrates high inter-rater agreement, test-retest reliability and high concurrent validity (Wechsler, 2008).

Centre for Epidemiologic Studies – Depression Scale (CES-D). Mothers and fathers each filled out this 10-item questionnaire which is a widely used self-report measure of depressive symptomology (Andresen, Malmgren, Carter, & Patrick, 1994). This scale has demonstrated high construct validity and internal consistency (Mohebbi et al., 2018).

Parental Stress Index (PSI). Parents filled out the PSI short-form which consists of 36 items measuring parenting stress in relation to child characteristics, parent characteristics, and parent-child interactive dysfunction (Abidin, 2012). It has demonstrated high internal consistency and test-retest reliability (Abidin, 2012).
**Parental speech input.** Trained research assistants transcribed the structured and free play interactions offline following CHAT conventions. All speech was transcribed verbatim. These transcripts were each reviewed by a senior transcriber. Parent language variables were extracted from the transcripts using the CLAN programme (MacWhinney, 2000). Language variables included number of words, mean length of utterance (MLU) measured in morphemes, vocabulary diversity (VOCD), and mean length of turn (MLT) ratio.

**Language complexity.** Mean length of utterance (MLU) is typically considered an index of language complexity calculated in CLAN by dividing the parent’s total number of morphemes by their total number of utterances. Morphemes were used in this calculation in consideration that this unit of speech may be developmentally sensitive compared to number of words. As a measure of language complexity, MLU assumes that longer utterances (i.e., higher MLU) imply more complex grammatical constructions (Brown, 1973). A measure of language complexity was calculated for each parent during structured and free play, respectively.

**Vocabulary diversity.** VOCD was calculated automatically in CLAN by summing the number of unique word roots spoken by parents during interaction. The calculation of VOCD takes into consideration the length of the interaction and uses repeated random sampling in its calculation. Alternative approaches (e.g., Type-Token Ratio) are based on the number of words in the sample and may therefore produce distorted measures of vocabulary diversity. Higher values of VOCD indicate that speech is more lexically rich.

**Balance in conversational turn-taking.** Balance in conversational turn-taking during father-child interaction was measured by computing the mean length of turn (MLT) for both fathers and their children and then calculating the ratio of child MLT to father
MLT. MLT was calculated by dividing the speaker’s total number of utterances by their total number of turns. A turn referred to a sequence of utterances spoken by one interlocutor (MacWhinney, 2000). A ratio closer to 1 indicated that fathers and children were affording each other equal opportunities to speak.

**Analytic Strategy**

Data were analysed using SPSS version 24. A series of pairwise t-tests was conducted in order to investigate mean differences in mothers’ and fathers’ language input during interaction with their children. Due to the number of t-tests conducted, a Bonferroni correction was applied in order to minimise the chance of making a Type 1 error. In order to compare language across free and structured play conditions, paired t-tests were also conducted. In order to investigate how parent and child characteristics shape parental speech input, a series of standard regression analyses were performed. The assumptions of multiple linear regression were met. Due to missing data these analyses were not run with the full sample of 80 participants (see Tables 3.1.3 and 3.1.4 for sample sizes).

**Results**

**Comparing Mothers’ and Fathers’ Language during Parent-Child Interaction**

Descriptive statistics for mothers’ and fathers’ speech during structured and free play with their child are presented in Table 3.1.1. There was high variability in all language variables amongst both mothers and fathers in the current sample, in both free play and structured settings. Paired t-tests were conducted in order to compare mothers’ and fathers’ speech input to their two-year-olds, in both free and structured play conditions (see Table 3.1.1). During both free and structured play, mothers used more diverse vocabulary compared to fathers. A Bonferroni correction yielded an adjusted alpha of .005. Once this was applied the comparison of mothers’ and fathers’ VOCD during free play only
remained significant ($d = 0.4^1$). Similarly, father-child MLT ratio was greater compared to mother-child MLT ratio in free and structured play conditions, but this comparison was no longer significant once the Bonferroni correction was applied.

**Context Specificity of Parental CDS**

Paired t-tests were conducted in order to compare parental speech input to their children across free and structured play conditions (see Table 3.1.2). Whilst the free play condition was ten minutes long in comparison to the five minute structured play, the language variables included in this analysis were proportions and ratios and therefore did not need to be transformed in order to account for time differences (McKee, Malvern, & Richards, 2000; Salo et al., 2016). Analyses were conducted separately for mothers and fathers. Mothers’ ($d = 1.36$) and fathers’ VOCD ($d = 1.01$) were significantly greater in the free play setting compared to structured play. MLT ratio in mother-child interaction ($d = 0.5$) and MLT ratio in father-child interaction ($d = 0.45$) were significantly greater in the free play setting compared to structured play. No significant difference between either parents’ MLU was found across settings.

---

1 Cohen’s $d$ is a measure of effect size (i.e., the size of the difference between two groups). Cohen (1988) proposed that $d = 0.2$ should be considered a small effect size, $d = 0.5$ a moderate effect size, and $d = 0.8$ a large effect size.
Table 3.1.1

*Descriptive statistics and paired t-tests comparing mothers’ and fathers’ speech input to two-year-olds (n = 80)*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Fathers</th>
<th></th>
<th>Mothers</th>
<th></th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Free play</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of words</td>
<td>661.83</td>
<td>240.72</td>
<td>174 – 1634</td>
<td>719.83</td>
<td>228.63</td>
</tr>
<tr>
<td>MLU</td>
<td>4.14</td>
<td>1.09</td>
<td>2.40 – 7.36</td>
<td>4.20</td>
<td>.92</td>
</tr>
<tr>
<td>VOCD</td>
<td>43.10</td>
<td>7.06</td>
<td>28.07-58.64</td>
<td>46.54</td>
<td>6.75</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.46</td>
<td>0.25</td>
<td>0.02 – 1.27</td>
<td>0.41</td>
<td>0.20</td>
</tr>
<tr>
<td>Structured play</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of words</td>
<td>411.29</td>
<td>117.96</td>
<td>175 – 698</td>
<td>430.16</td>
<td>126.38</td>
</tr>
<tr>
<td>MLU</td>
<td>4.10</td>
<td>1.08</td>
<td>2.37 – 8.12</td>
<td>4.33</td>
<td>0.83</td>
</tr>
<tr>
<td>VOCD</td>
<td>34.76</td>
<td>7.52</td>
<td>16.33-53.82</td>
<td>37.10</td>
<td>7.28</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.38</td>
<td>0.21</td>
<td>0.04 – .94</td>
<td>0.33</td>
<td>0.19</td>
</tr>
</tbody>
</table>

*Note.* MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn.

*p < .05; **p<.001; † significant after Bonferroni correction.*
Table 3.1.2

Descriptive statistics and paired t-tests comparing mothers’ and fathers’ CDS across structured and free play sessions (n = 80)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Free play</th>
<th></th>
<th></th>
<th>Structured</th>
<th></th>
<th></th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>Fathers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>4.14</td>
<td>1.09</td>
<td>2.40 – 7.36</td>
<td>4.33</td>
<td>0.83</td>
<td>2.79 – 7.89</td>
<td>0.38</td>
</tr>
<tr>
<td>VOCD</td>
<td>43.10</td>
<td>7.06</td>
<td>28.07-58.64</td>
<td>34.76</td>
<td>7.52</td>
<td>16.33-53.82</td>
<td>9.07**†</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.46</td>
<td>0.25</td>
<td>0.02 – 1.27</td>
<td>0.38</td>
<td>0.21</td>
<td>0.04 – 0.94</td>
<td>4.01**†</td>
</tr>
<tr>
<td>Mothers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>4.20</td>
<td>0.92</td>
<td>2.62 – 8.39</td>
<td>4.33</td>
<td>0.83</td>
<td>2.79 – 7.89</td>
<td>-1.28</td>
</tr>
<tr>
<td>VOCD</td>
<td>46.54</td>
<td>6.75</td>
<td>34.15-65.35</td>
<td>37.10</td>
<td>7.28</td>
<td>24.45-61.05</td>
<td>12.17**†</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.41</td>
<td>0.20</td>
<td>0.07 - 0.97</td>
<td>0.33</td>
<td>0.19</td>
<td>0.03 - 0.86</td>
<td>4.00 **†</td>
</tr>
</tbody>
</table>

Note. MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn.

**p < .001; † significant after Bonferroni correction.
Individual differences in Mothers’ and Fathers’ CDS

Descriptive statistics of parent and child variables collected from parent-report questionnaire data and direct assessment with the researcher are presented in Tables 3.1.3 and 3.1.4. These data are presented separately for mother, father, and child variables. Missing values from questionnaires were imputed using the techniques recommended by the authors of each individual measure, or using methods common in the literature. Taking the average score on a particular item across all participants is the most common method of imputation used for missing data on the CES-D for example, and whilst it may reduce the variance within a measure, it provides reliable estimates comparable with other imputation methods (Bono, Ried, Kimberlin, & Vogel, 2007). Missing data on the PSI were replaced by the participant’s average on that measure, whilst missing data points on the BRIEF-P were replaced with a score of 1. Rules regarding maximum number of items missing were also followed according to the specific recommendations for each measure. Questionnaire data were entirely missing for two participating families who were subsequently excluded from further analyses.

Child factors associated with CDS. Tables 3.1.5 and 3.1.6 present bivariate correlations between child characteristics and parent language variables during both free and structured play. These are presented separately for mothers and fathers. Child age was weakly positively correlated with father-child MLT ratio during free play and mother-child MLT ratio during structured play. There were no significant correlations between child age and parents’ VOCD and MLU. Child receptive language ability was weakly positively correlated with mothers’ VOCD in the free play condition and mothers’ MLU in the structured play condition. Child receptive language ability was weakly positively correlated with father-child MLT ratio during free play. Child expressive language was weakly positively correlated with fathers’ MLU during free play and mothers’ MLU during
structured play. Child expressive language was also weakly positively associated with mothers’ VOCD during free play. Child expressive language was weakly positively associated with MLT ratio in father-child interaction and mother-child interaction during structured play and MLT ratio in father-child interaction during free play. Child cognitive ability was weakly positively associated with mothers’ MLU during free play and VOCD during structured play. Child cognitive ability demonstrated small, positive associations with MLT ratio in father-child and mother-child interaction, during free and structured play.

**Parent factors associated with CDS.** Tables 3.1.7 and 3.1.8 present bivariate correlations between parent characteristics and parent language variables during both free and structured play. These are presented separately for mothers and fathers. Fathers’ verbal ability was weakly positively associated with his MLU during free play. Fathers’ and mothers’ scores on the CES-D were each weakly negatively associated with their MLU during free play. Fathers’ scores on the CES-D were also moderately negatively associated with his MLU during structured play. Fathers’ scores on the CES-D were weakly negatively associated with MLT ratio during father-child free play. No significant correlations between parents’ scores on the PSI and parent language variables were observed.
Table 3.1.3

Descriptive statistics of parent characteristics

<table>
<thead>
<tr>
<th>Measure</th>
<th>Fathers</th>
<th></th>
<th>Mothers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean (SD)</td>
<td>Range</td>
<td>N</td>
</tr>
<tr>
<td>VCI</td>
<td>78</td>
<td>111.56 (12.60)</td>
<td>78-148</td>
<td>78</td>
</tr>
<tr>
<td>CES-D</td>
<td>76</td>
<td>5.41 (3.80)</td>
<td>0-19</td>
<td>73</td>
</tr>
<tr>
<td>PSI</td>
<td>77</td>
<td>27.34 (14.26)</td>
<td>5-65</td>
<td>72</td>
</tr>
</tbody>
</table>

*Note.* VCI = Verbal Comprehension Index of WAIS; CES-D = Centre for Epidemiologic Studies – Depression scale; PSI = Parenting Stress Index; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version
Table 3.1.4

Descriptive statistics of child study variables

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayley Receptive Scaled Score (n=78)</td>
<td>12.32 (3.45)</td>
<td>5-19</td>
</tr>
<tr>
<td>Bayley Expressive Scaled Score (n=78)</td>
<td>11.54 (2.90)</td>
<td>4-18</td>
</tr>
<tr>
<td>Bayley Social-emotional Composite (n=72)</td>
<td>111.25 (16.76)</td>
<td>65-140</td>
</tr>
<tr>
<td>Bayley Cognitive Scaled Score (n=79)</td>
<td>10.49 (2.63)</td>
<td>5-19</td>
</tr>
<tr>
<td>BRIEF-P Composite (n=72)</td>
<td>86.72 (17.66)</td>
<td>63-140</td>
</tr>
</tbody>
</table>

*Note.* BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version
Table 3.1.5

**Correlations among child factors and fathers’ CDS**

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Child Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Bayley Rec</td>
<td>.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Bayley Exp</td>
<td>.30**</td>
<td>.52**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Bayley Cog</td>
<td>.23*</td>
<td>.55**</td>
<td>.43**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Bayley Soc</td>
<td>-.01</td>
<td>.10</td>
<td>.12</td>
<td>-.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6 BRIEF-P</td>
<td>.19</td>
<td>-.16</td>
<td>-.10</td>
<td>-.16</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>7 MLU FP</td>
<td>.10</td>
<td>.21</td>
<td>.25*</td>
<td>.24*</td>
<td>.15</td>
<td>-.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 VOCD FP</td>
<td>.17</td>
<td>.26*</td>
<td>.03</td>
<td>.12</td>
<td>.13</td>
<td>-.01</td>
<td>.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 MLT ratio FP</td>
<td>.26*</td>
<td>.29*</td>
<td>.35**</td>
<td>.44**</td>
<td>.08</td>
<td>-.14</td>
<td>.18</td>
<td>-.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MLU STR</td>
<td>.05</td>
<td>.04</td>
<td>.08</td>
<td>-.02</td>
<td>.06</td>
<td>.12</td>
<td>.62**</td>
<td>.03</td>
<td>-.11</td>
<td></td>
<td></td>
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<tr>
<td>11 VOCD STR</td>
<td>.08</td>
<td>.19</td>
<td>.10</td>
<td>.22*</td>
<td>-.19</td>
<td>-.13</td>
<td>.15</td>
<td>.36**</td>
<td>.06</td>
<td>.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 MLT ratio</td>
<td>.19</td>
<td>.06</td>
<td>.27*</td>
<td>.32**</td>
<td>.11</td>
<td>-.12</td>
<td>.10</td>
<td>-.13</td>
<td>.71**</td>
<td>-.11</td>
<td>.11</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Rec = receptive; Exp = expressive; Cog = cognitive; Soc = social-emotional; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; FP = free play; STR = structured play; * \( p < .05; ** \( p < .001.}
Table 3.1.6

Correlations among child factors and mothers’ CDS

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>9</th>
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<td>1</td>
<td></td>
<td></td>
<td></td>
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*Note. Rec = receptive; Exp = expressive; Cog = cognitive; Soc = social-emotional; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; FP = free play; STR = structured play; * p < .05; ** p < .001
Table 3.1.7

Correlations among father characteristics and fathers’ CDS

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Note. VCI = Verbal Comprehension Index; CES-D = Centre for Epidemiologic Studies – Depression scale; PSI = Parenting Stress Index; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; FP = free play; STR = structured play; * p < .05; ** p < .001.
Table 3.1.8

Correlations among mother characteristics and mothers’ CDS

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<td>4 MLU FP</td>
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<td>-.13</td>
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<td>5 VOCD FP</td>
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<tr>
<td>6 MLT ratio FP</td>
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<td>-.17</td>
<td>.10</td>
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<td>9 MLT ratio STR</td>
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<td>.65**</td>
<td>-.02</td>
<td>-.04</td>
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</table>

*Note. VCI = Verbal Comprehension Index; CES-D = Centre for Epidemiologic Studies – Depression scale; PSI = Parenting Stress Index; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; FP = free play; STR = structured play; * p < .05; ** p < .001.
Standard multiple regressions were run in order to test associations between parent and child variables and parents’ VOCD, MLU, and MLT ratio in parent-child interaction, in both structured and free play. These analyses were run separately for mothers and fathers. Predictors included child age, gender, child receptive and expressive language, and cognitive abilities, and parent depression and stress. The Bayley social-emotional scale, BRIEF-P and PSI were not included in subsequent analyses as these variables failed to demonstrate any association with the relevant language variables. Predictor variables were entered in separate models in order to differentiate the contribution of child gender and age from child receptive, expressive and cognitive scores and parents’ scores on the CES-D. Due to the sample size, adjusted R square is reported as a more modest indicator of variance in parental language.

Father’s vocabulary diversity. Results of multiple regression predicting fathers’ VOCD during free play resulted in a non-significant model (F-test non-significant). This indicates that the predictor variables included in the model did not provide a better fit to the data compared to a model containing no predictor variables. Similarly, the model predicting fathers’ VOCD during structured play did not fit the data well according to a non-significant F-test.

Mother’s vocabulary diversity. In the first model child gender predicted mothers’ VOCD during free play. In the second model, child gender also predicted mothers’ VOCD. The second model explained 16% of the variance in mothers’ VOCD (see Table 3.1). Findings indicated that mothers produced greater VOCD with girls compared to boys. The model predicting mothers’ VOCD during structured play did not fit the data well according to a non-significant F-test.
Table 3.1.9

*Multiple regression model predicting mothers’ VOCD during free play*

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Model 1</th>
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<th>Model 2</th>
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<tbody>
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<td></td>
<td>B (SE)</td>
<td>β</td>
<td>B (SE)</td>
<td>B</td>
</tr>
<tr>
<td>Child gender (ref boy)</td>
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<tr>
<td>Child age (in months)</td>
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<td>-0.95 (0.70)</td>
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<tr>
<td>Bayley Receptive</td>
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<td>Bayley Expressive</td>
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<td></td>
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</tr>
<tr>
<td>Bayley Cognitive</td>
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</tr>
<tr>
<td>CES-D</td>
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<td>-0.21 (0.21)</td>
<td>-0.12</td>
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</table>

Model 1: Adjusted R square = .08 (R square = .11).
Model 2: Adjusted R square = .16 (R square = .23).

*p < .05

**Father’s mean length of utterance.** Results of multiple regression predicting fathers’ MLU during free play resulted in a non-significant model (*F*-test non-significant).

This indicates that the predictor variables included in the model do not provide a better fit to the data compared to a model containing no predictor variables. The model predicting fathers’ MLU during structured play also did not fit the data well according to a non-significant *F*-test.

**Mother’s mean length of utterance.** Results of multiple regression predicting mothers’ MLU during free play resulted in a non-significant model (*F*-test non-significant).

With regard to structured play, the first model indicated that child gender predicted mothers’ MLU. In the second model child gender was also the only predictor of mothers’
MLU. This model accounted for 11% of the variance in mothers’ MLU during free play.

These findings indicate that mothers produce longer utterances with girls in structured play compared to boys (see Table 3.1.10).

Table 3.1.10

*Multiple regression model predicting mothers’ MLU during structured play*

<table>
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<td></td>
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<td>β</td>
<td>B (SE)</td>
<td>B</td>
</tr>
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</tr>
<tr>
<td>Child age (in months)</td>
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<td>0.01</td>
<td>-0.10 (0.09)</td>
<td>-0.16</td>
</tr>
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<td>0.01 (0.04)</td>
<td>0.01</td>
<td>0.04</td>
<td>0.25</td>
</tr>
<tr>
<td>Bayley Expressive</td>
<td>0.07 (0.04)</td>
<td>0.01</td>
<td>0.25</td>
<td>0.12</td>
</tr>
<tr>
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<td>-0.5</td>
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Model 1: Adjusted R square = .06 (R square = .08).
Model 2: Adjusted R square = .11 (R square = .19).

* *p < .05

Conversational balance in father-child interaction. In the first model, MLT ratio in father-child free play was predicted by child gender and age. In the second model, MLT ratio was predicted only by child cognitive ability. Higher cognitive ability as measured by the BSID predicted greater balance in conversational turn-taking. This model explains 29% of the variance in MLT ratio during father-child free play (see Table 3.1.11). MLT ratio in father-child interaction during structured play was not predicted by child gender or age. This model did not fit the data well according to a non-significant F-test. The second
model however fit the data well and demonstrated that MLT ratio during structured play was predicted by child receptive and expressive language, as well as cognitive ability (see Table 3.1.12). In this model higher cognitive ability and higher expressive language were associated with greater MLT ratio. Lower receptive language was associated with greater MLT ratio. Overall this model accounted for 13% of the variance in MLT ratio during father-child structured play.

Table 3.1.11

Multiple regression model predicting MLT ratio during father-child free play

<table>
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</thead>
<tbody>
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<td></td>
<td>B (SE)</td>
<td>β</td>
<td>B (SE)</td>
<td>B</td>
</tr>
<tr>
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<td>0.09 (0.05)</td>
<td>0.18</td>
</tr>
<tr>
<td>Child age (in months)</td>
<td>0.04 (0.02)</td>
<td>0.24*</td>
<td>-0.01 (0.02)</td>
<td>0.03</td>
</tr>
<tr>
<td>Bayley Receptive</td>
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<td></td>
<td>0.00 (0.01)</td>
<td>-0.01</td>
</tr>
<tr>
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<td>0.16</td>
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</tr>
<tr>
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<td>0.41*</td>
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</tr>
<tr>
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<td>-0.16</td>
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</table>

Model 1: Adjusted R square = .10 (R square = .13).
Model 2: Adjusted R square = .29 (R square = .35).

*p < .05
Table 3.1.12

Multiple regression model predicting MLT ratio during father-child structured play

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</tr>
<tr>
<td>Child age (in months)</td>
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</tr>
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</tr>
<tr>
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<td>0.02 (0.01)</td>
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Adjusted R square = .13 (R square = .21).

*p < .05

Conversational balance in mother-child interaction. In the first model, MLT ratio in mother-child free play was not predicted by child gender or age. In the second model MLT ratio was predicted only by child cognitive ability. Higher cognitive ability as measured by the BSID predicted greater balance in conversational turn-taking. This model explained 12% of the variance in MLT ratio during mother-child free play (see Table 3.1.13). With regards to structured play, MLT ratio was predicted by child age in the first model. In the second model MLT ratio was predicted by child cognitive ability only. Higher cognitive ability was associated with greater MLT ratio. This model accounted for 17% of the variance in MLT ratio during mother-child structured play (see Table 3.1.14).
Table 3.1.13

*Multiple regression model predicting MLT ratio during mother-child free play*

<table>
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<tr>
<th>Predictors</th>
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<th>Model 2</th>
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<td>B (SE)</td>
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<td>B</td>
</tr>
<tr>
<td>Child gender (ref boy)</td>
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</tr>
<tr>
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<td>-0.04</td>
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Model 1: Adjusted R square = .02 (R square = .05).
Model 2: Adjusted R square = .12 (R square = .19).

*p < .05*
Table 3.1.14

*Multiple regression model predicting MLT ratio during mother-child structured play*

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</tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Bayley Cognitive</td>
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<td>0.36*</td>
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</tr>
<tr>
<td>CES-D</td>
<td>0.00 (0.01)</td>
<td></td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model 1: Adjusted R square = .12 (R square = .14).
Model 2: Adjusted R square = .17 (R square = .24).

*p < .05

**Discussion**

The current study investigated differences in mothers’ and fathers’ CDS in interaction with their two-year-old children and how parental CDS varies across different activities and according to certain child and parent characteristics. With regards to the first hypothesis, and in line with previous research (e.g., Panscofar & Vernon-Feagans, 2006; Rowe et al., 2004), it was expected that mothers’ and fathers’ CDS would be similar. As expected, mothers and fathers did not differ in terms of language complexity, however, results indicated that mothers produced more diverse vocabulary compared to fathers. Whilst one previous study found that fathers produced more unique words in interaction with toddlers (Kwon et al., 2013), the results of the current study are similar to findings reported by Bingham and colleagues (2013) that mothers used more diverse vocabulary.
than fathers in interaction with their toddlers. A recent review of the parenting literature indicated that mothers may be more didactic in their play interactions compared to fathers, who engage in more physical activity and play for its own sake (Parke & Cookston, 2019b). It is possible that mothers may be more focussed on labelling objects and supporting child vocabulary in interaction than fathers, which may be associated with their production of a greater variety of vocabulary.

Previous comparisons of mothers’ and fathers’ CDS indicates that fathers produce more conversation-eliciting utterances during interaction with their children compared to mothers (e.g., Malin et al., 2014; Rowe et al., 2004). Greater conversational balance in interaction between fathers and their children compared to mother-child interaction may therefore be expected. Although there was greater balance in conversational turn-taking in father-child interaction than mother-child interaction in the current sample, this did not remain significant after applying a Bonferroni correction. Further research is needed to clarify whether features of fathers’ CDS encourage more child engagement in conversation compared to mothers.

A second goal of the current study was to investigate how the context in which interaction takes place relates to mothers’ and fathers’ CDS. Many studies comparing mothers’ and fathers’ speech to their preschool-aged children have employed a shared book-reading paradigm as the context for measuring parent-child language. This context provides an opportunity for parents to scaffold their language input to children and it is a situation which elicits high levels of joint-attention between parent and child (Fletcher, Cross, Tanney, Schneider, & Finch, 2008). The current study was interested in comparing parents’ language across free and structured play rather than during shared book-reading as CDS in these settings does not rely on the properties of a particular book and may be more
representative of parents’ natural language in interaction with their children. The second hypothesis of the current study was that parents would produce more diverse vocabulary, more complex language, and that there would be greater conversational balance between parent and child in free play compared to structured play.

Whilst Kwon and colleagues (2013) found parents’ language was more complex during structured play compared to free play, the current study did not find any significant differences between these two contexts. Findings revealed however that mothers and fathers both produced more diverse vocabulary in free play compared to structured play. Greater conversational balance in both mother-child and father-child interaction during free play compared to structured play was also observed. This mirrors the findings of Kwon and colleagues (2013) who found that parents used more diverse vocabulary during free play compared to structured play. Furthermore, the authors observed that children were more engaged and spoke more during the free play interaction. Higher engagement with this type of activity may be associated with greater involvement in back-and-forth conversation between parents and children, although this was not directly measured by the authors.

Exposure to language rich in vocabulary and grammatical complexity, as well as engagement in conversation are important for children’s language development (Romeo et al., 2018; Rowe, 2012; Zimmerman et al., 2009). Although structured play may provide an important context in which parents can scaffold their children’s activity, the goal-oriented nature of this form of play may limit parental vocabulary to the task at hand, as well as afford fewer chances for back-and-forth conversation between parent and child. In contrast, during free play, parent and child language may be less constrained by the specific stimuli and tasks. Although mothers’ vocabulary was more diverse overall than that of fathers,
both parents used more unique words in free play compared to structured play. The findings of this study suggest that engaging children in play that is less structured (i.e., play for the sake of play) may have implications for the language they hear as well as their own engagement in language interactions. In light of these findings, concerns that children’s opportunities for free play are declining (Hirsh-Pasek et al., 2009) should be heeded.

The current study also sought to outline the parent and child factors which contribute to variance in mothers’ and fathers’ CDS. The third hypothesis of the present study proposed that child age and not gender would be associated with parental CDS. Child gender contributed to a portion of the variance in mothers’ vocabulary diversity in the free play condition. Results indicated that being female was associated with greater maternal vocabulary diversity in this condition. The findings also indicate that being female was associated with mothers’ language complexity in the structured play condition. These findings were unexpected. As previously mentioned, past research has not found substantial gender differences in parental speech input to their children. Although girls may have a language advantage over boys at this stage of development, child language ability was not associated with mothers’ VOCD. Lovas (2011) suggested that the gender socialisation of language by parents may explain differences in language input to girls and boys, with parents placing a greater emphasis on language interactions with girls and physical interactions with boys. Lovas (2011) also suggests that female children’s expressed interest in language may encourage parents to produce more advanced speech input to girls compared to boys. Child gender and age did not account for any variance in fathers’ language once child language and cognitive abilities were accounted for.

Child age was associated with greater conversational balance in mother-child and father-child interaction, such that older child age was associated with greater balance in
turn-taking in the structured play condition. Once child language and cognitive abilities were added to the model however child age was no longer associated with balance in conversational turn-taking. This indicates that age-related differences in turn-taking may be better accounted for by developments in child cognitive abilities. Toddlerhood is a period of rapid cognitive and language growth and therefore advancing skills across the period of 22 – 26 months may support greater engagement in conversation. Similar results were found with regard to father-child conversational balance.

The fourth hypothesis of the present study was that child language and cognitive competencies would account for a portion of variance in parents’ CDS. Regression analyses demonstrated that child language and cognitive abilities were not associated with mothers’ and fathers’ vocabulary diversity or language complexity. This was surprising as past research (e.g., Schwab et al., 2018) suggests that parents adjust their language according to their children’s language abilities. Perhaps a more in-depth analysis of child language in real-time during interaction would uncover associations with parental speech input. Higher child cognitive ability was however associated with greater balance in conversational turn-taking in father-child and mother-child interaction, during both free and structured play. Conversational turn-taking is an indicator of both parent and child’s engagement in interaction and participation in conversation likely relies on several cognitive skills such as attention and executive function (Casillas, Bobb, & Clark, 2016). Parents may also be sensitive to their children’s cognitive abilities and produce more conversational-eliciting speech, a challenging aspect of CDS, commensurate with their child’s competencies.

Unexpectedly, lower child receptive ability was associated with greater conversational balance in father-child interaction during structured play. Whilst this
finding was not replicated across the other conditions, it perhaps reflects a mismatch between fathers’ language in this context and child linguistic proficiency. Children with lower receptive language ability may produce more clarification requests to fathers, and in turn, promote more back-and-forth conversation between father and child. Again, more in-depth analysis regarding the functions of speech in interaction is needed to elucidate this finding.

Finally, it was hypothesised that parental depression would be associated with parents’ CDS during the toddlerhood period. Although mothers’ and fathers’ scores on the CES-D were negatively correlated with their language complexity, parental depression did not explain any variance in the parent language measures examined by the present study, according to regression analyses. As mentioned previously, past research has found an association between the prosodic aspects of CDS and parental depression although it is possible that parent mood does not affect the features of parental speech input under investigation by the current study once other potential variables are considered. Future research may benefit from studying CDS among a clinically depressed sample of parents and their children.

**Strengths and Limitations**

The current study makes a significant contribution to understanding the factors which contribute to variation in parental CDS. A strength of the current study was the inclusion of both mothers and fathers, across multiple play contexts, allowing for a more accurate insight into children’s early interactive environment. Another strength of the current study was the reliance on observations of parent-child interaction in a setting designed to promote naturalistic behaviours as well as direct assessment of child cognitive ability and parent and child language abilities using standardised measures. Parent mood
and stress however were measured via self-report which may introduce biases such as social desirability.

A limitation of the present study is that findings were based upon observations of largely middle-class families. This may limit the generalisability of findings to families from lower socioeconomic backgrounds. Another limitation is that the results reported are derived from cross-sectional analyses. Longitudinal research is needed to investigate the direction of influences between parent and child factors under consideration. Finally, the variables included in the present analyses accounted for a small percentage of the variance in parental CDS, therefore factors which were not included in the present study likely have important implications for parental speech input to their children. Furthermore, many of the regression models produced insignificant $F$-tests, indicating that the variables under investigation did not fit the data well, particularly in relation to fathers’ vocabulary diversity and language complexity.

**Conclusion**

This study sought to clarify inconsistencies in the literature regarding differences in mothers’ and fathers’ CDS. Similar to previous research, the present findings indicate that mothers and fathers do not differ on measures of language complexity. Mothers did however produce more diverse vocabulary than fathers. Mothers and fathers used more diverse vocabulary during free play and there was also greater conversational balance between parent and child in this context compared to structured play. Child gender was associated with mothers’ but not fathers’ language complexity and vocabulary diversity, whilst child cognitive ability emerged as a potentially important predictor of conversational turn-taking in both mother-child and father-child interaction. In light of several limitations, further research which tests the associations proposed by the findings of this study
longitudinally is warranted. Overall, this study provides an important insight into the complex interplay of factors which contribute to variance in parents’ CDS in interaction with their toddlers, and highlights the importance of taking an ecological approach to the study of child development.
Study 2. Dynamic Associations between Parent and Child Language during Interaction

Abstract

Research indicates that parents attune their speech input to children’s vocalisations during the course of interaction. The goal of the present study was to investigate the fine-tuned adaptations parents make in response to their child’s speech. Associations between parent and child vocabulary diversity and language complexity (MLU) during the course of interaction at age two years, in both structured and free play conditions were analysed. Findings indicated that higher child MLU during free play was associated with higher paternal MLU. The present results demonstrated that fathers may tailor the complexity of their speech input according to the complexity of language produced by their child during interaction.
Introduction

Certain features of child-directed speech (CDS) are important for children at different stages of their development, depending on their developing language proficiencies (Rowe, 2012). During toddlerhood, research indicates that parents’ vocabulary diversity and language complexity are particularly salient in supporting children’s language development (e.g., Daneri et al., 2019; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010; Pancsofar & Vernon-Feagans, 2010; Rowe, 2012). At age two years, children typically produce sentences of two to four words in length and have a vocabulary of approximately 50 words (Centers for Disease Control and Prevention, 2019; Health Service Executive, 2018). It is therefore plausible that increased complexity and diversity of vocabulary of parental speech input directed at children of this age builds upon children’s initial vocabulary and syntactic language skills (Rowe, 2012). This is consistent with interactionist accounts of language learning according to which parents’ speech input falls within the child’s zone of proximal development and offers optimal support to their language learning (Vygotsky, 1978).

Transactional models of child development emphasise the active role of the child in interaction with parents, and as such how children contribute in important ways to their own development (Sameroff, 2009). Analyses included in Chapter 3 Study 1 demonstrated wide variability in parental CDS during interaction with their two-year-olds. Correlational analyses revealed associations between child receptive and expressive language abilities and parents’ vocabulary diversity and language complexity. These analyses focussed on broad associations between parents’ CDS during interaction and child language abilities measured by standardised assessment with results indicating that variability in two-year-
old children’s receptive and expressive language abilities was meaningfully related to mothers’ and fathers’ speech input.

Another line of research proposes that the processes by which parents attune their CDS to their child’s language abilities may take place at the micro-level of parent-child interaction (Kunert et al., 2011; Sokolov, 1993). Research has demonstrated that parents respond dynamically to their child’s language and behaviours during interaction, and both mothers and fathers adjust their speech in response to their child’s vocalisations (e.g., Elmlinger et al., 2019; Gros-Louis et al., 2006; Quigley & Nixon, 2019; Schwab et al., 2018). Schwab and colleagues (2018) demonstrated for instance that the number of different words produced by toddlers during interaction predicted fathers’ repetition, such that when children used more diverse vocabulary, fathers used less repetition. Longitudinal research suggests bidirectional relations between parents’ and children’s speech whereby parental CDS supports children’s language learning, and children’s speech during interaction also influences parents’ CDS (Huttenlocher et al., 2010).

The goal of the present analysis was to investigate the real-time dynamics of parents’ CDS and children’s speech during the course of interaction, with a view to understanding the fine-tuned adaptations parents make in response to their child’s speech. Associations between parent and child vocabulary diversity and language complexity during the course of interaction in both structured and free play conditions were analysed. It was hypothesised that child vocabulary diversity would be associated with mothers’ and fathers’ vocabulary diversity during interaction. It was also predicted that child language complexity would be associated with mothers’ and fathers’ language complexity.
Method

All methods and procedures used for measuring parental CDS are detailed in Chapter 3 Study 1. The procedure for measuring child speech variables during parent-child interaction included in the present analyses is detailed below.

Child speech. Similar to parental language, child language variables were extracted from the transcripts of parent-child interactions during free and structured play at child age two years. As was the case for parents’ language complexity, child language complexity was derived from children’s mean length of utterance (MLU) during interaction, measured in morphemes. Child vocabulary diversity was calculated as a proportion of the number of different word types over total number of words produced during interaction (type-token ratio; TTR). VOCD could not be calculated as an index for child vocabulary diversity as it requires a minimum speech sample of 50 words, which was not attained by all children in the current sample.

Analytic Strategy

Dynamic associations between parent and child speech during interaction were investigated using hierarchical linear regression. The assumptions of multiple linear regression were met.

Results

Descriptive statistics regarding mothers’ and fathers’ speech were detailed in Table 3.1.1 (see Chapter 3 Study 1). Descriptive statistics of child language variables are presented below in Table 3.2.1. Paired t-tests were conducted in order to compare child speech produced in interaction with mothers and fathers. Once a Bonferroni correction was applied, due to the number of tests conducted, no statistically significant differences remained. Bivariate correlations were run in order to investigate associations between
parents’ and children’s speech during free and structured play (see Tables 3.2.2 and 3.2.3). In free play, fathers’ and children’s language complexity demonstrated a weak positive association. There were no further associations between fathers’ CDS and child speech during interaction and no significant associations between any mother and child language variables.
Table 3.2.1

*Descriptive statistics of child language in father- and mother-child interaction during free and structured play (n = 80)*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Child-father</th>
<th></th>
<th></th>
<th>Child-mother</th>
<th></th>
<th></th>
<th>Paired t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td></td>
</tr>
<tr>
<td><strong>Free play</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>1.71</td>
<td>0.58</td>
<td>1 – 3.41</td>
<td>1.73</td>
<td>0.56</td>
<td>1 – 4.07</td>
<td>0.49</td>
</tr>
<tr>
<td>TTR</td>
<td>.44</td>
<td>.14</td>
<td>.22 - 1</td>
<td>.47</td>
<td>.15</td>
<td>.15 – 1</td>
<td>2.25*</td>
</tr>
<tr>
<td><strong>Structured play</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>1.67</td>
<td>.59</td>
<td>1 – 3.97</td>
<td>1.71</td>
<td>.60</td>
<td>1 – 3.86</td>
<td>0.79</td>
</tr>
<tr>
<td>TTR</td>
<td>.52</td>
<td>.17</td>
<td>.08 - 1</td>
<td>.55</td>
<td>.17</td>
<td>.18 – 1</td>
<td>0.93</td>
</tr>
</tbody>
</table>

*Note. MLU = mean length of utterance; TTR = type-token ratio.

*p < .05.*
Table 3.2.2

*Correlations between fathers’ CDS and child language during free and structured play (n = 80)*

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 FAT FP MLU</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 FAT FP VOCD</td>
<td>.21</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 CHI FP MLU</td>
<td>.38**</td>
<td>.09</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 CHI FP TTR</td>
<td>-.03</td>
<td>.11</td>
<td>-.18</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 FAT STR MLU</td>
<td>.65**</td>
<td>.06</td>
<td>.16</td>
<td>-.02</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 FAT STR VOCD</td>
<td>.14</td>
<td>.36**</td>
<td>-.01</td>
<td>-.15</td>
<td>.16</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 CHI STR MLU</td>
<td>.17</td>
<td>.05</td>
<td>.75**</td>
<td>-.16</td>
<td>.03</td>
<td>-.09</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8 CHI STR TTR</td>
<td>-.01</td>
<td>.10</td>
<td>-.08</td>
<td>.39**</td>
<td>.10</td>
<td>-.06</td>
<td>-.22</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note.* FAT = Father; FP = Free play; STR = Structured play; CHI = Child; MLU = Mean length of utterance; VOCD = Vocabulary diversity; TTR = Type-token ratio; ** *p < .001.*
Table 3.2.3  
*Correlations between mothers’ CDS and child language during free and structured play (n = 80)*

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MOT FP MLU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 MOT FP VOCD</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 CHI FP MLU</td>
<td>.20</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 CHI FP TTR</td>
<td>.02</td>
<td>-.01</td>
<td>-.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 MOT STR MLU</td>
<td>.50**</td>
<td>.11</td>
<td>.09</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 MOT STR VOCD</td>
<td>.17</td>
<td>.51**</td>
<td>.12</td>
<td>-.14</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 CHI STR MLU</td>
<td>.14</td>
<td>-.02</td>
<td>.76**</td>
<td>-.01</td>
<td>.13</td>
<td>.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 CHI STR TTR</td>
<td>-.01</td>
<td>.02</td>
<td>-.21</td>
<td>.42**</td>
<td>-.04</td>
<td>.05</td>
<td>-.19</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* MOT = Mother; FP = Free play; STR = Structured play; CHI = Child; MLU = Mean length of utterance; VOCD = Vocabulary diversity; TTR = Type-token ratio; ** p < .001.
To further investigate the relationship between fathers’ and children’s language complexity during interaction, a hierarchical regression model was fit to the data. This allowed any influence of child receptive and expressive language abilities to be controlled. According to the model, child MLU was a significant predictor of fathers’ MLU. This model explained 12% of the variance in fathers’ MLU (see Table 3.2.4). Findings indicate that higher child MLU during free play was associated with higher paternal MLU.

Table 3.2.4

*Multiple regression model predicting fathers’ MLU during free play*

<table>
<thead>
<tr>
<th>Model</th>
<th>Predictors</th>
<th>B (SE)</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bayley Receptive</td>
<td>0.01 (.04)</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>Bayley Expressive</td>
<td>0.01 (.05)</td>
<td>.02</td>
</tr>
<tr>
<td></td>
<td>Child MLU</td>
<td>0.70 (.26)</td>
<td>.36*</td>
</tr>
</tbody>
</table>

Adjusted R square = .12 (R square = .15).

*p < .05

Discussion

The findings of the present analysis demonstrated an association between fathers’ and child language complexity measured in real-time during parent-child interaction. Previous analysis of the current data did not find a relationship between fathers’ language complexity and child verbal ability assessed by standardised measures. Instead, the present findings indicate that fathers’ language was related to children’s speech production during the course of conversation. During free play, fathers produced syntactically more complex
utterances when their child used more complex speech. These results suggest that fathers are responding to the complexity of speech that their children are producing and perhaps comprehending during the course of conversation.

Although it is difficult to determine the direction of influence using correlational approaches, child MLU did not differ significantly between mother-child and father-child interaction which implies that parental language complexity is not driving children’s language complexity during interaction. Longitudinal analysis has however previously indicated that whilst parents’ language complexity may predict later child language complexity, child syntactic complexity did not predict later complexity of parents’ speech (Huttenlocher et al., 2010).

The association between child and father language complexity was demonstrated in free play only. As demonstrated in Chapter 3 Study 1, children were afforded more opportunities to take conversational turns during free play compared to structured play. Free play is less goal-oriented and may stimulate children to produce more complex speech. The association between child and parent language complexity was also demonstrated in father-child dyads and not within mother-child dyads. Research suggests that mothers are naturally inclined to promote their child’s learning (Parke & Cookston, 2019b) and may therefore consistently be using speech that is high in complexity with their toddlers, whereas fathers may be attuning their speech to that of their child’s during interaction.

The findings of the present study contribute to the body of research attesting to associations between parents’ and child’s speech at a micro-level of analysis. Furthermore the present findings add to our understanding of factors contributing to variance in fathers’ CDS. Results indicate that fathers may be responding to their child’s speech during the
course of interaction and tailoring the complexity of their language according to the complexity of their child’s utterances. The results of the present study however explain only a small portion of the variance in fathers’ language complexity during parent-child interaction. Previous analyses in Chapter 3 Study 1 failed to identify any child or parent factors which may explain individual differences in this aspect of fathers’ CDS. Variables which were not considered by the present study may therefore have important implications in shaping fathers’ speech input to their child.
Study 3. Associations between Father-Child language Interactions and Child Language and Executive Function Development

Abstract

Mothers and fathers may contribute in different ways to child development. This longitudinal study sought to investigate the unique role of mother-child and father-child language interactions in child language and executive function (EF) development. Forty-three two-year-old children (24 females; $M = 23.92$, $SD = 1.47$) and their parents engaged in mother-child and father-child structured and free play activities. Parents’ vocabulary diversity (VOCD), language complexity (MLU), and conversational turn-taking (MLT ratio) were measured from transcripts of these interactions. At age three years (24 females; $M = 37.38$ months, $SD = 1.87$) child language and EF development were assessed. Child language complexity and vocabulary diversity produced in interaction during semi-structured, triadic play with parents were also measured as a separate index of child language ability at this time point. Results indicated that controlling for mothers’ VOCD, fathers’ VOCD was significantly associated with child receptive language, child MLU, and child EF at age three years. These findings highlight the importance of considering the role of both mothers and fathers in child language and EF development.
Introduction

The preschool period is a critical time during which children make rapid advances in language (Horst & Torkildsen, 2019) and executive function (EF) development (Carlson, 2005; Garon et al., 2008; Zelazo et al., 2003). According to socio-cultural theories of development, variation in the quality of interactions between parents and their children contribute meaningfully to individual differences in child language and cognitive abilities among this age group (Luria; 1980; Vygotsky, 1978). There is growing interest in delineating how features of the father-child interactive environment in particular contribute to variation in child developmental trajectories (Cabrera et al., 2014).

Identifying the specific aspects of children’s early interactive environment which promote child language and EF development is of prime interest to researchers. Child-directed speech (CDS), the particular patterns of language input that adults use when communicating with young children, is a prominent feature of the parent-child interactive environment which extensive research indicates is important for child language development (Golinkoff, Can, Soderstrom, Hirsh-Pasek, 2015; Schwab & Lew-Williams, 2016b; Soderstrom, 2007). A limited number of studies also suggest that speech input to young children may be associated with child EF development (Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). Whilst previous research has demonstrated that both mothers’ and fathers’ CDS supports child language development (e.g., Baker & Vernon-Feagans, 2015; Leech et al., 2013; Pancsofar & Vernon-Feagans, 2010; Rowe et al., 2017; Schwab et al., 2018), no research to date has examined association between father-child language interactions and child EF development. The aim of this study was to investigate the unique contribution of father-provided language experiences at child age two years, to child language and executive function one year later at age three years.
CDS and Child Language Development

Exposure to speech input from parents that is rich in vocabulary diversity and linguistic complexity promotes child language development during the preschool period (Hoff, 2006; Huttenlocher et al., 2010; Pan, Rowe, Singer, & Snow, 2005; Rowe, 2012; Rowe, 2013; Rowe et al., 2017). As highlighted in Chapter 1 Part 3, the majority of research attesting to the importance of CDS is drawn from observations of children and their mothers, however, there is evidence to suggest that beyond the influence of mothers’ CDS, fathers play a unique role in children’s language development. Furthermore, research suggests that the features of CDS which support children’s language learning may differ for mothers and fathers (e.g., Pancsofar & Vernon-Feagans, 2006).

At present, the number of studies demonstrating associations between fathers’ speech input and child language development remains relatively small compared to mother-child language interaction research, and further investigation, across a variety of settings, is needed to demonstrate the replicability of findings in the literature. A further limitation of previous research has been the focus on child language development measured by standardised assessments, neglecting real-time measures of child language produced during interaction. Findings from Huttenlocher and colleagues (2010) demonstrated that parents’ vocabulary diversity and language complexity were associated with later child vocabulary diversity and language complexity produced during interaction. These findings underline the importance of examining child language produced during naturalistic interactions as an outcome variable alongside standardised measures.

CDS and Child EF Development

The quality of interactions between parents and their children is associated with child EF development (for a review see Chapter 2 Part 2). According to sociocultural
perspectives of cognitive development, children are exposed to and learn the skills needed for independent functioning within the context of interaction with more knowledgeable others, and these skills become gradually internalised by the child (Landry et al., 2002). The facilitative role of language in the development of EF is also emphasised by these accounts. Not only does language provide the tools to communicate with more experienced social partners which aids the development of these skills, but it provides a means of organising knowledge (Luria, 1980; Vygotsky, 1978). Despite hypothesised relationships between child language and EF development, and evidence highlighting the importance of parents for child development of these higher-order functions, there is little research investigating the association between parental language input and child EF.

Research has demonstrated that cognitive and language development may exert reciprocal influences on one another (e.g., Song et al., 2014). Several studies have also demonstrated that child verbal ability may mediate the relationship between parenting and child EF (e.g., Hammond et al., 2012; Matte-Gagné & Bernier, 2011). The precise nature of the relationship between language and EF development is however poorly understood (Gooch, Thompson, Nash, Snowling, & Hulme, 2016). According to the writings of Vygotsky and Luria, private speech aids children in organising and regulating their behaviour (Fernyhough, 2010). Some research has also shown that young children perform better on EF measures when they label important elements of the task (e.g., Kirkham, Cruess, & Diamond, 2003; Miller & Marcovitch, 2011). Parental speech input may therefore support EF development by promoting child language skills.

CDS may also directly engage child EF skills. Several studies have investigated how parents’ lexical diversity and syntactic complexity may support child EF development (Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). Theoretically,
exposure to speech rich in lexical diversity may promote child vocabulary acquisition, thereby furnishing children with the tools to support representational thinking, a cornerstone of EF (Zelazo, 2015). Using a symbol system such as language may support children’s capacity to form categories, represent objects and reason (Song et al., 2014), and therefore assist children in gaining conscious control over their behaviour (Marcovitch & Zelazo, 2009). Further to the advantages of diverse parental linguistic input, exposure to complex parental speech may also support child EF development. Syntactically complex parental language input provides young children with more examples of how words are combined to produce meaningful utterances and the rules which govern grammatical speech (Daneri et al., 2019). As these rules apply differentially under certain conditions, exposure to more complex sentence structures may support the development of conditional thinking. According to the Cognitive Complexity and Control theory of EF development, it is children’s increasing capacity for such if-then rule-based thinking which underpins advances in EF (Zelazo et al., 2003).

One study by Hughes and Ensor (2009) demonstrated that mothers’ language complexity during interaction with their two-year-olds was positively correlated with child EF at age four years. A recent study demonstrated that maternal vocabulary diversity and language complexity were predictive of later child EF development (Daneri et al., 2019). The authors demonstrated that maternal vocabulary diversity at 24 months and maternal language complexity at 36 months predicted child EF at 48 months. The authors found that child vocabulary development partially mediated the association between mothers’ vocabulary diversity and child EF, and fully mediated the association between language complexity and child EF at 48 months. Hughes and Devine (2017) however demonstrated a negative association between parents’ language complexity at age four years and child EF
at age five years. The authors suggested that lower concurrent child EF may precipitate greater parental support during interaction, which may encourage more elaborative speech from parents. Alternatively, more parent talk during interaction may indicate that parents are not providing adequate opportunities for children to practice self-regulatory skills, which in turn may be associated with poorer EF development over time (Hughes & Devine, 2017).

**The Current Study**

The literature investigating the role of fathers in child language and EF development during the preschool period is limited. A clearer understanding of the associations between mothers’ and fathers’ linguistic input and child developmental trajectories is needed. This study aimed to examine the association between father-child language interactions at age two years during structured and free play, and child language and EF performance at age three years. Free and structured play scenarios may be important contexts for shared-learning in the home, during which parents scaffold their children’s developing language and self-regulation skills. It was expected that beyond mothers’ speech input, fathers’ vocabulary diversity, language complexity, and conversational balance in father-child interaction would be positively associated with child language and EF abilities at age three years. It was expected that these features of language interactions between fathers and their two-year-olds would be associated with child language measured in real-time at age three years as well as scores on performance-based language assessments.

**Hypothesis 1.** Controlling for mothers’ CDS, it was expected that fathers’ vocabulary diversity, language complexity, and father-child conversational turn-taking at age two years would be associated with child language ability at age three years.
**Hypothesis 2.** Controlling for mothers’ CDS, it was expected that fathers’ vocabulary diversity, language complexity, and father-child conversational turn-taking at age two years would be associated with child language production during interaction at age three years.

**Hypothesis 3.** Controlling for mothers’ CDS, it was expected that fathers’ vocabulary diversity, language complexity, and father-child conversational turn-taking at age two years would be associated with child EF at age three years.

**Method**

**Participants**

Forty-three three-year-old children aged between 34 – 42 months (24 females; $M = 37.38$ months, $SD = 1.87$) and their parents who took part in the first wave of data collection at age two years ($M = 23.92$, $SD = 1.47$ months), returned approximately one year later for a follow-up visit. All mothers in this sample had completed second-level education, 79.1% had a Bachelor degree, and 30.2% had a postgraduate qualification. 93% of fathers had completed second-level education, 67.4% had a Bachelor degree, and 25.6% had a postgraduate qualification. Language variables from time 1 were missing for one participating family and two children were uncooperative during the language and EF assessment, and were subsequently removed from further analyses. The rate of attrition from Time 1 to Time 2 was 46.3%. Series of independent t-tests and chi-square tests were run to compare families who remained in the study and those who did not return at follow-up on a number of key variables. Families who remained in the study did not differ from those who did not return on measures of parental education, child language and EF at baseline. Measures of parents’ CDS did not differ significantly between those who took part at Time 2 and those who did not.
Procedure

At time 1, children and their parents engaged in free and structured play (detailed in the Method section of Chapter 3 Study 1). For the purposes of the current study, features of parental speech input were calculated from the transcripts of these interactions. At time 2, child receptive and expressive language abilities were assessed by a trained research assistant (RA) using the Bayley Scales of Infant Development (BSID-III; Bayley, 2006).

At time 2, father, mother and child triads engaged in ten minutes of semi-structured play during which they were asked to create a structure together using building blocks. Finally, child EF performance was assessed at age three using a battery of tasks, the order of which was counter-balanced across participants in order to account for potential fatigue effects. Parent-reported child EF data were also collected at this time point via the Behaviour Rating Inventory of Executive Function, Preschool Version (BRIEF-P; Gioia et al., 2003).

Measures

Parental speech input. Parent language variables were extracted from the transcripts of mother-child and father-child free and structured play interactions at age two years using the Computerised Language Analysis (CLAN) software and according to the Codes for Human Analysis of Transcripts (CHAT) conventions (MacWhinney, 2000). Features of CDS included in the present analyses were language complexity, a calculation of parents’ mean length of utterance (MLU) at the level of the morpheme; vocabulary diversity (VOCD); and balance in conversational turn-taking in parent-child interaction, measured as a ratio of parent’s and child’s mean length of turn (MLT). Refer to Chapter 3 Study 1 for a detailed account of how these variables were calculated.
Child verbal ability. Child language ability was assessed at age three years by a trained RA using the receptive and expressive scales of the BSID-III. Child scaled scores on these measures were used in the present analyses.

Child speech. At age three years, parents and children engaged in ten minutes of semi-structured play. Child type-token ration (TTR; an index of vocabulary diversity) and MLU were extracted from the transcripts of these interactions. Transcript data were available for 36 triads only.

Child EF. Child EF was assessed at age three years using a battery of five tasks developed by Willoughby and colleagues (2010). This battery has been used previously in the large-scale, longitudinal Family Life Project and associations between children’s scores on this battery and parenting quality have been demonstrated using these data (e.g., Camerota, Willoughby, Cox, & Greenberg, 2015; Daneri et al., 2019; Sulik et al., 2015; Towe-Goodman et al., 2014). These tasks were developed specifically for use with three-year-olds to assess working memory, inhibitory control and cognitive flexibility. The test battery has undergone formal psychometric evaluations, attesting to its criterion and predictive validity, and test-retest reliability (Willoughby & Blair, 2011; Willoughby et al., 2010).

Working Memory (WM). Children were presented with a card depicting a line drawing of a house, inside of which was a line drawing of an animal (cat, dog, pig, or rabbit) and a coloured dot (yellow, blue, red, or green) pictured above the animal. The child was asked to name the animal and then to name the colour. The RA put this card out of sight and presented the child with a new card depicting only the outline of the house. The child was then asked to name the animal that had been in the house. To succeed at the task, the child was required to hold both colour and animal briefly in mind, then name the
animal whilst overcoming interference from having named the colour. Children were presented six trials in which one house was depicted and four trials depicting two houses.

**Spatial Conflict (SC).** A response card, depicting a colourful picture of a bucket on the left-hand side and a beach ball on the right-hand side of the card, was placed in front of the child. The child was instructed that the RA was going to hold up a card with a picture of either a bucket or a ball on it and to touch the picture of the bucket on their own card whenever the RA held up a picture of a bucket, and to touch the ball whenever the RA held up a picture of a ball. For the first six trials, the bucket and the ball were depicted centrally on the RA’s card in order to teach the child the rules of the task. For the following six trials, the bucket and the ball were depicted laterally, with the bucket always on the left and the ball on the right (i.e., the same side as on the child’s response card). The purpose of these items was to establish an automatic motor response to touch their response card based on the spatial location of the picture presented. For the final eight trials, the pictures presented by the RA began to be depicted contra-laterally with buckets appearing on the right side of the card (for three out of the eight trials it appears on the right, for one out of the eight trials it appears on the left again) and balls appearing on the left of the cards held up by the tester (for three out of the eight trials it appears on the left, for one out of the eight trials it appears on the right again). Child scores on the six trials in which the spatial location of stimulus and response were incompatible were counted only as children were required to inhibit their prepotent response on these trials.

**Something’s the Same (STS).** This task began with four practice rounds in order to introduce the children to the three dimensions used in this task (colour, shape, and size). The RA presented the children with two cards depicting objects that were identical on one of these dimensions, and stated “These two pictures are the same. They are both
yellow/hearts/big/little”. The test phase involved presenting two cards to the child which were the same on one dimension, as in the practice round, and then presenting the child with a third card depicting an object that was identical on a second dimension to only one of the two previously presented cards (e.g., “These two pictures are the same. They are both yellow. Here is a new picture. This picture is the same as one of these (RA points to first two pictures). Can you tell me which one this new picture is the same as?”) If the first two pictures were the same in terms of colour, the third picture would be identical to one of the first two pictures in either shape or size. Children were presented with nine trials in total so that each dimension was assessed three times. This task was intended to assess cognitive flexibility as the child was required to shift from attending to the first dimension on which two items were identical to a second dimension in which two of the three items were identical.

**Silly Sounds Stroop (SSS).** Children were presented with a card depicting a cow and asked to name the animal and the sound it makes. They were then presented with a card depicting a duck and asked the same questions. Children were then told they were going to play a silly game such that whenever the RA pointed to the picture of the duck the child must “moo” and whenever the RA pointed to the picture of the cow the child must “quack”. There were twelve trials in total. This task was intended to assess inhibitory control of a prepotent response in favour of a rule-based, counterintuitive response.

**Animal Go/No Go task (GNG).** Children were presented with a large red button displayed on an iPad which made a beeping noise when pressed. They were asked to press the button any time the RA presented them with a card with an animal on it (sheep, cow, duck, dog, cat, rabbit), but asked not to press the button whenever the RA presented a card with a pig on it. It was confirmed that children understood the rules of the game by
showing each animal followed by the pig in turn whilst repeating the rules. There was a total of seven test trials which varied in the number of go trials (i.e., when the child should press the button) prior to each no-go trial, which were presented in a fixed, pseudorandom order (one-go, three-go, three-go, five-go, one-go, one-go, three-go). The task required the child to inhibit their motor response to one infrequently occurring stimulus.

Percentage of correct responses on each task was calculated. Cluster analysis was performed in order to identify structures within the data. Previous research suggests that both a one-factor model and a two-factor model, with tasks considered to measure inhibitory control (SC, SSS, GNG) loading onto one factor and tasks measuring working memory and cognitive flexibility (WM, STS) on another, fit the data well (Willoughby et al., 2010). Children performed at ceiling on the Spatial Conflict task (82.3% of children included in the present analysis scored over 80% on this measure), and it was subsequently decided to remove this task from further analyses. Results of cluster analysis performed on the four remaining tasks indicated that the two-factor model described by Willoughby and colleagues (2010) fit the current data well. An inhibitory control composite was calculated by averaging scores on the SSS task and the GNG task. Scores on the WM and STS tasks were averaged to create a working memory/cognitive flexibility composite score.

**Child EF (parent-report).** At time 2, one parent completed the Behaviour Rating Inventory of Executive Function, Preschool Version (BRIEF-P). The Global Executive Composite was used in the present analyses.

**Analytic Strategy**

Data were analysed using SPSS version 24. In order to investigate associations between father-child language interactions and child language and EF development, a
series of partial correlation analyses were performed controlling for mothers’ CDS. The assumptions of partial correlation were met.

Results

Preliminary Analysis

Descriptive statistics of child outcome measures at age three years are presented in Table 3.3.1. Descriptive statistics of parent-child language variables produced by the current sample at time 1 are presented in Table 3.3.2. Bivariate correlations between parent language variables at age time 1 and child language and EF at time 2 are presented in Tables 3.3.3 and 3.3.4. These are presented separately for free and structured play contexts.
Table 3.3.1

**Descriptive statistics of time 2 child outcome variables**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standardised Language (n = 41)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bayley Receptive</td>
<td>11.93 (1.25)</td>
<td>9 – 15</td>
</tr>
<tr>
<td>Bayley Expressive</td>
<td>13.37 (2.07)</td>
<td>7 – 17</td>
</tr>
<tr>
<td><strong>Real-time language (n = 36)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>3.45 (0.56)</td>
<td>2.17 – 4.45</td>
</tr>
<tr>
<td>TTR</td>
<td>.33 (.07)</td>
<td>.23 – .52</td>
</tr>
<tr>
<td><strong>EF task battery (n = 40)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working Memory</td>
<td>60.25 (35.19)</td>
<td>0 – 100</td>
</tr>
<tr>
<td>Spatial Conflict</td>
<td>86.67 (21.75)</td>
<td>0 – 100</td>
</tr>
<tr>
<td>Something’s The Same</td>
<td>87.50 (13.36)</td>
<td>55.56 – 100</td>
</tr>
<tr>
<td>Silly Sounds Stroop</td>
<td>55.83 (29.37)</td>
<td>0 – 100</td>
</tr>
<tr>
<td>Go-No-Go</td>
<td>57.86 (38.00)</td>
<td>0 – 100</td>
</tr>
<tr>
<td>BRIEF-P (n = 39)</td>
<td>89.44 (15.20)</td>
<td>64 – 111</td>
</tr>
</tbody>
</table>

*Note.* MLU = Mean length of utterance; TTR = Type-token ratio; EF = Executive function; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version.
Table 3.3.2

Descriptive statistics for mother-child and father-child language variables during structured and free play at time 1 (n = 40)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Fathers</th>
<th></th>
<th>Mothers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Free play</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>4.13</td>
<td>1.06</td>
<td>2.40 – 7.36</td>
<td>4.31</td>
</tr>
<tr>
<td>VOCD</td>
<td>42.54</td>
<td>6.76</td>
<td>28.99 – 54.38</td>
<td>46.84</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.45</td>
<td>0.23</td>
<td>0.02 – 1.27</td>
<td>0.39</td>
</tr>
<tr>
<td><strong>Structured play</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLU</td>
<td>4.13</td>
<td>1.15</td>
<td>2.37 – 8.12</td>
<td>4.45</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.36</td>
<td>0.18</td>
<td>0.11 – 0.94</td>
<td>0.31</td>
</tr>
</tbody>
</table>

*Note.* MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn.
Table 3.3.3
Correlations between time 1 parent free play language variables and child time 2 outcome variables

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
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<tbody>
<tr>
<td>1 FAT MLU</td>
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<tr>
<td>2 MOT MLU</td>
<td></td>
<td>.51**</td>
<td></td>
<td></td>
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<tr>
<td>3 FAT VOCD</td>
<td>.21</td>
<td>-.11</td>
<td></td>
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<tr>
<td>4 MOT VOCD</td>
<td>.05</td>
<td>.06</td>
<td>.26*</td>
<td></td>
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</tr>
<tr>
<td>5 FAT MLT ratio</td>
<td>.14</td>
<td>.23*</td>
<td>.07</td>
<td>.10</td>
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<tr>
<td>6 MOT MLT ratio</td>
<td>.13</td>
<td>.01</td>
<td>.09</td>
<td>-.10</td>
<td>.43**</td>
<td></td>
<td></td>
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<tr>
<td>7 Receptive Language</td>
<td>.11</td>
<td>.15</td>
<td>.22</td>
<td>.29</td>
<td>.18</td>
<td>.20</td>
<td></td>
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<tr>
<td>8 Expressive Language</td>
<td>.23</td>
<td>.12</td>
<td>.32*</td>
<td>-.16</td>
<td>-.29</td>
<td>-.23</td>
<td>.28</td>
<td></td>
<td></td>
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<tr>
<td>9 CHI MLU</td>
<td>-.01</td>
<td>-.01</td>
<td>-.01</td>
<td>-.18</td>
<td>.11</td>
<td>.07</td>
<td>-.07</td>
<td>.10</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>10 CHI TTR</td>
<td>-.16</td>
<td>-.05</td>
<td>.18</td>
<td>.04</td>
<td>-.09</td>
<td>-.20</td>
<td>.12</td>
<td>.01</td>
<td>-.48**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Inhibitory Control</td>
<td>.07</td>
<td>-.04</td>
<td>.31</td>
<td>.01</td>
<td>-.30</td>
<td>-.20</td>
<td>.15</td>
<td>.07</td>
<td>-.18</td>
<td>.21</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>12 WM/Cog Flexibility</td>
<td>.14</td>
<td>.35*</td>
<td>.09</td>
<td>-.01</td>
<td>.36*</td>
<td>-.13</td>
<td>.23</td>
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<td>-.01</td>
<td>.04</td>
<td>-.01</td>
<td></td>
<td></td>
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<tr>
<td>13 BRIEF-P</td>
<td>.09</td>
<td>.10</td>
<td>-.20</td>
<td>-.06</td>
<td>.23</td>
<td>.03</td>
<td>.13</td>
<td>.02</td>
<td>.26</td>
<td>-.10</td>
<td>-.35*</td>
<td>.17</td>
<td></td>
</tr>
</tbody>
</table>

Note. FAT = father; MOT = mother; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; CHI = child; TTR = type/token ratio; WM = working memory; Cog = cognitive; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version. ** p < .01; *p < .05.
Table 3.3.4

Correlations between time 1 parent structured play language variables and child time 2 outcome variables

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
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<th>11</th>
<th>12</th>
<th>13</th>
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<tbody>
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<td>1 FAT MLU</td>
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<tr>
<td>2 MOT MLU</td>
<td>.46**</td>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>3 FAT VOCD</td>
<td>.16</td>
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<td>1</td>
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<td>.11</td>
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<td>-.07</td>
<td>.19</td>
<td>-.01</td>
<td>.45**</td>
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<td>.44**</td>
<td>.14</td>
<td>.09</td>
<td>.25</td>
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<td>-.33*</td>
<td>.28</td>
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<tr>
<td>9 CHI MLU</td>
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<td>-.37*</td>
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<td>-.03</td>
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<td>10 CHI TTR</td>
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<td>-.14</td>
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<td>.33*</td>
<td>.05</td>
<td>.10</td>
<td>.11</td>
<td>.23</td>
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<td>.06</td>
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<td>.26</td>
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<td>-.35*</td>
<td>.17</td>
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</table>

Note. FAT = father; MOT = mother; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; CHI = child; TTR = type/token ratio; WM = working memory; Cog = cognitive; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version. ** p < .01; *p < .05.
Main Analyses

Partial correlations were carried out between each outcome variable and each measure of fathers’ speech, controlling for the corresponding measure of mothers’ speech (see Table 3.3.5). Results indicated that fathers’ VOCD produced during structured play was positively associated with child receptive language and working memory/cognitive flexibility at age three years, and negatively associated with child MLU. The association between fathers’ VOCD and child receptive language at age three years also remained significant after controlling for child receptive language at age two years, $r(38) = .44, p = .01$. Controlling for EF measured using the BRIEF-P at age two years, the relationship between fathers’ VOCD and working memory/cognitive flexibility remained significant, $r(36) = .37, p = .02$. Lastly, controlling for child language measured using the BSID at age two years, the relationship between fathers’ VOCD and child MLU in interaction at age three years remained significant, $r(33) = -.39, p = .02$. 
Table 3.3.5

Partial relations between father-child language interactions and child language and EF development controlling for mothers’ language

<table>
<thead>
<tr>
<th></th>
<th>Bayley Receptive</th>
<th>Bayley Expressive</th>
<th>MLU</th>
<th>TTR</th>
<th>Inhibitory Control</th>
<th>WM/Cog Flex</th>
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<td>.00</td>
<td>-.13</td>
<td>-.03</td>
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<td>-.12</td>
<td>.02</td>
<td>-.08</td>
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</tbody>
</table>

*Note.* FAT = father; MOT = mother; FP = free play; STR = structured play; MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn; CHI = child; TTR = type/token ratio; WM = working memory; Cog Flex = Cognitive flexibility; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version. *p < .05.
Discussion

This study investigated the associations between mothers’ and fathers’ speech input to their children during toddlerhood and child language and EF development at age three years. A shortcoming of previous research has been the tendency to overlook the role of fathers in child development, and whilst there were few differences between mothers’ and fathers’ speech input, the present study sought to elucidate whether fathers’ CDS is a significant source of variability in child language and EF abilities. Consistent with prior research, several aspects of mothers’ and fathers’ speech input at age two years demonstrated associations with child language and EF development at age three years.

The first goal of the current study was to elucidate the contribution of father-child language interactions to child receptive and expressive language development. It was hypothesised that, controlling for mothers’ CDS, fathers’ vocabulary diversity, language complexity, and father-child conversational turn-taking at age two years would be associated with child language ability at age three years. Whilst several features of fathers’ CDS emerged as significantly correlated with child language measured using the BSID, once mothers’ speech was controlled for, only fathers’ vocabulary diversity during structured play remained moderately, positively correlated with child receptive language scores at age three years. This finding is consistent with previous cross-sectional research which has demonstrated an association between fathers’ vocabulary diversity and child receptive language at age two years (Quigley & Nixon, 2019). The association between fathers’ vocabulary diversity and child receptive language at age three years also remained significant after controlling for child receptive language at age two years.

Unexpectedly, balance in conversational turn-taking in mother-child and father-child interaction during structured play was negatively correlated with child expressive language at age three years, although the effect of father-child conversational balance
disappeared after controlling for mother-child conversation. Balance in turn-taking during interaction indicates that both parent and child are engaged in conversation with greater balance indicating that children are given more opportunities to produce language and practice their developing expressive language abilities. The association between conversational balance and child expressive language development was found only in structured play interactions and not free play interactions. Overall, as demonstrated in Chapter 3 Study 1, conversational balance was significantly lower in structured play than free play, which may be related to the goal-oriented nature of this context. More in-depth analysis of the functions of communication in this context and levels of engagement may be necessary to elucidate this unanticipated finding.

The second goal of this study was to investigate associations between father-child language interactions at age two years and child language produced in play interactions with their parents at age three years. It was hypothesised that, controlling for mothers’ CDS, fathers’ vocabulary diversity, language complexity, and balance in father-child conversational turn-taking at age two years would be associated with child language production during interaction at age three years. Findings indicated that controlling for mothers’ speech, fathers’ vocabulary diversity in structured play was negatively correlated with child syntactic complexity during interaction at age three years. No aspects of parental speech input produced in free play at age two years were significantly related to child language complexity and vocabulary diversity produced during interaction at age three years.

Previous research suggests that variability in parental speech input may be more salient for child receptive language development than expressive language (Mahr & Edwards, 2018). This appears to be the case with regard to the current data which found
stronger associations between parent language and child receptive language. The findings are also consistent with previous research which demonstrated that fathers’, and not mothers’, lexical diversity was associated with later child language development (Panscofar & Vernon-Feagans, 2006; 2010). Mothers’ vocabulary diversity was greater than fathers’ overall but perhaps, as Pancsofar and Vernon-Feagans (2010) suggested, mothers may be producing more familiar words whereas fathers may be using more novel words, which affects child language development.

The third aim of the present study was to examine the relationship between parents’ language input and child EF development. It was hypothesised that controlling for mothers’ CDS, fathers’ vocabulary diversity, language complexity, and balance in father-child conversational turn-taking at age two years would be associated with child EF at age three years. There were no significant associations between parents’ speech and child scores on the composite of inhibitory control tasks. Similar to findings of Daneri and colleagues (2019), mothers’ language complexity during free play at age two years was associated with child working memory and cognitive flexibility at age three years. Complex speech input may engage child EF skills, challenge their processing skills, or indirectly support problem-solving by promoting child vocabulary growth (Baker & Vernon-Feagans, 2015). Controlling for mothers’ vocabulary, fathers’ vocabulary diversity during structured play was also associated with child working memory and cognitive flexibility. This association remained significant once child EF at age two years was controlled for.

There were no associations between parents’ speech input at age two years and child EF as measured by the BRIEF-P. Interestingly, scores on this measure were weakly correlated with directly assessed inhibitory control, and not significantly correlated with
directly assessed working memory and cognitive flexibility. Previous research has indicated that parent-reported child EF scores diverge from those obtained using observational methods and have indicated that performance-based and parent-reported assessments of EF measure fundamentally different aspects of child cognitive and behavioural functioning (Toplak et al., 2013).

The findings of the current study suggest that associations between parental speech input and child language and EF development may depend on the context in which it is elicited. Whilst previous studies have indicated that the quality of parental speech input may differ across contexts (Bingham et al., 2013; Doering et al., 2019; Gergely et al., 2017; Kwon et al., 2013; Salo et al., 2016), little research has examined associations between the contexts in which parent-child language interactions take place and child developmental trajectories. The results of the present study indicate that structured play may be an important context for father-child language interactions. Structured play may promote parental scaffolding for instance which may encourage child learning. Other aspects of parent-child interaction which support child development may also vary across contexts. Joint attention for example may support the internalisation of child language and self-regulatory skills and may be affected by the context of interaction. It is also important to consider how language elicited during specific contexts is generalisable to the daily experiences of parents and their children.

The small sample size of this study restricted the present analyses. Attrition rates were high, particularly among fathers. Due to power concerns, it was not possible to investigate predictive associations between father-child language interactions and child language and EF development using regression analyses. Furthermore, correlations between parent language variables and child outcome measures were small to moderate,
perhaps due to the homogeneity of the sample. It is possible that characteristics of our sample (i.e., middle-class families) contributed to less variability in parental speech input than would be observed in more diverse populations (Golinkoff et al., 2018; Kuchirko, 2017). It is difficult to determine the unique predictive associations of fathers’ speech input and child outcomes from the present analyses. Future research with a larger, more socioeconomically diverse sample is needed to test predictive associations between parental speech input and later child language and EF development.

Despite these limitations the current study had several strengths which should be considered in future research. The use of observational methods to capture naturalistic interactions between parents and children is considered gold standard in the field of fathering research (Cabrera & Volling, 2019). Performance-based measures of EF as well as parent-report scores were also included in the present analyses. Furthermore child language was directly assessed using a standardised tool as well as measured in real-time interaction. Real-time measures of child language were extracted from triadic interactions between child, mother and father which may be an ecologically valid indicator of children’s day-to-day language experiences (Cox & Paley, 1997). It is important to consider how triadic and dyadic settings may differently affect parent and child language production however. Bingham and colleagues (2013) demonstrated, for instance, that mothers’ vocabulary diversity and language complexity was greater than fathers’ during triadic play. Kwon and colleagues (2012) found that children demonstrated higher positive engagement in dyadic interaction compared to triadic. It is unclear how the increase in social complexity associated with triadic interaction may influence child language production.
Conclusion

CDS is an important feature of parent-child interaction. Correlational analyses revealed associations between mothers’ and fathers’ speech and child receptive and expressive language and EF at age three years. The small sample size restricted the depth of analysis and therefore the predictive associations between father-child language interactions and these aspects of child development remain unclear. Nevertheless, the findings suggest that fathers’ vocabulary diversity may be an important feature of father-child interactions for child language and EF development at age three years. Future research with larger sample sizes should investigate the predictive relations between father-child language interactions and child language and EF development.
Chapter 4

Study 1. It’s Your Turn: Conversational Turn-Taking in Father-Child Interaction and Child Executive Function Development

Abstract

This study investigated the longitudinal associations between mothers’ and fathers’ speech input and conversational turn-taking during parent-child interaction, and child executive function (EF) development. At age two years, transcripts of speech from twenty father-child and mother-child dyads during structured and free play were used to calculate parents’ language complexity, vocabulary diversity, and balance in parent-child conversational turn-taking. Child EF was measured at age four years using a battery of tasks. Results demonstrated a positive association between conversational balance in father-child interaction at age two years and child EF at age four years. These findings highlight that beyond exposure to parental speech, engaging children in conversation may have important implications for their cognitive development.
Introduction

The positive effects of parents’ language input on child development are well supported. Traditionally, research studying the influence of parental speech input on child development has focussed on the mother-child dyad but we know that fathers contribute in unique ways to child development (Cabrera et al., 2014; Lamb & Lewis, 2010). Furthermore, this research has primarily concentrated on the role of CDS in child language development, overlooking the rapid advances made during the preschool period in executive function (EF) development (Carlson, 2005; Garon et al., 2008; Zelazo et al., 2003). There is growing interest in delineating the ways in which fathers contribute to child development of EF (e.g., Gagné et al., 2018; Meuwissen & Carlson, 2015; Towe-Goodman et al., 2014). This study aimed to investigate how specific features of both the mother-child and the father-child communicative environment are associated with child EF development.

CDS and Child EF Development

Several studies have investigated associations between parents’ lexical diversity and syntactic complexity and child EF development (Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). See Chapter 3 Study 3 for an in-depth discussion of these studies. Findings described in Chapter 3 Study 3 demonstrated that controlling for mothers’ speech, fathers’ vocabulary diversity produced during father-child interaction at age two years was significantly associated with child EF at age three years.

Conversational Turn-Taking. Beyond exposure to varied and complex language, the literature on parental speech input has recently turned its focus to the importance of conversational turn-taking in parent-child interaction for child development (e.g., Gilkerson et al., 2017; Romeo et al., 2018). Turn-taking reflects the degree to which parent and child
are actively engaged with one another, with greater conversational balance signalling higher levels of joint-attention and mutual responsiveness. In relation to language learning, greater conversational turn-taking may support deeper engagement by the child with the linguistic structure of speech input, and may be a stronger predictor of child language acquisition than amount of speech input (Romeo et al., 2018; Zimmerman et al, 2009). Romeo and colleagues (2018) also demonstrated that Broca’s area showed greater activation amongst children exposed to higher levels of conversational turns. Previous research has found that this region of the brain supports not only speech comprehension and production, but also executive functioning (Fedorenko, Duncan, & Kanwisher, 2012).

The nature of conversational turn-taking may theoretically support children’s development of EF. Previous research has employed turn-taking in play (e.g., taking turns building a tower) as an index of EF ability (Kochanska et al., 1996; Smith-Donald, Raver, Hayes, & Richardson, 2007). Active participation in conversation may also engage the child’s developing EF and provide greater opportunities to practice these emerging skills. When participating in conversation interlocutors must keep track of incoming speech and relate this to previously heard verbal input. Children must also wait until it is their turn to speak again as well as resist distractions. Finally, the child must continuously switch from the role of speaker to the role of listener, both inhibiting and activating certain behaviours during the course of conversation. Children may therefore rely on their developing EF skills in order to comply with the rules of conversation. Previous research has demonstrated that parents’ responsiveness to child behaviours is an important predictor of child EF (Merz et al., 2017). Balance in conversational turn-taking signals high-levels of joint-attention and contingent responding between parent and child, which may facilitate children’s internalisation of self-regulatory skills (Bernier et al., 2010). Despite theoretical
links between turn-taking and EF, no research thus far has been conducted to test such an association.

**The Current Study**

The current study sought to investigate the associations between parent-child language interactions and child EF development across the preschool period. Existing research suggests that fathers may exert a unique influence on many domains of child development including child language (e.g., Pancsofar & Vernon-Feagans, 2006; Tamis-LeMonda et al., 2004) and cognitive development, including EF (e.g., Shannon et al., 2002; Towe-Goodman et al., 2014). In relation to fathers’ influence on child EF, previous research has suggested that the arousing and challenging patterns of interaction often associated with father-child play may support development in this domain, by providing more opportunities for children to practice regulatory skills and problem-solve (Grossman et al., 2002). The communicative style of fathers may also provide unique challenges to young children (Rowe et al., 2004), and influence child EF. For instance, studies have shown that fathers use more conversation-eliciting speech when interacting with their young children compared to mothers (e.g., Malin et al., 2014; Rowe et al., 2004), and may use more novel words (Pancsofar & Vernon-Feagans, 2010). Specifically, this study investigated the relationships between parents’ vocabulary diversity, language complexity and balance in turn-taking during parent-child interaction at age two years, and child EF development at age four years. It was hypothesised that mothers’ and fathers’ speech input and conversational balance in parent-child interaction at age two years would demonstrate positive associations with child EF at age four years.
Method

Participants

Of the forty-three families who took part in the second wave of data collection, twenty returned for a third, final session. At time 1 children were aged between 21 and 27 months (10 females; $M = 23.26$ months, $SD = 1.21$). At follow-up children were aged between 47 and 59 months ($M = 52.62$, $SD = 3.50$). See Chapter 3 Study 1 for a more detailed description of the present sample.

Attrition. Twenty-five percent of families recruited to the study returned for the follow-up assessments at Time 2 and Time 3 (Figure 4.1.1 depicts the flow of participants through each wave of the study). In order to test whether certain characteristics of these families were associated with retention a series of independent t-tests and chi-square tests was conducted. Families did not differ on level of education, child EF and language ability at baseline or on measures of parental CDS. It is important, however, to note that those who were retained and those who were not may differ according to variables which were not measured in the current study which may be associated with dropout (Enders, 2010). Furthermore, the approach used to compare groups fails to elucidate how variables may interact to increase the likelihood of dropout (Nicholson, DeBoeck, & Howard, 2017).
Figure 4.1.1. Flow diagram showing participant attrition during the three waves of the study.

Procedure

See Chapter 3 Study 1 for a detailed description of the study protocol at time 1.

Briefly, at time 1, parents completed a sociodemographic questionnaire and the Behaviour Rating Inventory of Executive Function, Preschool Version (BRIEF-P; Gioia et al., 2003), a parent-report measure of child EF. Child language and cognitive abilities were assessed at this time point using the Bayley Scales of Infant Development (BSID) III (Bayley, 2006), administered by a trained research assistant. Parent-child dyads were each observed during a five-minute structured play interaction and a ten minute free play interaction. These interactions were video recorded and transcribed offline by trained research assistants using the CHILDES software (MacWhinney, 2000). At time 3, child EF was assessed using a battery of tasks administered by a trained research assistant. At the end of each visit participants were debriefed and thanked for their time.
Measures

**Parental speech input.** Parents’ vocabulary diversity (VOCD) and mean length of utterance (MLU) were calculated from the transcripts of the dyadic structured and free-play interactions. Balance in conversational turn-taking (MLT ratio) during father-child and mother-child interaction was also measured. See Chapter 3 Study 1 for a detailed account of the calculations of MLU and VOCD.

**Conversational balance.** The calculation of MLT ratio was briefly discussed in Chapter 3 Study 1. A conversational turn begins when one interlocutor starts speaking and ends when the next speaker commences. One conversational turn can therefore consist of several utterances. The MLT ratio calculation is a measure of conversational load (MacWhinney, 2000) and is calculated as a ratio of each speakers’ mean length of turn. When the child assumes a more equal role in conversation with the parent, the MLT ratio will be closer to 1. Whereas other measures of conversational turn-taking quantify the number of adult-child conversational turns (e.g., Romeo et al., 2018), the present calculation provides insight into how interlocutors share the burden of conversation by considering the length of each speaker’s turn within turn-taking episodes. This provides information as to whether the conversation as a whole is being dominated by one speaker or whether the conversational load is relatively equally distributed across the course of the interaction. This measure is however limited in its depth of analysis and provides little information in regards to the qualitative content of the conversations between parent and child.

**Child EF at time 3.** A battery of three tasks designed to assess the core EF components of working memory, inhibitory control and cognitive flexibility were administered to children. These tasks included Head-Toes-Knees-Shoulders (Ponitz et al.,
2008), Spatial Conflict Arrows (Willoughby, Blair, Wirth, Greenberg, & the FLP Investigators, 2012), and the Dimensional Change Card Sort (Frye, Zelazo, & Palfai, 1995; Zelazo, 2006). These tasks have been widely used among this age group and are considered valid measures of EF during the preschool period (Carlson 2005; Hongwanishkul, Happaney, Lee, & Zelazo, 2005; McClelland et al., 2014; Ponitz, McClelland, Matthews, & Morrison, 2009; Willoughby et al., 2012). Task administration was counterbalanced across participants.

Heads-Toes-Knees-Shoulders. This task consisted of three rounds of ten trials. For the first ten trials, children were required to perform the opposite action to an instruction given by the researcher, with a total of two possible commands (e.g., when the researcher said “touch your head” the child was required to touch their toes and vice versa). In round two, children were required to perform the opposite action to one of four commands (touch their head when the researcher told them to touch their toes, touch their knees when the researcher told them to touch their shoulders, and vice versa). Finally, round three involved switching the rules such that the required opposite response to each command changed (e.g., when the researcher said “touch your head” the child was now required to touch their knees). Each set of trials was preceded by a practice round to ensure children understood the rules. Scores on each trial were rated as incorrect (0 points), self-correct (1 point) and correct (2 points). Children who received four or more points on a given round proceeded to the next set of trials. The maximum score a child could obtain across the three rounds was 60. According to the authors, this task engages EF as children must remember the new rules whilst processing the instructions of the experimenter, inhibit the prepotent response to follow the command of the experimenter, and switch between different sets of rules to complete the final part of the task. There were two versions of this task used, which
counterbalanced the order in which items were administered (i.e., form A began with the head/toes command whereas form B began with knees/shoulders command). Research assistants completed a training video prior to administering this task with participants.

**Spatial Conflict Arrows.** This task purports to measure a child’s ability to inhibit a dominant motor response. A response card, depicting two black buttons, one on the left-hand side and one on the right-hand side of the card, was placed in front of the child. The experimenter presented the child with a series of arrows pointing to the left and to the right. The child was instructed to touch the button on their response card that was on the same side that the arrow was pointing to. For the first eight trials, the arrow was depicted centrally on the researcher’s card in order to teach the child the rules of the task. For the following 13 trials, the arrows were depicted laterally, with the arrow pointing to the left always appearing on the left of the card and the arrow pointing right always depicted on the right (i.e., the same side as on the child’s response card). The purpose of these items was to establish an automatic motor response to touch the response card based on the spatial location of the picture presented. For the final 13 trials, the pictures presented by the experimenter were depicted contra-laterally with arrows pointing to the left appearing on the right side of the card and arrows pointing to the right appearing on the left of the card (i.e., the location of the arrow was incongruent with response location). Laterally depicted arrows were interspersed amongst incongruent trials. Child responses to the eight incongruent trials were recorded.

**Dimensional Change Card Sort.** The Dimensional Change Card Sort (DCCS; Frye et al., 1995; Zelazo, 2006) is a well-established measure of EF which assesses the core EF components of working memory, inhibitory control and cognitive flexibility. Children were presented with two target cards, one depicting a red rabbit and one depicting a blue
boat, each attached to a tray. They were told they were going to play the colour game and instructed to place all the red cards in the tray with the picture of the red rabbit attached and the blue cards in the tray with the picture of the blue boat attached (preswitch condition). After six trials the experimenter informed the child that they would no longer play the colour game and now they would play the shape game (postswitch condition). They were instructed to place all the cards depicting rabbits in the tray with the picture of the rabbit attached and all the cards depicting boats in the tray with the picture of the boat attached. If children scored five out of six trials correctly in the postswitch condition they were introduced to the final part of the task – the border condition. The children were now instructed that if there was a border on the presented card they must play the colour game and if there was no border they must play the shape game. There were 12 trials in the border phase. Children could score a maximum of 24 points on this task.

BRIEF-P. At time 3, one parent completed the Behaviour Rating Inventory of Executive Function, Preschool Version (BRIEF-P; Gioia et al., 2003), a 63-item parent-report questionnaire designed to assess child EF performance in everyday contexts. The Global Executive Composite, a summary index of the child’s overall EF abilities, was used in the present analyses. Higher scores on this composite indicate greater difficulties in EF.

Analytic Strategy

Data were analysed using SPSS version 24. Bivariate correlations were performed between the main study variables and sociodemographic variables and child baseline variables in order to determine appropriate covariates for subsequent analyses. Partial correlational analyses were conducted in order to investigate associations between parents’ vocabulary diversity, language complexity and conversational balance in parent-child interaction, and child EF development.
Results

Descriptive statistics for child language and EF measured at ages two and four years are presented in Table 4.1.1. Descriptive statistics of mother-child and father-child language variables measured during structured and free play interactions are presented in Table 4.1.2. On closer examination of the data it was observed that the majority of children performed at ceiling on the SCA task with 85% of participants getting seven out of eight trials or above correct. This task was removed from subsequent analyses. The EF tasks at age four years were considered separately in subsequent analyses as there were no significant relationships between the individual tasks.

Table 4.1.1

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<tr>
<td>T1 BSID Cognitive</td>
<td>10.05</td>
<td>2.37</td>
<td>6 - 14</td>
</tr>
<tr>
<td>T1 Child EF</td>
<td>83.90</td>
<td>16.73</td>
<td>63 - 117</td>
</tr>
<tr>
<td>T3 HTKS</td>
<td>25.32</td>
<td>14.38</td>
<td>0 - 52</td>
</tr>
<tr>
<td>T3 SCA</td>
<td>6.90</td>
<td>2.05</td>
<td>0 - 8</td>
</tr>
<tr>
<td>T3 DCCS</td>
<td>14.90</td>
<td>7.91</td>
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<tr>
<td>T3 BRIEF-P</td>
<td>83.25</td>
<td>16.27</td>
<td>63 - 112</td>
</tr>
</tbody>
</table>

Note. T1 = Time 1; T3 = Time 3; BSID = Bayley Scales of Infant Development; EF = executive function; HTKS = Heads-toes-knees-shoulders; SCA = Spatial conflict arrows; DCCS = Dimensional change card sort; FSIQ = Full Scale IQ; VCI = Verbal comprehension index; BRIEF-P = Behaviour Rating Inventory of Executive Function, Preschool Version
Table 4.1.2

*Descriptive statistics for mother-child and father-child language variables during structured and free play at age two years (n = 20)*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean (Fathers)</th>
<th>SD (Fathers)</th>
<th>Range (Fathers)</th>
<th>Mean (Mothers)</th>
<th>SD (Mothers)</th>
<th>Range (Mothers)</th>
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<td>0.96</td>
<td>2.71 – 6.48</td>
<td>4.51</td>
<td>1.22</td>
<td>2.91 – 8.39</td>
</tr>
<tr>
<td>VOCD</td>
<td>43.03</td>
<td>7.36</td>
<td>30.60 – 54.38</td>
<td>47.44</td>
<td>6.69</td>
<td>36.84 – 60.96</td>
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<td>MLT ratio</td>
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<td>0.19</td>
<td>0.02 – 0.83</td>
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<td>0.16</td>
<td>0.07 – 0.73</td>
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<td>2.86 – 8.12</td>
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<td>.93</td>
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<tr>
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<td>6.51</td>
<td>20.61 – 46.79</td>
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<td>MLT ratio</td>
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<td>0.03 – 0.56</td>
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</table>

*Note.* MLU = mean length of utterance; VOCD = vocabulary diversity; MLT = mean length of turn.
Table 4.1.3

Correlations between time 1 parent-child free play language variables and child time 3 outcome variables

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<tbody>
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**p < .01; *p < .05
Table 4.1.4

**Correlations between time 1 parent-child structured play language variables and child time 3 outcome variables**

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<td>.28</td>
<td>.41</td>
<td>-.34</td>
<td>-.11</td>
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<td>-.17</td>
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<td>.56**</td>
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<td>.19</td>
<td>.26</td>
<td>-.08</td>
<td>-.31</td>
<td>1</td>
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</tbody>
</table>

** p < .01; *p < .05
In order to test associations between parental speech input and child EF, a series of Spearman correlation analyses were computed between each of the study variables. These are presented separately for free and structured play contexts (see Tables 4.1.3 and 4.1.4). Measures of fathers’ VOCD, MLU and MLT ratio in father-child interaction were not correlated, indicating that these measures captured distinct aspects of the father-child communicative environment. This was similar for mother-child language variables.

Child age at time 1 was positively associated with MLT ratio in father-child interaction as well as child verbal ability. Only one EF task, the HTKS, was associated with child age at time 3. Carlson (2005) previously found age-related improvements on EF tasks comparing younger and older four-year-olds. With regard to the DCCS task specifically, Zelazo (2006) suggests that across age four children perform similarly, indicating that age-related associations with performance on this task among the present participants would not be anticipated. Fathers’ MLU in the free play condition demonstrated a significant positive association with child performance on the HTKS. However, once a partial correlation was conducted controlling for child age at time 3, this association was no longer significant, $r(16) = .29, p = .245$.

Father-child MLT ratio during structured play was positively associated with child performance on the DCCS at age four years. A scatterplot of this correlation is illustrated in Figure 4.1.2. Furthermore, the $p$-value for the correlation between MLT ratio and DCCS scores in free play was close to .05 ($p = .07$). This suggests that with more participants there may be an increase in power which may provide a statistically significant result. Bootstrapped confidence intervals for the MLT ratio during structured play and DCCS correlation coefficient were calculated, 95% CI [0.18, 0.79]. This interval does not cross zero, implying a statistically significant effect.
Figure 4.1.2. Correlation between MLT ratio in father-child interaction at age two years and EF performance at age four years ($n = 20$) with best-fitting regression line.

Given concurrent associations between child cognitive ability and conversational turn-taking demonstrated in Chapter 3 Part 1, a partial correlation was run controlling for child cognitive ability. Prior to conducting these analyses, the assumptions of partial correlation were checked. Scores on the dependant variable DCCS were negatively skewed, skewness = -1.07, kurtosis = -.32. Scores were subsequently reflected and log transformed which produced a satisfactory value of skewness, skewness = -.42, kurtosis = -.44. Finally, to aid interpretation, scores were re-reflected so that higher scores implied higher performance on the DCCS. Controlling for cognitive ability, MLT ratio in father-
child interaction was positively correlated with child scores on the DCCS, \( r(16) = .53, p = .02 \).

**Discussion**

The current study investigated longitudinal associations between parent-child language produced during mother-child and father-child interactions at age two years and child executive function development at age four years. Based on research carried out with mothers, it was expected that mothers’ and fathers’ vocabulary diversity and language complexity would be positively associated with child EF development. It was also hypothesised that a separate measure of conversational balance in parent-child interaction would be positively related to later child EF. This latter feature of parent-child interaction has not previously been examined in relation to child EF development. Results of partial correlation analyses indicated that conversational balance in father-child interaction only was associated with a measure of child EF at age four years. Contrary to expectations, after controlling for child age, parents’ language complexity at age two years was not associated with child EF at age four years. Furthermore, no significant association between parental MLU and child verbal ability was demonstrated. It is possible that parents’ language complexity was not attuned to the child’s ability and for this reason may not have been beneficial for EF development.

As hypothesised, greater balance in conversational turn-taking in father-child interaction at age two years was positively associated with child EF at age four years. Patterns of interaction which are challenging, such as those which encourage greater child verbal responding and reasoning, are hypothesized to stimulate children’s development. Compared to mothers’ speech input, father-child language interactions may be more challenging for young children (Malin et al., 2014; Rowe et al., 2004). Analyses in Chapter
3 Study 1 demonstrated that there was greater balance in conversational turn-taking in father-child interaction compared to mother-child interaction, although this difference did not remain significant after applying a Bonferroni correction. Furthermore, the same behaviours of mothers and fathers during interaction may be differentially significant for children’s development.

A particular challenge facing children during conversation may be in predicting the offset of the interlocutor’s turn, coupled with attending to the content of speech input, as well as preparing to take their own turn (Casillas et al., 2016). Adults rely on their knowledge of linguistic rules as well as on intonational and interpersonal cues when predicting an interlocutor’s end of turn (Ford & Thompson, 1996). Casillas and colleagues (2016) demonstrated that children become more efficient at initiating responses to questions across the preschool period. As well as benefitting from increased exposure to syntactic, intonational and pragmatic cues across early development, concurrent advances in EF during this period may support children’s capacity for prediction and planning in conversation.

In relation to speech production, a recent study demonstrated that child speech articulation skills may be positively associated with child EF (Netelebos, Gibb, Li, & Gonzalez, 2018). In a word repetition task, children aged four to six years were required to articulate words beginning with ‘s’ and ‘sh’ sounds. Results indicated that higher child EF predicted better performance on this task, and also performance on this task predicted higher child EF. Speech articulation requires constantly shifting between different phonetic rules as well as coordination of motor and language behaviours, therefore engaging core EF skills (Netelebos et al., 2018). The findings of these studies complement the results of
the present research, suggesting other ways in which child involvement in conversation may support EF development.

The current study makes a significant contribution to understanding the aspects of the child’s interactive environment which contribute to variation in EF development. A strength of the current study is its longitudinal design which permitted the investigation of parent-child influences on child development over time. Another strength is the naturalistic observational design of the study which is considered to approximate the linguistic environment of the child outside of the laboratory. The findings of the current study are however limited by the correlational design of the research as well as the small sample size. Results of the current study cannot rule out the possibility that variables which were not controlled for in the present analysis may account for the observed relationship between conversational turn-taking and child EF. It may be important for future research to account for the level of father-involvement, for example, when examining the relationship between father-child interaction and child development. Another interesting line of enquiry for future research may be to investigate the effectiveness of targeting early conversational turn-taking in parent-child interaction in promoting EF at this stage of development. Past research has demonstrated that conversational turn-taking in parent-child interaction is an amenable target for intervention (Brassart & Schelstraete, 2015; Ramírez, Lytle, & Kuhl, 2020) which may have positive effects on later child language development (Ramírez et al., 2020).

A further limitation of the current study was that EF was assessed via parent-report at time 1. Necessarily, many EF tasks are age-dependent such that measures designed to assess these emerging skills at one age are not suitable for slightly older children. Furthermore, there are few well-validated performance-based measures designed to assess
EF in children younger than three years (Hendry et al., 2018). As previously mentioned, research has indicated that parent-reported child EF scores and those derived from performance-based measures may reflect distinct aspects of child cognitive and behavioural functioning (Toplak et al., 2013). These methodological limitations in the field of EF research make it difficult to chart subtle developmental changes in EF across early childhood (Best & Miller, 2010) and restrict interpretations of the direction of developmental cause and effect between child EF and parent-child turn-taking. However, the performance-based assessment of child cognitive ability at Time 1 may provide a more robust indication of the child’s cognitive abilities.

**Conclusion**

EF is a critical component of child cognitive development and is an important predictor of later achievement (Bierman et al., 2008). As there can be wide individual differences in EF during the preschool period, understanding the aspects of parent-child interaction which may enhance the development of these skills is important. The findings of the present study indicate how features of the child’s interactive environment are associated with development of EF during the preschool period. Whilst previous research has focussed on the role of conversational turn-taking in relation to child language acquisition, the present study indicates that this feature of parent-child interaction may also have implications for child cognitive development. This study presents a new perspective on the relation between pragmatics and cognitive development during the preschool period, indicating that beyond the social rewards of engaging children in conversation, turn-taking may promote the development of EF skills. In addition, this study contributes to the emerging literature demonstrating the importance of father-child interaction for child development of EF. The findings indicate that fathers are important resources for children
and further investigation into the predictive relations between father-child language interactions and child development is warranted.
Study 2. Dynamics of Conversational Turn-Taking in Father-Child Interaction and Associations with Child Executive Function

Abstract

Research attests to the importance of parent-child language interactions for child executive function (EF) development. Beyond parental speech input, conversational turn-taking may be important for children’s EF. This study sought to examine the dynamics of conversational turn-taking in order to investigate the aspects of father-child conversation which were associated with child EF development. Twenty father-child dyads engaged in structured play at child age two years. Transcripts of these interactions were used to calculate fathers’ mean length of turn (MLT), proportion of questions, and father-child response latencies. Child EF was measured at age four years using the Dimensional Change Card Sort. Results demonstrated a negative association between fathers’ MLT and child EF, indicating that when fathers took longer turns at age two years, children had lower scores on a measure of EF at age four years. No associations between fathers’ proportion of questions or father-child response latencies and child EF were observed. These components of conversation also failed to demonstrate any associations with greater balance in father-child turn-taking. The present findings indicate that providing opportunities for children to engage in conversation may be important for EF development, however features of turn-taking which facilitate their involvement remain to be elucidated.
Introduction

Parents contribute in important ways to their children’s developing executive function (EF) skills. A small body of research suggests that one aspect of parent-child interaction which may influence child EF development is child-directed speech (CDS; Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). These studies demonstrated that the diversity of parents’ vocabulary and the complexity of their language produced during interaction with their young children may influence child EF development. Beyond exposure to parental speech input, pragmatic features of parent-child language interactions may contribute to child development of higher-order cognitive functions. Findings from the Infant and Child Research Lab demonstrated that turn-taking in father-child interaction was longitudinally associated with child EF (see Chapter 4 Study 1). Specifically, this research indicated that greater balance in conversational turn-taking during structured play interactions between fathers and their child at age two years was associated with child EF at age four years.

Greater balance in turn-taking occurs when parent and child take turns of similar length and no one interlocutor is dominating the conversation. It indicates that both interlocutors are actively involved in conversation and signals high levels of joint-attention. Certain features of fathers’ speech input may serve to scaffold children’s participation in conversation and therefore promote greater balance in turn-taking. Greater engagement in conversation may elicit children’s EF and provide them with opportunities to practice these emerging skills. Children must monitor the ongoing conversation, wait their turn, attempt to predict the end of the interlocutor’s turn and plan their own turn. In order to further explore the association between balance in turn-taking and child EF
development, it is important to examine the dynamics of father-child conversation and the aspects of turn-taking which are associated with child EF.

The present study therefore sought to investigate whether certain father-child turn-taking behaviours are associated with greater balance in conversation. The second aim was to examine associations between father-child turn-taking behaviours and child EF development. The units of turn-taking explored in the current study included fathers’ mean length of turn, proportion of questions posed by fathers, and response latencies between father and child turn transitions. Even before they can speak, infant language plays an important role in shaping the course of conversation. During the prelinguistic period, infants and parents engage in episodes of proto-turn-taking, using vocalisations and facial expressions (Bateson; 1979; Hilbrink, Gattis, & Levinson, 2015). Parents alternate their speech with their infants’ speech-like vocalisations, but not infant cries (Yoo et al., 2018). The present study therefore also considered how child language proficiency may be associated with parent-child turn-taking behaviours.

**Mean Length of Turn**

The first turn-taking behaviour examined by the present study was fathers’ mean length of turn (MLT). As greater balance in conversational turn-taking is associated with child EF, it was expected that fathers’ MLT would be inversely related to child EF. High MLT may indicate that one interlocutor is dominating the language interaction. Fathers who exhibit higher MLT may be providing fewer opportunities for their child to participate in conversation, and in turn fewer opportunities for engaging child EF. Previous research has demonstrated that when parents decreased the length of turns they took, children’s verbal participation in conversation increased (Brassart & Schelstraete, 2015; Girolametto, 1988). Greater balance in turn-taking is enhanced by sensitive and contingent responding...
to the child and providing sufficient time for the child to respond (Brassart & Schelstraete, 2015).

**Proportion of Questions**

The second turn-taking behaviour which was investigated in the current study was the proportion of questions produced by fathers during interaction with their two-year-old children. Previous studies suggest that fathers produce more conversation-eliciting speech such as *wh*-questions during interaction with their young children compared to mothers (Malin et al., 2014; Rowe et al., 2004). Others (e.g., Pancsofar & Vernon-Feagans, 2006) found no difference in the proportion of *wh*-questions asked by mothers and fathers. Conversation-eliciting speech is hypothesized to be a challenging feature of the child’s communicative environment and has previously been demonstrated to support child verbal reasoning (Rowe et al., 2017) and language development (Leech et al., 2013). *Wh*-questions require complex responses compared to yes/no questions and may therefore support children’s development of language and reasoning skills (Rowe et al., 2017).

It was expected that a higher proportion of questions posed by fathers would encourage greater verbal participation of the child during interaction and therefore be associated with greater balance in conversational turn-taking. No research to date has examined associations between parental questions and child EF development specifically. Questions may provide opportunities for children to practice their emerging self-regulation and problem-solving skills. Past research suggests that questions requiring more than a yes/no response (e.g., *wh*-questions) may be particularly challenging for children. It was expected that this form of question in particular may engage children’s EF and demonstrate an association with child EF at age four years.
Temporal Contingencies of Father-Child Utterances

Turns consist of three units: an utterance from the first speaker; a pause at the turn transition between speakers; and then, an utterance from the second speaker (Marklund, Marklund, Lacerda, & Schwarz, 2015). The third turn-taking behaviour investigated in the current study was the response latency between fathers’ and children’s speech. Compared to adult-directed speech, CDS is characterised by more frequent and longer pauses (Cooper & Aslin, 1990; Fernald et al., 1989). Pausing is an important unit of turn-taking which serves as a cue for speaker transitions (Schlangen, 2006).

Previous research has demonstrated an association between parental pause duration and child verbal ability. Specifically, parents respond more rapidly to children with greater language skills (Marklund et al., 2015). Longitudinal research has also demonstrated an association between the temporal alignment of parents’ verbal and non-verbal responses to their infants’ vocalisations and infant language development (Goldstein & Schwade, 2008). Findings from the EF literature have similarly indicated an association between the timing of parents’ contingent responses to child behaviours and child EF skills (e.g., Bibok et al., 2009). Contingent, rapid responses to child behaviours support the child in relating their present activity to particular outcomes, and sensitive interactions with caregivers are hypothesised to facilitate the internalisation of self-regulatory skills by the child (Bibok et al., 2009).

Taking each child utterance as the target utterance, this study sought to examine the timing of children’s responses to fathers’ preceding utterances and fathers’ timing of response following children’s utterances. Shorter child response latencies may be indicative of their proficiency with using language. It may also suggest children are more
adept at predicting the offset of the interlocutor’s turn as well as planning their own turn (Casillas et al., 2016), which are important steps in taking accurate turns (i.e., free from gaps and overlapping; Stivers et al., 2009). Casillas and colleagues (2016) analysed question-answer sequences between children aged one to three years and their caregivers, finding age-related improvements in the speed of their responses. The authors suggested that, as well as benefitting from increased exposure to syntactic, intonational and pragmatic cues across early development, concurrent advances in EF during the preschool period may support children’s capacity for prediction and planning in conversation.

Novel research on infant and adult neural activity during back-and-forth communication has also demonstrated that activation in the prefrontal cortex of one-year-olds preceded behavioural cues suggesting the PFC, a brain region associated with EF, was involved in the prediction or production of behaviours during interaction (Piazza, Hasenfratz, Hasson, & Lew-Williams, 2020). Given previous findings in relation to parental responsiveness and child language and EF development, longer paternal response latencies to child initiations were expected to be associated with poorer child EF. Longer response latencies were also expected to be negatively associated with balance in turn-taking.

The Current Study

To summarise, the current study sought to build upon previous findings that conversational balance in father–child interaction was associated with child EF development during the preschool period. The first aim of the present study was to elucidate the father–child turn-taking behaviours which may promote greater balance in conversation. Specifically, it was expected that fathers’ greater use of questions would promote more back-and-forth conversation between father and child and therefore support
equilibration in turn-taking. On the other hand, it was expected that longer pause durations between father and child utterances would be indicative of a less responsive interaction and be negatively correlated with balance in turn-taking.

The second aim of the current study was to examine associations between father-child turn-taking behaviours and child EF development. Given previous findings that balance in conversational turn-taking in father-child interaction at age two years was associated with child EF at age four years, this study sought to unpack the components of father-child conversation to understand how they might relate to child EF. Therefore the present analyses examined the associations between father-child turn-taking behaviours measured during interaction at age two years, and child EF measured at age four years. These behaviours included fathers’ MLT, fathers’ total proportion of questions and wh-questions, and response latencies between father and child. It was hypothesised that fathers’ longer MLT and longer response latencies between father and child would not provide optimum opportunities for engaging child EF and would therefore be negatively associated with a measure of child EF at age four years. On the other hand, more questions, particularly wh-questions, may challenge the child and support their EF development.

Finally, given previous findings that child verbal ability may be associated with parent-child conversation, associations between child language and turn-taking behaviours were also examined. It was expected that child language ability at age two years would be associated with fathers’ MLT, proportion of questions, and father and child response latencies.
Method

Participant information, general procedure and father and child language measures collected at time 1 (child age two years) are described in Chapter 3 Study 1. The procedure for measuring child EF at time 3 (child age four years) is detailed in Chapter 4 Study 1. The procedure for measuring turn-taking behaviours examined in the current study are detailed below. Turn-taking behaviours included fathers’ MLT, fathers’ total proportion of questions and proportion of wh-questions, and response latencies between father and child utterances. Conversational balance was operationalised as MLT ratio in the current study. The procedure for calculating MLT ratio is also described below.

Measures

Mean length of turn. Fathers’ mean length of turn was measured using the MLT command in CHAT (MacWhinney, 2000). This command divides the speakers’ total number of utterances by their total number of turns. A turn refers to a sequence of utterances spoken by one interlocutor. Table 4.2.1 provides a sample of turn-taking from one dyad in the current study. In this example, the father produced a total of three utterances over two turns and the child produced two utterances over two turns.
Table 4.2.1

Example of turn-taking

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAT</td>
<td>That’s right.</td>
</tr>
<tr>
<td>CHI</td>
<td>There?</td>
</tr>
<tr>
<td>FAT</td>
<td>Yeah.</td>
</tr>
<tr>
<td>FAT</td>
<td>That is a red car.</td>
</tr>
<tr>
<td>CHI</td>
<td>Red.</td>
</tr>
</tbody>
</table>

*Note. FAT = father; CHI = child.*

**Proportion of questions.** The frequency of questions produced by fathers was calculated in CHAT. Specifically, this was calculated using the combo +s"*?*" +t*FAT command. Frequency lists of all utterances containing a question mark were produced for each transcript. Open-ended questions (i.e., questions requiring more than yes/no response) were coded from these lists (see Table 4.2.2 for an example from the current sample). Proportion of total questions and open-ended questions was calculated from fathers’ total number of utterances.
Table 4.2.2

*Example of open-ended questions*

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAT</td>
<td>Who is that?</td>
</tr>
<tr>
<td>CHI</td>
<td>Horse.</td>
</tr>
<tr>
<td>FAT</td>
<td>Seahorse.</td>
</tr>
<tr>
<td>FAT</td>
<td>Where does the seahorse go?</td>
</tr>
<tr>
<td>CHI</td>
<td>There.</td>
</tr>
</tbody>
</table>

*Note.* FAT = father; CHI = child.

**Response latencies.** In order to code children’s response latencies, the offset of each parent utterance which preceded a child utterance was first marked. The onset of the child utterance was then marked. The time (in seconds and milliseconds) between the offset of fathers’ speech and the onset of the child utterance was then calculated. Fathers’ response latencies were calculated similarly by calculating the time between the offset of children’s utterances preceding a paternal utterance and the onset of this paternal utterance. Speaker onset was defined as the first phonetic cue of the speaker. Speaker offset was defined as the completion of the last phonetic cue of the speaker. Periods of laughing or crying were excluded. All onset and offset data were manually marked using visual waveform information in Audacity accompanied by audio recordings and transcripts of the interactions. See Figure 4.2.1 for an example of a father’s response latency following a child utterance.
Positive response latencies occurred when there was a gap between the offset of the first speaker’s utterance and the onset of the second speaker’s utterance. Negative response latencies occurred when there was an overlap between the offset of the first speaker’s utterance and the onset of the second speaker’s utterance. Turn transitions which exceeded five seconds were excluded. Previous research indicates that one-year-olds’ responses to adult utterances which occurred within 4.25 seconds were judged as related to the preceding turn (Balog & Roberts, 2004). Language Environment Analysis (LENA) technology also uses a maximum pause of five seconds in its calculation of adult-child conversational turn-taking (e.g., Romeo et al., 2018; Zimmerman et al., 2009).

**Figure 4.2.1.** Example of a father’s response latency following a child utterance. The father repeats the child utterance “up” after a pause duration of 694 milliseconds.

**Mean length of turn ratio in father-child conversation.** Conversational balance in father-child conversational turn-taking was operationalised as the ratio of child MLT to
fathers’ MLT (henceforth referred to as MLT ratio). MLT was calculated by dividing the
speakers’ total number of utterances by their total number of turns. The ratio of child-father
MLT was then calculated as an index of conversational balance such that a ratio closer to
one indicated greater balance. It is important to note that although MLT, which is
considered in the present analyses as a separate correlate of child EF, is a direct component
of MLT ratio, unlike MLT ratio it gives no indication of the child’s role in the language
interaction. A high MLT calculated for a father, for instance, provides no information on
his child’s involvement in that interaction or on that child’s own MLT; a father and child
taking equally long turns of 6 utterances each, for example, would have an MLT ratio of 1.

Analytic Strategy

Data were analysed using SPSS version 24. Bivariate correlations were conducted
in order to investigate associations between fathers’ proportion of questions and father-
child response latencies, and MLT ratio in father-child conversation. Bivariate correlations
were also calculated in order to test associations between fathers’ MLT, proportion of
questions and father-child response latencies and child EF at age four years. Finally,
bivariate correlations were conducted in order to examine concurrent associations between
father-child turn-taking behaviours and child language ability at age two years.

Results

Descriptive statistics for child and parent variables are presented in Table 4.2.3. On
average, child response latencies were 1.8 times longer than fathers’ response latencies.
Spearman correlations for all study variables are presented in Table 4.2.4. With regard to
the first aim of the study, this table includes associations between turn-taking behaviours
and MLT ratio, the index of conversational balance employed in the current study. This
table also includes analyses of associations between father-child turn-taking behaviours at age two years and child EF at age four years, in relation to the second aim of the study. Lastly, concurrent associations between father-child turn-taking behaviours and child language ability at age two years are shown in this table.

Fathers’ production of questions and father and child response latencies were not associated with MLT ratio. The only turn-taking behaviour at age two years which was significantly associated with child EF at age four years was fathers’ MLT. Fathers who produced longer turns during interaction at age two years had children who performed more poorly on a measure of EF at age four years, $rs(20) = -.47, p = .035$. No significant associations between child language ability and father-child turn-taking behaviours were observed.
Table 4.2.3
Descriptive statistics for paternal speech input, father-child conversational turn-taking, and child language and EF outcome measures

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>M</th>
<th>SD</th>
<th>Min - Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fathers’ MLT</td>
<td>5.44</td>
<td>5.01</td>
<td>2.48 – 25.25</td>
</tr>
<tr>
<td>Mean proportion of questions</td>
<td>23.32</td>
<td>8.48</td>
<td>5.04 – 41.24</td>
</tr>
<tr>
<td>Mean proportion of open-ended questions</td>
<td>7.05</td>
<td>5.46</td>
<td>2.16 – 25.77</td>
</tr>
<tr>
<td>Child mean response latency</td>
<td>1.09</td>
<td>0.30</td>
<td>0.72 – 1.92</td>
</tr>
<tr>
<td>Fathers’ mean response latency</td>
<td>.60</td>
<td>0.30</td>
<td>0.19 – 1.27</td>
</tr>
<tr>
<td>T1 BSID-III language composite</td>
<td>112.70</td>
<td>15.80</td>
<td>86 – 138</td>
</tr>
<tr>
<td>T1 MLT ratio</td>
<td>0.29</td>
<td>0.12</td>
<td>0.04 – 0.57</td>
</tr>
<tr>
<td>T3 child executive function</td>
<td>14.90</td>
<td>7.91</td>
<td>0 – 24</td>
</tr>
</tbody>
</table>

Note. T1 = Time 1; T3 = Time 3; MLT = Mean length of turn; BSID-III = Bayley Scales of Infant Development, Third Edition.
Table 4.2.4

*Correlations between father-child turn-taking behaviours and conversational balance, child verbal ability and EF*

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Child age in months</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Fathers’ MLT</td>
<td>-.29</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Mean proportion of questions</td>
<td>.24</td>
<td>-.35</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Mean proportion of open-ended</td>
<td>.15</td>
<td>-.28</td>
<td>.52*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Child mean response latency</td>
<td>.29</td>
<td>-.28</td>
<td>-.19</td>
<td>-.01</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Fathers’ mean response latency</td>
<td>-.03</td>
<td>-.21</td>
<td>-.19</td>
<td>-.11</td>
<td>.39</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. T1 child verbal ability</td>
<td>.48*</td>
<td>-.30</td>
<td>.15</td>
<td>-.05</td>
<td>.16</td>
<td>-.33</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. T1 MLT ratio</td>
<td>.46*</td>
<td>-.93**</td>
<td>.27</td>
<td>.19</td>
<td>.21</td>
<td>.16</td>
<td>.31</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9. T3 child executive function</td>
<td>.19</td>
<td>-.47*</td>
<td>.16</td>
<td>-.05</td>
<td>-.14</td>
<td>.01</td>
<td>.27</td>
<td>.56**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. MLT = Mean length of turn; T1 = Time 1; T3 = Time 3. $p < .01$; *$p < .05$
The proportion of questions to which children provided a response was calculated. On average, children provided responses to 29% of fathers’ total questions. Children responded 35% of the time when these questions were open-ended. The association between proportion of questions responded to by children and EF at age four years was insignificant for both total number of responses, $rs(20) = .48, p = .067$ and responses to open-ended questions, $rs(20) = .19, p = .433$.

**Discussion**

Previous findings drawn from the current sample demonstrated that balance in conversational turn-taking in father-child interaction at age two years was associated with child EF development at age four years. The present study therefore aimed to investigate the turn-taking behaviours of fathers and their two-year-old children in more depth and to first examine the aspects of father-child turn-taking which promote greater balance in conversation. It was hypothesised that fathers’ higher proportion of questions and shorter response latencies of fathers to child initiations would scaffold children’s participation in conversation and be associated with balance in turn-taking. Second, this study aimed to elucidate associations between father-child turn-taking behaviours and child EF development at age four years. It was expected that fathers’ mean length of turn, proportion of questions, and response latencies between father and child utterances would be associated with child EF development at age four years. Results indicated that fathers’ mean length of turn only was associated with child EF at age four years. Specifically, fathers who took longer turns during interaction at age two years had children with lower EF scores at age four years.

When fathers take longer turns it signals that children are being provided with less opportunity to participate in conversation. Sociocultural theories emphasise the crucial role
of social interaction in the development of higher order cognitive functions (Luria, 1966, 1980; Vygotsky, 1978). These theories posit that it is during the course of sensitive interactions with caregivers within the zone of proximal development that children internalise self-regulatory and problem-solving skills. Active involvement in language interactions may therefore facilitate this process. Fathers who take longer turns may not be providing sufficient opportunity for children to practice emerging EF skills. This also emphasises the active role of children in their own development. Previous research has demonstrated an association between child pragmatic and EF skills in four to five year olds (Blain-Brière, Bouchard, & Bigras, 2014).

It was expected that by posing more questions and responding rapidly to children’s speech initiations fathers would scaffold their participation in conversation. The present analyses however failed to demonstrate any associations between fathers’ use of questions or father-child response latencies and conversational balance. These features of turn-taking were also unrelated to child EF at age four years. Whilst on average more than one fifth of fathers’ utterances were questions, children only provided responses to just over one quarter of the questions posed to them. Perhaps the volume of questions was beyond the developmental capacities of the two-year-old children, failing to engage them in conversation and thus failing to elicit their EF. There was no association between proportion of questions and child language ability suggesting that fathers may not have been attuning this aspect of their speech input to their children’s communicative abilities.

Fathers’ shorter response latencies to child utterances and children’s shorter response latencies to fathers’ utterances also did not demonstrate an association with conversational balance or EF. Furthermore, no association between child or father mean response latency and child language ability was demonstrated. This was surprising as faster
child responding may indicate greater language proficiency, whilst previous research has demonstrated that parents respond quicker to children with stronger language skills (Marklund et al., 2015). More in-depth analysis of associations between the linguistic complexity of preceding utterances and subsequent responses may be necessary to elucidate how father-child response latencies facilitate turn-taking in interaction and reveal associations with child EF. Previous research has for example demonstrated that children are quicker to respond when producing simpler answers (e.g., yes/no) compared to more complex ones, potentially related to the lighter planning load associated with simpler responses (Casillas et al., 2016).

Further examination of the functions of conversation may also provide information on whether father and child are responding contingently to one another both temporally and semantically. Perhaps fathers’ utterances may have failed to follow the child’s focus of attention and were therefore not useful in supporting children’s engagement in conversation or eliciting their EF. It may also be useful to examine fathers’ response latencies within turns. Sufficient pausing following a parental utterance ensures the child has enough time to plan and initiate their response and facilitate children’s participation in conversation. It is possible that fathers are providing temporal space for their children to respond but, similar to asking questions, children are not availing of these opportunities to participate in conversation.

Previous research indicates that when parents reduce the length of their turns, children’s MLT increases (Brassart & Schelstraete, 2015). The present analyses suggest that beyond promoting children’s participation in conversation, taking shorter turns may support child EF. Further research into aspects of speech which may be associated with turn-taking behaviours such as complexity of verbal responses and the functions of
conversation may be required to elucidate the factors which support balanced conversation between fathers and children. In the absence of any association with child language ability perhaps when fathers attune their turn-taking behaviours to children’s communicative capacities, children’s participation in conversation would be enhanced.
Study 3. Associations between Fathers’ Scaffolding and Directive Speech and Child Executive Function Development

Abstract

Interactions between father and child contribute in important ways to children’s developing executive function (EF). Previous work conducted by the TCD Infant and Child Research Lab demonstrated that conversational turn-taking during father-child interaction at age two years was associated with higher child EF at age four years. This study sought to delve beyond the mechanics of conversation and investigate whether fathers’ scaffolding and directive speech could account for the association between turn-taking and EF. Twenty father-child dyads engaged in structured play at child age two years. Fathers’ scaffolding and directive utterances were coded from transcripts of these interactions. Child EF was measured at age four years using the Dimensional Change Card Sort. Results demonstrated that fathers’ verbal scaffolding and directiveness were not significantly associated with child EF development. These results indicate that it may be structural components of conversational turn-taking rather than the communicative function of fathers’ speech which are related to EF development during the preschool period.
Introduction

Variation in the quality of interactions between parents and their children contributes in meaningful ways to individual differences in child executive function (EF) development during the preschool period. Child-directed speech may be an important feature of parent-child interaction which influences child EF development (e.g., Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). Findings from the Infant and Child Research Lab demonstrated that conversational turn-taking in father-child interaction was longitudinally associated with child EF (see Chapter 4 Study 1). Specifically, this research indicated that greater balance in conversational turn-taking during structured play interactions between father and child at age two years was associated with higher child EF performance at age four years. The present study sought to investigate whether, beyond the mechanics of conversation, the functions of fathers’ communication were associated with child EF development. Research has consistently shown that parental scaffolding and directiveness are key constructs associated with EF development (see Fay-Stammbach et al., 2014; Valcan et al., 2018 for reviews). This study therefore aimed to determine whether the scaffolding and directive content of fathers’ speech during interaction with their two-year-olds was associated with child EF at age four years. As child language may mediate the association between parental speech and child EF, child verbal ability measured at age three years was also taken into consideration.

Scaffolding

Scaffolding refers to the processes by which caregivers support their children’s goal-directed activity so that they can successfully solve problems that are too challenging to complete alone (Wood et al., 1976). Optimal scaffolding is centred within the child’s zone of proximal development, and provides a level of intervention which is tailored to the
child’s capabilities. In other words, scaffolding is contingent on the child’s behaviour and may therefore be described as a process which is co-constructed by parent and child (Hustedt & Raver, 2002).

Measures of parental scaffolding are considered an index of the child’s social learning environment which may have long-term implications for child EF development (Marcisko et al., 2019). High quality parental scaffolding is theorised to fulfil many of the roles of children’s immature EF by regulating children’s thought, attention and behaviour in order to achieve goals (Bibok et al., 2009). These scaffolded interactions also allow children to practice decision-making and reflecting on their own activity, engaging their developing EF (Meuwissen & Carlson, 2015). With the support of their caregiver, children are provided with the opportunity to rehearse these skills which gradually become internalised as the child is able to take on more independence in problem-solving (Landry et al., 2002). Research has consistently demonstrated positive associations between parental scaffolding and child EF development across the preschool period (e.g., Bernier et al., 2010; Bibok et al., 2009; Hammond, Müller, Carpendale, Bibok & LiebermannFinestone, 2012; Hughes & Ensor, 2009; Hughes & Devine, 2017; Matte-Gagné & Bernier, 2011; Meuwissen & Carlson, 2015).

The majority of studies have focussed on maternal scaffolding behaviours. In a cross-sectional study, Meuwissen and Carlson (2015) demonstrated that fathers’ scaffolding was associated with child EF. Whilst this is the only study to examine fathers’ scaffolding behaviours specifically in relation to child EF development, it did not include a comparison of maternal scaffolding. Outside the EF literature several studies have compared maternal and paternal scaffolding behaviours. One study compared both mothers’ and fathers’ scaffolding of their two-year olds during a problem-solving task,
finding that overall both mothers and fathers provided equivalent levels of appropriate scaffolding to their children and that the scaffolding behaviours of both parents were predictive of the child’s subsequent independent problem-solving success (Conner, Knight, & Cross, 1997). Similar to these findings, Pratt and colleagues noted no significant differences between maternal and paternal scaffolding behaviours (Pratt, Kerig, Cowan, & Cowan, 1988). In contrast with these findings however, Gauvain, Fagot, Leve and Kavanagh (2002) found that fathers were less effective in scaffolding their child’s activities than mothers. Robust associations between fathers’ scaffolding behaviours and child EF remain to be demonstrated in the literature.

**Directiveness**

Parental scaffolding supports children’s active role in problem-solving (Landry et al., 2002). Parental directiveness, on the other hand, provides little opportunity for children to practice independent problem-solving by telling the child what actions to take to attain a goal and limiting the child’s opportunities to make decisions. This parental behaviour therefore serves to control the child’s behaviour. Research has demonstrated that parents’ controlling behaviours and use of directive language may be detrimental to child EF development (Bindman et al., 2013; Merz et al., 2016b; Meuwissen and Carlson, 2015). Directive interactions may not afford children ample opportunities to practice and internalise their emerging EF and may have long-term consequences on the development of this set of cognitive skills. A cross-sectional study by Meuwissen and Carlson (2015) demonstrated an association between fathers’ control, which included limiting the child’s active role in making task-related decisions, and child EF. This is the only study to examine fathers’ control and did not include a comparison with mothers’ behaviours.
It is important to consider that parents’ use of directives can also be considered as a high-level scaffolding intervention (Wood et al., 1976). Depending on the child’s capacity to problem-solve, parental intervention at this level may be necessary for task completion. Use of directives is typical with preschool aged children whose problem-solving skills are immature (Grolnick & Pomerantz, 2009). Too few directives may preclude children’s experience of successfully completing complex tasks and may contribute to negative attitudes towards future problem-solving (Bandura, 1977a). However, when parents overuse directives and do not provide any opportunities for their child to contribute to problem-solving, this may negatively impact EF over time (Wertsch, 1979).

The Current Study

The present study aimed to build upon the finding that conversational turn-taking in father-child interaction at age two years was associated with child EF at age four years by delving beyond the mechanics of father-child conversation and examining the functions of fathers’ communication. The current study was designed to determine whether the association between turn-taking and EF could be explained by analysing the functional content of fathers’ speech input. Fathers’ verbal scaffolding and directiveness were investigated due to their salience for child EF. Given that parental scaffolding fulfils many of the roles of EF, it was expected that fathers’ scaffolding utterances produced during structured play at child age two years would be associated with child EF at age four years. Whilst directiveness may support young children’s problem-solving efforts due to their immature EF, high levels of directive utterances were expected to be detrimental to children’s EF development over time.

Several studies have indicated that the influence of parental scaffolding on child EF development may be mediated by child verbal ability (e.g., Landry et al., 2002; Matte-
Gagné & Bernier, 2011). Previous research has demonstrated, for instance, that parental verbal scaffolding may support child language development during the preschool period, and child language ability in turn predicts child EF in middle childhood (e.g., Landry et al., 2002). Parental language which provides children with rules and strategies, and which elaborates on conceptual links between objects and activities, may furnish children with the verbal skills for independent problem-solving (Carlson, 2003). Furthermore, children with more advanced language skills are more likely to comprehend and internalise instructions and problem-solving approaches from adults, as well as to use tools such as private speech to reflect upon and regulate their behaviour (Matte-Gagné & Bernier, 2011). Child language measures at child ages two, three and four years were therefore also considered in the present analyses in order to investigate associations between paternal scaffolding and directive speech, child concurrent language ability and later language development, and child EF development.

**Method**

At time 1 (child age two years), father and child engaged in a five-minute structured play condition which consisted of removing and replacing pieces on a magnetic puzzle board. At time 1 child language skills were measured using the Bayley Scales of Infant Development, Third Edition (BSID-III; Bayley, 2006) and child EF was measured using the Behaviour Rating Inventory of Executive Function, Preschool Version (BRIEF-P; Gioia et al., 2003). For a detailed description of the procedure at time 1 see Chapter 3 Study 1. At time 2 child language ability was measured again using the BSID-III. At time 3, child verbal skills were measured using the Verbal Comprehension Index of the Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition (WPPSI-IV; Wechsler, 2012) and child EF was measured using the Dimensional Change Card Sort
The procedure for measuring child EF at time 3 is detailed in Chapter 4 Study 1. The coding scheme developed to measure fathers’ scaffolding and directive utterances at time 1 and the procedure for measuring child language ability at time 3 are detailed below.

**Fathers’ Communicative Functions**

**Scaffolding utterances.** Utterances were classified as scaffolding when they supported children’s active role in the completion of the task (Landry et al., 2002). The informational content of fathers’ utterances was therefore considered. Scaffolding utterances included conceptually informative hints (e.g., “It is a little bit too big”); utterances which related the present activity to previous experience (e.g., “It’s like fishing”); utterances which taught the child about cause and effect (e.g., “If you stick this bit here it pulls it up like a magnet”); and evaluations of the child’s concurrent attempts at solving the puzzle which the child could use as guidance (e.g., “No I think that goes somewhere else”; “Yes nearly there”). The key feature of these scaffolding utterances was that the majority of the responsibility for problem-solving was placed on the child.

**Directive utterances.** Utterances were classified as directive when they afforded children little opportunity for choice over their behaviours or problem-solving decisions. These included imperatives that required a particular child response (e.g., “Try it there”; “Watch me do it”); and prompts to the child to perform a certain act related to completing a step of the task (e.g., “Why don’t you try over there?”; “Will we do another one?”). The key feature of these directive utterances was that they placed little or no responsibility for problem-solving on the child.

**Other utterances.** Task-related speech which was not considered scaffolding or directiveness was coded as other. These utterances were considered not to contribute in any
meaningful way to the completion of any element of the task. This included labelling and naming the colours of puzzle pieces (e.g., “That is a squid”; “This is a white car”), offers to demonstrate solutions (e.g., “Will I show you?”); comments on the child’s activity which did not provide any extra guidance that the child could use to problem-solve (e.g., “Oh you are putting the car back in”); praise (e.g., “You did it well done”); general comments on the task (e.g., “This is so much fun”); bids to get child’s attention (e.g., saying the child’s name); onomatopoeias; and utterances which redirected the child’s attention to the task in general but did not assist the child in solving any element of the task (e.g., “Come back over here and sit down with Daddy”).

Child language ability at time 3. Child language ability was assessed using the Verbal Comprehension Index (VCI) of the Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition (WPPSI-IV; Wechsler, 2012). The VCI includes items that assess the child’s verbal reasoning skills, verbal concept formation, and general knowledge. Sample Items include asking the child to identify similarities between common objects and concepts (e.g., "Juice and milk are both ____ ?") and questions on general knowledge topics (e.g., "What do people use to stay dry in the rain?").

Analytic Strategy

Data were analysed using SPSS version 24. Scaffolding, directive and other utterances were calculated as proportions of fathers’ total task-related utterances. Bivariate correlations were conducted in order to investigate associations between fathers’ scaffolding and directive utterances and child EF at age four years. As fathers’ scaffolding and directiveness are theoretically contingent upon child developmental abilities, concurrent associations between these constructs and child age, language and EF were also examined. Finally, given previous findings that child language may mediate associations
between fathers’ communicative functions and child EF, associations with child language at each time point were assessed.

**Results**

Descriptive statistics for child and parent variables are presented in Table 4.3.1. In order to test associations between fathers’ scaffolding and directiveness and child EF and language development, a series of Spearman correlation analyses were computed between each of the study variables (Table 4.3.2). Presented in this table also are correlates of fathers’ scaffolding and directiveness, including child age, EF and verbal ability at time 1.

Neither proportion of scaffolding utterances or directives at time 1 were associated with child EF at time 3. Child age, EF and language ability at time 1 were not significantly associated with fathers’ scaffolding or directive utterances. Lastly, there were no associations between fathers’ scaffolding and directive utterances and child verbal ability at time 2 or time 3.

Given that directive utterances may be beneficial to young children provided they are not overused, it was decided that as well as investigating the association between child EF and fathers’ scaffolding and directiveness separately, the ratio of fathers’ scaffolding utterances to directives would be examined. A ratio closer to 1 indicated greater balance between fathers’ use of scaffolding and directive utterances whereas a ratio closer to 0 indicated fathers were using many directives and few scaffolding utterances ($M = 0.25, SD = 0.18, range = 0 – 0.74$). There was no significant correlation between scaffolding/directiveness ratio and child EF at age four years $rs(20) = .07, p = .765$. 
Table 4.3.1

Descriptive statistics for fathers’ communicative functions, child language and father and child EF measures

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>M</th>
<th>SD</th>
<th>Min - Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of scaffolding utterances</td>
<td>7.91</td>
<td>5.98</td>
<td>0 – 27.78</td>
</tr>
<tr>
<td>Proportion of directive utterances</td>
<td>36.30</td>
<td>13.92</td>
<td>13.98 – 72.26</td>
</tr>
<tr>
<td>Proportion of other task-related utterances</td>
<td>55.80</td>
<td>14.56</td>
<td>23.36 – 81.72</td>
</tr>
<tr>
<td>T1 Child age in months</td>
<td>23.27</td>
<td>1.21</td>
<td>21.17 – 27.03</td>
</tr>
<tr>
<td>T1 Child EF</td>
<td>83.90</td>
<td>16.73</td>
<td>63 – 117</td>
</tr>
<tr>
<td>T1 Child verbal ability</td>
<td>112.70</td>
<td>15.80</td>
<td>86 – 138</td>
</tr>
<tr>
<td>T2 Child verbal ability</td>
<td>118.40</td>
<td>9.78</td>
<td>87 – 132</td>
</tr>
<tr>
<td>T3 Child EF</td>
<td>14.90</td>
<td>7.91</td>
<td>0 – 24</td>
</tr>
<tr>
<td>T3 Child verbal ability</td>
<td>119.35</td>
<td>11.97</td>
<td>87 – 137</td>
</tr>
</tbody>
</table>

*Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; EF = Executive function.*
Table 4.3.2

*Bivariate correlations between fathers’ communicative functions, child verbal ability and EF*

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Proportion of scaffolding utterances</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Proportion of directive utterances</td>
<td></td>
<td>-.22</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Proportion of other utterances</td>
<td></td>
<td>-.11</td>
<td>-.91**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. T1 Child age in months</td>
<td></td>
<td>.12</td>
<td>.08</td>
<td>-.03</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. T1 Child EF</td>
<td></td>
<td>.01</td>
<td>.18</td>
<td>-.28</td>
<td>.17</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. T1 Child verbal ability</td>
<td></td>
<td>-.32</td>
<td>.07</td>
<td>.03</td>
<td>.45*</td>
<td>.20</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. T2 Child verbal ability</td>
<td></td>
<td>-.15</td>
<td>.14</td>
<td>-.14</td>
<td>.12</td>
<td>.39</td>
<td>.50*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8. T3 Child EF</td>
<td></td>
<td>.17</td>
<td>.01</td>
<td>.02</td>
<td>.19</td>
<td>-.17</td>
<td>.27</td>
<td>-.12</td>
<td>1</td>
</tr>
<tr>
<td>9. T3 Child verbal ability</td>
<td></td>
<td>.03</td>
<td>.28</td>
<td>-.36</td>
<td>-.02</td>
<td>-.05</td>
<td>.03</td>
<td>.07</td>
<td>.42</td>
</tr>
</tbody>
</table>

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; EF = Executive function; **p < .01; *p < .05
Discussion

The aim of this study was to examine longitudinal associations between fathers’ scaffolding and directive utterances during father-child interaction at age two years and child EF development at age four years. As previous findings from this sample indicated that conversational turn-taking was associated with child EF development, the current study sought to explore beyond the structural components of conversation and investigate the functions of fathers’ communication in relation to child EF. Contrary to findings in the literature, no associations between fathers’ scaffolding or directiveness and child EF development were observed.

Due to the specific aims of the present research, the current study was interested in examining the verbal content of fathers’ scaffolding and directive behaviours. Many of the studies which have found a relationship between scaffolding and child EF have included parents’ non-verbal behaviours in their operationalisation of scaffolding/directiveness. Including physical behaviours such as manipulations of task stimuli, pointing, and modelling of the task may be considered to provide a more complete representation of parents’ scaffolding and directive behaviours during problem-solving interactions (Hammond et al., 2012) and may explain the current null finding. One study which found a direct association between verbal scaffolding and child EF was also broader in its operationalisation of scaffolding and included praise of children’s performance (Hughes & Ensor, 2009). The narrow operationalisation of scaffolding in the current study may also explain the low proportion of verbal scaffolding measured in father-child interaction.

The present results suggest that the association between turn-taking and EF may be best understood at the structural level of analysis. Taking turns in conversation may elicit children’s EF as children must monitor the ongoing conversation, wait their turn, attempt to predict the end of their interlocutor’s turn as well as plan their own turn. It is also
possible that an aspect of fathers’ communicative functions not measured in the current study may be associated with child EF development. Previous research has for instance demonstrated a link between mental-state talk, parents’ verbal labelling of their child’s emotions, likes and dislikes, thoughts and beliefs during interaction (Meins, 1997), and child EF (e.g., Baptista et al., 2017; Bernier et al., 2010; Cheng et al., 2018; Gagné et al., 2018). Mental-state talk is considered to promote children’s conscious awareness and control over their own behaviours, regarded as key to EF performance (Bernier et al., 2010; Zelazo, 2004).

It is also important to consider that in cases where the child is capable of completing the task independently fathers may use less scaffolding and directive utterances overall. An important feature of scaffolding is challenging children, in order to continuously propel their development forward (Bibok et al., 2009). Fathers who are working within the child’s zone of proximal development may refrain from intervening when the child is able to complete one or some elements of the task but still seek to challenge the child, for instance by asking more wh-questions. This may be the case in dyads where greater “other” speech was observed. Alternatively, when children are struggling with completing the task, fathers’ language may be more focussed on managing their frustration and offering to demonstrate the task, which also fall into the “other” category of communicative functions. Without a measure of child activity during the problem-solving task it is difficult to infer the appropriateness of fathers’ scaffolding, directive and other utterances. Furthermore, as no concurrent associations between child age, EF and verbal ability and fathers’ scaffolding and directiveness were observed, these skills may provide little indication of the moment-by-moment processes by which fathers’ adapt their communicative functions to their child’s ongoing activity.
Finally, the small size of the current sample may have contributed to the present null findings. Added to this, it is possible that characteristics of our sample (i.e., middle-class families) led to less variability in parenting behaviours than would be observed in more diverse populations. Perhaps replication with a larger and more diverse sample would elucidate associations between fathers’ scaffolding and directive utterances and child EF development. However, given that the majority of studies which have demonstrated a link between scaffolding and child EF have been conducted in the context of mother-child interaction it is also possible that fathers support their child’s EF development through different pathways.

**Conclusion**

This study sought to build upon findings which demonstrated that turn-taking in father-child conversation was associated with later child EF by examining the functions of fathers’ conversation. Whilst previous research has consistently shown that parental scaffolding is important for child EF development during the preschool period, the current study did not find a significant association between fathers’ verbal scaffolding and directiveness at age two years and child EF at age four years. In the absence of any association with child EF, it appears that the structural components of conversation may have implications for child EF beyond its content.
Chapter 5

The Effect of Father-Child Conversational Turn-Taking during Shared Book-Reading on Child Executive Function

Abstract

The positive effects of father-child verbal exchanges during shared book-reading on child development are well supported. Research indicates that book type may influence the complexity of parents’ speech and conversational turn-taking between parent and child in this context. Previous work conducted by the TCD Infant and Child Research Lab demonstrated that greater balance in conversational turn-taking between fathers and their children at age two years was associated with higher child executive function (EF) at age four years. This study was an experimental investigation of the effect of fathers’ speech during a shared book-reading paradigm on child EF in the short-term. It was hypothesized that a light-text book condition would elicit greater balance in conversational turn-taking compared to a heavy-text book condition and that greater conversational balance would be associated with higher EF. Forty-six three-year-olds and their biological fathers were randomly assigned to a light-text or heavy-text shared book-reading condition. Child EF was measured at baseline and again directly following book-reading using the Dimensional Change Card Sort and a Stroop-like task. Transcripts of the book-reading interaction were prepared and analysed using CLAN. Balance in child-father conversational turn-taking (MLT ratio), fathers’ vocabulary diversity (VOCD) and language complexity were calculated. As expected, MLT ratio was greater in the light-text condition. Fathers’ VOCD was greater during the heavy-text book condition. Results failed to demonstrate a significant effect on EF depending on book-reading condition. These findings indicate that
shared book-reading may be an important context for promoting conversation between fathers and their children, although implications for child EF in the short-term remain to be determined.
Introduction

During the preschool period children’s EF undergoes rapid and marked improvements and meaningful variations in this critical component of cognitive development can be observed (Carlson, 2005). Children’s EF during this period is an important predictor of later academic achievement (Alloway & Alloway, 2010; Clark, Pritchard, & Woodward, 2010), social-emotional adjustment (Diamond, 2013), and health and financial stability in adulthood (Moffitt et al., 2011). Given the role of early EF in later achievement, approaches to maximise children’s development of these higher-order cognitive skills is a significant focus of research. Intervention studies have demonstrated that child EF is malleable and can be trained during the preschool period (Diamond & Lee, 2011). A substantial body of literature also attests to the importance of social interaction for child EF development, suggesting that parent-implemented interventions may be of particular benefit to children during the preschool period (Moriguchi, 2014). Child-directed speech (CDS) is an aspect of parent-child interaction which may be important for child EF and previous research from the Infant and Child Research Lab indicated that conversational turn-taking in father-child play may be associated with child EF development. This study sought to examine causal associations between conversational turn-taking and child EF by manipulating father-child language interactions during a shared book-reading paradigm.

Child-Directed Speech and EF Development

Parents contribute in important ways to their children’s developing EF skills (see Chapter 2 Part 2 for a review). Previous research has demonstrated that specific features of parent-child language interactions are associated with child EF development, demonstrating associations between mothers’ vocabulary diversity and grammatical
complexity, and child EF (e.g., Daneri et al., 2019; Hughes & Devine, 2017; Hughes & Ensor, 2009). In Chapter 3 Study 3 theory and research were discussed which suggests that CDS rich in lexical diversity and syntactic complexity may engage child reasoning skills, challenge their processing skills, or indirectly support problem-solving by impacting child vocabulary growth (Baker & Vernon-Feagans, 2015). This review also indicated that the process of language learning itself may support EF development.

**Fathers’ CDS.** Studies comparing maternal and paternal CDS have produced conflicting results. Regardless of any differences in the language input of mothers and fathers, evidence suggests that paternal CDS may have a unique impact on child development (e.g., Bakers & Vernon-Feagans, 2015; Malin et al., 2014; Pancsofar & Vernon-Feagans, 2006). Research also demonstrates that fathers play an important role in their child’s EF development (e.g., Gagné et al., 2018; Meuwissen & Carlson, 2015; Meuwissen & Carlson, 2018; Towe-Goodman et al., 2014). Whilst it has been claimed that fathers’ CDS may be particularly challenging for children (e.g., Rowe et al., 2004) and paternal conversation-elicitng speech has been linked to children’s development of verbal reasoning skills (Rowe et al., 2017), little research has investigated how paternal language input may contribute to child EF development.

Previous research from the Infant and Child Research Lab demonstrated that conversational turn-taking in father-child play at age two years was associated with child EF development at age four years (see Chapter 4 part 1). Research on conversational turn-taking highlights the active role of children in interaction and recent findings suggest that preschool-aged children initiate more conversations than adults when interacting with their mothers and fathers (VanDam, Campanella, Wolfenstein, Olds, & De Palma, 2019). Back-and-forth exchanges may engage children’s developing EF skills, providing an opportunity
to practice these emerging abilities. In order to effectively participate in conversation, children must keep track of incoming speech and relate this to previously heard verbal input, wait until it is their turn to speak, and must continuously switch from the role of speaker to the role of listener.

**Shared-Book Reading in Father-Child Interaction**

Shared book-reading is an important context for parent-child interaction and has been the subject of much research in relation to child development. It is a specific form of interaction during which parents provide cognitive stimulation to their children, with the purpose of helping them learn. Shared book-reading is a context during which high levels of joint attention between parent and child are evident (Baker & Vernon-Feagans, 2015). Children typically find books exciting, and high levels of arousal associated with this form of interaction may promote learning (Cameron-Faulkner & Noble, 2013). The literature attests to the benefits of shared book-reading for child language development (Demir-Lira, Applebaum, Goldin-Meadow, & Levine, 2019; Malin et al., 2014), early literacy (Deckner, Adamson, & Bakeman, 2006), problem-solving (Baker & Vernon-Feagans, 2015), and social and emotional development (Baker, 2013). Findings from a meta-analysis indicated that dialogic reading styles, which encourage greater text-related talk between caregiver and child (e.g., open-ended questions, elaborations, repetition), were of particular benefit to child language development (Flack, Field, & Horst, 2018).

A substantial body of literature has examined the influence of father-child shared book-reading on child development. The majority of these studies have compared mothers’ and fathers’ book-reading among low-income households. Mothers and fathers in these households report similar levels of shared book-reading (Duursma & Pan, 2010), although there may be differences in maternal and paternal reading styles. Fathers may produce
more extra-textual talk than mothers for instance (Duursma, 2016). Another study demonstrated that fathers may engage in more recasting of their child’s speech, pose more questions and provide more labels than mothers, and that these features of CDS may support child vocabulary development (Malin et al., 2014).

Although several studies have not found any substantive differences between mothers’ and fathers’ language during shared book-reading, research indicates that fathers’ CDS in this context may still contribute in important and unique ways to child development. Children tend to fare better in terms of language development in households where fathers show greater involvement in book-reading (Quach et al., 2018). Fathers’ book-reading with their toddlers has been shown to support both child language and cognitive development (Duurmsa, 2014). In a large sample of low-income families, Pancsofar and Vernon-Feagans (2010) demonstrated that fathers’ vocabulary during picture-book interactions with their infants was longitudinally associated with child communication and expressive language development, beyond the influence of mothers’ book-reading. Fathers who engage in more frequent shared book-reading also have children with better maths and reading performance in preschool (Baker, 2014). Baker and Vernon-Feagans (2015) demonstrated that above the influence of maternal speech input during a book-reading task, father’s language complexity was predictive of child vocabulary and problem-solving skills. Research has also shown that paternal use of questions and repetition of child speech during book-reading predicted child receptive and expressive language (Teufl et al., 2019). Lastly, engaging fathers in shared book-reading interventions has a positive effect on child language development (Chacko, Fabiano, Doctoroff, & Fortson, 2019).
Comparison of Book-Text and CDS

In order to better understand associations between shared book-reading and child development, research has compared parental language in this context to samples of speech elicited in other day-to-day contexts. These studies indicate that compared to samples of CDS, the text of children’s books may provide children with richer linguistic input and expose children to grammatical structures and vocabulary they may not otherwise encounter in day-to-day conversations (Cameron-Faulkner & Noble, 2013; Montag, 2019; Montag, Jones, & Smith, 2015). Not only does the text of children’s books contain rare vocabulary and grammatical constructions, but studies have shown that books also elicit rich extra-textual speech from parents (Demir-Lira et al., 2019; Noble, Cameron-Faulkner, & Lieven, 2018; Salo et al., 2016), as well as promote conversation between parents and their children (McArthur, Adamson, & Deckner, 2005).

Salo and colleagues (2016) compared fathers’ speech during toy play and book-reading and found that although fathers produced longer utterances during toy play, during book-reading they produced more diverse vocabulary, asked more questions and labelled objects more, which in turn elicited more speech from their children. Demir-Lira and colleagues (2019) demonstrated that parent language during book-reading was richer in vocabulary diversity and syntactic complexity compared to parent language outside of book-reading. Day-long recordings of parents and their children revealed that adult word counts and conversational turns with their children were significantly higher during shared-book reading compared to other types of interaction over the course of the day (Gilkerson, Richards, & Topping, 2016). Research also suggests that parents use a high degree of decontextualised talk during shared book-reading (Baker & Vernon-Feagans, 2015).
Research has also demonstrated that type of book may have an important influence on parents’ extra-textual talk. A study by Noble and colleagues (2018), for instance, examined the grammatical properties of popular children’s books and found that picture-books containing minimal text tended to evoke more extra-textual utterances, especially conversation-eliciting speech such as \textit{wh}-questions. On the other hand, parents who read books containing more text were less likely to produce extra-textual utterances and produced less utterances which required the child to respond. Furthermore, the extra-textual utterances evoked by light-text books were richer in grammatical profile than the extra-textual utterances produced by the heavy-text books. However, another study comparing the amount of extra-textual talk produced by a sample of twenty-four mothers during shared book-reading with their three-year-olds demonstrated that maternal vocabulary diversity and syntactic complexity did not differ between heavy- and light-text books (Muhinyi & Hesketh, 2017).

Previous research has demonstrated that book-type also affects children’s speech during shared book-reading, with picture-books eliciting greater talk compared to books with more text (Leech & Rowe, 2014; Sénéchal, Cornell, & Broda, 1995). It is also important to consider that caregivers may increase the complexity of their text-related talk as children grow older (McArthur et al., 2005), presumably in tandem with children's increased language proficiencies. Increases in the complexity of parents’ extra-textual speech during shared-book reading over time may be important for children's language development (Chang & Luo, 2019; Kuchirko, Tamis-LeMonda, Luo, & Liang, 2016).

\textbf{Shared Book-Reading as a Context for Manipulating Father-Child Conversation}

The majority of studies emphasising the importance of parents for child EF are correlational by design and little research has investigated how features of parent-child
interaction which support child EF can be incorporated into intervention programs. A recent experimental study by Meuwissen and Carlson (2019) demonstrated the feasibility of manipulating a single aspect of parent-child interaction, namely parental autonomy support, and measuring its effect on child EF. During a single lab visit the experimenters briefly trained parents to approach a problem-solving task with their children with either high or low levels of autonomy support (i.e., using high-levels of instruction versus allowing the child to lead the interaction), and subsequently assessed child self-regulation and EF performance.

Whilst no research to date has examined parent-child language during shared-book reading and how this relates to child EF development, previous studies have used this context to manipulate parental speech input and to test short-term effects on child performance on a particular outcome measure. In one study children were exposed to books containing either active or passive voice constructions and the effect of book-type on child selective trust was measured (Leech, Haber, Arunachalam, Kurkul, & Corriveau, 2019a). In another experiment children were exposed to either present-oriented or future-oriented books and the effect on subsequent child prospecton skills was examined (Leech, Leimgruber, Warneken, & Rowe, 2019b). Whilst these studies took place between child and an adult experimenter, research has also demonstrated that fathers’ language during shared-book reading is amenable to manipulation. In a brief intervention study, Seven and Goldstein (2019) showed that by embedding decontextualised language into the text of children’s books, fathers’ use of this form of language generalised to book-reading interactions outside of the intervention period.
The Current Study

The majority of previous research exploring the associations between parenting and EF has focused on the mother-child relationship. There is evidence to suggest that father-child shared book-reading may have important implications for child development. The first part of the present analysis aimed to compare father-child language produced during shared book-reading of a light-text and a heavy-text book. It was expected that fathers in the heavy-text condition would produce more diverse vocabulary and syntactically complex speech compared to fathers in the light-text condition. On the other hand, it was expected that there will be more conversational turn-taking between father and child in the light-text condition.

The second part of the analysis sought to investigate the effect of book-reading condition on subsequent child EF performance. It was expected that greater conversational turn-taking would prime child EF and be associated with improved performance on an EF task-battery. It was hypothesised that type of book would have an effect on child performance on a subsequent EF task battery. Previous research suggests that factors such as child language ability (Quigley & Nixon, 2019), fathers’ EF (e.g., Meuwissen & Carlson, 2015) and fathers’ mood (Wilson & Durbin, 2010) may be associated with the quality of father-child interaction. These factors, as well as fathers’ home shared book-reading habits, were therefore considered as possible covariates in the present analyses.

Method

Participants

Forty-six children aged between 31 to 42 months (20 females; $M = 37.89$ months, $SD = 2.71$) and their biological fathers were recruited to take part in the current study. Sample size was calculated to detect a medium effect size (moderate additional variance
explained by book-reading condition controlling for covariates) with 80% power at the 5% level of significance. The analysis indicated that the sample size needed to detect an $f^2$ of .25 was 42. Recommended number of ten cases per predictor was adhered to in analyses (Knofczynski & Mundfrom, 2008). Participants were recruited through social media, flyers distributed to crèches and supermarkets, and snowballing. All children included in the current study were born full-term and were typically developing. Children were from two-parent households consisting of a mother and father and their biological children. All participating families were White and the majority were considered to be middle-class. Fathers were monolingual, Irish-English speaking, and residing in the family home. Fathers were aged between 25 to 51 years ($M = 38.74$, $SD = 5.74$). Almost two-thirds of fathers (65.2%) had a Bachelor’s degree, 28.3% had a Master’s degree, and 2.2% had a doctorate degree. In relation to home book-reading habits, the fathers in this sample on average reported reading to their child at least once a day.

**Procedure**

The study was conducted at an Infant and Child Research Lab based in a university setting with the approval of the relevant Research Ethics Committee. Informed consent was obtained from participants prior to commencement of testing. Information on family sociodemographic factors, family home-reading practices, and paternal EF were collected via questionnaire. Once the child was considered to be settled into the lab environment, a baseline assessment of child EF was carried out by a trained research assistant. Father-child dyads then performed a shared book-reading task together. Dyads were randomly allocated to either a light-text book condition or a heavy-text book condition. Immediately following the book-reading paradigm, child EF was assessed again with a second battery of tasks. Child verbal ability was then measured. Participants were debriefed and thanked for
their time. Families were offered breaks when needed and the session took approximately 1 hour 15 minutes.

**Measures**

**Parent questionnaires.** Demographic information about the child, father and coparent (age, education, employment, child developmental history) was collected via parent report. Information on home-reading habits (e.g., how often do you read to your child?) were also collected via questionnaire (see Appendix F). Fathers’ reading frequency was used in the present analyses.

**Fathers’ EF.** Paternal EF was measured using the Behaviour Rating Inventory of Executive Function – Adult Version (BRIEF-A; Roth, Isquith, & Gioia, 2005). This is a 75-item self-report standardised measure used to assess adults’ EF in everyday settings. The Global Executive Composite, an overall summary score, was used in the present analyses.

**Child EF.** Child EF was assessed at baseline and again following the book-reading task. Tasks at baseline included one of two versions of the Dimensional Change Card Sort and one of two Stroop-like tasks. Following the book-reading task the alternative versions of each of these tasks was administered. The specific tasks administered at baseline and following the book-reading task were counterbalanced across participants.

**Dimensional Change Card Sort.** The Dimensional Change Card Sort (DCCS; Frye et al., 1995; Zelazo, 2006) is a well-established measure of EF which assesses the core EF components of working memory, inhibitory control and cognitive flexibility. In version one, children were presented with two target cards, one depicting a red rabbit and one depicting a blue boat, each attached to a tray. They were told they were going to play the *colour game* and instructed to place all the red cards in the tray with the picture of the red
rabbit attached and the blue cards in the tray with the picture of the blue boat attached (preswitch condition). After six trials the experimenter informed the child that they would no longer play the colour game and now they would play the shape game (postswitch condition). They were instructed to place all the cards depicting rabbits in the tray with the picture of the rabbit attached and all the cards depicting boats in the tray with the picture of the boat attached. If children scored five out of six trials correctly in the postswitch condition they were introduced to the final part of the task – the border condition. The children were now instructed that if there was a border on the presented card they must play the colour game and if there was no border they must play the shape game. There were twelve trials in the border phase. Children could score a maximum of 24 points on this task. Version 2 of the DCCS followed the same rules as described above but used different shapes and colours (green trucks and yellow flowers).

**Day/Night.** The Day/Night task (Gerstadt, Hong, & Diamond, 1994) is a Stroop-like task measuring child inhibitory control. The stimuli for this task included a white card with a yellow sun on it and a black card with a white moon and stars. Children were instructed to say ‘night’ when the experimenter presented the white card and ‘day’ when presented with the black card. Successful performance on this task requires children to inhibit a prepotent response in favour of a more effortful one. After a brief practice session to ensure children understood the rules, testing began. There were a total of 16 test trials and cards were presented in a fixed, pseudorandom order (ABBABAABBABAABAB).

**Grass/Snow.** The Grass/Snow task (Carlson & Moses, 2001) is a Stroop-like task measuring child inhibitory control. The stimuli for this task included a blank white card and a blank green card. Children were instructed to point to the green card when the experimenter said ‘snow’ and point to the white card when the experimenter said ‘grass’.
Similar to the Day/Night task, this measure requires children to inhibit a prepotent response in favour of a more effortful one. Testing began following a brief practice session designed to ensure children understood the rules of the game. There were a total of 16 test trials and cards were presented in a fixed, pseudorandom order (ABBABAABBABAABAB).

**Dyad book-reading task.** Dyads were randomly assigned to read either the light-text or heavy-text book. Fathers assigned to the light-text condition read Hug by Jez Alborough whilst fathers assigned to the heavy-text book condition read One Year with Kipper by Mike Inkpen. These are the same light-text and heavy-text books used in the study by Noble and colleagues (2018). Both books comprised 16 pages and contained colourful illustrations on each side. According to the publishers, these books were appropriate for children aged 2 – 5 years. Fathers were instructed to read the book to their child as they would a new book at home. Apart from one father, all dyads were unfamiliar with their assigned book. Dyads took between 5 - 15 minutes to complete this task.

The father-child shared book-reading interaction was video-recorded using Mangold VideoSync Pro 1.5 and transcribed offline according to the Codes for Human Analysis of Transcripts format (MacWhinney, 2000). Interactions were transcribed from the moment father and child began to engage with the book to the moment they closed the book/when book-related talk ended. The Computerised Language Analysis (CLAN) software was used to calculate the vocabulary diversity and language complexity of both father and child, and balance in conversational turn-taking between father and child.

**Vocabulary diversity.** The VOCD command in CLAN provides a measure of the number of unique word tokens spoken by fathers during interaction. VOCD could not be calculated as an index for child vocabulary diversity as it was for parents’ speech as it
relies on the production of a minimum of 50 words, which was not attained by all children in the current sample. Child vocabulary diversity was therefore calculated as a proportion of the number of different word types over total number of words produced during interaction (type-token ratio; TTR).

**Language complexity.** Mean length of utterance (MLU) is a commonly used measure of language complexity and was calculated for both child and father by dividing their total number of morphemes by their total number of utterances. An utterance was defined as a unit of speech delineated by a change in intonation, pause, or change in conversational turn (MacWhinney, 2000).

**Balance in conversational turn-taking.** Balance in conversational turn-taking during father-child interaction was measured by computing the mean length of turn (MLT) for both fathers and their children and then calculating the ratio of child MLT to father MLT. MLT was calculated by dividing the speaker’s total number of utterances by their total number of turns. A turn referred to a sequence of utterances spoken by one interlocutor (MacWhinney, 2000). A ratio closer to 1 indicated that fathers and children were affording each other equal opportunities to speak.

**Child verbal ability.** Child receptive and expressive language abilities were assessed using the Bayley Scales of Infant Development, Third Edition (BSID-III; Bayley, 2006). The composite score of children’s overall language ability was used in the present analyses.

**Analytic Strategy**

Data were analysed using SPSS version 24. A series of t-tests was run in order to examine differences in the quality of father-child language variables between the heavy-text and light-text book-reading conditions. Bivariate correlations between
sociodemographic variables, data collected via questionnaire on home-reading habits and father EF and the main father and child language and EF variables were run in order to establish important covariates. In order to test whether book-reading condition had an effect on EF hierarchical multiple regressions were fit to the data.

**Results**

**Comparison of Father-Child Talk during Heavy- and Light-Text Book-Reading**

Descriptive statistics for father-child language variables produced during the shared book-reading paradigm are presented in Table 5.1. These are presented separately for the heavy-text and light-text condition. The data presented in this table include a combination of book-text and extra-textual talk in order to provide a full picture of the language to which children in each condition were exposed. A series of independent $t$-tests was conducted in order to investigate mean differences in father and child language in the high-text and low-text conditions. Due to the number of $t$-tests conducted, a Bonferroni correction was applied in order to minimise the chance of making a Type 1 error. The Bonferroni correction yielded an adjusted alpha of .01. Cohen’s $d$, a measure of effect size (i.e., the size of the difference between two groups) is also reported in Table 5.1. Results demonstrated that fathers produced more diverse vocabulary and syntactically complex language during the heavy-text condition compared to the light-text condition. There was significantly greater balance in father-child conversational turn-taking during the light-text condition. Finally, children produced more diverse vocabulary during the heavy-text condition. There were large effect sizes in relation to each of these mean differences. There was no significant difference in child syntactic complexity between the two book-reading conditions.
In order to compare the quality of fathers’ extra-textual talk elicited by each book-type, only utterances which were not read from the text of the books were also compared across the two conditions (see Table 5.2). Results demonstrated that fathers who read the heavy-text book produced extra-textual talk that was richer in diverse vocabulary compared to fathers who read the light-text book, with a large effect size. There was no significant difference in grammatical complexity of extra-textual talk between fathers who read the heavy- or light-text book.

Table 5.1

<table>
<thead>
<tr>
<th>Measure</th>
<th>(n = 23)</th>
<th></th>
<th>(n = 23)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>t</td>
<td>d</td>
</tr>
<tr>
<td>FAT VOCD</td>
<td>65.97</td>
<td>10.07</td>
<td>26.66</td>
<td>4.97</td>
<td>16.80* †</td>
<td>4.95</td>
</tr>
<tr>
<td>FAT MLU</td>
<td>6.93</td>
<td>0.87</td>
<td>5.18</td>
<td>0.66</td>
<td>7.66* †</td>
<td>2.27</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.24</td>
<td>0.08</td>
<td>0.43</td>
<td>0.15</td>
<td>-5.32* †</td>
<td>1.58</td>
</tr>
<tr>
<td>CHI TTR</td>
<td>.56</td>
<td>.15</td>
<td>.43</td>
<td>.11</td>
<td>3.46* †</td>
<td>0.99</td>
</tr>
<tr>
<td>CHI MLU</td>
<td>2.76</td>
<td>0.64</td>
<td>2.85</td>
<td>0.74</td>
<td>-0.44</td>
<td>0.13</td>
</tr>
</tbody>
</table>

*Note. FAT = Father; CHI = Child; VOCD = Vocabulary diversity; MLU = Mean length of utterance; MLT = Mean length of turn; TTR = Type-token ratio
*p < .001; † significant after Bonferroni correction.
Table 5.2
Mean differences in fathers’ extra-textual talk between heavy- and light-text conditions

<table>
<thead>
<tr>
<th>Measure</th>
<th>Heavy-text (n = 23)</th>
<th>Light-text (n = 23)</th>
<th>T</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAT VOCD</td>
<td>39.72 5.67</td>
<td>27.54 4.95</td>
<td>7.76*†</td>
<td>2.29</td>
</tr>
<tr>
<td>FAT MLU</td>
<td>5.49 1.01</td>
<td>5.38 0.71</td>
<td>0.40</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note. FAT = Father; VOCD = Vocabulary diversity; MLU = Mean length of utterance
* p<.001; † significant after Bonferroni correction.

Effect of Shared Book-Reading Condition on Change in Child EF

Descriptive statistics for sociodemographic variables, child verbal ability, father EF and child EF performance at baseline and post-manipulation are provided in Table 5.3. This table also provides the mean calculations of father-child language variables for the entire sample. In order to determine important covariates for subsequent analyses, correlations were calculated between sociodemographic variables and the main parent and child variables (see Table 5.4). One data point on the BRIEF-A was missing for three fathers. These missing data points differed for each participant and were replaced by a score of one, as per the manual instructions for this measure. EF data were entirely missing for one father. Fathers’ EF was associated with several main study variables and was therefore retained as a covariate.

Bivariate correlations between the main study variables are presented in Table 5.5. Baseline measures of EF were not related to any aspect of parent-child language. Post-
manipulation scores on the Stroop task were moderately negatively correlated with child MLU.

Table 5.3
Descriptive statistics for main study variables and covariates of entire sample

<table>
<thead>
<tr>
<th>Study Variables</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child age (months)</td>
<td>37.89</td>
<td>2.71</td>
<td>31.07 - 42.17</td>
<td>-0.07</td>
</tr>
<tr>
<td>Father age (years)</td>
<td>38.74</td>
<td>5.74</td>
<td>25 - 51</td>
<td>-0.22</td>
</tr>
<tr>
<td>Child verbal ability</td>
<td>112.85</td>
<td>8.84</td>
<td>86 - 132</td>
<td>-0.67</td>
</tr>
<tr>
<td>Father EF</td>
<td>111.18</td>
<td>20.15</td>
<td>80 - 172</td>
<td>0.72</td>
</tr>
<tr>
<td>Baseline DCCS</td>
<td>42.03</td>
<td>23.47</td>
<td>4.17 - 87.50</td>
<td>0.64</td>
</tr>
<tr>
<td>Baseline Stroop</td>
<td>59.23</td>
<td>29.40</td>
<td>6.25 - 100</td>
<td>-0.25</td>
</tr>
<tr>
<td>FAT VOCD</td>
<td>46.31</td>
<td>21.37</td>
<td>21.19 - 79.56</td>
<td>0.18</td>
</tr>
<tr>
<td>FAT MLU</td>
<td>6.05</td>
<td>1.17</td>
<td>3.75 - 9.23</td>
<td>0.45</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>0.33</td>
<td>0.16</td>
<td>0.08 - 0.69</td>
<td>0.55</td>
</tr>
<tr>
<td>CHI TTR</td>
<td>.50</td>
<td>.15</td>
<td>.23 - .87</td>
<td>0.48</td>
</tr>
<tr>
<td>CHI MLU</td>
<td>2.81</td>
<td>0.69</td>
<td>1.69 - 4.77</td>
<td>0.76</td>
</tr>
<tr>
<td>Post-manipulation DCCS</td>
<td>36.68</td>
<td>22.42</td>
<td>0 - 79.17</td>
<td>0.74</td>
</tr>
<tr>
<td>Post-manipulation Stroop</td>
<td>47.01</td>
<td>28.80</td>
<td>0 - 100</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Note. EF = Executive function; DCCS = Dimensional change card sort; FAT = Father; CHI = Child; VOCD = Vocabulary diversity; MLU = Mean length of utterance; MLT = Mean length of turn; TTR = Type-token ration.
Table 5.4  
**Correlations between sociodemographic variables and main study variables**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Child age</th>
<th>Father Ed</th>
<th>Child verbal ability</th>
<th>Father reading habits</th>
<th>Father EF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline DCCS</td>
<td>.14</td>
<td>.13</td>
<td>-.15</td>
<td>.10</td>
<td>.32*</td>
</tr>
<tr>
<td>Baseline Stroop</td>
<td>.05</td>
<td>-.01</td>
<td>.26</td>
<td>.04</td>
<td>.11</td>
</tr>
<tr>
<td>Child verbal ability</td>
<td>-.36*</td>
<td>-.05</td>
<td>1</td>
<td>.45**</td>
<td>-.09</td>
</tr>
<tr>
<td>FAT VOCD</td>
<td>.14</td>
<td>-.09</td>
<td>.03</td>
<td>-.13</td>
<td>.22</td>
</tr>
<tr>
<td>FAT MLU</td>
<td>.06</td>
<td>.01</td>
<td>.11</td>
<td>-.11</td>
<td>.34*</td>
</tr>
<tr>
<td>MLT ratio</td>
<td>.06</td>
<td>.01</td>
<td>.11</td>
<td>.16</td>
<td>-.16</td>
</tr>
<tr>
<td>Child TTR</td>
<td>.02</td>
<td>-.18</td>
<td>.05</td>
<td>.04</td>
<td>.30*</td>
</tr>
<tr>
<td>Child MLU</td>
<td>.06</td>
<td>.05</td>
<td>.02</td>
<td>-.05</td>
<td>-.11</td>
</tr>
<tr>
<td>Post-manipulation DCCS</td>
<td>.24</td>
<td>-.13</td>
<td>.09</td>
<td>.18</td>
<td>.08</td>
</tr>
<tr>
<td>Post-manipulation Stroop</td>
<td>-.16</td>
<td>-.10</td>
<td>.23</td>
<td>.17</td>
<td>-.26</td>
</tr>
</tbody>
</table>

*Note.* EF = Executive function; DCCS = Dimensional change card sort; FAT = Father; CHI = Child; VOCD = Vocabulary diversity; MLU = Mean length of utterance; MLT = Mean length of turn; TTR = Type-token ration; Father ED = Father Education; *p < .05; **p < .01
Table 5.5
Correlations between main study variables

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Baseline DCCS</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Baseline Stroop</td>
<td>.19</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 FAT VOCD</td>
<td>.22</td>
<td>.13</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 FAT MLU</td>
<td>.23</td>
<td>.17</td>
<td>.78**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 MLT ratio</td>
<td>-.09</td>
<td>.15</td>
<td>-.53**</td>
<td>-.66**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 CHI TTR</td>
<td>.04</td>
<td>.01</td>
<td>.52**</td>
<td>.52**</td>
<td>-.67**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 CHI MLU</td>
<td>-.18</td>
<td>.08</td>
<td>-.13</td>
<td>.01</td>
<td>-.01</td>
<td>-.23</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Post DCCS</td>
<td>.44**</td>
<td>.15</td>
<td>.27</td>
<td>.23</td>
<td>-.07</td>
<td>.07</td>
<td>-.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9 Post Stroop</td>
<td>-.13</td>
<td>.33</td>
<td>.09</td>
<td>.15</td>
<td>-.02</td>
<td>.09</td>
<td>-.37*</td>
<td>.09</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. EF = Executive function; DCCS = Dimensional change card sort; FAT = Father; CHI = Child; VOCD = Vocabulary diversity; MLU = Mean length of utterance; MLT = Mean length of turn; TTR = Type-token ratio; *p < .05
Random assignment check. In order to check that the heavy-text and light-text book groups created by random assignment did not differ significantly on any baseline variables, a series of *t*-tests was conducted. Groups did not differ significantly on baseline EF, sociodemographic factors, fathers’ home-reading habits, paternal EF or child verbal ability. There was a greater number of boys in the present sample compared to girls. Twelve boys and eleven girls were randomly assigned to the heavy-text condition and fourteen boys and nine girls were assigned to the light-text condition. A series of *t*-tests was conducted in order to investigate potential gender differences across the main study variables. Although girls outperformed boys on both pre-test and post-test EF measures, these differences did not attain statistical significance. There were no significant differences in fathers’ VOCD, MLU or father-child MLT ratio between boys and girls. Finally, there were no gender differences in child TTR or MLU.

Group effects on change in EF. To test for an effect of book-reading condition on EF, hierarchical multiple regression analyses were performed with post-manipulation EF as the outcome variables and book-type as the predictor, controlling for baseline EF and fathers’ EF (see Table 5.6). There were no significant effects of book-reading condition on child EF post-manipulation; DCCS $\Delta R^2 = .05; \ F(1, 41) = 2.63, \ p = .112$; Stroop $\Delta R^2 = .03; \ F(1, 41) = 1.17, \ p = .285$. 95% bootstrapped confidence intervals based on one thousand samples were calculated: DCCS: 95% CI [-22.05, 0.83]; Stroop: 95% CI [-25.35, 8.04].
Table 5.6
Hierarchical regression analyses for child post-manipulation EF

<table>
<thead>
<tr>
<th></th>
<th>DCCS</th>
<th>Stroop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
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<tr>
<td>Constant</td>
<td>26.51</td>
<td>17.521</td>
</tr>
<tr>
<td>Baseline EF</td>
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<td>0.14</td>
</tr>
<tr>
<td>Father EF</td>
<td>-0.07</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>38.09</td>
<td>18.61</td>
</tr>
<tr>
<td>Baseline EF</td>
<td>0.43</td>
<td>0.14</td>
</tr>
<tr>
<td>Father EF</td>
<td>-0.13</td>
<td>0.16</td>
</tr>
<tr>
<td>Book (ref heavy-text)</td>
<td>-10.13</td>
<td>6.24</td>
</tr>
</tbody>
</table>
Discussion

This study sought to examine father-child language exchanges during shared book-reading and investigate the short-term effects of conversational turn-taking in this context on child EF. Results demonstrated that conversational turn-taking between father and child was influenced by book-type. Specifically, there was greater balance in turn-taking between dyads who read the light-text book compared to dyads who read the heavy-text book. This study adds to the body of work that indicates that book-type affects the quality of parents’ language during shared book-reading. The groups in the present sample were formed using random assignment and were matched on baseline variables, suggesting that differences in father-child language could be attributed to condition, rather than child or parent characteristics. It was expected that greater turn-taking would prime children’s EF skills and would be associated with greater performance on a subsequent EF battery. Manipulation of father-child conversational turn-taking however demonstrated no immediate effects on child EF performance.

Previous research comparing book-type effects on extra-textual talk has primarily been carried out in the context of mother-child shared book-reading (e.g., Muhinyi & Hesketh, 2017; Muhinyi, Hesketh, Stewart, & Rowland, 2019; Noble et al., 2018). Whilst Noble and colleagues (2018) found that a light-text book elicited greater grammatical complexity of mothers’ extra-textual talk compared to a heavy-text book, the present study found no significant difference in this aspect of fathers’ extra-textual speech. The authors used the same books as the present study, however, their operationalisation of language complexity included detailed coding of verb and sentence-types.

Similar to the present findings, Muhinyi and Hesketh (2017) demonstrated no differences in mothers’ language complexity between heavy- and light-text books. The authors however also found no difference in mothers’ vocabulary diversity across these
two conditions whereas the present findings demonstrated that fathers’ extra-textual talk was significantly richer in vocabulary diversity in the heavy-text condition. The current results also demonstrated that children produced more diverse vocabulary in this condition compared to the light-text condition. Rather than the amount of text contained in a book, recent findings suggest that it may be the complexity of the storyline which influences the quality of caregivers' extra-textual talk, with more complex stories precipitating greater extra-textual talk overall and richer vocabulary diversity and syntactic complexity (Muhinyi et al., 2019). Several challenging concepts in the present heavy-text book (e.g., tadpoles turning into frogs; seeing your breath in cold air) may have elicited more sophisticated vocabulary from fathers compared to the relatively simple story-line in the light-text book.

Despite the significant effect of book-type on conversational turn-taking, no influence on child EF was demonstrated. In fact, EF performance declined for children in both conditions. This finding is similar to the study by Meuwissen and Carlson (2019), where it was observed that children became less well-regulated from pre-test to post-test. It is possible that fatigue across the session was a contributing factor to the present findings and decrease in performance may have been due to loss of focus. A recent study examined preschool-aged children’s performance over the course of an EF assessment and found that children’s accuracy declined over the duration of each EF task (St. John et al., 2019). Children’s immature abilities to maintain task performance over time, coupled with fatigue, may have contributed to a decrease in EF from baseline to post-manipulation. Although decreases in EF across conditions did not achieve statistical significance, children in the light-text condition experienced slightly greater decreases. It is possible that greater back-and-forth conversation placed more demands on children.
Previous research suggests that it may also be important to measure child interest during shared book-reading when studying associations between this activity and child development. Malin and colleagues (2014), for instance, demonstrated that child interest during shared book-reading mediated the association between the quality of parents’ extratextual talk and child vocabulary skills. Another study demonstrated that child interest was associated with the rate of mothers’ extra-textual talk (Deckner et al., 2006). Joint-attention, which is theoretically a core feature of shared book reading, may enhance the internalisation of skills practiced by children within this context (Baker, 2013). Engaging children in conversation may be one method to maintain child interest during shared book-reading as well as a means to stimulate their verbal and cognitive skills. The ability to maintain attention and resist the urge to explore the playroom may also be indicative of children’s EF skills and could be used as a measure of child attention and EF.

Whilst the present intervention demonstrated no immediate effect on conversational balance during father-child interaction, it is possible that effects on EF would be seen over a longer period of time. A recent meta-analysis of shared book-reading interventions on child language found a small effect size (Noble et al., 2019). The authors suggested that the very short time frames of typical intervention studies may account for this finding and that greater effects may be found from higher-dose, long-term interventions. It is conceivable that over a longer period of time, the effects of conversational turn-taking on child EF would be elucidated.

Parent interventions which are simple to implement have great potential to support children’s development. Furthermore, cost-effective interventions are important for widespread implementation. Shared book-reading interventions are also easily accessible. Recent research demonstrated, for instance, that dialogic training improved the quality of
picture book-reading interactions between parent and child in rural Kenya, even amongst illiterate caregivers (Knauer, Jakiela, Ozier, Aboud, & Fernald, 2020). In relation to child engagement in book-reading, previous research has indicated that toddlers may be more engaged with electronic books compared to print books and may also produce more text-related talk in this context (Strouse & Ganea, 2017). A recent eBook intervention study, which involved a character who asked questions during book-reading, increased both parent and child's extra-textual talk and conversational turns between parent and child (Troseth et al., 2020).

Evidence suggests that shared book-reading between fathers and their children may be a salient context for development during the preschool period. Although no positive short-term effect of shared book-reading on child EF was found in the current study, there was a positive association between fathers' involvement in shared book-reading in the home and child language ability. Fathers have previously been referred to as an “under-tapped resource” which shared book-reading interventions should target in order to maximise their efficacy (Duursma & Pan, 2010, pp. 1163). The present measures of father-child reading quality, namely vocabulary diversity, grammatical complexity and conversational turn-taking, each support children’s language development (e.g., Hoff, 2006; Huttenlocher et al., 2010; Rowe, 2012; Zimmerman et al., 2009). Previous parent-training intervention studies have found that conversational turn-taking in parent-child interaction is an amenable target for intervention (Brassart & Schelstraete, 2015; Ramírez et al., 2020). In the present study, these aspects of father-child communication were elicited by book-type, in a naturalistic setting, requiring no specific instructions.

Both heavy- and light-text books elicited important, but different, aspects of father-child language indicating that both types of book may support children’s development.
Muhunyi and Hesketh (2017) suggested that light-text books may be particularly well-suited to provide high quality linguistic and interactive experiences to children who may have poorer language or attentional abilities and may struggle with engaging in heavier text books. Heavy-text books, on the other hand, may be more suitable for children who can benefit from the grammatical and linguistic complexity of more challenging story-books. It may be important to match the complexity of children’s books to their language abilities, in order to maximise their potential for learning.

Limitations and Future Directions

Given the relatively novel approaches taken in this study, it is important to acknowledge its limitations when interpreting the present findings. The sample size of the current study was small. Despite targeting fathers directly in recruitment approaches, it remained a challenge to engage fathers in the present research. Many of the father-child visits to the lab were organised by mothers. This may indicate that although recruitment strategies targeted fathers only, mothers may have been disproportionately exposed to the study advertisements, both physical and online. It is also possible that fathers who did nominate themselves for participation may be particularly involved with their children and feel competent in their parenting role (Meuwissen & Carlson, 2019). Furthermore, the majority of participants were considered middle-class families. It is therefore difficult to infer how well the current findings can be extended to the wider population. Future research should include a more diverse sample. Research with at-risk populations provides important insights needed in order to inform effective interventions.

As previously mentioned, a task for future research may be to examine how conversational turn-taking elicited during shared book-reading may affect child EF development over a longer period of time. In relation to child language development, studies demonstrate the
importance of conversational back-and-forth between parent and child, yet no study has specifically examined turn-taking during book-reading and later effects on child language development. It may also be of interest to examine how educating fathers on the importance of vocabulary diversity, language complexity and turn-taking for child development may affect the quality of parent-child language exchanges during shared book-reading. Lastly, it is also important to highlight that although demonstrating the effect of manipulation on EF is relevant to building a case for causality, it may not be possible to conclude causal attributions from regression analyses. It is important to consider how results of regression analyses are interpreted in light of the validity of the measures employed and the possibility that other factors may interplay and influence the findings.

**Conclusion**

The present study is the first to examine the effect of book-type on father-child language interactions during shared book-reading. Findings demonstrated that type of book had a significant impact on the quality of father-child language and interactive behaviours. As EF is an important predictor of later achievement (Bierman et al., 2008; Moffitt et al., 2011), it is of key interest to understand how features of the parent-child interactive environment may enhance the development of these skills. This study attempted to demonstrate the effect of parent-child interactive behaviours on child EF in an experimental context. Although it was expected that book-type would have an effect on child EF, specifically that conversational turn-taking elicited by the light-text book would prime greater EF performance, no such effect was demonstrated in the current study. In conclusion, shared book-reading may be an important context for promoting conversation between fathers and their children, however implications for child EF remain to be determined.
Chapter 6

General Discussion

Early executive function (EF) lays the foundation for later achievement and well-being. There is wide variation in EF abilities among preschool-aged children. Identifying the antecedents of these individual differences is a key focus of research. In order to maximise children’s potential for developing these crucial skills it is important to understand how the quality of the early interactive environment influences these emerging capacities. The aim of the present research was to examine how interactions between fathers and their children contribute to children’s development of EF. Specifically, this thesis investigated longitudinal associations between fathers’ child-directed speech (CDS) and child EF development. A sample of eighty families (mother, father, child) were recruited to the current study at child age two years. Participating families were followed up at child age three and four years. Parent-child language variables were extracted from structured and free-play interactions at child age two years. At each time point child performance on a series of language and EF measures was assessed. In order to test associations between father-child language and child EF arising from these analyses, a second sample of forty-six three-year-old children and their fathers was recruited to take part in an experimental study. This section summarises the key findings of the thesis, emphasising how this work contributes to current understanding in the field of child EF development. Finally, the strengths and limitations of the present research are outlined with recommendations for future research.

Chapter 3 comprised three studies. Study 1 compared mothers’ and fathers’ CDS during interaction with their two-year-old children and investigated the influence of interactive context and parent and child characteristics on parental CDS. Findings
demonstrated that mothers produced more diverse vocabulary during play compared to fathers, however, both mothers and fathers produced more varied vocabulary during free play compared to structured play. The free play context was also associated with greater balance in conversational turn-taking between parent and child compared to structured play. Finally, an association between child cognitive ability and conversational balance in both mother-child and father-child interaction was observed.

These findings demonstrate the importance of context in shaping the language to which children are exposed and in which children engage and highlight that characteristics of the child him/herself shape the course of language interactions between parent and child. This research is consistent with a transactional model of development which frames the development of the individual as arising from dynamic bidirectional interactions between the child and their environment (Sameroff, 2009). In order to further explore children’s active role in interaction, Study 2 investigated associations between child speech produced during interaction and parents’ CDS. Results demonstrated a positive association between the grammatical complexity of the speech produced by fathers and their children, suggesting that fathers may tailor the complexity of their speech input according to the complexity of language produced by their child during interaction.

Finally, Study 3 sought to investigate longitudinal associations between fathers’ CDS at child age two years and child language and EF development at age three years. In addition to the administration of a standardised language assessment, child language produced during interaction was measured at age three years, providing real-time measures of child language competencies. Results demonstrated that fathers’ vocabulary diversity was positively associated with child receptive language ability, EF and child language complexity produced during play at age three years. These effects remained significant
when controlling for mothers’ vocabulary diversity. These findings emphasise that features of mother-child and father-child language may exert differential effects on child development and are consistent with previous findings that fathers’ and not mothers’ lexical diversity were associated with child language development (e.g., Pancsofar & Vernon-Feagans, 2010). It is noteworthy that fathers in the current sample produced less diverse vocabulary than mothers overall. Previous research has indicated that fathers’ vocabulary may be of particular salience to children due to the number of rare, challenging words they tend to produce during parent-child interaction (Ratner, 1988).

Chapter 4 comprised one main study and two auxiliary studies arising from findings of Study 1. Study 1 examined longitudinal associations between father-child language at age two years and child EF development at age four years. A key finding of this study was that balance in conversational turn-taking in father-child interaction at age two years was associated with child EF at age four years. Again, these findings emphasise that the active participation of the child in interaction is important in shaping development. When fathers encourage children to engage in conversation this may have important implications for their EF development. Study 2 sought to examine turn-taking in father-child interaction in greater depth by analysing key features of conversation which may be associated with child EF. Fathers’ length of turn, proportion of open-ended questions, and father-child response latencies were examined. Despite research indicating that the challenging nature of fathers’ open-ended questions may be important for child reasoning skills (e.g., Rowe et al., 2017), no association with child EF was revealed. Fathers’ mean length of turn was the only unit of turn-taking measured in Study 2 which demonstrated an association with child EF. When fathers took longer turns at age two years, children had lower EF at age four years.
Study 3 sought to delve beyond the mechanics of conversation and investigate whether fathers’ scaffolding and directive speech could account for the association between turn-taking and EF. Despite previous research which has indicated that these are important constructs for EF in mother-child interaction, results demonstrated that fathers’ verbal scaffolding and directiveness were not significantly associated with child EF development. The findings suggest that structural components of conversational turn-taking rather than the communicative function of fathers’ speech may be important for child development of EF.

Chapter 5 comprised one study for which a new sample of fathers and their three-year-old children were recruited. The goal of this study was to test associations between conversational turn-taking in father-child interaction and child EF using an experimental design. A shared book-reading paradigm was used to manipulate father-child language during interaction and to test associations with change in child EF from baseline to post-manipulation. One group was assigned to read a light-text book which was hypothesised to elicit greater conversational balance between father and child whilst the other group was assigned to read a heavy-text book, proposed to minimise turn-taking. Results demonstrated that shared book-reading condition effectively influenced conversational turn-taking in father-child interaction; however no effect on child EF in the short-term was found. Table 6.1 summarises the key findings of the present collection of studies.

**Strengths of the Study**

The present research reports several novel findings which contribute to the literature on the importance of father-child interactions for child EF development. The inclusion of both mothers and fathers in this study provides an insight into the ecology of the developing child and is a significant strength, particularly in light of fathers’
underrepresentation in developmental research. With regard to the EF literature, this is the first study to examine associations between fathers’ CDS and child EF development.

Whilst previous research has suggested that the challenging nature of fathers’ conversation-eliciting speech may be important for child verbal reasoning skills (e.g., Rowe et al., 2017), this is the first study to examine father-child conversation in relation to child EF development specifically. Finally, the present research also proposes a novel approach to manipulating father-child conversation in the context of shared book-reading.
Table 6.1
Summary of key findings

1. Cross-sectional findings

A profile of fathers’ CDS at child age 2

<table>
<thead>
<tr>
<th>Mothers’ CDS vs fathers’ CDS</th>
<th>Structured play vs free play</th>
<th>Influences on fathers’ CDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fathers’ CDS less lexically diverse than mothers’ CDS.</td>
<td>Greater father-child conversational balance in free play compared to structured play.</td>
<td>Child cognitive ability was associated with father-child conversational balance. Child syntactic complexity was associated with fathers’ syntactic complexity.</td>
</tr>
</tbody>
</table>

2. Longitudinal findings

(a) Associations between fathers’ CDS at child age 2 and child language and EF at age 3

Controlling for mothers’ CDS, fathers’ vocabulary diversity at age 2 was associated with child receptive language, EF, and syntactic complexity during interaction at age 3.

(b) Associations between fathers’ CDS at child age 2 and child EF at age 4

Higher conversational turn-taking in father-child interaction at age 2 was associated with higher child EF at age 4, controlling for cognitive ability at age 2.

3. Decomposing the association between conversational turn-taking and EF

(a) Dynamics of turn-taking

Fathers’ mean length of turn at age 2 was negatively associated with child EF at age 4. Response latencies at turn-transitions and fathers’ wh-questions were not associated with child EF.

(b) Communicative functions of fathers’ CDS

Fathers’ verbal scaffolding/directiveness were not significantly associated with child EF suggesting the association between turn-taking and EF may be best understood at the structural level of analysis.
4. Experimental investigation of effect of father-child conversational turn-taking on EF

Father-child conversational turn-taking was affected by book-type. Father-child conversational balance was greater in the light-text book condition. There was no effect of increased turn-taking during this condition on subsequent child EF performance.

There are several strengths in the design of the current study. The quality of parent-child interactions were assessed using observational methods. Observation of father-child interactions is currently considered the gold-standard approach to understanding the importance of father-child relationships for child development (Cabrera & Volling, 2019). The unobtrusive positioning of the wall-mounted cameras in the laboratory play room encouraged naturalistic interactions between parent and child. The lab setting also allowed for stimuli and environmental factors to be controlled for across all participants, facilitating comparability across the present sample (De Barbaro, Johnson, Forster, & Deak, 2013). Furthermore, this environment facilitated the administration of the various developmental assessments with the child, which are ideally undertaken in settings with minimal distractions (Anderson & Reidy, 2012). Direct assessment of child language and EF is another strength of the research as this provided an objective measure of child abilities. Parent-report measures of child capabilities may be subject to social desirability and recall bias (Baumeister, Vohs, & Funder, 2009; Chorney, McMurty, Chambers, & Bakeman, 2014).

The current study examined how features of the parent-child interactive environment were associated with child EF development both cross-sectionally and longitudinally. The nature of longitudinal research permits the investigation of patterns of
associations between parent-child interactive behaviours and child development over time. Different aspects of parent-child interaction may support particular domains of child development at specific points in time. Furthermore, longitudinal research provides an indication of the direction of effects. Fine-grained analyses were also used to complement the longitudinal approach, in order to clarify the associations between father and child speech in the immediate conversational context, as well as associations with child development over time. Micro-analytic coding allowed for the timing between child and fathers’ utterances to be identified and associations with EF examined. Finally, the experimental design of the final study used to investigate associations between father-child language and child EF was a major strength of the thesis. This experiment offered a new perspective on the use of shared book-reading as a context for manipulating father-child language and also permitted the investigation of the mechanisms by which fathers may influence child EF.

Limitations

The small sample size of the present research restricted the sophistication of analysis and rigour of the present findings. A disadvantage of longitudinal research is the high rates of attrition associated with this design. The small sample size did however increase the feasibility of performing more detailed analyses in Chapter 4 in relation to turn-taking which may not have been achievable with a larger group of participants. The homogeneity of the sample, which comprised White, highly educated, married parents, may limit the generalisability of the current findings. This homogeneity may explain, for instance, the lack of association between parental education (an index of socioeconomic status) and conversational turn-taking in the present study. Previous research has demonstrated a greater number of turns between parent and child among higher SES
households (Romeo et al., 2018). There may have been limited variability in mothers’ and fathers’ CDS in the present sample compared to more diverse populations. This is important to acknowledge given established associations between socioeconomic status and CDS (Schwab & Lew-Williams, 2016b).

When considering the influence of CDS on children’s development it is also important to acknowledge cultural assumptions regarding developmental milestones and processes of development which are primarily drawn from research in Western communities (Kuchirko & Nayfeld, 2020). As previously mentioned, there are communities outside of the Western world where CDS is relatively rare (e.g., Casillas et al., 2019). Furthermore, different cultures may have distinct expectations for children's verbal participation in interaction (Girolametto et al., 2002). Cross-cultural research may offer important insights into the interactive processes which are important for executive function development.

Participants in the present collection of studies were also homogeneous in relation to family composition. Families comprised two-parent households consisting of a biological resident father and mother. The fathering literature has suggested that fathers’ resident status is positively associated with children’s healthy development as there are increased opportunities for interactions which benefit children (Flanders et al., 2010). Risk factors associated with diverse family structures (e.g., one-parent households; stepfamilies) may influence parent-child processes (Simons, 1996). It may therefore be important to consider family structure when generalising the present findings and when making comparisons across future replications.

Future research should examine associations between CDS and child EF development in socioeconomically and culturally diverse samples and be sufficiently
powered to investigate further demographic characteristics which may influence father-child/family processes. With regard to the book-reading study described in Chapter 5, future research may offer insights into the generalisability of turn-taking interventions beyond the well-advantaged, Western sample used in the present research. It may be important to consider whether type of book is associated with turn-taking in families of diverse linguistic, cultural or SES backgrounds.

Finally, the present sample was self-selected. Recent research demonstrates that parent and child variables may differ between families who take part and choose not to take part in research, indicating there may be a degree of bias inherent in sampling in developmental psychology (Yu, Shafto, & Bonawitz, 2020). It is more difficult to recruit fathers to research compared with mothers therefore it may be important to consider how the present findings generalise to families outside of the study population.

With regard to sampling methods, it is also important to consider how the brief play interactions measured in the lab environment represent the daily experiences of parents and children. Despite advantages of studying behaviour in a laboratory setting, as discussed above, behaviours measured in this setting may have lower ecological validity than observations taken in the home. Comparisons of parental CDS across hour-long video recordings and day-long recordings, for instance, suggest that brief recordings may provide a denser sample of speech input to infants and may provide a somewhat inflated approximation of children’s daily language experiences (Bergelson et al., 2019). This approach is however widely used in the literature and permits detailed analyses of parent-child language during interaction.

Finally, any research examining the development of child EF is susceptible to limitations associated with measuring this construct. This is discussed in detail in Chapter 2
Part 1 but is important to reiterate. Tasks purported to measure EF suffer from task impurity, such that performance on these measures often relies on other “lower-level” cognitive systems. For instance, a child’s mastery of basic semantic concepts such as colour and shape may affect their performance on a given EF task (Miyake & Freidman, 2012). In order to circumvent this issue a common method is to assess child EF using a battery of tasks. Similar to many previous studies, the present research demonstrated low inter-correlations between the EF measures within the task-batteries. Issues in measuring EF are not particular to the present thesis but apply to the field as a whole.

Theoretical Implications

This thesis adds to the growing literature on the importance of fathers for child development. Research focusing solely on the role of mothers overlooks the rich ecology of the developing child. The measurement of father-child interaction was built into the design of the current study, allowing for a systematic analysis of their role in child development across the preschool period. Research indicates that although fathers may still spend less time providing care to their children compared to mothers, it is the quality, not quantity, of father-child interactions which have important implications for child development (Cabrera, Volling, & Barr, 2018). The findings of the thesis emphasise the value in analysing the quality of father-child interactions over traditional methods of measuring fathers’ involvement which is often reported by mothers.

The findings of the present study are consistent with social interactionist accounts of cognitive development which emphasise the importance of interactions between children and more knowledgeable others for child development. Previous research has demonstrated how father-child play is important for children’s self-regulation development due to its stimulating and challenging nature. The current findings indicate that fathers may also
challenge and stimulate children through back-and-forth conversation. This study contributes to the emerging research investigating the role of fathers’ CDS in child development. The majority of previous studies have focussed on child language development. This is the first study to examine associations between fathers’ CDS and child EF development. Furthermore, whilst there is a substantial body of literature detailing the influence of mothers’ parenting on child EF development, the present thesis adds further insight into the role of fathers in this domain.

It is worth considering in greater detail the null finding that conversational turn-taking during shared book-reading did not have an effect on child EF (Chapter 5). The book-reading experiment was designed to test predictive associations between father-child conversational turn-taking and EF which emerged from the main longitudinal analyses of the present collection of studies. This null finding may indicate that such an association does not truly exist or may reveal that limitations of the study design failed to detect a true relationship. Limitations of the study design (e.g., the short time period over which the experiment was conducted) were outlined in Chapter 5. A further possible design limitation was that change in EF performance was measured using “cold” EF tasks. Performance on these cognitive tasks may be less malleable to change in the short-term compared to children’s EF/self-regulatory behaviours which can be coded during problem-solving tasks. It is possible that children’s EF-related behaviour is more susceptible to brief parent-child interactions compared to their cognitive capacities measured by cold EF tasks. Therefore, the present study design may have masked a true association between father-child turn-taking and child EF.

Null results are often undervalued and a bias towards publishing statistically significant findings remains prevalent in scientific research (Button et al., 2013). This may
give rise to an overestimation of effects or, alternatively, the publication of false positives. Issues of publication bias and underpowered studies have contributed to what has come to be known as the “replication crisis” in psychology (Pashler & Wagenmakers, 2012). Issues of power in developmental research and specific challenges in conducting research with children highlight the importance of replicability in developmental psychology (Frank et al., 2017). Null findings can indicate whether a particular avenue of research or intervention design is worth pursuing as well as providing theoretical insight into the psychological phenomena under investigation.

Finally, consistent with ecological models of parenting, the present analyses attempted to provide a situated insight into the role of fathers’ CDS in child EF development over time. The present collection of studies examined the influence of context in which father and child play on the language to which children are exposed to and produce themselves. The studies also examined reciprocal and temporal relations between father and child speech, and identified father and child characteristics which may shape patterns of interaction between father and child. The scope of these analyses was however limited due to power concerns, particularly in providing a nuanced profile of the role of mothers’ CDS versus that of fathers.

It may be that increased exposure to balanced turn-taking from two parents may support children’s EF, for instance. Future research may benefit from profiling both mothers’ and fathers’ turn-taking behaviours during parent-child interaction and testing concurrent associations between the combinations of mothers’ and fathers’ turn-taking and children’s EF. Such family-level analyses may account more closely for the microsystem influences on child development, a space which is occupied by both mothers and fathers in the current sample (Volling et al., 2019). As previously mentioned, power concerns
curtailed the scope of the present statistical analyses and therefore the unique or combined contribution of both mothers’ and fathers’ CDS on child EF development over time was difficult to ascertain. The present findings lay the groundwork for future inquiries which may be able to answer these questions.

From a transactional perspective, children actively shape the interactions in which they partake with parents and this, in turn, influences the course of their development (Sameroff, 2009). In relation to the focus of the current collection of studies, children elicit CDS from their parents and the quality of this speech has an influence on child developmental trajectories. The present analyses investigated the influence of fathers’ CDS on child EF development and although child-level characteristics contributing to variance in fathers’ CDS were explored in Chapter 3, the small samples of the present studies restricted the statistical sophistication of transactional models which could be tested. Although bidirectionality in father-child interaction is acknowledged, statistically it was only possible to test unidirectional influences of father’s CDS on child EF.

**Practical Implications**

The present findings highlight the importance of early father-child interactions for child development. The results suggest that efforts to empower and encourage fathers to be actively involved in caregiving may have important implications for children. Equipping fathers with the knowledge that they are important resources for their children may benefit both fathers and their children. The results of the present study also emphasise the importance of both free and structured play as contexts for shaping the language children hear and their development. Given that engagement in structured play activities at the expense of free play is on the rise, parents should be informed of the benefits associated with both forms of play and encouraged to participate in play for the sake of play with their
children. Expanding the contexts in which parents and child interact will expose children to new words and different grammatical structures. Free play interactions may also be less directive in nature and provide opportunities for children to take the lead and practice self-regulatory skills.

The results of the thesis may inform programs aimed at improving child language and EF abilities. As the findings indicate that the father-child interactive environment is an important context for child development, programs designed to improve the quality of parent-child interactions should include both mothers and fathers in order to maximise positive effects on children. In relation to conversational turn-taking specifically, research has demonstrated the efficacy of interventions designed to increase this aspect of interaction in the context of the mother-child relationship. The present findings demonstrate the feasibility of interventions targeting conversational turn-taking in father-child interaction. The current research also contributes to research demonstrating the practicability of engaging fathers in shared book-reading interventions.

**Future Directions**

Research examining the role of fathers in child EF development is a key area of interest in the field at present. This is the first collection of studies to examine the associations between fathers’ CDS and child EF. Future studies with greater and more diverse samples are required to replicate the findings of this thesis. The family composition of the participants in the current research may be considered quite traditional. Future studies investigating the importance of fathers for child development could comprise more diverse family structures (e.g., same-sex parents, non-resident fathers). The current research focussed solely on EF development among a typically developing sample. Future
studies may investigate whether the current findings extend to atypically developing samples.

The final study included in this thesis did not demonstrate an effect of conversational turn-taking during shared book-reading on child EF in the short-term. Future research may extend this study to examine whether turn-taking elicited in this context over a longer period of time has an impact on child EF. It may also be useful to examine whether the two book-reading conditions used in this experiment affect mother-child language similarly. Previous research has demonstrated that there may naturally be more back-and-forth conversation during book-reading between fathers and their children compared to mother-child book-reading (Malin et al., 2014).

Conclusion

The collection of studies presented in this thesis demonstrate the importance of fathers for child EF development. In order to attain a more comprehensive account of the developing child’s early environment it is crucial to consider the multiple contexts within which a child develops. Research on both mother-child and father-child interaction provides an important insight into the early interactive experiences of children and how this shapes their development. The findings of the present thesis are the first to demonstrate an association between the early linguistic experiences provided by fathers and child EF development. Furthermore, the results present a new perspective on the role of pragmatics in child development of EF. Conversational turn-taking may be an important feature of the father-child interactive environment and the present findings demonstrate the malleability of this aspect of child-directed speech. Promoting “serve and return” interactions between fathers and children may have significant implications for children’s EF and equip children with the skills needed for future success.
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doi:10.1006/brcg.1999.1117

doi:10.1207/s15326942dn2601_6


National Institute of Child Health and Human Development Early Child Care Research

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Appendices
Appendix A. Ethical Approval

School of Psychology Research Ethics Committee

26th March 2017

Dear Linda,

The School of Psychology Research Ethics Committee recognises you as a named investigator on the project entitled "Parent-child interaction and child development outcomes" which received ethical approval in September 2014.

Adverse events associated with the conduct of this research must be reported immediately to the Chair of the Ethics Committee.

Yours sincerely,

Richard Carson
Chair,
School of Psychology Research Ethics Committee
Dear Parent,

Re: time, date

We look forward to welcoming you to the lab on the time and date above. This letter contains some more information about your visit.

Arriving at the lab

Please find a map showing how to find the lab attached.

Taking part

Your child will be with one of you for the entire visit. However, mother and father will be asked to come into a separate nearby testing room, one at a time, to complete some questionnaires and a verbal performance task. You and your child will be able to take breaks when you need them. Tea, coffee and a changing mat are available.
If you are coming in the afternoon, it would be a good idea to schedule your visit for just after your child’s naptime. A number of the tasks are intended to be challenging for a two year old and it will be helpful for your child to be well-rested.

The length of the visit depends on the mood of each child on the day, but we will do our best to finish within approximately three hours.

Before visiting the lab

One of the tasks we will ask of your child involves manipulating pieces of cereal (we typically use Cheerios), although your child is not required to eat anything. Please let us know if they have any allergies, or any other information about your child you think might be relevant.

Thank you

At this point, we would like to thank you again for generously giving your time to take part in the study. As always, please feel free to contact us with any questions.

Jean, Liz and Linda

infantresearch@tcd.ie
www.facebook.com/TCDinfantchildresearch

Dr Jean Quigley quigleyj@tcd.ie 01 896 2697
Dr Elizabeth Nixon enixon@tcd.ie 01 896 2867
How do I get to the Infant and Child Research Lab?

We will meet you in the ground floor lobby of Áras an Phiarasaigh and take you to the lab which is located upstairs (an elevator is available for strollers).
Appendix C. Consent Forms

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
Future use of Data and Video Material
Parent – Child Interaction: Information and Consent Form

The video material and data collected in the study are very valuable resources which could be used to answer a lot of different research questions.

We would be grateful if you would consider consenting to the inclusion of the data and video material collected from your family for other research projects in the future. All data would be used strictly and solely for research purposes. You and your child would be identifiable in the videos, but only researchers would have access to these and all other data would be anonymised.

Please take the time to consider this request and if you feel you would like to consent to this use of your video, please sign below.

I agree that the researchers may use the video material recorded with my family in future research projects.

I understand that this stored video material will be confidential to the research team and used only for the purpose of research.

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 Phiaraisigh, Trinity College, Dublin 2
Follow-up

Parent–Child Interaction: Information and Consent Form

We would like to take this opportunity to thank you for your generosity in participating in this study.

This type of research assumes that the way we routinely interact with our infants and young children influences not only their behaviour and responses in the short term but critically influences many aspects of their later development.

The data we have collected from you today is very valuable and can help us to answer many questions about the dynamics of interaction. We are also very interested in how our behaviour now impacts children’s development over time. We would love to be able to explore this further with your child at a later date.

If you are willing to participate in a follow-up visit or questionnaire in 1 year’s time, please sign below.

I agree that the researchers may contact me to participate in a follow-up study within a 2 year period.

[ ]

I understand that I am free to decline to participate in a follow-up study when contacted.

[ ]

Participant (Parent)’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
Appendix D. Debriefing Sheet

Parent–Child interaction: Debriefing Form

Thank you for your help!

Many thanks for giving us your time to participate in our study. Remember that the information which you have shared with us is confidential will be used only for the purpose of the research.

Any identifying details will be changed to protect your anonymity.

If the lab visit has raised any issues which have been upsetting or distressing for you, we recommend that you get in touch with your GP or your local health centre.

Also, please find below the contact details of some relevant organisations which you may find useful.

**Barnardos**

CallSave 1850 222300  email info@barnardos.ie

www.barnardos.ie

**Parentline: Helpline for parents under stress**

LoCall 1890 927277  email info@parentline.ie

www.parentline.ie

If you require further information about the research or want to contact the research team, our details are:

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
Appendix E. Recruitment Poster for Book-Reading Study

Invitation!

We are seeking three-year-olds and their dads to visit our lab to take part in a study about play and development.

We are currently recruiting children aged 34 – 40 months and their fathers to come to our lab in Trinity College Dublin at a time and day that suits you.

The visit will take approximately 90 minutes during which your child will complete short language and cognitive tasks. We will also observe you and your child performing a short task together.

Please contact us at infres@tcd.ie for more information or to book a visit.
Appendix F. Demographic Questionnaire for Book-Reading Study

Participant:

Note 'your child' refers to the child participating in the study.

Date of birth (DD/MM/YY)  Nationality  Language(s)
Child  ___ / ___ / ___  ________________  __________________
Father  ___ / ___ / ___  ________________  __________________
Mother  ___ / ___ / ___  ________________  __________________

1. Has your child had any longstanding illness, condition or disability or were there any complications with their birth or pregnancy?

   Yes ____ (if yes please specify below)  No ___

   __________________________________________

   __________________________________________

2. Please state your main occupation (including job-seeking or training scheme, maternity leave, home duties/looking after family, self-employed, retired, long-term sickness or disability, etc. giving a detailed description of your job title.

   Father: ___________________  Mother: ___________________
3. What is the highest level of education which you have completed to date?

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Father</th>
<th>Mother</th>
</tr>
</thead>
<tbody>
<tr>
<td>No formal education</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Primary</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Lower secondary (e.g. Junior Cert)</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Upper secondary (e.g. Leaving Cert)</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Third-level non degree (e.g. Diploma)</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Bachelor degree/Professional qualification</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Postgraduate Master’s degree</td>
<td>_____</td>
<td>_____</td>
</tr>
<tr>
<td>Doctorate</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

4. How often do you read to your child? (please circle)
   a. More than once a day
   b. Once a day
   c. A few times a week
   d. A few times a month
   e. Rarely
   f. Never
5. *How often does your partner read to your child?* (please circle)
   a. More than once a day
   b. Once a day
   c. A few times a week
   d. A few times a month
   e. Rarely
   f. Never

6. *How many children’s books do you own* (Please estimate number)?
   ______________________________

7. *Please list your child’s favourite books.*
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________
   _______________________________________________________

8. *Did you read to your child this week?* Yes / No (please circle)
   If yes
   a. Which days?
   _______________________________________________________
   b. What time of day?
   _______________________________________________________


c. What book(s)?
________________________________________

9. Did you or a caregiver read to your child yesterday? Yes / No (please circle)

If yes
a. What time of day?
________________________________________

b. Who read to the child?
________________________________________
c. What book(s)?
________________________________________

10. Did you or a caregiver read to your child today? Yes / No (please circle)

If yes
a. What time of day?
________________________________________

b. Who read to the child?
________________________________________
c. What book(s)?
________________________________________