Depression and Anxiety in the Postnatal Period: An Examination of Mother–Infant Interactions and Infants' Language Development.

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Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except where it has been acknowledged in the text. I hereby declare that I have not submitted this material, either fully or in part, for a degree at this institution or any other institution.

Signature

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Abstract

Infancy is a time period associated with significant and rapid social-emotional and cognitive development. Environmental influences, particularly the quality of the mother–infant interaction, assist in shaping these early capacities. Maternal factors such as depression and anxiety can have a negative impact on a mother's sensitivity towards her infant and indirectly compromise child developmental outcomes. However, little is known about the impact of depression and anxiety on communicative interactions and language outcomes in young infants. This thesis reports a longitudinal study, which primary objective was to examine the mechanisms through which maternal depression and anxiety influence infant language development via the quantity and quality of mother–infant interactions. The second objective was to evaluate the effectiveness of a video feedback intervention aimed at promoting maternal responsiveness, a construct that captures the quality of early mother–infant interactions.

To address these objectives this longitudinal study followed a sample of mother–infant dyads in which the mothers were or were not affected by anxiety and depression symptoms, between the infants' ages of 6 to 18 months. The study included four components that measured the quantity and quality of the mother–infant interactions and infant developmental outcomes between groups and across time. The first component of the longitudinal study involved home recordings examining the quantity of maternal speech input to the infants at 6 and 12 months of age. The second component involved the assessment of infants' lexical abilities at 18 months of age. The third component consisted of assessments of the quality of mother–infant interactions at 9 and 12 months. The final component involved the evaluation of a short intervention aimed at promoting maternal responsiveness within mother–infant interactions.

Findings demonstrated that maternal depression and anxiety have an effect on infants' early lexical abilities via both the *quantity* and *quality* of mother–infant interactions. These results suggest that variability in mothers' emotional health influences infants' home language experience, the concurrent frequency of vocalisations, and their later vocabulary size and lexical processing efficiency at 18 months. Maternal responsiveness, a measure of the quality of mother–infant interactions, emerged as the strongest predictor of infant vocabulary size. This finding demonstrated the need to consider mothers' levels of responsiveness in addition to depression when designing interventions to mitigate the risk for adverse child developmental outcomes such as language delays. An evaluation of a short video-feedback intervention supported the potential of Video Interaction Guidance to improve maternal responsiveness levels in mothers with low maternal responsiveness. It is anticipated that these findings will inform continued improvements in research-informed intervention programmes designed to maximise infants' primary social contexts in their first two years of life.

CHAPTER 1

Literature Review

An infant's developmental trajectory is influenced by both environmental and genetic factors (Bronfenbrenner, 1979). Communication with a primary caregiver, usually the mother, is an infant's first social and linguistic experience and is therefore a powerful factor in influencing the infant's subsequent linguistic development (Papoušek, 2007; Tamis-LeMonda, Bornstein & Baumwell, 2001). Communication does not reside in individuals but is continuously constructed by both partners in an interaction (Fogel, 1992a; 1992b). As a continually evolving dynamic, the mother–infant interaction is shaped by maternal and infant factors that form an interactive feedback loop (Kitamura, 2013; Kitamura & Burnham, 2003; Kuhl, 2007). Emotionally and developmentally attuned communication is at the core of these mother–infant interactions (Siegel, 2012), and it can be compromised by maternal factors such as emotional well-being, which in turn predicts developmental outcomes in the child, including language abilities, which are the primary focus of this thesis.

Maternal emotional health is one environmental factor that has been associated with adverse developmental outcomes in the infant (Beebe et al., 2012; Field, 1995), including early language abilities (Kaplan et al., 2014; Reck et al., 2018). However, the specific mechanisms, through which maternal emotional health influences the developmental trajectory remains unclear (Reck et al., 2018). One proposed pathway of influence is through the quality of mother–infant interactions. In this view, maternal responsiveness is at the core of these interactions, and it is an important indicator of their quality. Accordingly, a responsive mother will be able to interpret her infant's communicative cues and respond to them promptly, contingently, and appropriately (Bornstein & Tamis-LeMonda, 1989). See Section 2 for a detailed literature review of maternal responsiveness.

Maternal depression and anxiety can compromise maternal responsiveness. Withdrawn or intrusive maternal behaviours have the potential to impair a mother's ability to both interpret her infant's communicative cues and to respond to them appropriately (Ainsworth, 1979; Howard Steele, Steele, & Croft, 2008). Supporting this claim, deficits in maternal responsiveness have been associated with adverse developmental outcomes such as poorer language abilities (e.g., Hudson, Levickis, Down, Nicholls, & Wake, 2015).

These factors can be schematised in a conceptual framework of the mother–infant communication feedback loop that contains the pathway through which maternal emotional health influences infant development. This framework was developed as part of this thesis, and it is summarised in Figure 1.

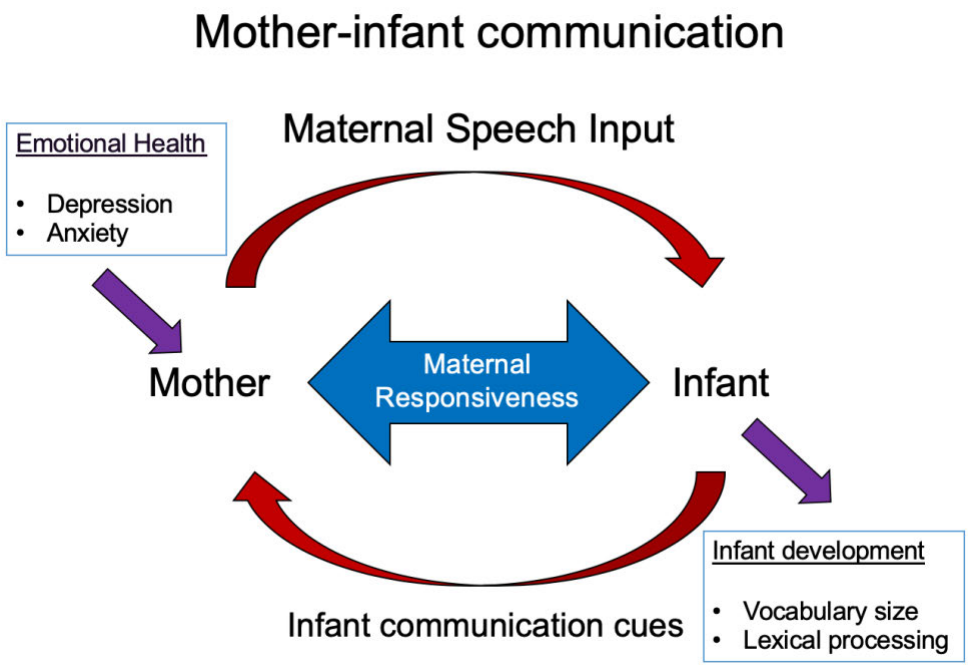

Figure 1. A conceptual framework for the mother–infant communication feedback loop, and the pathway by which emotional health influences developmental outcomes.

The majority of research examining the impact of maternal emotional health on language outcomes has involved assessments of later language abilities in preschool and

school-aged children (e.g., Milgrom, Westley & Gemmill, 2004; NICHD Early Child Care Research Network, 1999). Few studies have been dedicated to examining the impact of maternal depression and anxiety on infants' emerging language abilities, such as vocabulary size, which can be assessed already in the first years of life (Kaplan et al., 2014; Reck et al., 2018). This is despite the strong link between early vocabulary size and later language milestones and academic achievement (e.g., Morgan, Farkas, Hillemeier, Hammer & Maczuga, 2015), and the high prevalence of maternal depression and anxiety in the postnatal period (e.g., Matthey, Barnett, Howie & Kavanagh, 2003; Reck, Noe, Gerstenlauer & Stehle, 2012). In addition, a high proportion of this previous research consists of cross-sectional studies that only provide evidence about concurrent relations between maternal emotional health measures and infants' developing cognitive skills. Therefore, further longitudinal and analytical research is imperative in order to provide a comprehensive examination of the links between depression, anxiety throughout the postnatal period and infants' earliest language outcomes.

This is the primary goal of this thesis, which addresses the concerns outlined above by implementing a longitudinal study conducted across home and laboratory settings with a sample of mother–infant dyads in which the mothers were and were not affected by maternal anxiety and depression from the time when their infants were 6 months until 18 months of age. The specific aim of this thesis is to specify the processes that mediate the relation between the quality of early mother–infant interactions and infant development, and how such processes may be affected by maternal depression and/or anxiety. In addition, the efficacy of a short video feedback intervention designed to promote maternal responsiveness within mother–infant interactions, is evaluated. This latter component addresses the goal of employing the findings from this thesis to inform research-based screening techniques for the early identification of infants at risk for language delay, and of providing direction for the

design and implementation of early psychological intervention with mother–infant dyads at critical time-points in infants' development (Kingston, Tough, & Whitfield, 2012; Reck, Tietz, Müller, Seibold, & Tronick, 2018).

The remainder of this Chapter is dedicated to an examination of the previous literature concerning maternal emotional health, the quality of mother–infant interactions, and infants' emerging lexical abilities. This literature will inform the project design outlined in Chapter 2 and provides a foundation for the remainder of the thesis. The first section of the literature review provides an overview of depression and anxiety in the postnatal period, as maternal factors that influence the mother–infant feedback loop. Section 2 examines the importance of maternal responsiveness as the core construct in our conceptual framework and its role in supporting infants' language development. Section 3 examines the quantity of maternal speech input represented by the top arrow of Figure 1. Section 4, the final section of the literature review, examines infants' early lexical abilities represented as the outcome variables in our conceptual framework. In Section 5 there is an overview of the thesis and a summary of the subsequent chapters.

1.1 Maternal Emotional Health Concerns in the Postnatal Period

Infancy is frequently identified as a period during which environmental stimulation can potentially and substantially influence children's language and cognitive development (Sohr-Preston & Scaramella, 2006). Unfortunately, infancy is also a period in which there is an increased risk of emotional health concerns for mothers. In this thesis, the term 'emotional health concerns' is used to refer to the presence of clinically elevated maternal depression and/or anxiety symptomatology in the first 18 months post-partum. Depression and anxiety are the two most common mental health conditions experienced in the postnatal period (Matthey, Barnett, Howie & Kavanagh, 2003; Reck, Noe, Gerstenlauer & Stehle, 2012), and they frequently co-occur. The impact of both conditions will be examined as independent

variables in our conceptual framework linking maternal emotional health with infants' language abilities (Figure 1). Even though maternal depression and anxiety are examined in this thesis when infants were between 6 and 18 months of age, it is possible that mothers in the risk group experienced emotional health concerns from pregnancy into the first 6 months of life (Matthey et al., 2003; Reck et al., 2008). Therefore, this literature review will consider evidence of the effects that maternal emotional health concerns yield on infants' development from birth and throughout their first years of life.

1.1.1 Depression in the postnatal period.

Women who are pregnant or are new mothers have an increased risk of developing depression. Postnatal depression (PND) is not a diagnosis recognised by official classification systems such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-5: American Psychiatric Association, 2013). However, the DSM-5 includes postnatal depression as a specifier (with peri-partum onset) for Major Depressive Disorder (MDD) and persistent depressive disorders. PND is also a term that has been adopted by health professionals to describe women who are experiencing symptoms such as low mood in the postnatal period. Health professionals have noted that the symptoms of PND are similar to those of major depressive disorder (MDD), and they include loss of appetite, sleep disturbance, weight changes, loss of interest in pleasurable activities, agitation, concentration difficulties, feelings of guilt and worthlessness, and suicidal thoughts (Clay & Seehusen, 2004). In contrast to postpartum blues (a mild emotional disturbance in the first week postpartum), women who have PND appear to be at higher risk of developing episodes of depression after the postnatal period has ceased (Philipps & O'Hara, 1991).

Maternal depression in the postnatal period has been associated with infants' social, emotional, cognitive, and language development, regardless of whether it has been detected through clinical diagnosis or via self-reported measures (Gitlin & Pasnau, 1989; Murray &

Cooper, 1997). Empirical research based on clinical diagnosis of depression in the postnatal period often relies on a diagnosis of MDD as the criterion for including mothers into a depressed group to enable comparison with a control group of non-depressed mothers. A diagnosis of MDD in the postnatal period requires mothers to have experienced at least one major depressive episode that is not in response to a significant loss (e.g., a bereavement), and that occurs in the absence of a manic or hypermanic episode (American Psychiatric Association, 2013). One-quarter to one-third of women in Western Societies will experience one major depressive episode in their lifetime, and women are twice as likely as men to develop MDD. Women are most likely to be diagnosed in their twenties, and an episode will commonly co-occur within childbearing years (Sohr-Preston & Scaramella, 2006). Self-reported measures of depression symptoms are also commonly used in empirical research that examines depression in the postnatal period. In these cases, mothers' own ratings of their emotional state are used, and it allows for the inclusion of mothers who experienced more varied emotional health concerns. This approach enables not only group-level comparisons of depressed and non-depressed mothers but also the use of severity of depression symptoms as a continuous independent variable in research designs.

There is some evidence to suggest that prenatal symptoms of depression and anxiety can have a negative impact on infants' biology; for example, increases in infants' heart rate and cortisol levels (Field, 1995; Murray & Cooper, 1997). Maternal depression can also have a negative impact on the quality of the interactions that a mother has with her infant (Field, 1995). Research indicates that these effects have been found across a number of different populations. For example, aside from being widely documented across Western societies (Field, 2010), these effects have been observed in both Arabic (Eapen, Ghubash, Salem & Sabri, 2005) and Turkish (Danaci, Dinc, Devei, Sen & Icelli, 2002) cultures. In the United Kingdom, Murray and colleagues (Murray, Fiori-Cowley, Hooper & Cooper, 1996) found

that mothers with depression interacted less sensitively with their infants. In Switzerland, a study found that mothers with depression were less vocal and also smiled less when interacting with their infants as compared to controls (Righetti-Veltema, Conne-Perréard, Bousquet & Manzano, 2002).

Distinctive features of the mother–infant interaction are of particular interest to clinical practitioners as they can be predictors of developmental difficulties from a very young age (Beebe et al., 2012). Some of the maternal communication features associated with depression involve mothers communicating less frequently with their infants and with more negative affect, lower levels of responsiveness, and fewer shared behavioural states (Field, 1995; Field, Healy, Goldstein & Guthertz, 1990; Reck et al., 2004). Many studies examining mother–infant interactions have focused on infants between the ages of 3 and 6 months. The maternal play behaviours observed between these ages are proposed to provide an important context in which infants learn foundational communication skills such as turn-taking (Field, 2010).

Mother–infant dyads typically engage in play behaviour that includes vocalisation, smiling, imitation, and game playing. In these activities, mothers demonstrate sensitivity to their infants' developmental age and needs (Reissland, Shepherd & Herrera, 2003). However, mothers with depression display these behaviours less frequently when engaging with their infants (Field, 2005). The quality of speech that mothers with symptoms of depression use when addressing their infants is also different, and is characterised by less-exaggerated pitch height and range (Porritt, Zinser, Bachorowski & Kaplan, 2014), delayed response onset to their infants' vocalisations compared to mothers without depression (Bettes, 1988). Non-depressed mothers typically adjust their speech input to younger babies by shortening the mean length of their utterances, whereas mothers with depression do not make this adjustment (Reissland, Shepherd & Herrera, 2003).

Infants of mothers with depression have also been reported to vocalise less and to be less responsive compared to infants of non-depressed mothers (Field, 2002). In addition, they demonstrate less positive affect and more self-regulatory behaviours (Tronick & Reck, 2009) and go on to perform more poorly in cognitive, neuropsychological, social, and emotional domains throughout childhood and adolescence (Beck, 1998). Specifically, infants of mothers with depression have been shown to have lower expressive language skills and to obtain lower scores on measures of cognitive-linguistic functioning compared to children of non-depressed mothers. For example, the NICHD Early Child Care Research Network (1999) conducted a longitudinal study that followed mother–infant dyads between 6 and 36 months, and assessed children's language and general cognitive abilities at 36 months. After controlling for demographic risk factors, the children of mothers with chronically or occasionally elevated depression scores were found to perform more poorly than those of non-depressed mothers on measures of verbal comprehension and expressive language, and they placed lower on assessments of school readiness. Expressive language scores also were lower for the children of chronically depressed mothers when compared to children of less depressed mothers. These differences in expressive language scores were mediated by maternal sensitivity, a measure based on ratings given to mother–infant play sessions taken when infants in their sample were 6, 15, 24, and 36 months. In a similar longitudinal study, the roles of caregiving and socio-economic status (SES) were examined in relation to the influence of maternal depression and infant language development at 36 months (Stein et al., 2008). Structural equation modelling suggested that maternal depression symptoms had an indirect effect on children's language development through the quality of the mothers' early caregiving. These two large-scale longitudinal studies converge in not only demonstrating that maternal depression has an early and long-lasting effect on infants' development, but also that this relation may be mediated by the quality of mother–infant interactions.

1.1.2 Anxiety in the postnatal period.

In addition to depression, this thesis includes mothers who experience postnatal anxiety. The DSM-5 denotes several different classifications of anxiety disorder, including specific phobias, panic disorder, and generalised anxiety disorders (American Psychiatric Association, 2013). The different classifications of anxiety disorders share features of excessive fear and anxiety and related behavioural disturbance (American Psychiatric Association, 2013). Prevalence rates of anxiety disorders are comparable to rates of depression in the postnatal period, with estimates ranging from 3% to 43% in Western Societies (Kuo et al., 2004; Wenzel, Haugen, Jackson & Robinson, 2003). Nevertheless, research examining the relationship between maternal anxiety and infant development is scarce (Feldman et al., 2009; Leach et al., 2015). This is despite the high incidence of anxiety disorders among women of childbearing age (Farr, Dietz, O'Hara, Burley & Ko, 2014; Nicol-Harper, Harvey & Stein, 2007) and the awareness that anxiety disorders can result in high levels of distress and impairment in mothers' daily functioning (Barlow, 2004). The scarcity of research in this field may be related to the difficulties associated with the measurements of anxiety (including the number of different anxiety classifications) and the high levels of co-morbidity between anxiety and depression (Leach et al., 2015).

Research on the effect of maternal anxiety on mother–infant interactions has yielded inconsistent results (Kaitz & Maytal, 2005). For example, there is evidence that mothers with high levels of anxiety are less responsive and engaged with their infants (Murray, Cooper, Creswell, Schofield & Sack, 2007; Nicol-Harper et al., 2007). A recent study found maternal anxiety to be a stronger predictor than maternal depression of maladaptive mother–infant interaction patterns (Crugnola et al., 2016). In contrast, other findings demonstrate no difference in maternal sensitivity between anxious and non-anxious mothers (Murray et al., 2007) and no group differences between maternal interactive behaviours when comparing a

clinically anxious group with a non-clinical group of mothers (Reck, Tietz, Müller, Seibold & Tronick, 2018).

Studies examining the association between maternal anxiety and adverse child developmental outcomes are also inconsistent. For instance, many studies examining the impact of maternal anxiety on children, have examined *prenatal* anxiety, and results have shown an association between maternal anxiety during pregnancy with lower cognitive ability and language scores in childhood (see Van den Bergh, Mulder, Mennes and Glover, 2005 for a review). It is, however, unclear whether this effect is due to the continuous manifestation of anxiety after birth given that the majority of women who experience anxiety in the postnatal period report that the onset of their anxiety occurred in the prenatal period (Matthey et al., 2003; Reck et al., 2008). The few studies that have specifically focused on *postnatal* anxiety, however, have yielded inconsistent findings. A recent study by Reck et al. (2018) found that mothers who met the criteria for an anxiety disorder in the postnatal period had infants who scored significantly lower than controls on a standardised measure of their emerging language abilities at 12 months. This is in line with several earlier studies that have found that infants of mothers with anxiety perform poorer in cognitive tasks compared to infants of non-anxious mothers (see Glasheen et al., 2010 for a review). In contrast, a study by Keim et al. (2011) did not find a significant relationship between mothers' self-reported anxiety scores and their infants' cognitive development. Inconsistencies in these findings have been attributed to the lack of homogeneity in defining and measuring maternal anxiety and its high co-morbidity with depression (Leach et al., 2015). Postnatal depression symptoms may mask anxiety symptoms leading to heightened risk of postnatal anxiety disorders remaining undetected (Grant, McMahon & Austin, 2008; Kaitz, Maytal, Devor, Bergman & Mankuta, 2010).

It is noteworthy that the literature review so far as well as the remainder of this chapter focus solely on mothers, which overlooks the roles that early interactions with other caregivers may play in scaffolding infants' early development. It is undeniable that sensitive parenting can be provided by both mothers and fathers (Tamis-LeMonda, Baumwell, & Cristofaro, 2012). While the majority of family contexts in Western societies identify the mother as the primary caregiver there is also wide variability in family structures, and there is an increasing trend for partners to be more involved in their children's daily lives (Cabrera et al., 2004). However, this thesis focuses specifically on mother–infant interactions given that they are the subject of previous and present intervention programmes (Brady, Warren & Sterling, 2009). An in-depth discussion of this literature examining the influence of a non-depressed fathers is outside of the scope of this thesis. However, there is some suggestion that the presence of non-depressed fathers can but does not always buffer the negative effects of maternal depression on developmental outcomes for children (Mezulis, Hyde & Clark, 2004).

In summary, maternal depression and anxiety in the postnatal period are factors that can influence the quality of mother–infant interactions and the trajectory of children's cognitive development. However, there is remaining uncertainty concerning the specific mechanisms through which these factors influence infants' language abilities. One pathway through which maternal depression and anxiety symptoms may influence children's language development, is the quality of the home language environment or *maternal speech input*, which is depicted by the top arrow of the conceptual model of the mother–infant communication feedback loop (Figure 1). This includes the *quality* and *quantity* of infant-directed speech (IDS), or the special speech register that caregivers use when addressing infants. This pathway requires an appreciation for the social context in which infants learn language. This next section, therefore, reviews mother–infant interactions as an important

social context for language acquisition and explores the ways in which speech quality and quantity may be affected by maternal emotional health symptoms.

1.2 The Social Context of Language Acquisition

Language development is increasingly accepted as a product of both neurobiology and environment (Spencer et al., 2009). These factors underlie the wide variability observed in early language development. A prominent example is the case of vocabulary growth (Fenson et al., 1994). Some infants produce their first words before their first birthday, while others start to speak before their second birthday (Fenson, Marchman, Thal, Dale & Reznick, 2007). Different theories of language acquisition stress different factors as sources of the wide range of these individual differences (Rowe, 2012). An interactionist perspective holds that environmental factors are fundamental for language learning (Snow, 1972, 1994), and that while genetics contributes to individual variation (see Stromswold, 2001 for a review), environmental factors also play an important part (see Hoff, 2006 for a review). Hoff (2006) proposes that a significant portion of individual and group differences in children's language abilities can be explained by variations in environmental support through their parents, school and socio-economic status.

Social constructionist theories of language development highlight the importance of a child's social context as the most significant environmental factor influencing their language development (Vygotsky, 1962). That is, children are predisposed to use language as a communication tool, and language learning is made possible by social interaction (Kuhl, 2007). Mothers can act as mediators of language learning (Vygotsky, 1934, 1986), as the mother–infant interaction is typically the primary social context in which an infant acquires language. According to this view, the regular interactions occurring between the adult and the child form the foundation for language acquisition. In fact, this communication foundation is

built long before an infant says their first word (Golinkoff, Can, Soderstrom & Hirsh-Pasek, 2015).

Finally, the dyadic systems view of communication highlights the notion that communication does not reside in individuals but is continuously constructed by both partners in an interaction (Fogel, 1992a, 1992b). As a continually evolving dynamic, the mother–infant interaction is shaped by maternal and infant factors that form an interactive feedback loop (Kitamura, 2013; Kitamura & Burnham, 2003; Kuhl, 2007). For example, when interacting with their infants, mothers try both to maintain and to repair the flow of conversational exchanges (Golinkoff, 1986), and there is empirical evidence to demonstrate that the contingency of social responses to infants' early babbling influences their vocalisations (Goldstein, King & West, 2003; Goldstein & Schwade, 2008). Goldstein and Schwade (2008) found that 9-month-old infants produced vocalisations that were more mature and complex when their mothers responded contingently to their babbling compared to when they responded following a delay signalled by the researcher.

Indeed, infants are not passive recipients of adult language input but engage in a dyadic process of reciprocated turn-taking episodes that develop into conversations over time (Trevarthen & Aitken, 2001). Infant vocalisations, even when pre-linguistic, contribute to the framework in which they learn language (Franklin et al., 2013) and elicit immediate adult responses (e.g., Goldstein et al., 2003). Ko et al. (2016) found that the vocalisations of 12 to 30-month-old infants were more mature when the infants initiated the interaction as opposed to when they made responses within mother–initiated interaction. This suggests that infants are not merely passive listeners of language but are active agents in their interactions and language learning.

As infants begin to say their first words, typically around 12 months of age, conversational interactions continue to provide a forum for infants' developing receptive and

expressive language skills (Clark, 2009). Language acquisition is maximised when these conversational interactions with adults are congruent with the child's developmental level (Bruner, 1981; Baumwell, Tamis-LeMonda & Bornstein, 1997). The importance of the social context of language learning is illustrated in studies showing that the number of conversational turns to which children are exposed compared to the number of adult words is a stronger predictor of children's lexical abilities (Weisleder & Fernald, 2013). Children also learn more efficiently from live interactions with adults as opposed to exposure to electronic media (Kuhl, Tsao & Liu, 2003), further reinforcing the crucial role of interactions with life and responsive interlocutors.

1.2.1 Infant directed speech.

Infants' progression from non-linguistic communicators to active users of language is supported primarily through social interaction with their parents and exposure to high-quality speech input (Elsabbagh et al., 2013). As such, the social context of language learning can be optimised to support language acquisition. Mothers support their infants' communication development through the *quality* and *quantity* of their speech input (Kaplan et al., 2014), both of which can contribute positively to a rich and stimulating home language environment (Kuhl, 2004). One approach to the measurement of the quality of speech input to infants is through the examination of infant-directed speech (IDS), which is the special speech register that caregivers use when speaking to infants. It is this speech register that is hypothesised to provide a rich environment for language learning for young infants (Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015). It also has the potential to contribute to the pathway through which maternal depression influences child language outcomes (Kaplan et al., 2014), especially given that qualitative differences have been observed in the IDS produced by mothers with depression compared to the IDS by non-depressed mothers (e.g., Bettes, 1988; Porritt et al., 2014).

Compared to adult-directed speech (ADS), IDS features include: exaggerated pitch height and range (Fernald et al., 1989), slower speech rate (Panneton, Kitamura, Mattock, & Burnham, 2006), simplified grammatical structure (Soderstrom, 2007), higher levels of positive affect (Kitamura & Burnham, 2003; Singh, Morgan, & Best, 2002), longer vowels and pauses (Andruski & Kuhl, 1997), increased repetition (Fernald & Simon, 1984), greater variations in fundamental frequency (McRoberts & Best, 1997), and acoustic exaggeration of speech sounds (Burnham, Kitamura, & Vollmer-Conna, 2002; Kalashnikova, Carignan, & Burnham, 2017; Kuhl et al., 1997). IDS is also characterised by exaggerated facial expressions such as raised eyebrows, eye widening, and smiles (Chong, Werker, Russell, & Carroll, 2003; Kitamura, Guellaï, & Kim, 2014; Werker & McLeod, 1989). It has been proposed that IDS is a reflexive, instinctive, and unconscious speech behaviour that mothers produce when they are in the presence of their infant (Papousek, Papousek, & Bornstein, 1985). This is supported by research demonstrating the difficulty that adults have in reproducing IDS features in the absence of an infant (Fernald & Simon, 1984).

Importantly, the specific characteristics of IDS mentioned above have been proposed to serve the function of facilitating early language acquisition. The acoustic correlates of positive affect in IDS have been proposed to facilitate the learning process by attracting and maintaining infants' attention to speech (Cooper & Aslin, 1990; Kitamura & Burnham, 2003) and facilitating the neural processes involved in encoding the information in their speech input (Kalashnikova, Peter, Liberto, Lalor & Burnham, 2018).

These properties of IDS are manifested differently in speech produced by mothers with depression. Mothers with depression tend to produce IDS with more negative affect (Field, 1995; Reck et al., 2004), less exaggerated pitch height and range (Porritt et al., 2014), and lower pitch modulation (Bettes, 1988; Kaplan, Bachorowski, Smoski & Hudenko, 2002; Zlochower & Cohn, 1996). A study by Bettes (1988) examined the IDS to 3- and 4-month-

old infants born to mothers with mild to moderate scores on the Beck Depression Inventory (BDI). Analysis of maternal speech segments revealed that, compared to mothers with fewer depression symptoms (BDI<10), mothers with more depressive symptoms (BDI>10) demonstrated flatter pitch contours, i.e. reduced modulation in their fundamental frequency contours. They also provided fewer vocalisations in response to their infants' vocalisations, and there was greater variability in these mothers' responses with regard to response latency and pauses between vocalisations.

More recent work by Kaplan and colleagues also links maternal depression with the quality of maternal IDS and infants' performance in associative learning tasks. For example, in a series of experiments using a conditioned-attention paradigm, IDS was initially identified as serving as a priming stimulus that facilitated associative learning (Kaplan et al., 1996). In a later study, Kaplan, Bachorowski & Zarlengo-Strouse (1999) found that the IDS produced by mothers with depression was less effective at promoting associative learning. That is, the more flattened IDS produced by depressed mothers was less effective at promoting basic learning for infants, such as when infants were required to learn associations between a face and a voice. Initially, this weakened learning-promoting effect for infants only occurred in response to IDS produced by mothers with depression, i.e. the infant's own mother or an unfamiliar depressed mother. However, older infants who had been exposed to this type of IDS for a longer period of time also demonstrated poorer learning in response to IDS produced by mothers without depression (Kaplan, Dungan & Zinser, 2004). This reduction in the ability to benefit from the learning-promoting effects of IDS from non-depressed mothers suggests that infants have an experience-based change in their responsiveness to maternal IDS, which may alter their ability to learn from IDS cues from adults who are not impacted by emotional health concerns.

In comparison to studies assessing the *quality* of IDS by depressed mothers, research examining the *quantity* of IDS in this population has been scarce. The next section will provide an examination of the amount of IDS available to infants as a potential mediator of the relationship between depression and anxiety and infants' language outcomes.

1.2.2 The quantity of speech input.

The quantity of speech input to infants has been shown to impact their cognitive and emotional development (Hart & Risley, 1995, 1999; Landry et al., 2001). In their landmark study, Hart and Risley (1995) found that parents from higher SES backgrounds spoke more to their children using a greater variety of words compared to parents with lower SES. This difference was estimated to equate to as much as 30 million words by the time the child reaches 3 years of age. This variability can in turn predict their vocabulary growth (Hart & Risley, 1995), language skills (Hart & Risley, 2003), academic performance at primary school (Walker, Greenwood, Hart & Carta, 1994), and lexical processing and vocabulary size (Ramírez-Esparza, García-Sierra & Kuhl, 2014). In short, mothers who speak more to their infants tend to have infants who also speak more and who later develop more advanced language abilities (Paavola, Kunnari, Moilanen, & Lehtihalmes, 2005).

Recent technological advances have allowed researchers to obtain direct measures of children's language environments through day long home recordings. The most widely used system in this field is the Language Environment Analysis (LENA*)* system (LENA Foundation, 2009). The LENA system is comprised of a digital language processor (DLP) that is contained in a custom-made piece of clothing worn by the child. It records all sounds produced within 2 metres around the infant for up to 16 hours of continuous recording in a day. Its accompanying software then generates automatic counts of the number of adult words, conversational turns and child vocalisations. This has enabled researchers to examine

the language-learning environments of children in a time-efficient manner to explore the environmental factors that affect differences in children's language abilities.

Weisleder and Fernald (2013) used the LENA system to investigate the relation between children's home language environment and their emerging lexical processing abilities. Families from low and high SES backgrounds were recorded at home over an 11- hour period, and automatic counts of the number of adult words and child words were generated. Later, in a laboratory visit, infant's language processing efficiency was measured using a looking-while-listening task, which yielded individual indices of accuracy and latency of familiar word recognition (see Fernald, Zangl, Portillo, & Marchman, 2008). Results showed differences between SES groups already emerging at 18-months in both vocabulary development and language processing efficiency. In addition, the effect of the amount of speech input on expressive vocabulary was mediated by language processing efficiency. These findings suggest that experiential differences in infants' language experience, including the quantity of their speech input, may contribute to differences in children's early language abilities.

A recent study investigated the home language environments of 109 families using the LENA system (d'Apice, Latham, & von Stumm, 2019). LENA recorders were worn by 2- to 4-year-old children on three different days. In addition to the automatic measures generated by the LENA software, researchers transcribed 6 five-minute excerpts from the recordings and found that the total number of words that children heard over the course of the day, together with the lexical diversity of their parents' language input, was positively associated with children's lexical diversity and cognitive abilities. This finding is congruent with a study by Zimmerman et al. (2009) who sampled the home language environments of 275 families with children aged 2 to 24 months. They obtained 12-hour recordings on a monthly basis for 6 months and found a significant relationship between the number of adult words across the day long recording and children's language. That is, increases in the amount of adult speech

was associated with increases in children's language skills as assessed by the Preschool Language Scale (PLS-4: Zimmerman, Steiner & Pond, 2002).

In contrast to these findings, a study examining the home language environments of toddlers aged 12 to 20 months did not find an association between adult word count measures and toddlers vocabulary size (Greenwood, Thiemann-Bourque, Walker, Buzhardt & Gilkerson, 2011). Similarly, recordings obtained in a 3-year longitudinal study with 108 infants – starting when they were 14 months of age and repeated annually – did not find a link between the number of words mothers used and their children's vocabulary growth (Pan, Rowe, Spier & Tamis-Lemonda, 2004). These findings suggest that other factors in children's language environment, such as the number of conversational turns may be contributing to individual variations in vocabulary size.

While the quantity of adult words has been examined in detail in relation to SES, this variation in children's language environments has not been investigated in relation to maternal depression and anxiety. However, analyses of mother–infant interactions in laboratory settings have shown that mothers with depressive disorders produce a reduced speech rate (Teasdale, Fogarty & Williams, 1980) and shorter MLU (Reck et al., 2004), suggesting that the overall quantity of speech produced by depressed mothers could also be reduced. However, this has not been investigated directly. Examination of the quantity of maternal speech input and conversational turn counts is relevant to this thesis. As depression has been associated with withdrawn interactive behaviours, it is predicted that the severity of maternal emotional health symptoms will be related to reduced numbers of adult words and conversational turn counts in children's environments. It is also predicted that in turn, the volume of adult words and conversational turns will have a negative impact on infants' emerging language abilities.

1.2.1.3 Adult–child conversational turns.

A conversational turn is counted by the LENA system when an adult vocalisation occurs within five seconds of a child vocalisation and vice versa (Ford, Baer, Xu, Yapanel & Gray, 2008). Recent empirical evidence suggests that the volume of parent–child conversational turn counts plays a larger predictive role in supporting children's language and cognitive development than does the number of adult words. Gilkerson et al. (2018), for example, obtained day long audio recordings from 146 infants (aged 2 to 47 months) each month during a 6-month period. During follow-up evaluations when the children were 9–14 years of age, the number of adult–infant conversational turns at 18–24 months accounted for 14–27% of variance in their vocabulary, verbal comprehension, and IQ. The number of adult words also correlated with language outcomes, but this relation was weaker after controlling for families' SES. In addition, Romeo et al. (2018) found that conversational turn counts mediated the relationship between SES and the verbal ability of 4-6-year-old children. By using functional magnetic resonance imaging techniques, their study was the first to show that conversational turns, and not adult words, predicted activation in language-related brain regions in young children. These findings suggest that an important factor in accounting for disparities in children's language abilities relates to conversational turn counts, in addition to the number of adult words.

1.3.1.4 The volume of infant vocalisations.

Conversational turns, as defined above, typically are comprised of adult and infant vocalisations. While adult words have been quantified extensively and shown to relate to language outcomes in the infant, infant vocalisations have received less attention. This may be due to studies that have not found an association between the children's vocalisation count in day-to-day interactions and their later language ability (e.g., Dwyer, 2017). However, the number of infant vocalisations could be different in infants of depressed mothers. Infant vocalisations serve a social function since infants as young as 5 months appear to learn that

their vocalisations can elicit social responses from adults (Goldstein, Schwade & Bornstein, 2009), and infant vocalisations, in turn, are influenced by how mothers respond to them. Goldstein et al. (2003) found that mothers' contingent responses to their 8-month-old infants elicited an increase in the number of their infants' vocalisations. Contingency in mother–infant interactions can be disrupted in maternal depression, which may result in a reduction in infant vocalisations. For example, a study by Bettes (1988) examining IDS to 3- to 4-month-old infants found that mothers with higher levels of depression provided fewer vocalisations in response to their infants' vocalisations and demonstrated greater variability in their responses with regard to response latency and pauses between vocalisations. These deficits in mother–infant interactions, could contribute to changes in the vocalisation quantity in cases of infants with mothers experiencing symptoms of depression (Field, 2002). This hypothesis is supported by research involving preschool children (2.5–3.5 years), whereby children who had mothers with depression spoke less than children of non-depressed mothers (Breznitz & Sherman, 1987). This raises the question of whether infants who have mothers with depression vocalise less in their day-to-day interactions, and if so, whether this predicts their later language outcomes. These questions will be examined in more detail in Chapter 3.

Previous research examining infants' early home language environments has focused primarily on toddlers in the second and third years of life (Gilkerson et al., 2018). However, attention to the first year of life is required given the mounting evidence that this time is crucial for language acquisition, especially to early phonological development (Werker, 2018) and word-learning processes (Hollich et al., 2000). A recent longitudinal study conducted in Australia examined the relationship between maternal education and the early language environments of 50 families when the infants were aged 6 to 9 months and 12 to15 months (Dwyer, Jones, Davis, Kitamura & Ching, 2019). They found a relationship between maternal education and the quantity of adult words and conversational turns. There was no

link, however, between the quantity of infant vocalisation counts and maternal education. Conversational turn count was the only LENA variable that predicted infants' later vocabulary size (Dwyer, 2017). While SES differences have been examined in this young age group, the impact of maternal depression and anxiety on the *quantity* of maternal speech input during their first year of life remains unexplored.

In summary, the social context of communication is important in providing infants with a rich language-learning environment, which includes high *quality* and *quantity* of speech input and conversational turns. The question remains, however, as to whether or not the language environments and volume of vocalisations are different in mother–infant dyads affected by depression and anxiety symptoms compared to those who are not affected. It is also unknown whether any differences in day-to-day interactions would in turn impact infants' emerging language abilities. To further address these questions, we consider the role of maternal responsiveness as a significant predictor of early language development, which can be impacted directly by maternal health concerns in the postnatal period.

1.3 Maternal Responsiveness

1.3.1 Parenting sensitivity.

A growing body of research indicates that a highly sensitive and responsive parenting style provides numerous benefits for children in terms of their linguistic, cognitive, and social-emotional development (Landry, Smith, Swank, Assel & Vellet, 2001; Tamis-LeMonda et al., 2001). Sensitive parenting in infancy provides a vital foundation for children's rapidly emerging language abilities (Tamis-LeMonda & Baumwell, 2010). Parental sensitivity is also related to a number of variables, including maternal emotional health, which can enhance or diminish the quality of the parent–child interaction. Despite its utility as a predictor of important developmental outcomes, the way in which the different

components of parental sensitivity relate to each other remains poorly understood (Bornstein, Tamis-LeMonda, Hahn & Haynes, 2008).

This section discusses the history, definition, and theoretical framework for understanding the effects of maternal responsiveness on child development. This is followed by a selective review of the research that demonstrates a relationship between maternal responsiveness and child development, specifically language development outcomes.

1.3.2 Attachment theory.

Maternal sensitivity is defined as a mother's ability to perceive and accurately interpret her infant's signals and communicative actions and to respond to them in an appropriate way (Ainsworth, Blehar, Waters & Wall, 1978; Shin, Park & Kim, 2006). The term 'maternal sensitivity' was coined by Ainsworth et al. (1978), who focused on the interactions between mothers and young infants. The work of Ainsworth et al. (1978) focused on infants and their parents and arose from Bowlby's (1969) theoretical framework of attachment. Attachment theory posits that the emotional connection, or the affective bond, between a mother and her child is primarily formed in the first year of life in the context of the mother–infant interaction (Beebe et al., 2010; Bowlby, 1969; Schore, 2001, 2003). In her foundational work with Ugandan mothers and infants, Ainsworth (1967) demonstrated that maternal sensitivity is positively correlated with secure attachment in infants. In her later research with North American mother–infant dyads, Ainsworth identified three styles of attachment: secure, insecure-avoidant, and insecure-resistant.(Ainsworth, Blehar, Waters & Wall, 1978). Main and Solomon (1986) discovered a fourth attachment category, referred to as insecure-disorganised/disoriented.

Maternal sensitivity is a strong predictor of children's attachment style, and it is considered to be a key indicator of the quality of the mother–infant interaction (Crittenden & Bonvillian, 1984). An infant who has an emotionally available and sensitive mother is likely

to develop a secure attachment style, and in turn anticipate appropriate responses to their communication cues. A mother who exhibits greater maternal sensitivity has the ability to see things from her infant's point of view and therefore read her infants' communication skills and respond to them appropriately, promptly, and effectively (Ainsworth, Bell & Stayton, 1974; Bornstein, 1989). The infant's expectancies of their mother's sensitivity in turn influence their social and emotional development (Bowlby, 1969; Steele, Steele, Croft & Fonagy, 1999).

In the past few decades, researchers examining mother–infant interactions and child development have expanded the parameters of Ainsworth's original definition and uses of the concept of maternal sensitivity (Massouda, Davis & Logsdon, 2011). Accordingly, studies examining the construct of maternal sensitivity can be found in research that looks beyond the first year of life in other theoretical frameworks including social-cultural (Vygotsky, 1978) and the socialisation of young children (Grusec & Goodnow, 1994). The clinical implications of maternal sensitivity research have been considered across multiple disciplines such as nursing, psychology, social work, and education. As a result, maternal sensitivity has been defined and studied in different ways by different researchers, making the synthesis of the literature and comparison across studies challenging (Warren & Brady, 2007). For example, a variety of terms have been used to describe sensitive parenting, and new definitions are still being compiled (Winders Davis & Logsdon, 2010; Shin, Park, Ryu & Seomun, 2008). The term maternal sensitivity has often been used interchangeably with similar terms such as maternal responsiveness (Paavola, Kunnari, Moilanen & Lehtihalmes, 2005) and maternal competency (Pauli–Pott, Mertesacker & Beckmann, 2004).

Evidence suggests that regardless of the term used to describe maternal responsiveness, its definition must include the *contingency* of a mother's response to her infant as this is an important predictor of several child development outcomes, including

language acquisition, cognitive development, social relationships, and emotional security (Bornstein et al., 2008). The majority of research studies examining maternal responsiveness either implicitly or explicitly highlight the importance of maternal responses that are contingent or linked conceptually and temporally to changes in the infant's behaviour (Tamis-LeMonda & Baumwell, 2010). Some researchers have reported a curvilinear relationship between contingent maternal behaviours and child outcomes whereby high as well as low levels of contingency may be inappropriate (Jaffe et al., 2001). The inclusion of 'contingency' in any definition of maternal responsiveness, therefore, is important as it highlights the fact that responsiveness occurs in the context of a bidirectional and reciprocal process (Maccoby, 2007).

Maternal responsiveness is a broad and multi-level construct that can operate at different levels of analysis. Warren and Brady (2007) describe three levels of maternal responsiveness: general, molar, and molecular. *General responsiveness* refers to a mother's response to her infant's basic biological and welfare needs such as food and clothing. *Molar responsiveness* refers to a mother's appropriate response to her infant's developmental needs. For example, measurements of responsiveness at this level include rating scales of a mother's warmth or positive affect towards her infant (Landry, Smith, Swank & Guttentag, 2008) Finally, *molecular responsiveness* refers to maternal responses that occur in response to changes in an infant's behaviour including cases when the mother speaks to the infant following his or her vocalisation. While general responsiveness is important for child welfare, the research studies examining child language development to date have tended to concentrate on the latter two levels. As mother–infant interaction is the focus of this thesis, the term maternal responsiveness will be used for its remainder in reference to the molecular level. At the *molecular* level, responsiveness refers to maternal behaviour that is contingent,

follows rather than re-directs and build's on the infants' focus of attention and activity (Spiker, Boyce & Boyce, 2002).

1.3.3 A social interactionist perspective of development.

The transactional model of development provides a theoretical framework for the understanding of the critical role that maternal responsiveness plays in children's development (Sameroff & Chandler, 1975). This transactional model proposes that the relation between children and their environment is bi-directional (Sameroff & Mackenzie, 2003). This model posits that early language development is facilitated through a cumulative process of reciprocal interactions between infants and their caregivers (Hoff, 2013). This process becomes increasingly bi-directional during infants' first months and years of life. Responsive parenting is evident in a mother's adjustment to her child's emerging language skills, as she changes her behaviour in ways that further support or scaffold the language development of her child. As a mother supports her infant's exploration and engagement with their environment, maternal responsiveness operates through the reciprocal adjustment process described in the transactional model, impacting significantly on child language, cognitive development, and attachment style (Landry, Smith, Swank & Miller-Loncar, 2000; Wolff & Ijzendoorn, 1997).

While the mother–infant interaction is a dyadic process, it is generally considered to be the mother's responsibility to establish and monitor attunement within the interaction (Beckwith, Rozga, & Sigman, 2002). The maternal contribution within mother–infant interactions is also the vehicle for interventions aimed to optimise well-being within the relationship (Brady et al., 2009). Maternal responsiveness highlights the mother's contribution to the interaction with her infant as the keystone parent component in a three-stage sequence of communication: child action – parent reaction – effect on the child (Bornstein, Tamis-Lemonda, Hahn & Haynes, 2008). In this system a mother's response is

considered to be *contingent* when it is conceptually linked to her infant's proceeding action (e.g., saying 'doll' after her infant looks at the doll). Her response is considered *prompt* when given within several seconds of a change in her child's behaviour (Brady et al., 2009). Finally, a mother's response is considered *appropriate* if presented in a way that is conceptually and positively linked to the child's behaviour. A response from a mother that is constructive, warm, and positive as opposed to critical or negative will be considered appropriate (Tamis-LeMonda & Baumwell, 2010).

All these three aspects of mothers' responses – contingency, promptness, and appropriateness – are at the core of maternal responsiveness (Tamis-LeMonda & Bornstein, 2002). Mothers who are highly responsive will be sensitive to their infants' cues and respond to them reasonably quickly while establishing clear contingency and in ways that are well matched to their infants' developmental level (Crockenberg & Leerkes, 2011). Mothers who respond contingently, promptly, and appropriately to their infants will help to facilitate secure attachment, self-efficacy and motivation in their children (Ainsworth et al., 1974; Bornstein et al., 1992; Skinner, 1986). Children of highly responsive mothers also tend to have greater language abilities, including receptive (Hann, Osofsky & Culp, 1996) and expressive language skills (Tamis-LeMonda, Damast, Baumwell & Bornstein, 1996).

On the other hand, a mother who scores relatively low on a measure of maternal responsiveness may display inadequate timing in interactions with her infant, and/or withdrawn or intrusive behaviours such as over-structuring, over-directing, or over-stimulating her infant (Biringen, Emde, Brown, Lowe, Myers & Nelson, 2000). That is, her responses are less likely to be timely, contingent on her infant's behaviour, or sensitive to the child's developmental needs. A mother who exhibits lower maternal responsiveness is unlikely to take her infant's perspective, but will rather respond to her infant on the basis of other determinants such as her own desires, mental state, and thoughts about her infant's

needs (Koren-Karie, Oppenheim, Dolev, Sher & Etzion-Carasso, 2002). A mother's responsiveness to her infant, therefore, has a crucial role in infant development, and it is one of the most important predictors of secure mother–infant attachment and developmental outcomes such as language ability (Ijzendoorn et al., 2007).

1.3.4 Links between maternal responsiveness and language development.

There is an association between maternal responsiveness measured in the first years of life and children's receptive (Hann et al., 1996) and expressive language skills (Hudson, Levickis, Down, Nicholls, & Wake, 2015). In an Australian population-based study, Hudson et al. (2015) examined the relationship of maternal responsiveness and language abilities of recruited 'slow-to-talk' toddlers. At 2 years of age, toddlers and their mothers participated in a 15-minute play session that was rated for maternal responsiveness using a five-point global rating scale (1 = very low; 5 = very high). Expressive and receptive Language skills were measured at 3 and 4 years using standardised assessment tools, with maternal responsiveness strongly predicting receptive, expressive, and total language standard scores at both 3 and 4 years.

There is also evidence that maternal responsiveness has a role in predicting the age at which children achieve language milestones. In a prospective longitudinal study, Tamis-LeMonda et al. (2001) examined maternal responsiveness in mother–infant dyads (N = 40) in relation to the timing when five expressive language milestones are achieved: first imitations, first spontaneous words, achievement of 50-word expressive vocabulary size, combinatorial speech, and the ability to use language to refer to the past. In normally-developing children, these milestones usually emerge in succession and are considered as marking important achievements in infants' language and cognitive abilities (Fenson et al., 1994; Tamis-Lemonda, Bornstein, Kahana-Kalman, Baumwell & Cyphers, 1998). Maternal

responsiveness at both 9 and 13 months predicted all five language-acquisition milestones. Maternal responsiveness at 13 months was a stronger predictor of language milestones when compared with maternal responsiveness scores at 9 months. Therefore, this research suggests that the *quality* of mother–infant interactions, measured by maternal responsiveness, supports and scaffolds language acquisition in young children.

1.3.5 Pathways through which maternal responsiveness supports language acquisition.

Tamis-LeMonda and Bornstein (2002) proposed four primary ways in which responsive mothers support language acquisition: (1) through the prompt timing of their responses; (2) by fostering secondary intersubjectivity; (3) by establishing topics of communication; and (4) by fostering secure attachment.

Temporal contingency is a crucial component of maternal responsiveness (Tamis-LeMonda, Kuchirko, & Song, 2014). It has been proposed that the temporal contingency of a mother's response to her infant's communication cues support language acquisition, specifically vocabulary building as they can help the infant to make associations between languages and objects and therefore map words to objects (Plunkett, 1997). For these mapping to form, a word and a referent need to co-occur within a brief period of time, or time window. Infants have a strong dependency on such time windows as their linguistic knowledge and associative networks are at a formative stage (Rovee-Collier, 1995), and contingent parental responses during interactions provide infants with new labels within these key windows. Another explanation for the role of temporal contingency relates to perceptual salience, which is fundamental to early word learning (Hollich et al., 2000). Sensitivity to her infant's cues and a prompt response to them requires a mother to match her verbal input to changes in her infant's focus of attention and the object or event that the infant considers to be salient.

The emergence of intersubjectivity around 9 months of age refers to an infant's appreciation that meanings can be shared with others, and dyadic interactions may involve references to events and objects external to the mother–infant dyad (Tamis-LeMonda & Bornstein, 2002; Trevarthen & Aitken, 2001). Around this age, infants rely less on their own direct unmediated experience and more on the knowledge and social information provided by adults in their environment. They will, for example, follow an adult's eye gaze and imitate what an adult does with novel objects in order to capitalise on adult knowledge (Moore & Corkum, 1994). These infant behaviours expand the possibilities for learning, and mother–infant interactions become increasingly triadic at the end of the first year of life. These social referential skills continue to evolve in the second year as infants become more adept at using social cues (Baldwin & Moses, 1996). Tamis-LeMonda and Bornstein (2002) propose that maternal responsiveness fosters infants' secondary intersubjectivity by reinforcing the social and communicative functions of language, which may indirectly facilitate language development. Maternal responsiveness requires a mother to be attuned to her infant's communication cues, emotions, interests, and intentions. Doing so reinforces the intersubjective nature of experiences and illuminates the mother's role as an interpreter of a shared world (Nicely, Tamis-LeMonda, & Bornstein, 1999).

In addition to establishing topics of conversation between a mother and her infant, responsiveness can optimise language learning through joint attention (Bloom, 1993). That is, a responsive mother recognises the focus of her infant's attention and then responds by providing word labels. In this way, the mother creates an optimal environment for language learning, guiding the infant to match a linguistic symbol to its visual referent (Bloom 1993; Tamis-LeMonda et al., 2001), thus increasing the probability that they will make a connection between the two. This suggests that infants are better able to acquire new

linguistic information when it refers to the target of joint attention by both the mother and the infant.

Maternal responsiveness is important in the development of secure attachment in infants (Ainsworth et al., 1974; Skinner, 1986). Responsiveness may indirectly affect children's language development by fostering secure attachment, which in turn supports children's motivation, exploration and information-seeking behaviours (Tamis-LeMonda & Bornstein, 2002). Securely attached children develop both self-efficacy and motivation, which is reflected in task-directed and persistent exploratory styles that may contribute to language learning (Belsky, Garduque & Hrncir, 1984). Secure attachment may also provide a context through which children are able to better learn language from their caregivers (see Section 2.2. and Appendix L for additional information regarding attachment theory and the links with secure attachment and child developmental outcomes).

In summary, maternal responsiveness is at the core of mother–infant interactions and has been linked with children's language abilities. As depicted in our conceptual framework of the mother–infant feedback loop, the quality of mother–infant interactions can be influenced by maternal factors. The next section discussed the influence that mothers' depression and anxiety can have on the quality of their interactions with their infants.

1.3.6 Maternal responsiveness and maternal emotional health concerns.

The quality of mother–infant interactions can be disrupted by maternal depression and anxiety symptoms. Depression symptoms can negatively impact a mother's degree of responsiveness to her infant and indirectly compromise child developmental outcomes (Giallo, Treyvaud, Cooklin & Wade, 2012). The positive association between maternal depression and adverse child developmental outcomes has been explained by the potentially negative impact of depression on a mother's ability to respond sensitively to her infant's

needs or communication cues (Field, 1998; Van Doesum, Hosman & Riksen-Walraven, 2005). Two primary behavioural styles have been observed in depressed mothers as they interact with their infants: (1) an intrusive or over-stimulating behavioural style, and (2) withdrawn or under-stimulating style (Malphurs, Raag, Field, Pickens & Pelaez-Nogueras, 1996). Both interaction styles have the potential to compromise the contingency, promptness, and appropriateness of maternal responses. It is this potential disruption to the quality of the mother–infant interaction, rather than the depression itself, that is used to explain adverse child developmental outcomes (Huang, Lewin, Mitchell & Zhang, 2012). In fact, maternal depression has been the most commonly cited factor that adversely impacts maternal sensitivity (Appelbaum et al., 1999; Lovejoy, Graczyk, O'Hare & Neuman, 2000). However, while this association has been made, care needs to be exercised when investigating the influence of maternal emotional health concerns on early infants' cognitive and emotional development, to avoid negative feelings such as guilt and pressure for mothers who may already be experiencing negative emotional symptoms.

The positive association between maternal depression and lower levels of maternal responsiveness has been observed in both longitudinal and cross-sectional studies. Campbell et al. (Campbell, Matestic, von Stauffenberg, Mohan & Kirchner, 2007) followed over 1000 children and their families from the infant age of 1 month through to school entry, examining the trajectory of maternal depression symptoms, maternal sensitivity, and child outcomes. Maternal sensitivity ratings based on mother–child interactions were high when depression symptoms were low. Conversely, maternal sensitivity was low when maternal depression symptoms were high.

The qualities of mother–infant interactions in relation to maternal anxiety is less often studied than maternal depression; however, interactive difficulties have been observed in dyads with anxious mothers (Müller, Zietlow, Tronick & Reck, 2015). For example, there is

evidence that mothers with high anxiety have diminished perception (Blank, Schroeder & Flynn, 1995; Shin et al., 2008) and are less responsive to and engaged with their infants (Murray, Cooper, Creswell, Schofield & Sack, 2007; Nicol-Harper et al., 2007). Nicole-Harper et al. (2007) conducted a study examining maternal anxiety and found that mothers with high levels of anxiety engaged with their 10- to 14-month-old infants using less sensitive and emotional vocalisations. In another study, Field at al. (2005) assessed the anxiety and anger levels of mothers with depression. They found that mothers with higher scores on the State-Trait Anxiety Inventory (Spielberger, Gorsuch & Lushene, 1970) were more intrusive and interacted less sensitively with their 3-month-old infants compared to controls. Finally, Stein et al. (2012) examined mother–infant interactions with mothers who met the criteria for generalised anxiety disorder (GAD) in the first 6 months postpartum. They found that worry and rumination in mothers diagnosed with GAD (versus controls) was associated with lower responsiveness and vocalisations to 10-month-old infant vocalisations.

In summary, the literature underlines the important role that the quality of mother–infant interactions plays in supporting language acquisition. Maternal responsiveness, which lies at the core of mother–infant interactions, can be affected negatively by depression and anxiety symptoms, thus accounting for the negative effects of maternal emotional health and children's language abilities. The next section examines the literature that pertains to infants' emerging lexical abilities, which serve as the outcome language development measures examined in this thesis.

1.4 Early Language Acquisition

The literature review so far has described depression and anxiety as maternal factors that influence the conceptual framework depicted in Figure 1. We have also discussed the importance of maternal responsiveness as the core of the mother–infant feedback loop, and a construct that can be compromised by maternal depression and anxiety symptoms. In

addition, we have examined the quantity of speech input represented by the top arrow (maternal speech input) of the mother–infant feedback loop, which may function as another pathway through which maternal emotional health could impact infants' developmental trajectory. In this final section of the literature review, we examine infants' early lexical abilities, as the outcome variables in our conceptual framework. Empirical evidence to date has linked maternal depression and anxiety with the language abilities of older children, but studies examining infants' emerging lexical abilities are scarce. The following section, therefore, provides a brief overview of language acquisition in the first 18 months of life. This includes the foundational processes that emerge during infancy through language exposure, and the potential relation between these processes and mothers' emotional health during the postnatal period.

1.4.1 Early speech perception in infancy.

Infants' exposure to their language environment commences before they are born. The human foetus is sensitive to environmental auditory information, albeit mainly low-frequency components, from the beginning of the third trimester of pregnancy. Accordingly, newborns demonstrate a preference for their native languages sharing the same rhythmic qualities (Nazzi, Bertoncini & Mehler, 1998), and they also recognise and prefer their mother's voice over other female voices (Decasper & Fifer, 1980; Mehler, Bertoncini, Barriere & Jassik Gerschenfeld, 1978). Through exposure to mothers' language input, infants become increasingly sensitive to the prosodic information of their native language. This early speech input to infants shapes their speech perception and the process of attuning to the speech sounds of their native language (Kuhl, 2000).

Newborns are also able to discriminate most consonant and vowel contrasts, regardless of whether those sounds belong to their native language environment (e.g., Aslin, Jusczyk & Pisoni, 1998; Burnham, 1986; Werker & Tees, 1999). Between 4 and 11 months

of age, a process of perceptual reorganisation takes place, whereby an infant's attention and, therefore, their sensitivity to most non-native contrasts decreases, while sensitivity to native contrasts is maintained or even increases in some cases (Werker & Lalonde, 1988). Accordingly, at 11 months of age, infants no longer easily discriminate most phonetic contrasts that are not native to their language (Best et al., 1995), and this decreasing sensitivity to non-native contrasts is a significant predictor of later language development (Kuhl, 2000). This finding is relevant to language acquisition as there is a positive association between infants' performance in native and non-native speech discrimination tasks with their later word-learning abilities (Tsao, Liu & Kuhl, 2004).

Variations in language experience associated with maternal depression appear to influence children's language outcomes and potentially the processes that accompany language acquisition. For example, there is some evidence that maternal depression and/or treatment with serotonin reuptake inhibitors (SSRIs) alters the trajectory of perceptual attunement (Weikum, Oberlander, Hensch, & Werker, 2012). Weikum et al. (2012) found, in contrast to the usual developmental trajectory, that infants of mothers with depression demonstrated poor discrimination between non-native phonetic contrasts at 6 months but demonstrated better-than-average discrimination of non-native contrasts at 10 months. In contrast, mothers with depression who were prescribed antidepressant medication (SSRIs) during pregnancy had infants who demonstrated attunement to the phonetic contrasts in their native language, possibly due to a neurochemical acceleration of their brain development (Weikum et al., 2012). This highlights the potential impact of maternal depression and possible treatment with SSRIs, on the foundational perceptual processes associated with language acquisition.

Maternal depression and anxiety have also been associated with lower vocabulary sizes at 12 months. Kaplan et al. (2014) found a significant negative correlation between self-

reported maternal depression scores and 12-month-old infants' percentile scores on the Bayley Expressive Communication subscale but not the general cognitive and receptive communication subscales of the Bayley-III (Bayley, 2006). A similar study focusing on maternal anxiety examined the emerging language abilities of 12-month-old infants with mothers who met the criteria for an anxiety disorder in the postnatal period (Reck et al., 2018). This study showed that infants scored significantly lower than controls in the language subtests of the Bayley-III (Bayley, 2006). Taken together, the research reviewed above suggests that the onset of language delay in the children of depressed and/or anxious mothers may commence quite early during infancy and be reflected in infants' early pre-lexical and lexical skills.

1.4.2 Infant vocalisations and early lexical abilities.

Infant vocalisations are initially constrained by the anatomical structure of their vocal tract. A newborn baby typically produces vocal sounds that are limited to crying and vegetative sounds such as burping, spitting, and swallowing (Stark, 1986). By the time a child reaches 8 weeks of age, they are able to produce cooing and laughter sounds. This is followed by babbling, the production of rhythmic consonant–vowel syllables (Oller, 1980). Infants experiment with producing different sound patterns through babbling and imitation, which provides them with the phonetic prerequisites for later word production (McCune & Vihman, 2001). Speech production plays an important role in infants' early word learning, and it is related to their speech perception skills (e.g., DePaolis, Vihman & Keren-Portnoy, 2011; Majorano, Vihman & DePaolis, 2014). For example, there is a reciprocal relationship between an infant's speech-production patterns and the speech input to which they are exposed. That is, speech production affects the way in which a child listens to speech (DePaolis et al., 2011), and lexical input affects the accuracy of their production (Ota & Green, 2013). This again highlights the importance of high-quality speech input in promoting

a rich language-learning environment and assisting infants in achieving early language milestones.

There is evidence to suggest that before an infant has produced their first word, their vocalisations serve a social function. For example, infants as young as 5 months of age appear to learn that their vocalisations can elicit social responses from adults (Goldstein et al., 2009). Maternal responses to infants' vocalisations can in turn influence the quantity of infant vocalisations. Goldstein et al. (2003) found that mothers' contingent responses to their 8-month-old infants elicited an increase in infant vocalisations. Deficits in the mother–infant interaction could therefore contribute to changes in the quantity of infant vocalisations. However, at present, it is not known whether vocalisation quantity is reduced in mother–infant dyads with depression, and what relationship this might have with infants' emerging vocabulary size.

Infants generally produce first words around the end of their first year of life and the process of learning to recognise, understand and produce new words continues with rapid growth during infants' second year of life, with an acceleration occurring around 18 months of age (McMurray, 2007). Their vocabulary increases rapidly in a phenomenon sometimes referred to as the vocabulary spurt (Dapretto & Bjork, 2000; McMurray, 2007). As such, this age typically reflects a landscape change in infants' language use, and therefore presents as a good developmental time point for assessing individual variation in vocabulary size, especially variation that may be associated with maternal depression and anxiety.

1.4.3 Research challenge.

A large portion of research examining the impact of maternal emotional health on children's language outcomes has focused primarily on preschool and school-aged children (e.g., NICHD Early Child Care Research Network, 1999). Few studies have studied the impact of maternal depression and anxiety on infants' emerging language abilities such as

vocabulary size in their first two years of life (Kaplan et al., 2014; Reck et al., 2018). This is despite the strong link between early vocabulary size and later language milestones and academic achievement (e.g., Morgan, Farkas, Hillemeier, Hammer & Maczuga, 2015) and the high prevalence rates of maternal depression and anxiety in the postnatal period (e.g., Matthey, Barnett, Howie & Kavanagh, 2003; Reck, Noe, Gerstenlauer & Stehle, 2012). Understanding the mechanisms through which depression and anxiety may impact emerging language abilities through the quality of mother–infant interactions may assist with the early identification of children at risk of language delay. It may also inform the content and developmental time points for early intervention programmes.

This thesis addresses these concerns by conducting a longitudinal study that investigated the effects of maternal mental health concerns on the quantity and quality of early mother-infant interactions, and their consequences for infants' early language development. This study, therefore, makes two novel contributions to the existing literature. First, it is implemented across distinct contexts (home and laboratory settings), thus providing evidence about the effects of maternal depression and anxiety on the natural day-to-day interactions between mothers and their young infants. Second, it identifies maternal depression as a moderators of the relation between maternal responsiveness and vocabulary size, defining maternal responsiveness as a target for future intervention designed to mitigate the effects of maternal mental health concerns on infants' linguistic development.

The primary objective of this study is to examine the mechanisms through which maternal depression and anxiety influence the quality of mother–infant interactions and subsequently infants' developing lexical abilities. Its second objective is to evaluate the effectiveness of a video feedback intervention aimed to promote maternal responsiveness in mothers affected by depression and anxiety. To achieve these objectives, this longitudinal study included a sample of mother–infant dyads with or without maternal anxiety and

depression who participated between the infant ages of 6 and 18 months. The study consists of three main components designed to obtain measures of the mother–infant interaction and developmental outcomes between groups and across time. A fourth exploratory component is designed to examine the effectiveness of an intervention with a sub-set of mother-infant dyads. It is expected that the results will have significant clinical implications for the early identification of infants at risk of language delay, and will provide direction on developmental time points at which early psychological interventions with mother–infant dyads may be most effective (Kingston, Tough & Whitfield, 2012; Reck et al., 2018).

1.4.4 Research questions and predictions.

This thesis has three main and one exploratory component embedded in the longitudinal study introduced above that aim to answer four main research questions presented as follows.

1.4.4.1 Home language environment and quantity of infant vocalisations.

Do maternal emotional health concerns (depression and anxiety) impact negatively on the quantity of mothers' speech input with their infants (number of adult words and conversational turns) and the quantity of infant vocalisations? This question is addressed in *Chapter 3*, where we report on the findings from the longitudinal study examining home language environments using the LENA system.

Prediction 1. On the basis of evidence that mothers with depression talk at a slower speech rate (Teasdale et al., 1980), respond less frequently to infant vocalisations, and demonstrate greater variability in their responses (Bettes, 1988), it is predicted that the *quantity* of adult speech input (adult words and conversational turns) and the *volume* of infant vocalisations in the risk group will be reduced compared to the control group. In addition, the home language measures are predicted to be negatively correlated with depression and anxiety maternal measures.

1.4.4.2 Infants' lexical abilities.

Are infants' early language abilities (lexical processing and vocabulary size) lower in the risk compared to the control group, and are they correlated with maternal depression and anxiety measures? These questions are addressed in *Chapter 4*, where we examine infants' vocabulary size and lexical processing efficiency using a vocabulary checklist and an experimental looking-while-listening task.

Prediction 2. Due to the previous findings of associations between depression and anxiety and infant vocabulary size (Kaplan et al., 2014; Reck et al., 2018), and given the link between vocabulary size and lexical processing efficiency (Fernald et al., 2013), it is predicted that the linguistic abilities of infants (lexical processing skills and vocabulary size) will be lower in infants in the risk compared to the control group. It is also anticipated that infants' lexical abilities will be negatively correlated with maternal anxiety and depression measures.

1.4.4.3 The relations between maternal responsiveness, emotional health, and vocabulary.

Does the quality of the mother–infant interactions (maternal responsiveness) differ between the risk and control groups, and is it associated with depression and anxiety measures? Is maternal responsiveness linked to depression and anxiety measures and does it predict infants' vocabulary? These questions are addressed in *Chapter 5*, which examines the relationship between maternal responsiveness in the first year of life and infants' vocabulary size during their second year. It details the findings from analyses examining the relationships and pathways through which maternal emotional health variables and maternal responsiveness interact as they together influence infant language abilities.

Prediction 3. There is evidence to suggest that the quality of mother–infant interactions can be impaired by both depression (Giallo, Treyvaud, Cooklin & Wade, 2012)

and anxiety (Murray, Cooper, Creswell, Schofield & Sack, 2007; Nicol-Harper et al., 2007). Maternal responsiveness levels have also been shown to predict language outcome (Landry, Smith, Swank, Assel & Vellet, 2001; Tamis-LeMonda et al., 2001).

It is therefore predicted that:

3.a The *quality* of mother–infant interactions (maternal responsiveness) will be lower in the risk compared to the control group and negatively correlated with depression and anxiety measures.

3.b Maternal responsiveness will predict infants' expressive vocabulary size.

3.b Maternal emotional health concerns (depression and anxiety) will moderate the relationship between maternal responsiveness and infants' vocabulary size.

1.4.4.4. Promoting maternal responsiveness: Evaluation of an intervention.

Is video interaction guidance, as a therapeutic intervention, effective at improving maternal responsiveness, and is it acceptable to at-risk mother–infant dyads in the postnatal period? These questions are addressed in Chapter 6, which reports on a study with a subsample of mothers from the risk group. On the basis of the evidence that short video feedback interventions are effective in improving the quality of mother–infant interactions (see Chapter 6 for a literature review), it is expected that mothers who participate in the Video Interaction Guidance (VIG) intervention will demonstrate improvements in maternal responsiveness compared to a comparison group of mother–infant dyads who did not engage in the intervention. This study is exploratory given that only a self-selected sub-set of the mothers with depression and/or anxiety chose to take part in the intervention. However, it will be supplemented by a set of qualitative analyses to lay the grounds for future research directly aimed at the design of intervention programmes targeted to this population.

Chapter 2 provides an overview of the longitudinal study included in this thesis, detailing the main measurement approaches employed in the empirical chapters of this thesis.

It also contains detailed information about the profiles of the mothers and infants involved in the study. Chapters 3 to 5 report the individual components of the longitudinal study. Chapter 3 examines the language environment (quantity of adult words and conversational turns) and the quantity of infant vocalisations in the home and their relation to maternal depression and anxiety. Chapter 4 examines infants' lexical processing abilities and vocabulary size. Chapter 5 presents analyses investigating maternal depression and anxiety and maternal responsiveness in mother–infant interactions during the infant's first year of life and their impact on infants' vocabulary size and lexical processing efficiency. Chapter 6 assesses the effectiveness of the VIG intervention in promoting maternal responsiveness, and also assesses the acceptability of VIG for mothers with signs of emotional health concerns in the postnatal period. Finally, Chapter 7 presents an overview of the main findings of this work, together with clinical implications and recommendations for future research.

CHAPTER 2

Study Overview and Participant Information

This Chapter provides an overview of the longitudinal study that examines mechanisms through which maternal depression and anxiety influence the quantity and quality of mother–infant interactions and infants' language development. The longitudinal study followed mother–infant dyads from 6 to 18 months of age and involved four main components that will be reported in detail in the four chapters that follow.

2.1 Longitudinal Study Overview

2.1.1 Study design.

The design of this longitudinal study comprised measures of the mother–infant interaction and developmental outcomes compared between groups and within groups across time. The first component involved recordings of infants' home language environment at 6 and 12 months of age (see Table 1). The second component involved the assessment of infants' emerging lexical abilities at 18 months of age. The third component consisted of observations of mother–infant play sessions conducted at 9 and 12 months that were used to produce maternal responsiveness ratings. The final component involved the evaluation of a short intervention aimed at promoting maternal responsiveness within mother–infant interactions. Figure 2 provides an overview of the assessment and intervention timeline.

Table 1.

Overview and summary of study aims and infant ages.

Study	Aim	Infant age
Component One. The quantity of maternal speech input to infants at home.	To compare across ages and groups (control vs. risk) the amount of maternal speech input (adult words and conversational turns) to infants at home, and the volume of infant vocalisations. To examine the above variables in relation to mothers' depression and anxiety symptoms.	6 &12 months
Component Two. Vocabulary and lexical processing.	To compare across groups (control vs. risk) infant vocabulary and lexical processing skills. To examine infants' lexical abilities in relation to mothers' depression and anxiety symptoms.	18 months
Component Three. Maternal responsiveness	To compare across ages and groups (control vs. risk) maternal responsiveness during mother–infant play sessions. To examine maternal responsiveness in relation to mothers' depression and anxiety symptoms.	9 & 12 months
Component Four. Video Interaction Guidance intervention	To evaluate the Video Interaction Guidance (VIG) intervention using quantitative and qualitative methods.	9 to 12, & 18 months

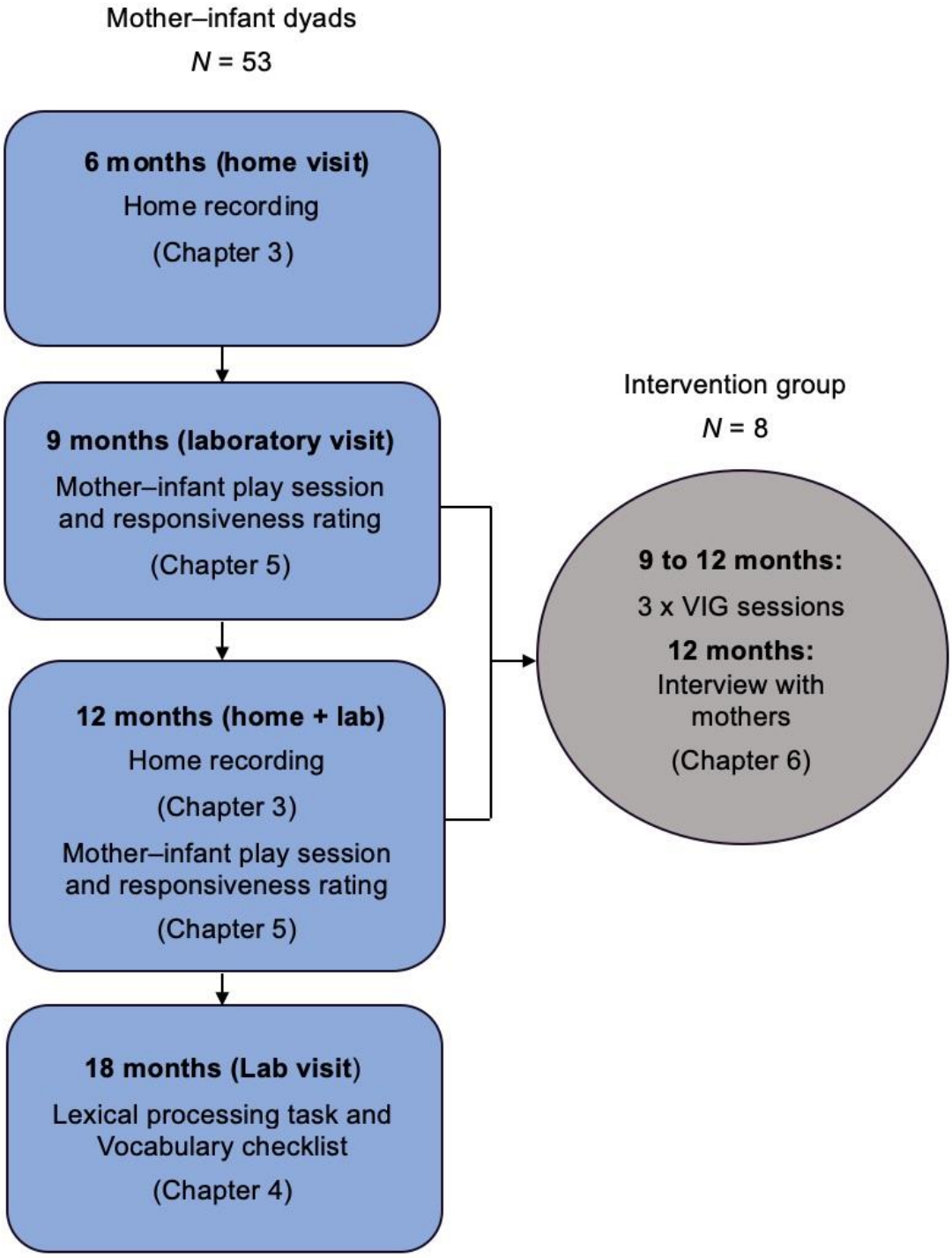

Figure 2. Longitudinal study timeline of assessment and intervention tasks by infant age.

2.2 Participants

2.2.1 Recruitment.

Approximately half of the participants for the present longitudinal study were connected to an existing large-scale longitudinal project. Mothers from that project's database whose babies were within the appropriate age range for the present project, were contacted through a telephone call. Mothers were provided with an explanation of the time commitment, location, and testing schedule associated with participation in this study. In the event that they were interested, mothers were asked a number of screening questions to ensure they met the initial eligibility criteria for this study. Based on mothers' responses, they were invited to participate if their babies were full term (>36 weeks gestation), passed their newborn hearing screening test, were not at risk for neurological disorders, and were not are exposed to more than one language (>10 hours second language exposure per week). A total of 24 moth-infant dyads were recruited following this method.

An additional 29 mother–infant dyads were recruited from an infant laboratory database and via the distribution of study flyers through community notice boards, libraries, play groups, community agencies such and social media.

2.2.2 Participant details.

Fifty-three mother–infant dyads participated in the project. Approximately half of the dyads were allocated to the control group (n = 29, 13 female infants) and half to the risk group (n = 24, 13 female infants). At the time of recruitment, mothers' age ranged from 25 to 41 years (M = 33.19, SD = 4.12) and fathers' age ranged from 25 to 49 years (M = 35.45, SD = 6.18). Independent t-tests confirmed that there were no significant differences between the control and risk groups on parent age and the number of children in the family. See Table2

for descriptive and inferential statistics for family characteristics by mother–infant control versus risk group.

The infants were born into two parent households, full term (37- 42 weeks), with normal birth weight, and no history of birth or postnatal complications. Infants were acquiring English in a monolingual context and were not exposed to a second language, and they had no reported hearing difficulties, neurological conditions, or health problems. See Table 3 for descriptive and inferential statistics for additional infant characteristics by mother–infant control versus risk group. Independent *t*-tests confirmed that there were no significant differences between the control and risk groups on any of the demographic variables.

2.2.3 Socio-economic status.

Socio-economic status (SES) refers to an individual's social position, and it is usually based on factors such as education and income (Ganek & Eriks-Brophy, 2018). Recent studies have identified SES differences in children's brain development (Tomalski et al., 2013) and their emerging language skills (Fernald, Marchman, & Weisleder, 2013; Noble et al., 2015). With the exception of cases of extreme poverty, evidence points to maternal education as the SES factor most likely to predict parenting practices (Hoff, 2003a) and child developmental outcomes (e.g., Boyle et al., 2006). Maternal education has been linked to children's language skills (e.g., Noble, McCandliss, & Farah, 2007) and appears to be a stronger predictor than family income (e.g., Rowe, 2008). It has been posited that the associations with SES and child language outcomes may be related to disparities in the volume and complexity of early speech input in the home environment (Hart & Risley, 1995; Hirsh-Pasek et al., 2015; Rowe, 2012).

Table 2.

Descriptive and inferential statistics for family characteristics by mother–infant control versus risk group.

	Group				
Demographic variables	Control	Risk	*t*	*df*	*p*
Mothers age (years)					
Mean (SD)	33.14 (3.49)	33.25 (4.86)	.201	51	.842
Range	26 - 40	25 - 41			
Fathers age (years)					
Mean (SD)	34.37 (6.19)	36.67 (6.06)	-1.245	50	.219
Range	25 - 49	27 - 46			
Number of children					
Mean	1.39	1.32	.334	51	.740
Range	1-5	1-3			
Mothers' education: *n* (%)					
High School	2 (7)	0 (0)			
Diploma or trade	5 (17)	1 (5)			
Undergraduate degree	15 (52)	15 (65)			
Postgraduate degree	7 (24)	7 (30)			
Fathers' education: *n* (%)					
High School	5 (17)	1 (4)			
Diploma or trade	14 (48)	5 (22)			
Undergraduate degree	6 (21)	14 (61)			
Postgraduate degree	4 (14)	3 (13)			
Maternal employment					
6-month assessment: n (%)					
Nil paid work	15 (56)	6 (26)			
Part time paid work	9 (33)	14 (61)			
Full time paid work	3 (11)	3 (13)			
12-month paid work: n (%)					
Nil paid work	8 (30)	3 (13)			
Part time paid work	13 (48)	17 (74)			
Full time paid work	6 (22)	3 (13)			
18-month assessment: n (%)					
Nil paid work	5 (19)	3 (13)			
Part time paid work	15 (58)	14 (61)			
Full time paid work	6 (23)	6 (26)			

Table 3.

Descriptive and inferential statistics for infant characteristics by mother–infant control versus risk group.

	Group				
Demographic variables	Control	Risk	*t*	*df*	*p*
Birth weight (kg)					
Mean (SD)	3.54 (.52)	3.53 (.49)	-3.59	51	.721
Range	2.38 - 4.74	2.7 - 4.89			
Birth order: *n* (%)					
First born	18 (62)	17 (71)	-.207	51	.837
Later born	11 (38)	7 (29)			
Infant gender: *n* (%)					
Male	16 (55)	11 (46)	-.667	51	.508
Female	13 (44)	13 (54)			
Child care (hours/week) *n* (%)					
6-month assessment					
0 – 10	24 (96)	18 (81)			
10 – 20	0 (0)	2 (9)			
20 – 30	1(4)	1 (5)			
30 – 40	0 (0)	1 (5)			
More than 40	0 (0)	0 (0)			
12-month assessment					
0 – 10	11 (44)	12 (52)			
10 – 20	5 (20)	7 (31)			
20 – 30	5 (20)	1 (4)			
30 – 40	1 (4)	2 (9)			
More than 40	3 (12)	1 (4)			
18-month assessment					
0 – 10	8 (32)	6 (26)			
10 – 20	9 (36)	8 (35)			
20 – 30	4 (16)	4 (17)			
30 – 40	1 (4)	3 (13)			
More than 40	3 (12)	2 (9)			

In the present study, maternal education and average household income were used as indices of participants' socioeconomic status (SES). Education levels for all mothers ranged

from high school to postgraduate degree. The median education level for mothers was an undergraduate university degree, and this did not differ between the risk and control groups, Mann-Whitney $U = 263$, $p = .144$. Table 2 provides details of how many mothers in each group completed high school, college, undergraduate and postgraduate university qualifications. As SES is multifaceted, household income was also included as an additional measure of SES. The estimated average household weekly income levels were calculated based on the postcodes of participants' place of residence (Australian Bureau of Statistics). There was no significant difference in estimated household income level between the risk and control groups, Mann-Whitney U = 262.5, p = .086.

2.2.4 Group allocation criteria.

2.2.4.1 Depression and anxiety measures.

At the time of signing consent to participate in the longitudinal study, mothers completed a Family Information Sheet (Appendix A) that asked brief questions concerning their past and current depression and anxiety status and treatment. In addition, mothers were asked to complete the following two self-reported measurements of depression and anxiety:

Centre for Epidemiologic Studies Depression Scale – Revised (CESD-R: Eaton et al, 2004). The CESD-R (see Appendix B) is a 20 item self-reported scale of depressive symptoms that closely reflects the American Psychiatric Association Diagnostic and Statistical Manual (DSM-IV) criteria for major depression. All items are measured on a 5-point Likert scale (e.g. from "Not at all" to "nearly every day for the last 2 weeks"). Examples of items include: "My appetite was poor" and "I did not like myself". The CESD-R has been previously used in perinatal populations (Vieten & Astin, 2008). A total score of ≥ 16 indicates clinical levels of depression. The scale has demonstrated excellent psychometric qualities such as high internal consistency, strong factor loadings, and convergent and divergent validity (Hoffman & Hatch, 2000).

State-Trait Anxiety Scale (STAI: Spielberger et al, 1987). The State subscale of the STAI (see Appendix C) was used at all assessment time points and is designed to measure current feelings of tension, anxiety, and nervousness. All items are measured on a 4-point forced-choice scale (e.g. from "Not at all" to "Very much"). Examples of items include: "I am tense; I am worried" and "I feel calm; I feel secure". This 20-item scale has been widely used with women in the perinatal period where scores of ≥ 40 have been used to indicate clinical or high levels of state anxiety in childbearing women in prior Australian studies (Barnett & Parker, 1986; Grant, McMahon, & Austin, 2008; Hart & McMahon, 2006). The STAI has demonstrated good psychometric properties and with both clinical and non-clinical populations (Spielberger et al, 1987).

Due to variability in the onset time of depression and anxiety symptoms following the birth of a baby, questionnaires were completed at several time points during the postnatal period (6, 9, 12, and 18 months). Mothers were allocated to the risk group if they: (i) had a current diagnosis of depression or anxiety or (ii) reported depression or anxiety scores that exceeded the clinical threshold (i.e. CESD-R ≥ 16; STAI ≥ 40).The remaining mothers were allocated to the control group. Due to the high co-morbidity of depression and anxiety symptoms in the postnatal period, both were measured and included in the risk group. In clinical settings comorbidity of conditions is considered to be the norm rather than the exception (Corinna Reck et al., 2018). Mother–infant dyads remained in the risk group for the duration of the study despite potential changes to their depression and anxiety scores. The risk group also included mothers with a current diagnosis of depression and anxiety, but subclinical symptomatology, if they were receiving treatment for their condition. This decision was made given that depressed mother–infant interactions styles can persist beyond periods of acute symptomatology (Cohn & Tronick, 1989), with adverse developmental

outcomes known to persist beyond the remission of depression (e.g., Murray, Halligan, & Cooper, 2010).

Empirical research employs both categorical and continuous approaches to data analysis in studies examining maternal emotional health variables (Sohr-Preston & Scaramella, 2006).

Categorical approaches are often used to compare clinical populations (e.g., mothers whose symptoms meet the criteria required for a clinical diagnosis of depression), with non-clinical populations. This commonly involves the assessment of the presence or absence of a clinical diagnosis of a mood or anxiety disorder (e.g., Major Depressive Disorder or Generalised Anxiety Disorder). In the present study, two groups were formed (risk and control) to accommodate the comorbidity of depression and anxiety conditions in the present sample. As described above, mothers were allocated to the risk group if they had a clinical diagnosis and/or elevated depression and anxiety measures that exceeded a clinical threshold. The remaining mother–infant dyads were allocated to a control group.

Continuous approaches to the assessment of depression are well suited to subclinical experiences of depression in the postnatal period and usually involve data collection using self-reported measures of symptoms at a given point in time. This approach to research can be valuable, as it considers subclinical levels of symptomatology that are still accompanied by significant levels of functional impairment for mothers, with potential implications for child development. Previous studies, for example, have found an association with subclinical depression symptoms and considerable social impairment (West & Newman, 2003) and increased risk for major depressive disorder and other psychopathology (Kessler, Zhao, Blazer, & Swartz, 1997).

In the longitudinal study both categorical and continuous approached were taken to guide group allocation and data analyses.

Table 4.

Summary of self-reported measures employed to assist with participant group allocation.

		Groups	
Infant age	Details of screening measures	Risk	Control
6, 9, 12, 18 months	*Center for Epidemiologic Studies Depression Scale - Revised (CESD-R: Eaton et al, 2004).* The CESD-R is a 20 item self-rated questionnaire that closely reflects the DSM-IV criteria for depression (see Eaton et al, 2004).	Score ≥ 16	Score < 16
6, 9, 12, 18 months	*State-Trait Anxiety Inventory (STAI: Spielberger et al, 1987).* The state scale of the STAI is a 20 item self-rated questionnaire that assesses current feelings of anxiety.	Score ≥ 40	Score < 40

Note. DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 2013).

2.2.5 Risk management.

To ensure mothers received the appropriate level of psychological support while participating in the study, appropriate risk management strategies were incorporated into the study design (see Appendix D for details of the risk management plan). The first level of response in the risk management plan was activated when mothers' total scores on either the CESD-R or STAI exceeded clinical thresholds. In this case, mothers received a notification email with a recommendation to either contact their General Practitioner and/or access additional support services detailed within the email. The second level of response was to be activated in the event that mothers verbally disclosed to the researcher that they were at risk of self-harm or suicide and/or it was evident in responses on relevant items on the depression

measure (i.e. CESD-R, Questions 14 and 15). The second level of response was not required for the duration of the longitudinal study.

2.2.6 Group comparisons on emotional health measures.

A mean postnatal depression score and mean postnatal anxiety score were calculated for each participant by averaging scores obtained at each data collection point. This accounted for potential variation in the *severity* and *persistence* of maternal depression and anxiety symptomatology during the postnatal period, which is known to influence child development outcomes (Murray et al., 1999). The mean depression and anxiety scores differ from the cut off scores described in the group allocation criteria as they reflect the average score obtained across the four assessment time points.

Independent samples *t*-tests confirmed that there was a significant difference in mean depression scores (CESD-R) for mothers in the risk group (M = 4.72, SD = 3.54) compared to mothers in the control group (M = 9.05, SD = 6.79), $t(33.13) = -2.82$, $p = .008$, $d = .800$, and in the mean anxiety scores (STAI) for mothers in the risk group (M = 35.28, SD = 7.26) compared to controls (M = 28.29, SD = 35.28), $t(38.28) = -4.05$, $p = .000$, $d = 1.14$. Table 5 provides descriptive statistics for maternal depression and anxiety scores at the four testing time points.

2.3 Methodology Overview

There are a number of different approaches to measuring emerging lexical abilities during infancy. The approaches employed in this longitudinal study include a combination of home audio recordings, laboratory methods, and parent-report checklists. Day long audio recordings were used to explore the quantity of speech input to infants at home and the volume of infant vocalisations (Chapter 3). Laboratory methods were also used to assess infants' lexical processing efficiency, and a parent-report checklist provided a measure of

their expressive vocabulary size (Chapter 4). The quality of the mother–infant interaction was measured using video-recordings of mother–infant play sessions and a rating scale of maternal responsiveness (details of this measurement approach is outlined in Chapter 5). In addition, infants' IQ was assessed using a standardised measure.

Table 5.

Maternal depression and anxiety scores by risk versus control group.

Descriptive statistics		Group		*t*	*df*	*p*
		Control	Risk			
6-month assessment		*n* = 20	*n* = 19			
Depression	Range	0 - 11	0 - 28			
	Mean (SD)	4.95 (3.50)	9.32 (7.61)	-2.282	25.01	.031
Anxiety	Range	21 - 39	22 - 52			
	Mean (SD)	29.10 (5.93)	34.47 (9.23)	-2.151	30.45	.039
9-month assessment		*n* = 24	*n* = 22			
Depression	Range	0 - 13	1 - 23			
	Mean (SD)	4.75 (4.25)	9.45 (8.07)	-2.442	31.18	.020
Anxiety	Range	20 - 46	21 - 55			
	Mean (SD)	29.21 (6.52)	36.45 (8.96)	-3.155	44	.003
12-month assessment		*n* = 27	*n* = 23			
Depression	Range	0 - 13	0 - 27			
	Mean (SD)	4.78 (3.94)	9.17 (7.77)	-2.459	31.40	.020
Anxiety	Range	21 - 39	20 - 51			
	Mean (SD)	28.30 (4.99)	35.87 (8.69)	-3.692	33.83	.001
18-month assessment		*n* = 29	*n* = 24			
Depression	Range	0 - 20	0 - 26			
	Mean (SD)	5.04 (4.51)	8.96 (7.98)	-2.095	36.33	.043
Anxiety	Range	20 - 42	20 - 62			
	Mean (SD)	28.29 (6.52)	34.83 (10.90)	-2.523	37.61	.016
Mean postnatal score						
Depression	Range	0 - 13	0 - 22.5			
	Mean (SD)	4.72 (3.54)	9.05 (6.79)	-2.819	33.13	.008
Anxiety	Range	20.75 - 39.67	21 - 45			

Mean (SD)	28.29 (4.75)	35.28 (7.26)	-4.051	38.28	.000

Note. Depression = CESD-R scores; Anxiety = STAI scores.

2.3.1 Home-based audio recordings.

Elicitation of maternal speech in the laboratory can lead to over-estimations of the quantity of adult talk (Shneidman & Goldin-Meadow, 2012; Tamis-LeMonda, Kuchirko, Luo, Escobar, & Bornstein, 2017). Recording maternal speech in the home environment provide more realistic estimates and in addition can capture a range of communication interactions between mothers and their infants. However, empirical studies using home-based audio recordings, particularly outside of the United States of America are scarce. One reason for this is that home recordings are labour intensive and costly (Mehl, 2017). Early studies using home-based recordings (e.g., Hart & Risley, 1995) involved trained researchers going into family homes with hand-held audio-recorders, and later spending extensive time transcribing, coding and conducting reliability checks on the coded data. This restricted the duration of home recordings which ranged from 1.5 minutes to 1.5 hours in length (e.g., Hart & Risley, 1995; Rowe, 2012). A limitation of home recordings has been the presence of researchers in the home, which could be perceived as intrusive or result in observer reactivity (Gardner, 2000). The present study addresses these limitations by taking advantage of advancements of the LENA System (see Section 1.3.2). Additional details regarding the LENA system are provided in Chapter 3.

2.3.2 Laboratory methods.

In contrast to the home environment, research laboratories provide access to a controlled experimental setting and specialised equipment. Infants' lexical processing skills were assessed in the laboratory when they were 18-months-old using the looking-while-

listening (LWL) task. The LWL procedure (see Fernald, Zangl, Portillo, & Marchman, 2008) uses real-time measures of children's gaze patterns in response to speech. Its cognitive demands are low, and it can be used with automated eye-tracking technology, making it well suited for infants in their second year of life. Details of this task are outlined in Chapter 5.

2.3.3 Parental report.

Parental reports were used to measure infants' expressive vocabulary size. One advantage of engaging parents in their child's vocabulary assessment is that they tend to be the closest observers of their infants' language production. Parents also have the opportunity to observe their infants' language use in a broad range of settings. Despite vulnerability to under- or over-estimating their child's abilities (Arriaga, Fenson, Cronan, & Pethick, 1998; Feldman et al., 2000), parental reports of vocabulary checklists address variability in infant performance in a laboratory setting (e.g., shyness, inattention, cooperation and mood).

The Australian English Inventory (OZI: Kalashnikova, Schwarz, & Burnham, 2016) was given to mothers to complete at a laboratory visit when infants were 18 months of age. The OZI is the Australian English adaption of The MacArthur-Bates Communicative Development Inventory (CDI: Fenson, Marchman, Thal, Dale, & Reznick, 2007), and it is a vocabulary checklist consisting of 558 words that are likely to be familiar to infants from 12 to 30 months (see Appendix E). Chapter 5 details the context in which this tool was used to examine expressive vocabulary as an outcome variable. We will also return to the OZI when assessing its relation to infants' home language environment (Chapter 3), infants' lexical processing efficiency (Chapter 4).

2.3.4 Standardised measure of infant IQ.

Due the association between maternal emotional health and poor cognitive outcomes for children, the Cognitive Scale of the Bayley Scales of Infant and Toddler Development,

Third Edition (Bayley-III) (Bayley, 2006) was used to assess infants' cognitive abilities as a potential mediating variable in the study. The Bayley-III assesses infant and toddler development across the following five domains: Cognitive, Language, Motor, Social-Emotional, and Adaptive. The Bayley-III provides four types of norm-referenced scores including: percentile ranks, scaled, composite and growth scores. The cognitive scale of Bayley III measures sensory motor development, exploration and manipulation, object relatedness, concept formation and memory.

The Cognitive Scale of the Bayley-III was administered as a measure of cognitive abilities when infants were 18-months-old. Administration was by a trained researcher in a quiet room as outlined in the Bayley-III administration manual. The Cognitive Scale composite scores were available for 47 infants (Control 25; Risk 22). IQ data for seven babies were missing due to fussiness (2) and inability to come to the lab (5). Two infants (control group) were excluded from further analysis due to a recent diagnosis of a mild-moderate hearing loss (n = 1) and a score > 3SD below the mean on the cognitive subtest of the Bayley-III. Independent samples t-tests with remaining infants (Control 23; Risk 22) confirmed that there were no differences in IQ scores between the control (M = 106.30, SD = 10.58) and risk groups (M = 107.95, SD = 14.36), $t(45) = -.440$, $p = .662$, $d = .131$. Table 6 provides an overview of the time schedule and details of assessment and intervention tasks.

2.4 Social and environmental influences on mother-infant interactions

A mother's ability to interact with her infant and support her infant's development is influenced by a number of social and environmental factors in addition to maternal emotional health. These factors have the potential to shape the environment in which an infants' development occurs. There is a growing body of evidence supporting the hypothesis that a combination of risk factors, rather than a single risk factor, explains adverse child

development outcomes (e.g., McMahon, Barnett, Kowalenko, & Tennant, 2006). The project design addresses these risk factors through the inclusion of five measures: maternal self-efficacy, the quality of the parents' relationship, maternal reflective functioning, and mother-infant attachment and infant temperament. Questionnaires were employed to assess these factors. Due to potential variability in some of these measures over time, questionnaires were completed at different time points during the postnatal period (see Table 7 for a timeline summary of the questionnaires; and Appendices G to K for further details). Two of these measures, parental sense of competence and reflective functioning are reported as part of planned analyses in Chapter 6.

The interested reader should see the Appendices (M to Q) for detailed results of group comparisons on maternal self-reported measures. In summary, the risk and control groups differed on two subscales of the Maternal Postnatal Attachment Scale (i.e. Quality of Attachment and Absence of Hostility), whereby the risk group had significantly lower scores on both subscales compared with the control group. A significant group difference was evident on the Irritability dimension of the Short Temperament Scale for Infants, whereby infants in the risk group were significantly higher on the irritability dimension than controls. Finally, there was a significant difference between the control and risk groups on the Satisfaction subscale of the Parenting Sense of Competence Scale (PSOC) at the 9-month assessment, whereby mothers in the control group reported higher levels of satisfaction in the parenting role. At the 12-month assessment, mothers in the control group reported significantly higher levels of Efficacy in the parenting role compared with those in the risk group. There were no significant differences between on any of the PSOC subscales at the 18-month assessment.

Table 6.

Time schedule of assessment and intervention tasks.

Assessment and intervention tasks	Infant age (months)	Chapter	Appendix
Family Information Sheet	6	NA	A
Infant IQ (Cognitive scale of Bayley-III)	18	Chapter 2	NA
Day-long audio (LENA) home recordings	6 & 12	Chapter 3	NA
Looking-while-listening task	18	Chapter 4	NA
Expressive vocabulary checklist (CDI)	18	Chapters 3, 4 and 5	E
Participant information and consent forms	6	NA	F
Maternal self-reported questionnaires (Completed online or at laboratory assessments)	All time-points	Chapter 2	G - K
Mother–infant play sessions and Ratings for Maternal Responsiveness	9 & 12	Chapters 5 and 6	L
VIG intervention (additional participant information and consent form)	9 - 12	Chapter 6	T
Post intervention interview with mothers (additional participant information and consent form)	12	Chapter 6	U-V

Note. LENA = Language Environment Analysis System; CDI = The Australian English adaption of the MacArthur-Bates Communicative Development Inventories; VIG = Video Interaction Guidance.

Table 7.

Timeline and overview of maternal self-reported measures.

Construct and measure	Infant Age	Appendix
Self-efficacy: *Parenting Sense of Competence Scale (PSOCs: Gibaud-Wallston & Wandersman, 1978).* The PSOC measures parental competence on three subscales; 1. Satisfaction, 2. Efficacy, and 3. Interest.	9,12,18 months	G
Relationship with partner: *Intimate Bonds Measure (IBM: Wilhelm & Parker, 1988).* The IBM is a 24-item scale that assesses the intimacy between a couple on two dimensions; Care and Control.	6, 9, 12, 18 months	H
Reflective functioning: *Parental Reflective Functioning Questionnaire (PRFQ-1: Luyten et al., 2009).*The PRFQ-1 is a 39-item questionnaire designed to measure reflective functioning (or 'mentalizing') in parents of children aged 0 - 3 years.	9, 12 months	I
Mother–infant attachment: *Maternal Postnatal Attachment Scale (MPAS: Condon & Corkindale, 1998).*The MPAS is a 19-item questionnaire designed to measure mothers' attachment thoughts and feelings towards her baby.	6, 9, 12, 18 months	J
Infant temperament: *Short Temperament Scale for Infants (STSI: Sanson et al, 1987).* The STSI is a parent report of infant temperament.	6 months	K

The groups did not differ on the Intimate Bond Measure, which means the quality of the support available to mothers through their partner was similar across groups. The groups also did not differ on the Parental Reflective Function Questionnaire, which means that

mothers did not differ significantly in their ability to imagine mental states in oneself and others.

2.4.1 Summary.

In this Chapter we presented a detailed overview of the present longitudinal study and participant sample group. All four components of the longitudinal study that are outlined in the chapters that follow involve mother–infant dyads from this sample group. In the next Chapter we will outline the first component of our longitudinal study, the day long home recordings obtained during infants first year of life. Data from these recordings will be examined in relation to mothers' group allocation, and their depression and anxiety symptoms, and infants' vocabulary size at 18 months.

CHAPTER 3

Day-to-day Interactions in the First Year of Life

Chapter 1, Section 1.1 reviewed the existing literature investigating depression and anxiety in the postnatal period. Depression and anxiety are maternal factors known to influence children's language outcomes, and are the most commonly experienced mental health conditions in the postnatal period (Matthey, Barnett, Howie, & Kavanagh, 2003; Reck, Noe, Gerstenlauer, & Stehle, 2012). Maternal depression and anxiety can have a negative impact on the quality of mother–infant interactions (see Section 1.2.8). In Section 1, we speculated that these disruptions could, in turn, reduce the volume of infant vocalisations. However, this has not been examined directly. While research has explored the impact of maternal depression on the quality of maternal speech input to infants, little is known about its impact on the quantity of speech input (see Section 1.3.2). Furthermore, previous research examining day-to-day interactions using LENA recordings, has focused primarily on toddlers in the second and third year of life (Gilkerson et al., 2018). This is the case despite the mounting evidence that the first year of life is a crucial period for language acquisition (Werker, 2018). The impact of maternal emotional health on infants' home language environment during their first year of life remains unexplored.

The objective of this Chapter is to examine potential relations between maternal depression and anxiety and the quality of maternal speech input in day-to-day interactions (number of adult words and conversational turns) and the volume of infant vocalisations in the home environment. To achieve this objective, day long audio recordings were obtained at infant ages of 6 and 12 months using the LENA system (see Sections 1.3.2 and 2.3.1).

This first component of the longitudinal study addressed two aims: (1) to assess the early home language environment (i.e. number of adult words and conversational turns) and the quantity of vocalisations by infants who do and do not have mothers with elevated

depression or anxiety symptoms, and (2) to assess specific predictors of infants' early vocabulary development (i.e. maternal emotional health symptoms and the quantity of adult speech, conversational turns, and infant vocalisations).

To assess the home language environment and the quantity of infant vocalisations, the home audio recordings obtained at 6 and 12 months were analysed. To assess early language ability, infants' expressive vocabulary size was used.

Below we outline the specific research questions and predictions for this Chapter:

(1) *Are infants exposed to fewer adult words and conversational turns if their mothers are in the risk group compared to controls?* Given that previous studies have reported a slower speech rate (Teasdale et al., 1980) and withdrawn and intrusive interactive behaviours in mothers with depression (Murray & Cooper, 1996), it was predicted that day long interactions would contain fewer adult words and conversational turns involving the at risk mother–infant dyads compared to control dyads.

(2) *Do infants with mothers in the risk group vocalise less than controls, and if so, in what context?* As infants with depressed mothers have been found to be less responsive during interactions (Field, 2002), it is predicted that fewer vocalisations would be detected for mother–infant dyads in the risk group compared to controls. If infants do vocalise less, it raises a question with regards to potential differences in the context in which infants vocalise less. For example, they may vocalise less in all contexts or only during conversation with their mother. Answering this question will clarify whether a potential deficit in the volume of infant vocalisations may be related to an overall reduction in vocal ability or a reflection of the social interaction with their mother.

(3) *Do infants with mothers in the risk group have smaller vocabulary sizes at 18 months compared to controls?* Since maternal depression and anxiety have been negatively

related to infants' language development outcomes (e.g., Kaplan et al., 2014; Reck et al., 2018), it was predicted that higher maternal depression and anxiety scores would be associated with smaller infant expressive vocabulary sizes.

(4) *Does infants' home environment (i.e. the quantity of adult words and conversational turns) predict vocabulary size at 18 months?* It was predicted that the quantity of adult words (e.g., Hart & Risley, 1995; Ramírez-Esparza et al., 2014) and conversational turns (e.g., Romeo et al., 2018) in the first year of life, would predict vocabulary size at 18 months.

(5) *Does the quantity of infants' vocalisations at home predict vocabulary size at 18 months?* As the vocal production of infants can be diminished in relation to maternal depression (Field, 2002), it was predicted that the quantity of infant vocalisations would predict vocabulary size at 18 months.

3.2 Method

3.2.1 Participants.

Data for this component were available for 42 mother–infant dyads from the longitudinal study. Half of the dyads were in the risk group (n = 21, 11 female infants) and half in the control group (n = 21, 12 female infants) based on the mothers' current diagnosis of depression and anxiety and/or elevated symptoms (see Chapter 2 for participants details and group allocation criteria). At the time of recruitment, mothers' age ranged from 25 to 41 years (M = 33, SD = 4.15).

3.2.2 Materials and apparatus.

Day-long home recordings were obtained and analysed using the Language Environment Analysis system (LENA Foundation, 2009). The LENA system is an automatic

speech monitoring and language environment analysis tool used for infants and toddlers. The LENA Digital Language Processor (DLP) records all sounds in an infant's natural language environment and measures approximately 1×5×8 cm and weighs 85 grams. The DLP consists of a power button, a record/pause button, a display screen and a USB port for uploading. The DLP can record and store up to 16 hours of digitally recorded sound. It is worn by infants in a snap locked pocket on the front of a custom-made vest. Once the acoustic recording is complete, it can be uploaded to the LENA software and stored by participant for later analysis (Xu, Yapanel, & Gray, 2009). The LENA software is capable of outputting the full audio (16 bit, 16 kHz sampling rate, PCM WAV format) and generating summary reports of the audio data (Van Dam et al., 2015). Once uploaded and recharged, the DLP can be used again by another participant without impacting the data stored in the LENA software.

The reliability and Validity of LENA has been tested extensively in the home environment of typically developing infants and children (Sangwan, Hansen, Irvin, Crutchfield, & Greenwood, 2015). In comparison with human transcribes, LENA reliably identifies English vocalisations has been validated to have a high degree of accuracy in coding (Xu et al., 2009).

The LENA System includes software with advanced speech-identification algorithms that evaluate the audio signal using statistical likelihood techniques. The LENA System automatically analyses and segments the audio recordings into 12 categories including speakers, environmental sounds, and silence. A day long recording will typically include 20,000 to 50,000 segments of speech (VanDam & Silbert, 2016). After determining segment boundaries, the LENA software assigns a label to each segment using the proprietary algorithms. Segments of the recording are initially categorized as either speech or non-speech. The speech segments are labelled as "meaningful speech" or "distant speech". Meaningful speech refers to vocalisations within 6-feet of the DLP (at least 35 decibels

hearing level [dBHL]. Distant speech refers to vocalisations occurring 6 to 12 feet away from the DLP (<35 dBHL) and is therefore difficult for the LENA software to decipher. Non-speech segments are labelled as silence, noise (e.g., rattles, etc.) or electronic media (e.g., TV, radio) (Ford et al., 2008). Meaningful speech refers to human vocal activity that includes adult female, adult male, target infant wearing the DLP, and/or other children in the infant's environment.

The LENA software automatically produces 12-hour projections of three home language measures: adult word count, child vocalisation count, and conversational turn count. Additional details regarding the mother's interaction with her infant were extracted using the Advanced Data Extractor (ADEX) software provided by the LENA foundation (Ford et al., 2008). The ADEX software was used to extract estimates for child vocalisation counts (i) during mother–infant conversations, and, (ii) during infant monologues. Each measure was used as a dependent variable in our analyses, and it is explained in detail below.

3.2.2.1 Adult word count.

This measure estimates the number of adult words spoken "near and clear" to the infant, or loudly enough to register clearly in the LENA recorder (Ford et al., 2008). In practice, it has been estimated that these words occur typically within a 10-ft radius of the infant wearing the DLP (Gilkerson et al., 2017). The adult word count (AWC) does not distinguish between adult speech directed specifically to the infant, and adult speech overheard by the infant. As AWC excludes adult words that overlap with other voices, it is considered to only slightly underestimate the actual adult words spoken (Xu et al., 2009).

The adult word count does not provide information regarding the gender of the adult speaker. To ensure that there were no group differences in the quantity of male vs. female speech, ADEX software was used to extract the female and male word counts separately. There was no difference in male adult word count between the control (M = 796, SD = 541)

and risk groups (M = 973, SD = 802) at 6-months, $t(39) = -.765$, $p = .131$, $d = .238$, and 12 months (Control M = 4141, SD = 3823; Risk M = 3678, SD = 2795), $t(40) = .572$, $p = .275$, $d = .177$. There was also no difference in female adult word count between the control (M = 2569, SD = 1177) and risk groups (M = 2619, SD = 1143) at 6-months, $t(39) = -.047$, $p = .566$, $d = .015$, and 12 months (Control M = 11793, SD = 5423; Risk M = 9584, SD = 1084), $t(40) = 1.401$, $p = .193$, $d = .432$.

3.2.2.2 Conversational turn count.

This measure estimates the number of adult-infant interactions during the day and provides an estimate of the reciprocal vocalisations between an adult and an infant. A conversational turn consists of adult vocalisations that occur within five seconds of a child vocalisation and vice versa (Ford et al., 2008). The conversational turn count includes interactions with both male and female adults in the child's environment.

3.2.2.3 Child vocalisation count.

This measure estimates the number of speech-related sounds (e.g., words, babbling, and pre-speech sounds) produced by the infant that are bounded by at least 300 milliseconds of non-speech sounds or silence. The child vocalisations exclude all non-speech sounds such laughing and crying and vegetative sounds produced by the infant's digestive tract and respiratory tract such as burping, coughing and sneezing (Ford et al., 2008; Gilkerson, Coulter, & Richards, 2008). As an infant's vocalisation is bounded by silence and may be of variable length, a single sound in isolation (e.g., "b"), or a continuous string of babble (e.g., "Babababa"), or a string words with no pauses or breaks more than 300 ms (e.g., "Mummy I want the book"), would be all assigned a count of one vocalisation (Gilkerson et al., 2017).

3.2.2.4 Child vocalisations in conversations with adult female vs. child vocalisations child monologues.

A vocalisation activity block (VAB) begins with any human vocalisation (child or adult initiated) and concludes with five seconds or more of silence or non-speech sounds. The VABS containing reciprocated interactions are considered conversations and are labelled according to who initiated the block (e.g., female adult, male adult, or child) and who responded (e.g., adult or child). VABS that consist of a single voice are considered to be monologues and are labelled according to the identity of the speaker (e.g., male, female, or child). The block types used in the present study were female adult initiated with infant response and infant initiated with adult response. Infant vocalisation counts within these blocks were summed to enable a comparison of infant vocalisation group differences in the context of conversational interactions. Infant monologue VABS were also extracted to enable a comparison of infant vocalisation group differences in the absence of conversational interactions.

3.2.3 Procedure.

LENA recordings were collected when infants were 6 and 12 months of age. Mothers were given a recording kit and were shown how to use it by an experimenter during a home visit. The recording kit consisted of a DLP, a custom-made infant vest, and a laminated instruction sheet. To ensure that sufficient recording time was obtained (≥ 10 hours) to generate the 12-hour projections, mothers were instructed to begin recording when their infant woke in the morning and to stop recording when their infant went to bed at night. When their infant had a nap or a bath, mothers were instructed to remove the vest, but place it safely in the infant's environment during these times so the infant's vocalisations would continue to be recorded.

As the present study investigated mother–infant conversational interactions, mothers were asked to choose a recording day when they were the primary caregiver at home with their infant[1]. Mothers were also advised to avoid activities on recording days that involved considerable background noise (e.g., sporting events, birthday parties) as the accuracy of LENA counts reduces in these environments (Xu et al., 2009). Upon completion of the recording, mothers notified the researcher who picked up the recording kit during a subsequent home visit.

A total of 84 (42 x 2) daylong recordings were obtained. Recordings for one participant (Risk group) were excluded from analyses because the mother failed to accurately follow the recording instructions at the 6-month recording, resulting in counts below expectations on all measures. The recording duration of the remaining 6-month recordings ranged from 11 hours 23 minutes to 16 hours (*M* = 14 h 24 min), and 12-month recordings ranged from 10 hours 29 minutes to 16 hours (*M* = 14 h 41 min).

3.2.4 Expressive vocabulary size.

When the infants were 18 months of age, mothers completed the Australian English (OZI: Kalashnikova, Schwarz, & Burnham, 2016) adaptation of the MacArthur-Bates Communicative Inventory (Fenson et al., 1994). This measure is described in Section 2.3.3.

[1] This instruction was given to ensure that mothers were the primary care-giver on recording day. As such, a decision was made to refer to Adult Word Counts, Conversational Turn counts and Female Speech as if the adult speaker was always the mother. We acknowledge, however, this may not have always been the case.

3.3 Results

First, the adult word count, conversational turn count, and child vocalisation count collected when the infants were 6 and 12 months of age were compared between the control and risk groups using repeated-measures Analyses of Variance (ANOVA) with each automatic LENA measure as the dependent variable and infant age (6 and 12 months) and group (control and risk) as the independent variables. Next, these measures were entered in multiple regression analyses to assess their relation to infant's vocabulary size at 18 months.

3.3.1 Home recording measures.

Means and standard deviations of LENA automated home recording measures are depicted in Figure 3.

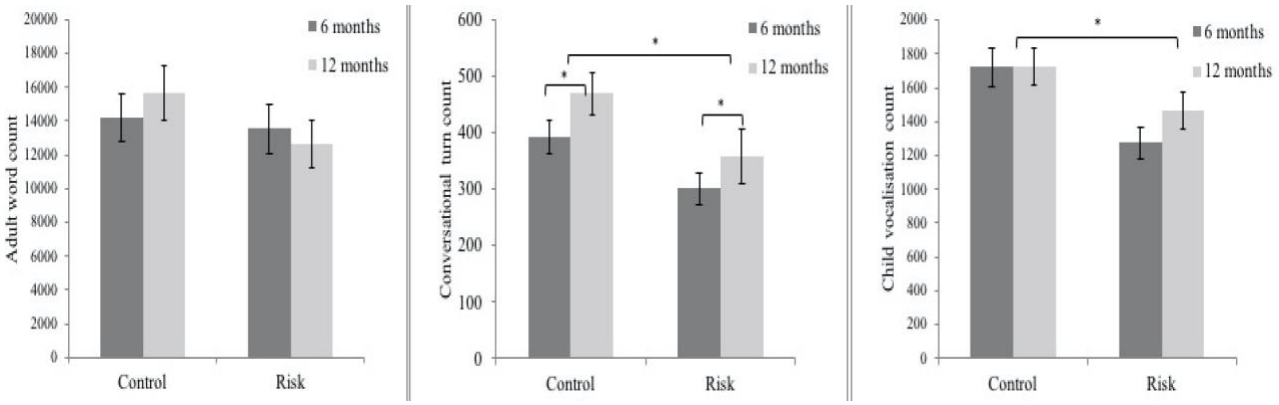

Figure 3. Risk and control group comparisons of daily language measures at infant age 6 and 12 months: (a) adult word count, (b) conversation turn count, and (c) infant vocalisation count.

3.3.1.1 Adult word count.

There was no main effect of group, $F(1, 39) = 1.145$, $p = .291$, $\eta^2 = .029$, age, $F(1, 39) = .073$, $p = .788$, $\eta^2 = .002$, and no group by age interaction ($F(1, 39) = 1.96$, $p = .302$, $\eta^2 = .027$). This indicates that infants in the risk group were exposed to a similar number of adult words in their environment as controls at both 6 and 12 months of age.

3.3.1.2 Conversational turn count.

The ANOVA yielded a main effect of group, whereby mother–infant dyads in the risk group engaged in fewer conversational turns compared with controls, $F(1, 39) = 5.848$, $p = .02$, $\eta^2 = .130$. There was also a main effect of age, $F(1, 39) = 4.834$, $p = .034$, $\eta^2 = .110$, but no significant group by age interaction, $F(1, 39) = .084$, $p = .773$, $\eta^2 = .002$. Regardless of group, the number of conversational turns increased with infant age.

3.3.1.3 Child vocalisation count.

In this case, there was a main effect of group, $F(1, 39) = 8.691$, $p = .005$, $\eta^2 = .944$, but there was no main effect of age, $F(1, 39) = 1.224$, $p = .275$, $\eta^2 = .030$, and no significant group by age interaction, $F(1, 39) = 1.080$, $p = .305$, $\eta^2 = .027$. Regardless of age, infants in the risk group vocalised significantly less compared to controls.

3.3.1.4 Conversations vs. monologues.

Next, infant vocalisations were analysed separately according to the two different contexts identified using ADEX software: infant monologues and conversations (Figure 4). It was anticipated that fewer vocalisations in the context of both conversations and monologues would suggest an overall diminished vocalisation ability in the risk group. Alternatively, a group difference in conversational contexts only would suggest the difference is not due to an overall reduction in the risk group infants' "talkativeness", but rather to the mother's degree

of verbal engagement with her child.

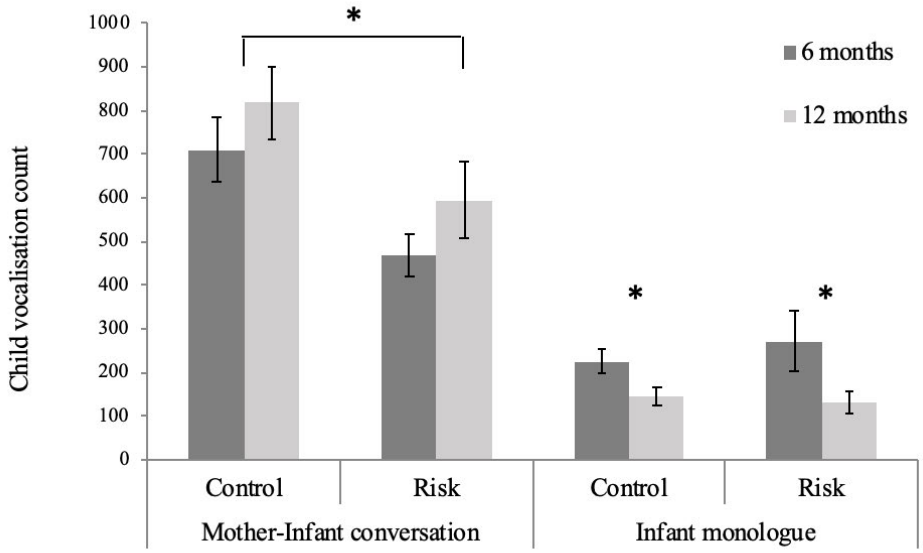

Figure 4. Risk and control group daily infant vocalisation counts in (a) mother–infant conversations and (b) infant monologues at infant age 6 and 12 months.

Conversations. When considering mother–infant conversations, there was a main effect of group, whereby infants in the risk group vocalised less in conversations with their mother, $F(1, 39) = 7.907$, $p = .008$, $\eta^2 = .169$, compared with controls. There was no main effect of age, $F(1, 39) = 3.224$, $p = .080$, $\eta^2 = .076$, or significant group by age interaction, $F(1, 39) = .020$, $p = .888$, $\eta^2 = .001$. These results suggest that regardless of age, infants in the risk group vocalised significantly less in conversations with their mother, than those in the control group.

Infant monologues. For infant monologues, however, there was no main effect of group; infants in the risk group vocalised to a similar extent as controls, $F(1, 39) = .118$, $p = .773$, $\eta^2 = .003$). However, there was a main effect of age, $F(1, 39) = 9.104$, $p = .004$, $\eta^2 = .189$, but no significant group by age interaction, $F(1, 39) = .697$, $p = .409$, $\eta^2 = .018$, so

infants vocalised less in monologues at 12 months of age compared to when they were 6 months of age. Together these findings suggest that infants in the risk and control groups vocalised to a comparable extent when alone, but risk infants vocalised significantly less than controls in the context of mother–infant conversations.

In summary, infants in the risk group engaged in fewer conversational turns and vocalised less, despite having access to a similar number of adult words in their environment compared to controls. Furthermore, infants in the risk group vocalised less in mother–infant conversations, but not when they were alone.

3.3.2 Home language environment and vocabulary size

One participant's OZI score was classified as an outlier because it was above three standard deviations from the mean and excluded from further analysis (Field, 2009). While infants in the risk group had numerically lower scores (M = 60.74, SD = 68.75) than controls (M = 78.25, SD = 49.88), this group difference was not statistically significant, $t(37) = .91$, $p = .367$, $d = .292$.

An initial correlational analysis was conducted to assess the relationships between expressive vocabulary size and the following variables: mean depression and anxiety scores, adult word count, conversational turn count, and child vocalisation count (Table 1). Vocabulary scores were negatively correlated with the mean anxiety measure ($r = -.544$, $p < .005$), and this relation approached significance for the mean depression measure ($r = -.31$, $p = .057$). Thus, mothers with higher indices of depression and anxiety had infants with smaller vocabulary sizes at 18 months. Vocabulary scores also were positively correlated with conversational turns ($r = -.46$, $p = .01$) and infant vocalisations ($r = -.34$, $p = .05$) at 12 months but not at 6 months of age. Vocabulary scores were not significantly correlated with adult word counts at either age.

Table 8.

Pearson correlations with expressive vocabulary scores, automated LENA language measures and mean depression and anxiety measures.

	1	2		3		4		5
	OZI	AWC		CTC		CVC		Mean
		a	b	a	b	a	b	Dep.
2. AWC								
a. 6 months	.09							
b. 12 months	.28							
3. CTC								
a. 6 months	.12	.65**	.49**					
b. 12 months	.49**	.14	.70**					
4. CVC								
a. 6 months	.03	-.23	.07	.47**	.30			
b. 12 months	.39*	-.23	.20	.12	.80**			
5. Mean Depression	-.31	.00	-.14	-.18	-.15	-.16	.12	
6. Mean Anxiety	-.44**	-.10	-.10	-.07	-.15	-.13	-.19	.67**

Note. * p <. 05; ** p < .01; *** p < .001; OZI = Australian English Communicative Development Inventory; AWC = Adult Word Count; CTC = Conversational Turn Count; CVC =. Child Vocalisation Count; Mean depression = average CESD-R scores; Mean anxiety = average STAI scores.

As shown in the correlational analyses, conversational turns and child vocalisation counts were significantly correlated with each other at both 6 (r = .47, p < .01) and 12 months (r = .75, p < .001). This is not unexpected as child vocalisations are incorporated into both measures. However, because conversational turn counts are a measure of infant-adult conversational interactions, it may provide an index of the role of the quantity of conversational interactions in explaining the variance in infants' early linguistic development.

Therefore, two separate step-wise multiple regression analyses were conducted with vocabulary scores as the dependent variable and conversational turn counts and child vocalisation counts as predictor variables respectively. In each model, the predictor variables were entered in the following order: maternal emotional health measures at Step 1, conversational turn or vocalisation count at 6 months at Step 2, and conversational turn count or vocalisation count at 12 months of age at Step 3. This order was determined by the prediction that after controlling for maternal depression and anxiety, the number of conversational turns (Model 1) and infant vocalisations (Model 2) at each age, would explain a significant amount of variance in infants' vocabulary scores at 18 months of age. Results of the models are summarised in Tables 9 and 10.

As seen in Tables 9 and 10, Model 1 (conversational turn counts) accounted for 38% of variance in expressive vocabulary scores ($F(1, 34) = 9.69$, $p < .01$; $R^2 = .38$), and Model 2 (child vocalisation count) accounted for 32% of variance ($F(1, 34) = 5.80$, $p < .05$; $R^2 = .32$). In the two models, maternal emotional health variables accounted for a significant 20% of variance in expressive vocabulary size. In the second step of both models, the addition of 6-month conversational turn counts (Model 1) and 6-month child vocalisation counts (Model 2) did not explain a significant amount of variance in expressive vocabulary. In the third step of both models, the addition of 12-month conversational turn counts (Model 1) and 12-month child vocalisation counts (Model 2) did explain a significant amount of variance in expressive vocabulary at 18 months. Both regression models revealed that maternal anxiety accounts for variance in infant's vocabulary scores, but this was no longer the case after the addition of conversational turn counts and child vocalisations counts to the regression models.

Table 9.

Multiple regression model with maternal emotional health and conversational turn count at 6 and 12 months (Model 1) predicting expressive vocabulary size.

	Step 1: R^2= .198, $F(1, 36) = 4.455$, $p = .019$			
Predictors	***β***	***SEM***	***t***	***p***
Mean postnatal depression	-.031	2.269	-.153	.879
Mean postnatal anxiety	-.425	1.756	-2.134	.040
	Step 2, $R^2 = .001$, $\Delta R^2 = .006$, $F (1, 35) = .243$, $p = .625$			
Mean postnatal depression	-.015	2.320	-.075	.940
Mean postnatal anxiety	-.432	1.779	-2.141	.039
6 months, Conversational Turn Count	.075	.070	.49	.625
	Step 3, $R^2 = .38$, $\Delta R^2 = .176$, $F (1, 34) = 9.685$, $p = .004$			
Mean postnatal depression	-.006	2.077	-.035	.972
Mean postnatal anxiety	-.350	1.609	-1.917	.064
6 months, Conversational Turn Count	-.115	.069	-.769	.447
12 months, Conversational Turn Count	.471	.046	3.112	.004

Table 10.

Multiple regression model with maternal emotional health and child vocalisation counts at 6 and 12 months (Model 2) predicting expressive vocabulary.

	Step 1, R^2 = .198, ΔR^2 =.198, F(1, 36) = 4.455, p = .019			
Predictors	***β***	***SEB***	***t***	***p***
Mean postnatal depression	-.031	2.269	-.153	.879
Mean postnatal anxiety	-.425	1.756	-2.134	**.040**
	Step 2, R^2 = .199, ΔR^2 =.001, F (1, 35) = .046, p = .832			
Mean postnatal depression	-.034	2.305	-.166	.869
Mean postnatal anxiety	-.426	1.780	-2.110	.042
6 months, Child Vocalisation Count	-.033	.019	-.214	.832
	Step 3, R^2= .316, ΔR^2 =.117, F (1, 34) = 5.803, p = .022			
Mean postnatal depression	-.063	2.166	-.333	.742
Mean postnatal anxiety	-.331	1.705	-1.713	.096
6 months, Child Vocalisation Count	-.168	.019	-1.097	.280
12 months, Child Vocalisation Count	.378	.019	2.409	**.002**

3.4 Discussion

This Chapter presented the first longitudinal investigation of day-to-day interactions experienced by infants of mothers affected by depression and anxiety, with a specific focus on conversational interactions during the first year of life and relation to infants' developing vocabulary size. Our findings showed that infants in the risk group had access to a similar number of adult words in their environment compared to controls. However, these infants'

recordings had lower conversational turn counts, and these infants vocalised less, particularly in conversations but not when vocalising alone. Mothers who reported elevated depression and anxiety symptoms also had infants with lower vocabulary scores at 18 months of age. The quantity of conversational turns and infant vocalisations were stronger predictors of infant vocabulary size than depression and anxiety measures.

3.4.1 Adult words vs. conversational turns.

Contrary to our prediction, the amount of adult words heard by infants was similar in both risk and control groups. Consistent with our prediction, the number of mother–infant conversational turns was significantly less in the risk versus the control group. These findings highlight the importance of the social context and qualitative aspects of infants' language experience (e.g., turn taking and maternal responsiveness). Conversational turns may be especially valuable in supporting language development as they provide increased opportunities for infants to both experiment with their language (by vocalising) and receive immediate feedback from adults (Romeo et al., 2018). The importance of the quantity of conversational turns is that it creates a social feedback loop in which mothers modify their responses and quality of IDS according to their infants' age and developmental needs (Kitamura & Burnham, 2003). Furthermore, conversational turn counts were a significant predictor of infants' later vocabulary size over and above mothers' individual scores of depression and anxiety. In fact, the vocabulary scores between the two groups were not statistically different suggesting that depression and anxiety alone do not explain individual differences in language development, but that this relation may be mediated by the quality of mother infant interactions. This issue is further investigated in Chapters 4 and 5.

There are several potential explanations for the group difference in the quantity of mother–infant conversational turns observed here. The first relates to potential deficits in maternal responsiveness. Maternal responsiveness refers to maternal behaviours in response

to a child's exploratory and communicative overtures that are contingent, prompt, and developmentally-appropriate (Bornstein, 1989). Mothers who are highly responsive will be sensitive to their infants' cues and respond to them reasonably quickly while establishing a clear contingency in ways that are well-matched to their infants' developmental level (Tamis-LeMonda & Baumwell, 2010). Research examining maternal responsiveness either implicitly or explicitly highlights the importance of a mother's response being contingent or linked conceptually and temporally to changes in her infant's behaviour (Tamis-LeMonda & Baumwell, 2010). Maternal depression is the most commonly cited factor that adversely impacts maternal responsiveness (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Mothers with elevated depression are more likely to provide responses to their infant that are inconsistent, insensitive, intrusive, or rare (Ainsworth, 1979). It is this potential disruption to the quality of the mother–infant interaction, rather than the depression itself, that is used to explain adverse developmental outcomes in children (Huang et al., 2012).

On a related note, the number of conversational turns may reflect disruptions to the temporal contingency of maternal responses in the risk group. Mothers with depression commonly demonstrate disruptions to temporal contingency in the form of rare or delayed responses to their infant (Ainsworth, 1979). This can particularly impact the use of automatic measures since conversational turn counts, unlike adult word counts, are a language measure that encompasses dyadic aspects of communication such as contingency (Romeo et al., 2018). For example, LENA defines a conversational turn as an adult vocalisation within five-seconds of an infant's vocalisation and vice versa (Ford et al., 2008), so if risk mothers produced responses which were delayed, they would have been excluded from the final counts.

The reduced number of conversational turns in the risk group is also explained by differences in social engagement that may accompany depression and anxiety symptoms. In

addition to intrusive behaviours, there is evidence that mothers with high anxiety are less responsive and engaged with their infants (Murray et al., 2007), which may have been the case for the mothers in the risk group in this study. Conversational turns may therefore provide a more holistic measure of the social aspect of the mother–infant interaction, and therefore be more sensitive to interaction deficits associated with maternal depression and anxiety.

In this component of the study it is unclear whether the reduced quantity of mother–infant conversational turn counts in the risk group was driven by mothers or their infants. Since the mother–infant interactive feedback loop is a continually evolving dynamic, it is likely that both mothers and infants influenced the fewer number of conversational turns in the risk group (Kuhl, 2007). Field and colleagues (1988), for example, found that in young (three- to 6-months-old) infants of postnatally depressed mothers generalised their depressed interaction pattern to interactions with adults who were not depressed. In turn, these non-depressed mothers began to demonstrate interaction behaviours similar to the depressed mothers (e.g., decreased contingent responsivity, vocalisations and game playing).

3.4.2 Home language environment and vocabulary size.

Disruptions to temporal contingency may also explain the negative correlations between depression and anxiety symptoms and expressive vocabulary scores. The prompt timing of a mother's response to her infant predicts and may promote language acquisition (Bornstein et al., 2008). This is posited to be due to the role of contingency as a facilitator of early word association that assists children to map words to objects (Plunkett, 1997). For example, a word-object association forms when both the word and the object need to co-occur within a brief time window, and infants have a strong dependency upon time windows as their linguistic knowledge and associative networks are still in a formative stage (Rovee-Collier, 1995).

The finding that conversational turns are the strongest predictor of vocabulary size also supports language development theories that emphasise social interaction. Kuhl (2007) coined the term "social gating" to describe the importance of the social context of IDS in promoting infant's acquisition of knowledge specific to their native language. As such, IDS does not occur in isolation but within a social context (Golinkoff et al., 2015). This context can be affected by maternal factors such as depression and anxiety. The present finding regarding the social aspect of language exposure (i.e. conversational turns and not adult words) as more important in supporting language development dovetails with similar findings with older children (Gilkerson et al., 2018; Romeo et al., 2018; Zimmerman et al., 2009) and highlights the importance of this social exchange in the first year of life.

Infants' degree of exposure to the acoustic qualities of IDS that can support language development can also partially account for the link between conversational interactions and infants' developing vocabulary size observed here. The LENA adult word count measure does not distinguish between speech directed specifically to the infant (IDS), and adult speech (ADS) overheard by the infant (Gilkerson et al., 2017). This distinction may, however, be reflected more in the conversational turn count measure. This measure is more likely to reflect the quantity of IDS spoken to the infant, a speech register that promotes language learning and contributes to their later vocabulary size (Kalashnikova & Burnham, 2018). For example, exposure to IDS in the laboratory has been shown to assist infants with phoneme discrimination (Liu, Kuhl, & Tsao, 2003), word segmentation (Thiessen, Hill, & Saffran, 2005), detection of phrase boundaries (Jusczyk et al., 1992), word recognition (Song et al., 2010), and word learning and memory (Ma, Golinkoff, Houston, & Hirsh-Pasek, 2011). Fewer conversational turns, as in the case of mother–infant dyads with elevated maternal depression or anxiety, could imply less exposure to the language-promoting benefits of IDS,

resulting in smaller infant vocabulary sizes. However, due to limitations associated with the LENA conversational turn count measure, this cannot be concluded with certainty.

3.4.3 Infant vocalisations and the communication feedback loop.

As expected, infants in the risk group vocalised less compared to the control group. This finding is in contrast with research involving other populations such as the case of infants with mild, moderate, severe or profound hearing loss whose vocalisation quantity did not differ from controls (Iyer & Oller, 2008). Caskey and colleagues (2011) found that premature infants actually increased the volume of their vocalisations in the presence of caregivers. The present study, in contrast, found a reduction in the number of infant vocalisations in the risk group when infants were in the presence of mothers versus when they were alone. This finding may reflect the specific features of the interaction style of depressed mother–infant dyads when compared with non-depressed dyads.

Infant vocalisations contribute to the mother–infant conversational exchange and the framework within which their relationship develops (Franklin et al., 2013). Infants appear to learn that their vocalisations can serve a social function through eliciting immediate adult responses (e.g., Goldstein et al., 2003). They can become active agents in their interactions and language learning. This is supported by a study in which 12 to 30 month old infants' vocalisations were found to be more mature when the infants initiated the interaction as opposed to when they responded within the mother–infant interaction (Ko et al., 2016).

The influence of adult responses to infants' vocalisations also drives home the importance of the social context of IDS. When interacting with their infants, mothers try to both maintain and repair the flow of conversational exchanges (Golinkoff, 1986). One reason for the reduced number of infant vocalisations in the risk group may relate to empirical evidence that the contingency of social responses to infants' early babbling influences their vocalisations (Goldstein et al., 2003; Goldstein & Schwade, 2008). When mothers' vocal

responses are sensitively time-locked (contingent) to their infants' vocalisations, both the *quality* and *quantity* of the infants' vocalisations increases. Goldstein and Schwade (2008) found that 9-month-old infants produced vocalisations that are more mature and complex when their mothers responded contingently to their babbling compared to when they responded following a delay signalled by a researcher (see Goldstein et al., 2003 for similar findings). Given that depressed mothers are less likely to provide contingent responses to their infant (Biringen, Emde, Brown, Lowe, Myers, & Nelson, 2000), it is plausible that mothers in the risk group responded less contingently to their infants' vocalisations, leading to a reduction in overall infant vocalisation quantity and quality during mother–infant conversations. In addition, given that babbling constitutes an important phase in language development (Goldstein & Schwade, 2008), it is not surprising that the quantity of infant vocalisations also predicted vocabulary size in the present study.

When examining the mother–infant interaction from a broader perspective, fewer infant vocalisations in depressed mother–infant dyads may have also resulted from infants imitating their mothers' depressive interactive style (Field, 1988; Reck et al., 2012). Previous research has shown a general depressive or withdrawn/avoidant interaction pattern of infants who have depressed mothers. This has included observations of increased withdrawal and avoidance behaviours such as avoidance of eye contact and lower levels of positive affect (Cohn, Matias, Tronick, Connell, & Lyons-Ruth, 1986). This unique interactive style may serve a self-regulatory function for infants (Tronick & Gianino, 1986). That is, behaviours such as frequent head turning and active avoidance of eye-contact, serve a self-protective function for the infant, to avoid the potential negative affect and stress associated with interacting with a non-responsive mother (Reck et al., 2008). Physiological signs of infant stress have been identified in depressed mother–infant dyads during interactions. Field and colleagues (1998), in their study of 3- to 6-month-old infants revealed clear signs of infant

stress (raised cortisol levels, elevated pulse and decreased vagal tone) when infants were interacting with their postnatally depressed mothers. The reduced number of vocalisations within the contact of mother–infant conversations may reflect infants' attempt to avoid stress that serves both a self-protective and a self-regulating function. This would also explain why the reduction in vocalisations was only present in a social context as opposed to when infants were vocalising alone in monologues.

One consideration related to LENA's automated measures (e.g., adult word count), is that it does not capture variations in the lexical diversity of input such as diversity in vocabulary, phrases, and clauses that the mothers used in speech to their infant (Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010). For example, mothers could have provided a large number of words to their infant but simply could have repeated the same number of limited words. In addition, automated word counts such as conversational turns, may not be reflective of the true number of interactions between mother and infant. As a conversational turn is registered when an infant vocalisation occurs within 5 seconds of an adult word (and vice versa), a conversational turn count could be recorded by LENA incidentally. However, all participants were exposed to the same limitations of the automated recording system, suggesting that the significant group difference in conversational turn counts is related to the group allocation criteria.

3.5 Conclusion

Empirical evidence repeatedly affirms the relationship between high levels of maternal responsiveness and greater language abilities such as receptive and expressive language skills. Our study provides direct evidence that this link may be mediated by the quantity of the daily interactions, specifically the number of conversational turn counts. We did not find significant differences in vocabulary size between the risk and control groups, which raises the question about additional factors that could be mediating vocabulary growth

in this risk population. However, we showed that mean depression and mean anxiety scores were significant predictors of infants' vocabulary scores.

This Chapter provides support for the importance of early and frequent conversational turns with young infants to support their vocabulary development. This seems especially critical in depressed or anxious mother–infant dyads, as this is associated with a reduction in the number of mother–infant conversational turns and infant vocalisations. These effects of maternal emotional health on mother–infant interactions on infants' later vocabulary size highlight the need for attention on early communicative interactions between parents and their infants as well as for screening for symptoms of depression and anxiety soon after or even before birth.

CHAPTER 4

Infants' Lexical Abilities

Chapter 3 examined the impact of maternal depression and anxiety symptoms on the quantity of mothers' speech input to their infants in the first year of life. The findings indicated a significant relation between maternal depression and anxiety scores and the number of conversational turns and infant vocalization counts. These two measures of day-to-day interactions were also found to be predictors of vocabulary size at 18 months. Continuing with this project's longitudinal schedule, this section assesses infants' lexical processing efficiency at 18 months. The aim of this section is to assess the influence of maternal depression and anxiety on infants' lexical processing skills and expressive vocabulary size, and the relation between these two measures of early lexical competence. As 18 months is an age that reflects a landscape change in infants' emerging lexical abilities, it offers an optimal time point for assessing individual variation in the development of this skill.

4.1 Infant's Lexical Abilities and Maternal Emotional Health Concerns

Despite the recent focus on lexical processing efficiency and its relationship to later language outcomes, it is unknown how depression and anxiety may influence the speech-processing efficiency of infants. As discussed in Section 1.4.1, variation in language experience associated with maternal health concerns appears to influence children's language outcomes and potentially the processes that accompany language acquisition. This includes a change in the usual developmental trajectory related to early native speech sound discrimination skills (Weikum et al., 2012). These early skills have in turn been shown to predict infants' later lexical abilities (Tsao et al., 2004; Werker & Yeung, 2005). In addition,

infants of mothers with depression and anxiety have reduced expressive language abilities at 12-months of age (Kaplan et al., 2014; Reck et al., 2018). Taken together, this research suggests that the onset of language delay in children of depressed and/or anxious mothers may commence quite early in infancy and be reflected in infants' early pre-lexical and lexical skills.

Despite the evidence associating maternal emotional health concerns to language outcomes, the effect of maternal depression and anxiety on infants' lexical processing abilities is unknown. This component of the longitudinal study aims to assess infants' early lexical skills, specifically expressive vocabulary size and lexical-processing skills. These measures were selected as both vocabulary size and lexical processing skills predict later literacy skills, school readiness, and academic performance in primary school (e.g., Morgan, Farkas, Hillemeier, Hammer, & Maczuga, 2015). Vocabulary size was assessed using a parental report, which is a well-established method for obtaining valuable information about infants' early language development (Fenson, Marchman, Thal, Dale, & Reznick, 2007). An objective assessment of infants' lexical processing abilities provides a valuable complement to parental reports of vocabulary size. Recent developments in experimental techniques have enabled researchers to obtain a direct measure of infants' lexical processing abilities, which have been found to yield consistent concurrent and predictive relations to language outcomes (Fernald et al., 2013).

4.1.1 Lexical Processing Skills.

As infants enter their second year of life, their vocabulary continues to grow with an acceleration occurring around 18 months of age (McMurray, 2007). At around the same age, infants become increasingly faster and more efficient at recognising familiar words in continuous speech (Fernald, Pinto, Swingley, Weinberg, & McRoberts, 1998; Fernald, 2000). Lexical processing is a fundamental skill associated with language learning, and it refers to

the ability to access the meaning of familiar words stored in the lexicon. Along with the notable increase in their vocabulary production during the second year of life, the number of words infants recognise also increases (e.g., Fernald, Perfors, & Marchman, 2006). Infants also become more adept at recognising the same word in different contexts. In addition, the speed and accuracy of their word recognition becomes more efficient (e.g., Fernald et al., 1998).

Lexical processing skills are correlated with vocabulary growth and later language outcomes for children (Fernald et al., 2006). Word recognition skills demonstrated by toddlers at 25 months of age predict later language skills at eight years of age (Marchman & Fernald, 2008). Lexical processing skills also predict later vocabulary size. These word recognition skills are typically assessed between 12 and 24 months using an eye-tracking task that monitors the speed of language processing in real-time. Using this method, Marchman and colleagues found in a series of experiments that individual differences in lexical processing skills at 18 months can predict expressive vocabulary at 30 months in both pre-term and full-term infants (Marchman et al., 2019). In addition, individual differences in processing speed in pre-term infants tested at 18 months of age were shown to predict receptive vocabulary at 3 years (Marchman, Adams, Loi, Fernald, & Feldman, 2016), and global language and cognitive abilities at 4.5 years (Marchman et al., 2018). Taken together, these studies demonstrate the relevance of early lexical processing skills to language development and later language milestones.

4.1.2 The Looking-While-Listening procedure.

The looking-while-listening (LWL) procedure is commonly used to assess lexical processing abilities (see Fernald, Zangl, Portillo, & Marchman, 2008). It uses real-time measures of children's gaze patterns in response to speech. It imposes low cognitive demands and can be used with automated eye-tracking technology, making it well suited for infants in

their second year of life. The LWL procedure measures the speed and accuracy with which infants are able to match a spoken word (auditory stimulus) with a visual representation of a word when presented with alternatives (visual stimuli) in real time. For instance, in a LWL task, an infant may be presented with the images of a cup and a ball side by side and hear "Look at the ball!".

With regards to lexical processing during infancy, the LWL procedures can provide a detailed picture of young infants' ability to comprehend or find meaning in spoken language. LWL provides measures of speech processing moment-by moment, so that response latencies can be coded on multiple trials, over multiple items, and with millisecond precision (Fernald et al., 2008). Fernald and colleagues (1998), were the first researchers to employ the LWL procedure to examine infants' language processing speed using real time measures. Infants' gaze patterns were coded as they looked at pictures of familiar objects (target and distracter) and heard speech naming one of the pictures. They found that the mean response latency (shifting from distracter to target picture) decreased over time between 15 and 24 months, demonstrating an average increase in infants' processing speed with infant age.

Infants' lexical processing abilities have been found to have high predictive validity of later literacy skills, school readiness, and academic performance in primary school (e.g., Morgan et al., 2015). A number of studies have used the LWL procedure to assess lexical processing abilities in infants at-risk for language deficits including late-talkers and children at risk for language delay (Fernald & Marchman, 2012). A group that has been studied recently is at-risk due to an environmental factor, specifically socio-economic status (SES). Significant group differences (low- versus high-SES) were identified in language processing speed when infants were 18 and 24 months of age (Fernald et al., 2013). Infants from the higher SES group demonstrated greater language processing efficiency and higher vocabulary scores. This finding suggests that experiential differences in infants' language experience

(e.g., quantity of speech input), may contribute to differences in children's language processing efficiency.

The overall objective of this Chapter is to investigate the relation between the speech processing efficiency of infants who have mothers with elevated depression or anxiety symptoms. Infants' vocabulary size and lexical processing skills were assessed as part of our longitudinal study to address two aims: (1) to assess the effects of maternal depression and anxiety on infants' performance on a lexical processing task, and (2) to assess the effect of maternal depression and anxiety on infants' expressive vocabulary size. As seen above, given that 18 months is a time point of acceleration in infants' lexical skills, it was decided to address these aims when infants from the longitudinal sample reached this age.

First, on the basis of the established relationship between maternal depression and language outcomes (see Chapter 1), it was predicted that infants in the risk group would demonstrate deficits in their lexical processing abilities compared with infants in the control group. It was also predicted that infants' speed and accuracy of lexical processing would be correlated with maternal depression and anxiety scores.

Second, as maternal depression and anxiety have been negatively related to infants' language development outcomes (e.g., Kaplan et al., 2014; Reck et al., 2018), it was predicted that infants in the risk group would have smaller expressive vocabulary sizes compared with infants in the control group, and that higher maternal depression and anxiety scores would be associated with smaller infant expressive vocabulary sizes.

4.2 Method

4.2.1 Participants.

A total of 46 infants from the longitudinal study (24 female) participated in the assessment of their lexical abilities. Seven infants from the longitudinal study were unavailable to attend the laboratory to complete the lexical processing task. From the infants who took part, data for 10 infants (Control = 8, Risk = 2) were excluded from the final analysis due to equipment failure (n = 2) acquired hearing loss (n = 1), having less than 40% of gaze samples (n = 2), and failure to complete the task (n = 5). The remaining subgroup of 36 infants (19 female) consisted of 19 infants in the control group and 17 in the risk group. At the time of testing, infants were 18-months-old.

4.2.2 Materials and apparatus.

Infants' lexical processing skills were assessed using the Looking-While-Listening (LWL) procedure (see Fernald, Zangl, Portillo & Marchman, 2008). Infants' gaze duration to the objects on the screen was recorded using a Tobii X120 eye tracker. The visual stimuli were presented on a 19 inches square LG monitor approximately 60 cm in front of the infant. The auditory stimuli were presented to infants through an Edirol MA-15D speaker placed directly below the monitor.

4.2.2.1 Auditory stimuli.

Target words were selected on the basis of previous research and familiarity to 18-month-old infants (Fernald et al., 2006; Song, Demuth, & Morgan, 2010). A total of 6 target words; ball, book, car, cup, hat, and shoe, were embedded in two types of carrier phrases: question "Where is the target?" and exclamation "Look at the target!". Two filler words were chosen for the filler trials: "Wow" and "Look".

An Australian-English speaking female was recorded for all audio stimuli in a sound proof booth. The female speaker was instructed to imagine that she was speaking to an infant. Five tokens of each carrier phrase and target word were recorded. The final tokens were selected as exemplars by two judges (PhD students) with experience with IDS. In order to verify the stimuli, an acoustic analysis of the phrases was conducted using Praat, version 6.0.40 (Boersma & Weenink, 1996) (see Table 11). Results indicated that pitch and word duration were in the usual range for IDS and consistent with stimuli used in previous research (Fernald et al., 1989; Ma, Golinkoff, Houston, & Hirsh-Pasek, 2011; Thiessen, Hill, & Saffran, 2005).

Table 11.

Acoustic analysis of auditory stimuli.

Audio stimuli	F0	F0 Minimum	F0 Maximum	Target word duration (seconds)
Look at the ball	336.20	168.79	480.09	0.55
Look at the book	315.29	175.04	523.88	0.47
Look at the car	351.04	163.61	489.15	0.58
Look at the cup	332.74	175.71	522.07	0.46
Look at the hat	330.45	194.33	502.10	0.56
Look at the shoe	312.72	147.73	492.46	0.62
Where is the ball	304.13	79.32	447.90	0.61
Where is the book	315.40	205.26	515.13	0.44
Where is the car	287.85	148.85	423.22	0.65
Where is the cup	355.72	214.39	524.28	0.40
Where is the hat	362.54	216.69	511.25	0.60
Where is the shoe	322.11	163.12	439.58	0.62
Filler-Look	312.03	184.15	526.11	NA
Filler-Wow	257.28	173.89	355.55	NA

4.2.2.2 Visual stimuli.

Visual stimuli for test trials consisted of 6 colourful pictures of familiar objects that were presented side-by-side in pairs (target and distracter). The pictures were presented on a white background, and they were selected to be comparable in size and visual saliency (see

Figure 5 for an example test trial). The images appeared in blocked pairs: ball-cup, hat-book, shoe-car. The side of target presentation was counterbalanced across trials.

Example test trial 'shoe-car'	Example filler trial
Visual Stimuli	Visual Stimuli
	
Auditory stimuli, "Look at the shoe"	Auditory stimuli, "Wow"

Figure 5. Example test trial and filler trial for the look-while-listening task.

Four filler trials were included to maintain infants' attention during the task. Filler trials consisted of four colourful images presented in each corner of the screen. All four images were approximately at the same distance from the centre of the screen. Images differed across the four filler trials and included varying combinations of: a baby, banana, teddy bear, hairbrush, dog, cat, spoon, strawberry (see Figure 1 for an example filler trial). A total of 24 test trials and four fillers were constructed using iMovie software version 10.0.9. Each experimental trial was of 6-second duration. Visual stimuli were accompanied by silence followed by the carrier phrase including the onset of the target word at three seconds (see Figure 6). This enabled a measure of infant eye gaze duration prior to the naming of the

target object at 3 seconds (pre-naming), and after the naming of the target object (post-naming).

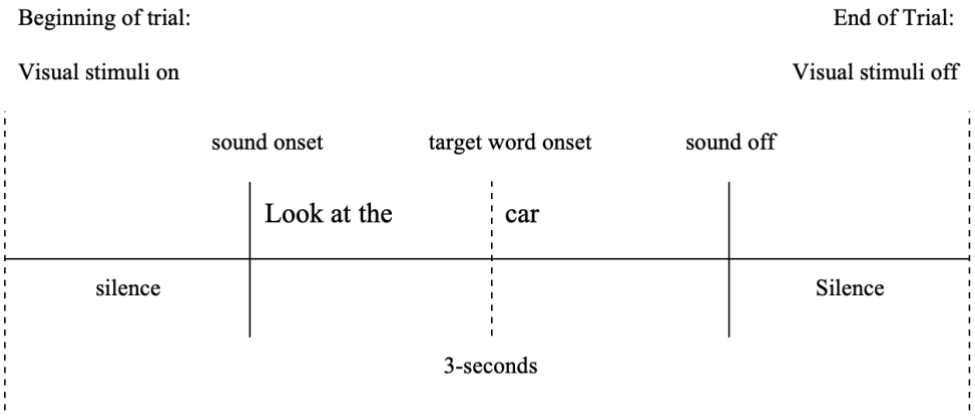

Figure 6. An example of an experimental trial timeline of 6-second duration.

The 24 test trials were divided into 4 blocks separated by a different filler trial. Each block consisted of 6 different target words. The order of trials within each block was randomised. Two blocks contained the carrier phrase "Where is the target?" and two blocks used "Look at the target!". In each block the target picture was presented an equal number of times on the left and right side.

4.3 Procedure

4.3.1 The Looking-While-Listening task.

Infants sat on their caregiver's lap in a child-friendly laboratory room with minimal light interference facing a computer monitor. To prevent them from interfering with the infants' performance, caregivers listened to mixed auditory sounds via Macally headphones. In addition, mothers were instructed to divert their eyes away from the computer monitor to prevent their own gaze from interfering with the eye-tracker's recording. Prior to the start of the task, infants completed a 5-point infant calibration routine. The researcher observed the

infant from an adjoining control room via live feed using a webcam located on the top of the computer monitor and directed towards the infant's face.

Each infant completed 28 trials: 24 test trials and four filler trials (Swingley & Aslin, 2000). Before the commencement of each trial, infants were presented with an attention-getter stimulus. The presentation of each trial was controlled by the researcher upon the infant fixating their gaze on the attention-getter stimulus. Each test trial commenced with the simultaneous presentation of two images (target and distracter), which remained on screen for the 6 second trial duration. The visual stimuli were accompanied by silence followed by the carrier phrase including the onset of the target word at three seconds. The total duration of the LWL task was approximately five minutes.

4.3.2. Expressive vocabulary checklist.

When the infants were 18 months of age, mothers completed the Australian English (OZI: Kalashnikova, Schwarz, & Burnham, 2016) adaptation of the MacArthur-Bates Communicative Inventory (Fenson et al., 1994). Mothers were asked to identify words on the checklist that their child can say. OZI data was unavailable for one infant from the control group.

4.3.3 Data processing and analysis.

Two rectangular Areas of Interest (AoIs) encompassing each object were defined for each test trial. The AoIs were located on the right and left sides of the screen encompassing the visual referent. The size and position of the AoIs was identical across all trials.

Raw gaze data were extracted from Tobii Studio software and were processed using EyeTracking R in R (Dink & Ferguson, 2015). First, segments with data loss were identified, and trials with less than 25% detected gaze were excluded from all subsequent analyses. On average, infants contributed trials with 72% of detected gaze per trial, and this did not differ

between the risk and the control groups, $t(29) = -.321$, $p = .750$. Next, two response windows were defined: the pre-naming window and post-naming window. The pre-naming window was from 0 to 3300 msec, which included looks to the target and the distracter prior to the presentation of the target label. The post-naming window is the critical response window for analyses of the accuracy and latency of infants' looking behaviours. This window was from 3300 to 4800 msec, which included looks to the target and the distracter in response to the target label. A 1500 msec response window was used for analyses as looking behaviours later in the trial are unlikely to represent responses to the target label (Marchman & Fernald, 2008). Proportion of time looking (PTL) to the target out of the total looking time to the target (T) and the distracter (D) was calculated [PTL = T/(T+D)] for each time window and was used as the dependent variable in all analyses.

Finally, trials were categorised based on whether the infant had fixated the target object (target-initial trials) or distracter object (distracter-initial trials) at the onset of the target word (Fernald et al., 2008). This enabled an onset contingent analysis to assess the latency (response time) required to switch gaze from distracter to target object after hearing the target name.

4.4 Results

The descriptive statistics for response times on the LWL task are shown in Table 12.

Table 12.

Mean (SD) accuracy and latency in the LWL task.

Measure	Group	
	Control	Risk
Accuracy	.67 (.14)	.57 (.12)
Latency	-.39 (.86)	.39 (1.01)

First, infants' PTL to the target during the pre-naming window was compared between the control and risk groups. An independent-samples *t*-test analysis showed no group differences, $t(30) = -.306$, $p = .762$. However, one-sample *t*-tests confirmed that infants in the control, $t(17) = -.872$, $p = .395$, and risk groups, $t(13) = -.272$, $p = .790$, did not look at target above chance levels (chance = .5) prior to hearing its label (Bonferroni correction for multiple comparisons used to adjust the *p*-value to .025). These analyses demonstrate that infants in the two groups did not exhibit any visual preferences to the referents used in the task that may have impacted their post-naming looking behaviours.

The time course of control and risk infants' looking behaviours during the experimental trials are presented in Figure 7.

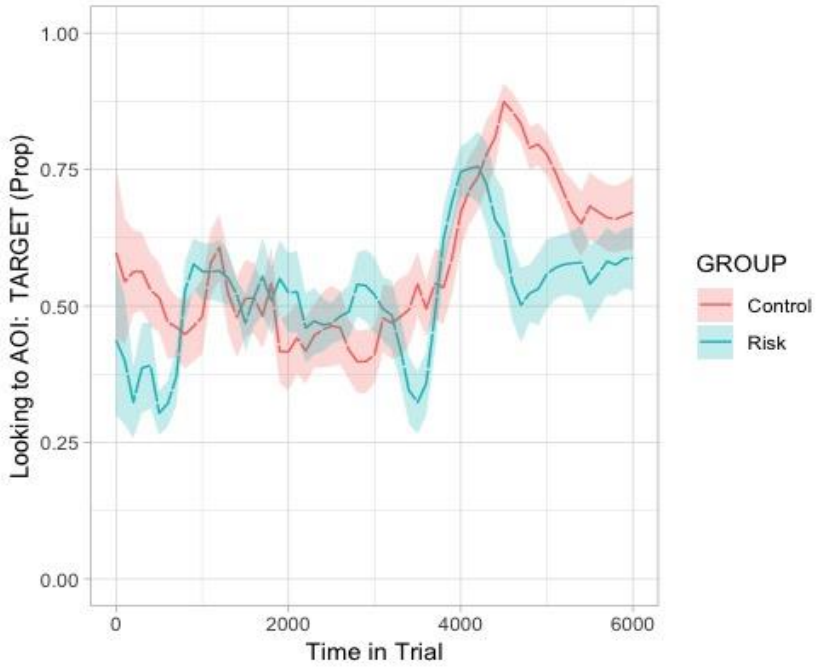

Figure 7. The time course of looking behaviours (control versus risk group infants) during the experimental trials.

Next, *post-naming* performance was compared between the two groups on measures of accuracy and latency upon hearing the target label.

4.4.1 Accuracy.

This term refers to infants' proportion of correct fixation (i.e. the proportion of looking to the target versus distracter following hearing the target label). An independent-samples t-test showed that infants in the control group were significantly more likely to fixate the target than infants in the risk group after hearing its label, $t(30) = 2.085$, $p = .046$. One-sample *t*-tests were conducted to determine whether infants were fixating the target above chance levels (0.5). Only infants in the control group fixated the target significantly above chance levels, $t(17) = 5.082$, $p < .001$, as this was not the case for the risk group, $t(13) = 2.265$, $p = .041$ (The Bonferroni correction was applied given that the sample was divided into two sub-samples (risk and control) resulting in multiple comparisons to the data . The Bonferroni correction for multiple comparisons adjusted the *p*-value to .025) (Figure 8).

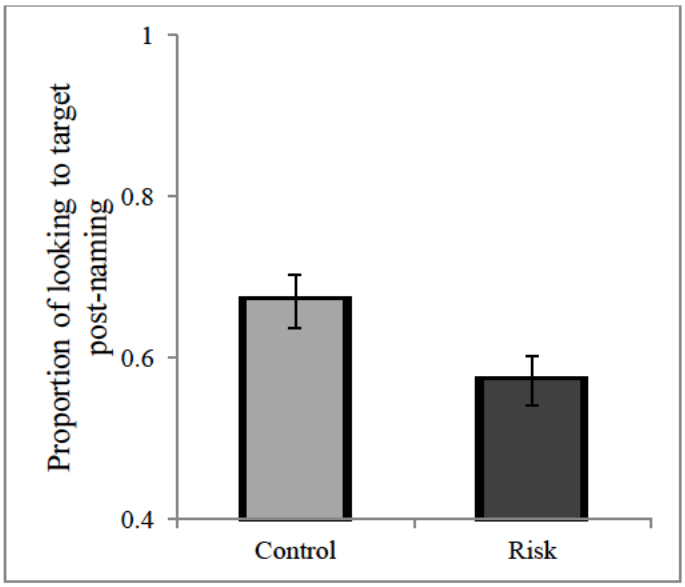

Figure 8. Proportion of looking to target (control versus risk group infants) during the post-naming window.

4.4.2 Latency.

This term refers to the measure of the speed with which infants switched their gaze from the distracter to target after hearing the target label. In order to assess infants' lexical processing efficiency, an onset contingent gaze analysis was conducted. Only trials in which the infant was fixating the distracter at the start of the post-naming phase were included in this analysis in order to assess the latency of gaze switches from the distracter to the target in response to the target label. Twenty-two infants did not contribute data to these analyses. Response latencies for the two groups are shown in Figure 9. Data for 4 infants were excluded as their latency values were identified as outliers (more than 3 SD away from the mean). Raw latencies were converted from msec to z-scores for these analyses. An independent-samples *t*-test showed that risk infants were marginally slower in directing their gaze to the target compared to the control infants, but this difference did not reach statistical significance, $t(20) = -1.927$, $p = .068$, $d = .832$.

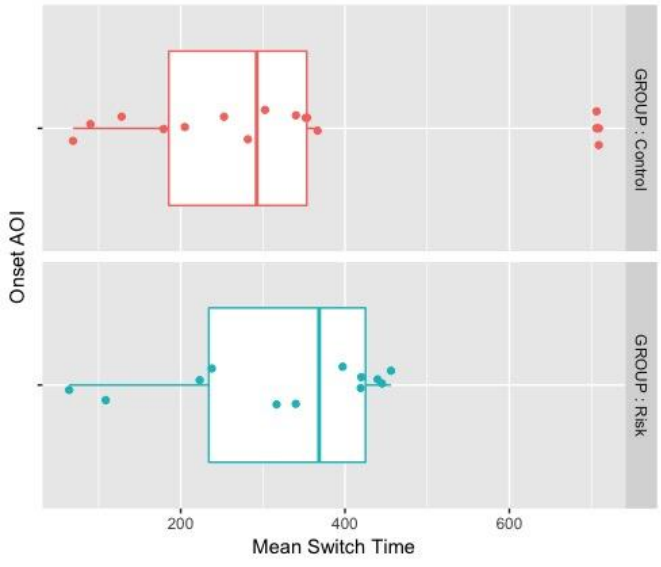

Figure 9. Mean latencies (control versus risk group infants) switching from distracter to target object on target trials.

4.4.3 Expressive vocabulary size.

Reflecting the results reported in Chapter 3, no statistically significant differences were observed in the expressive vocabulary scores for this subset of risk and control groups, $t(29) = .806$, $p = .427$, even though control infants' scores ($M = 83.72$, $SD = 48.16$) were numerically higher compared to the risk infants ($M = 65$; $SD = 80.91$). Next, we assessed the relations between infants' lexical processing performance and their vocabulary size as well as their mothers' depression and anxiety scores. As expected, infants' expressive vocabulary size at 18 months was significantly correlated to the proportion of looking time to target post-naming, $r(31) = .538$, $p = .002$, and latency of gaze switch to target, $r(21) = -.550$, $p = .010$. This confirms that our experimental task was capturing individual lexical abilities.

4.4.4 Links between lexical processing and maternal emotional health measures.

Importantly, infants' lexical processing accuracy was also significantly correlated to mean maternal depression, $r(32) = -.607$, $p < .001$, and mean maternal anxiety, $r(32) = -.398$, $p = .024$, as assessed across the longitudinal project (mean scores from 6 to 18 months). Infants of mothers who scored higher mean depression and anxiety scores in the postnatal period were less likely to fixate the target object after hearing its label in this task.

The latency of gaze switch to target was negatively correlated with mean depression scores, $r(22) = .415$, $p = .055$. Infants with mothers with higher depression scores took longer to switch from the distracter to the target object. Latency was not significantly correlated with anxiety scores (see Table 13).

Table 13.

Pearson correlations (r) of response time and vocabulary at 18-months and mothers depression and anxiety scores.

Variable	Accuracy	Latency	Mean depression	Mean anxiety
OZI	.538**	-.550**	-.476**	-.426*
Accuracy	1/1	-.492*	-.607**	-.398*
Latency		1/1	.415	.343
Mean Depression			1/1	.735**
Mean Anxiety				1/1

Note. Depression = CESD-R scores; Anxiety = STAI scores; OZI = Australian English Communicative Development Inventory; * $p < .05$; ** $p < .01$.

4.4.5 Links between maternal depression and anxiety and lexical processing skills.

Infants' vocabulary size and maternal depression and anxiety scores were significantly correlated. Therefore, we were interested in assessing directly whether maternal depression and anxiety explained variance in infants' individual lexical processing performance above the variance explained by their individual expressive vocabulary size. For this purpose, two hierarchical linear regression models were constructed, one with proportion of looking time to target post-naming as the dependent variable and the other with latency of gaze switch to target as the dependent variable. Both models removed variance of the

expressive vocabulary scores in the first block and included mean depression and anxiety scores as the predictor variables in the second block. Both models were significant accounting for 34.6% and 20.7% of variance respectively. However, maternal depression was the only significant predictor of infants' proportion of looking time to target in the lexical processing task in Model 1 but not in Model 2 (see Table 6 below). Importantly, after removing the variance explained by vocabulary size, maternal depression remained as a significant predictor of lexical processing performance but this was not the case for maternal anxiety.

Table 14.

Hierarchical linear regression models with proportion of looking time to target post naming (Model 1) and latency of gaze switch to target (Model 2) as dependent variables.

Model 1: Proportion of looking time to target					
Removed covariate	R^2 = .389, F(2, 28) = 8.930, p = .001				
	B	***SEB***	***β***	***T***	***P***
Vocabulary size	.327		.327	2.035	.052
Entered predictor variables					
Mean postnatal depression	-.019	.006	-.677	-3.180	**.004**
Mean postnatal anxiety	.002	.004	.076	.358	.723
Model 2: Latency of gaze switch to target					
Removed covariate	R^2 = .286, F(2, 18) = 3.609, p = .048				
	B	***SEB***	***β***	***T***	***P***
Vocabulary size	-.589	.328	-.383	-1.798	.090
Entered predictor variables					
Mean postnatal depression	7.978	5.584	.399	1.429	.170
Mean postnatal anxiety	2.618	4.234	.173	.618	.544

Note. Depression = CESD-R scores; Anxiety = STAI scores.

4.5 Discussion

This is the first study to investigate the lexical processing abilities and expressive vocabulary size in infants of mothers who have elevated depression and anxiety symptoms.

First, the present results revealed deficits in infants' lexical processing abilities that are correlated with their mothers' depression scores. Second, a negative correlation was found between infants' expressive vocabulary size and maternal depression and anxiety scores. Third, infants' vocabulary size was associated with their lexical processing abilities.

The first aim of assessing infants' lexical abilities was to examine the effects of maternal depression and anxiety on infants' performance on a lexical processing task. Consistent with our prediction, infants in the risk group demonstrated deficits in their lexical processing abilities. One of the most important findings of this study is the observation that by the age of 18 months, there are already significant differences in infants' lexical abilities related to their mothers' depression and anxiety. That is, infants in the risk group did not fixate the target above chance levels. It is noted that the risk group did perform above chance when the strict Bonferroni was not applied, but importantly, their performance was significantly different to the performance of infants in the control group. While this is the first study to examine the effect of maternal depression on lexical processing abilities, our findings are consistent with studies with older children that have linked maternal depression with child language outcomes (Milgrom et al., 2004; NICHD Early Child Care Research Network, 1999). Findings from the present study, however, extend the previous literature by showing that deficits in lexical abilities, specifically lexical processing efficiency, are present very early on. Most importantly, this finding demonstrates that the deficits identified in later language skills are not only associated with vocabulary size, but with foundational perceptual processes associated with language acquisition and that can be detected already in children's second year of life.

It was also predicted that infants' accuracy and speed of lexical processing would be correlated with maternal depression and anxiety scores. This was the case for accuracy as discussed above, but latency scores were not correlated with any of the emotional health

variables. The response time required for the risk-group infants to switch from distracter to target was only marginally slower than infants in the control group. In the present study, it is likely that the absence of a group difference for latency (versus accuracy) is due to the smaller sample size (n = 22), caused by the exclusion of target-initial trials. The absence of a link between latency and vocabulary size has been observed in another lexical processing study, which yielded a relation between accuracy and vocabulary scores, but not for latency and the vocabulary scores of 18-month-old infants (Hurtado, Marchman, & Fernald, 2008). A positive correlation between latency and vocabulary size was evident, however, when the same infants were tested again at 24-months.

The second aim of this study consisted in examining the effect of maternal depression and anxiety on infants' lexical processing skills and expressive vocabulary size. Consistent with our prediction, both depression and anxiety scores were negatively correlated with vocabulary size. The relationship with maternal anxiety scores and vocabulary in the present study is consistent with recent findings that 12-month-old infants with mothers with an anxiety disorder score significantly lower than controls on standardised measures of their language abilities (Reck et al., 2018). Our finding is also consistent with several outcome studies that have associated maternal depression with delays in children's later language outcomes. For example, the NICHD Early Child Care Research Network (1999) conducted a longitudinal study that followed mother–infant dyads at 6, 15, 24, and 36 months, and assessed children's language and general cognitive abilities at 36 months. After controlling for demographic risk factors, children of mothers with chronically or occasionally elevated depression scores performed more poorly than non-depressed mothers on measures of verbal comprehension and expressive language in addition to an assessment of school readiness. Milgrom, Westley, and Gemmill (2004) assessed 42-month-old infants with mothers who had been admitted as inpatients for major depression during the perinatal period. They found that

these infants had significantly lower language and cognitive scores, compared to controls, on the Early Screening Profile. In addition, they had lower scores on the full-scale (but not verbal IQ) of the Wechsler Preschool and Primary School Scale of Intelligence-Revised (WPPSI-R). Interestingly, as discussed in Section 1.2.6, these outcomes were mediated by observer-based assessments of maternal responsiveness when infants were 6-months-old.

In summary, findings from the present study highlight the negative effect of maternal depression and anxiety symptoms on infants' early lexical processing abilities. This study also provides additional evidence that early real-time lexical processing measures align with early vocabulary development at 18 months of age. These findings have potential clinical implications regarding early identification of infants who may be at risk for delayed language development, associated with their mother's depression and anxiety symptoms.

In Chapter 3 we were able to detect a difference in the home language environment of infants developing in families with maternal depression and anxiety compared to children from families with no history of depression and anxiety. In this Chapter, we were able to see a difference in infants' early lexical abilities that were strongly correlated with maternal depression symptoms. In Chapter 5, we will examine the relationships between maternal depression and anxiety, maternal responsiveness and infants' vocabulary growth. By analysing these variables together, we aim to delineate the complex relationships between maternal emotional health and infants' emerging lexical abilities.

CHAPTER 5

Maternal Responsiveness and the Links with Maternal Depression and Infants' Vocabulary Size

Maternal responsiveness is at the core of the mother–infant feedback loop. As discussed in Chapter 1, mothers who are highly responsive are sensitive to their infants' cues and respond to them reasonably quickly, while establishing a clear contingency in ways that are well-matched to their infants' developmental level (Crockenberg & Leerkes, 2011). In turn, children of highly responsive mothers also tend to develop greater language abilities, including receptive (Hann et al., 1996) and expressive language skills (Tamis-LeMonda, Damast, Baumwell, & Bornstein, 1996) (see Chapter 1 for a detailed review of the literature on maternal responsiveness and its relation to language development).

Maternal responsiveness is widely accepted as one of the most crucial dimensions of the mother–infant interaction (Wolff & Ijzendoorn, 1997). However, it is also a construct that can be negatively impacted by maternal depression and anxiety symptoms (Ainsworth, 1979; Howard Steele, Steele, & Croft, 2008). In fact, there is evidence to suggest that it is not the depression itself that causes adverse developmental outcomes in infants, but instead, its impact on maternal responsiveness, or the quality of the interactions a mother has with her infant (Huang et al., 2012), which in turn results in negative effects on infants' linguistic development. Some questions remain, however, regarding the mechanisms through which depression and anxiety symptoms interact with maternal responsiveness and whether this interaction magnifies the effect of maternal responsiveness on infants' language abilities. Answering this question may guide interventions with mother–infant dyads in which infants are at risk of language delay due to their mothers' psychological symptoms.

The overall objective of this component of the longitudinal study is to investigate the relationship between maternal depression and anxiety, and maternal responsiveness in the postnatal period and infant' early vocabulary growth at 18 months. For this purpose, the expressive vocabulary scores collected using the OZI (see Chapter 2) were used as well as ratings of maternal responsiveness, which were based on behavioural observations of mother–infant play sessions conducted at 9 and 12 months. Similar to the analyses presented in previous chapters, and following the pathways of the interactive feedback loop, the expressive vocabulary scores were used as the outcome measure in this component, and maternal responsiveness was used as the predictor or mediator measure.

Four predictions were constructed for the analyses reported in this Chapter. First, given that depression and anxiety have been linked to disruptions in the quality of mother–infant interactions (see Section 1.2.8), it was predicted that mothers in the risk group would have lower maternal responsiveness scores compared with mothers in the control group.

Second, as maternal depression and anxiety have been negatively related to infants' language development outcomes (e.g., Kaplan et al., 2014; Reck et al., 2018), it was predicted that infants in the risk group would have smaller expressive vocabulary sizes compared with infants in the control group, and that higher maternal depression and anxiety scores would be associated with smaller infant expressive vocabulary sizes.

Third, as maternal responsiveness has been linked with lower expressive language abilities in 3 and 4 year old children (Hudson et al, 2015) and in the timing of the early language milestone achievement (Tamis-LeMonda et al., 2001), it was predicted that maternal responsiveness scores in the postnatal period would predict infants' vocabulary size at 18-months.

Finally, given that maternal depression and anxiety have been linked to impairments in the quality of mother–infant interactions (see Section 1.2.8), and these emotional health

variables and maternal responsiveness have been linked to adverse language abilities (Kaplan et al., 2014; Reck et al., 2018; Hudson et al., 2015), it was predicted that depression and anxiety would interact with maternal responsiveness in their relation to infant vocabulary size.

5.1 Method

5.1.1 Participants.

A total of 48 mother–infant dyads from the longitudinal study (26 control; 22 risk) were available to attend the laboratory to participate in at least one mother–infant play session. Eleven mother–infant dyads (7 Control; 4 Risk) were unavailable to attend at either the 9-month (6 control; 3 Risk) or 12-month (1 Control; 1 Risk) assessment.

5.1.2 Procedure.

5.1.2.1 Mother–infant play sessions.

Mothers and their infants were invited to participate in a brief play session in a child-friendly interview room when their infants were 9 and 12 months of age. Mothers were asked to interact with their infants using a set of age-appropriate toys including a toy phone, a four-piece jigsaw puzzle, a doll, nesting cups, two matching shakers/rattles, a roller toy with a mirror and movable parts, and a book. The mothers were informed that the play session would be video-recorded and were asked to interact with their baby as they would do at home. The mother and infant sat on the floor during the interaction. The experimenter (thesis

author) sat at a desk in the same room and recorded the interaction using a tablet[2]. The researcher remained silent and did not engage in the interaction in any way. The duration of the recording was approximately 10 minutes.

5.1.2.2 Maternal responsiveness ratings.

An observer-based approach was employed for the measurement of maternal responsiveness, given that observational methods provide greater predictive validity than survey-based approaches (Tamis-LeMonda, Briggs, McClowry, & Snow, 2009; Zaslow et al., 2006). Observer-based approaches typically involve video-recording mother–infant interactions during semi-structured activities such as playtime (Shannon, Tamis-LeMonda, London, & Cabrera, 2002) or more structured activities such joint book-reading (Rodriguez et al., 2009). Global rating scales are commonly used either in real time or through later analysis of video-recorded mother–infant interactions. Global ratings can consist either of a single measure designed to capture all the critical elements of maternal responsiveness in one score (Ainsworth et al., 1978; Down, Levickis, Hudson, Nicholls, & Wake, 2015) or of separate ratings of specific maternal behaviours (Clark, 1985). Global rating scales are a cost-effective alternative to behaviour frequency counts, which do not provide information on the appropriateness or contingency of maternal responsive behaviours, thus failing to capture critical elements of maternal responsiveness (Crockenberg & Leerkes, 2011). For these reasons, this study employed the Parental Responsiveness global rating scale (PaRRiS) described below.

[2] This recording method was employed to increase the flexibility of the recording process, i.e. to move with the infant to different locations of the room if required.

5.1.2.3 The Parental Responsiveness Rating Scale (PaRRiS).

The PaRRiS measurement tool was used to score the quality of the mother–infant interactions during the 10-minute play session. The PaRRiS was adapted from the Marfo global rating scale of responsiveness (Marfo, 1992) (see Appendix L for details). The videos were rated in real time, without rewinding or pausing the recording. A score was then assigned for overall maternal responsiveness using the PaRRiS five-point Likert-style scale (1 = Very Low; 5 = Very High responsiveness).

A total of 85 mother–infant play sessions were obtained and rated for maternal responsiveness. The candidate was trained in the use of the PaRRiS by one of the co-developers of the scale who also assisted with providing blind ratings for 32 (38%) of the videos. Inter-rater reliability checks with the blind rater occurred on regular occasions during the study to ensure that there was no change in inter-rater consistency over time. Where there were occasional one-point differences between the raters, those cases were discussed until arriving to a consensus and to ensure that accurate ratings were applied to each participant's video.

5.1.2.4 Expressive vocabulary size.

Expressive vocabulary scores were collected using the OZI (see Section 2.3.3).

5.1.3 Data analysis.

As reported in Section 2.2.6, maternal depression and anxiety scores were averaged across the postnatal period to obtain a mean depression and mean anxiety score for each participant. In a similar manner, responsiveness ratings at both 9 and 12 months were averaged to provide a mean maternal responsiveness score for the postnatal period.

Three sets of analyses were conducted. First, the maternal responsiveness scores and vocabulary scores for the risk and control groups were compared using independent t-tests.

Second, correlational analyses were conducted to assess the relations of maternal depression and anxiety, maternal responsiveness, and infant vocabulary scores. Next, a hierarchical regression was conducted to test the relation of predictor variables, depression, anxiety, and maternal responsiveness, and the dependent variable, infant vocabulary size. Finally, to test the prediction that depression and anxiety would interact with maternal responsiveness in their effect on infant vocabulary, two moderation analyses were conducted. Moderation implies an interaction effect, whereby the introduction of a moderating variable (M) changes the magnitude of the relationship between the predictor variable (X) and outcome variable (Y) (Hayes, 2018). The conceptual pathway for the moderation analyses conducted in this Chapter is presented in Figure 10.

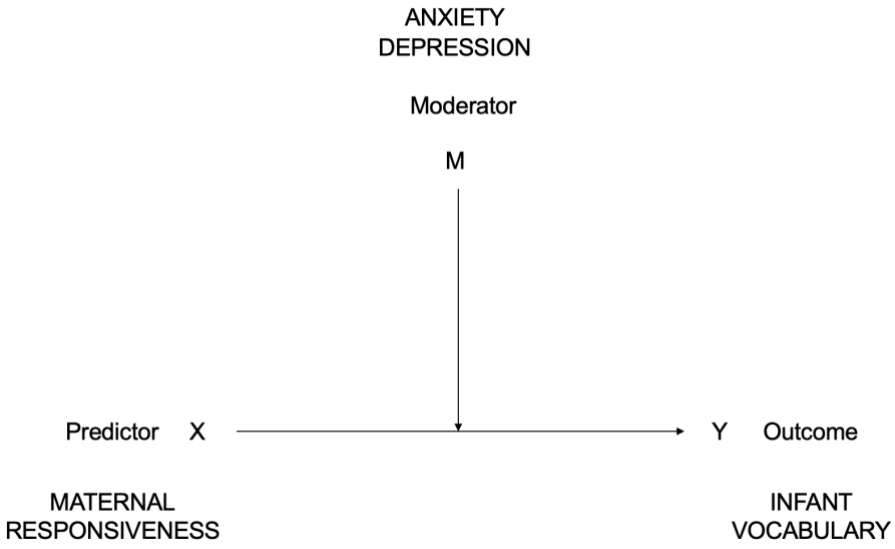

Figure 10. A conceptual diagram of the influence of potential moderator variables (M) on the relationship between the predictor (X) and outcome (Y) variables.

The moderation analyses were conducted following the regression-based Conditional Process Analysis approach using custom dialog "PROCESS" (Version 3.3; Hayes, 2018) in SPSS. This approach adds a second step to the hierarchical regression model described above

and includes an additional test of the interaction between M and X to determine whether the interaction is a significant predictor of variance in Y (see Hayes (2018) for further details). In this second step the standard errors and 95% confidence interval (CI) of the moderation effect are bootstrapped and bias-corrected (based on 5000 samples). To assist with its interpretation and to avoid multicollinearity, the analysis package automatically standardises all variables by centring them around the mean, i.e. mean and +/- 1 SD from the mean.

5.2 Results

5.2.1 Group comparisons in maternal responsiveness and vocabulary size.

Independent-sample *t*-tests comparing mean maternal responsiveness scores between the risk and control groups (Control 26; Risk 22) confirmed that there were no significant differences in maternal responsiveness between the control (M = 2.94, SD = .75) and risk groups (M = 3.00, SD = .87).

Next, independent-samples *t*-tests comparing infant expressive vocabulary size at 18-months, revealed higher scores in the control group (M = 77.19, SD = 49.14) than the risk group (M = 60.19, SD = 65.26), but this difference was not statistically significant $t(45) = 1.0$, $p = .621$.

5.2.1.1 Relations between vocabulary size, maternal responsiveness and emotional health variables.

First, correlational analyses showed significant relations between infants' expressive vocabulary size and their mothers' mean depression scores ($r(48) = -.29$, $p = .045$), anxiety scores ($r(48) = -.38$, $p = .008$), and maternal responsiveness ratings ($r(45) = .36$, $p = .016$). Interestingly, mean maternal responsiveness scores were not significantly correlated with mean depression ($r(48) = .019$, $p = .898$) or anxiety scores ($r(48) = -.207$, $p = .159$).

Second, a hierarchical multiple regression analysis was conducted with infant expressive vocabulary size as the dependent variable, and maternal depression and anxiety scores as independent variables in the first step, and then maternal responsiveness ratings entered as an independent variable in the second step. This step order was determined by the prediction that after controlling for maternal depression and anxiety, mean maternal responsiveness should explain a significant amount of variance in infant vocabulary scores at 18 months.

The resulting model explained 16% of variance ($F(3, 41) = 3.86$, $p < .016$; *Adj* $R^2 = .163$), and maternal responsiveness was the only significant predictor ($\beta = .311$, $SE = 10.236$, $t = 2.145$, $p = .038$) of infant vocabulary (see Table 15). Specifically, in Step 1, the maternal depression and anxiety variables were entered into the model, which was significant accounting for 9% of variance in expressive vocabulary scores, *Adj* $R^2 = .092$, $F(2, 42) = 3.22$, $p = .050$. In Step 2, maternal responsiveness was entered into the model, which was significant and accounted for an additional 9% of variance in expressive vocabulary scores, $\Delta R^2 = .087$, $F(1, 41) = 4.60$, $p = .038$.

Table 15.

Multiple regression model with maternal emotional health and maternal responsiveness as the predictor variables and expressive vocabulary size as the dependent variable.

	Step 1, *Adj* R^2= .092, *F*(2, 42) = 3.22, *p* = .050			
Predictors	***β***	***SEM***	***t***	***p***
Mean postnatal depression	-.042	2.137	-.208	.836
Mean postnatal anxiety	-.334	1.608	-1.667	.103
	Step 2, *Adj* R^2= .163, ΔR^2 =.087, *F*(1, 41) = 4.60, *p* = .038			
Mean postnatal depression	-.161	2.136	-.805	.426
Mean postnatal anxiety	-.205	1.617	-1.017	.315
Maternal responsiveness	.311	10.236	2.145	**.038**

The regression model tested how depression and anxiety scores and maternal responsiveness ratings account for variance in vocabulary scores. When all three independent variables were entered into the model, maternal responsiveness was the only significant predictor of vocabulary size. The model did not, however, test for potential interactions between maternal responsiveness and the other two predictor variables in relation to vocabulary size as the outcome variable. Therefore, two moderation models were conducted, with maternal responsiveness as the predictor variable (X), vocabulary scores as the outcome variable (Y), and depression and anxiety as moderating variables (M) in Models 1 and 2 respectively.

5.2.1.2 Moderation effect of anxiety on the relation between maternal responsiveness and infant vocabulary.

The first regression model was conducted to test the hypothesis that mothers' anxiety levels (M) moderate the relationship between maternal responsiveness (X) and infant vocabulary scores (Y). In the first step, two variables were included: maternal responsiveness and mothers' anxiety. These two variables accounted for a significant amount of variance in infant vocabulary, *Adj* R^2 = .170, $F(1, 42) = 5.519$, $p = .007$. The maternal responsiveness and anxiety variables were used to create the maternal responsiveness × anxiety interaction term.

In Step 2, the interaction term was added to the regression model, which was not statistically significant, $\Delta R^2 = .057$, *F* change $(1, 41) = 3.167$, $p = .083$. Maternal anxiety does not, therefore, have a significant moderating effect on the relation between responsiveness and vocabulary.

5.2.1.3 Moderation effect of depression on the relation between maternal responsiveness and infant vocabulary.

A second regression model was conducted to test the hypothesis that mothers' depression levels (M) moderate the relationship between maternal responsiveness (X) and infant vocabulary scores (Y). In the first step, two variables were included: maternal responsiveness and mothers' depression. These two variables accounted for 16% of variance in infant vocabulary, *Adj* $R^2 = .16$, $F(2, 42) = 5.27$, $p = .009$.

In Step 2, the interaction term of maternal responsiveness × depression was created and added to the regression model. This accounted for 9% of variance in infants' vocabulary scores, $\Delta R^2 = .093$, $F(3, 41) = 5.391$, $p = .025$. Maternal depression, therefore, has a moderating effect on the relation between maternal responsiveness and vocabulary.

Next, to assist with the interpretation of this effect and to understand the nature of the moderating effect of depression[3] on the relation between maternal responsiveness and infants' vocabulary size, interaction points were plotted (see Figure 12) using model-generated weighted scores representative of three categories (low, average and high) for both maternal responsiveness and depression variables.

Examination of the resulting interaction plot confirmed that mothers' depression has a *decreasing* influence on the relation of maternal responsiveness on vocabulary scores, but this influence is conditional. When mothers' depression scores fall in the low or average categories, low maternal responsiveness levels are associated with low infant vocabulary size, and as mothers' responsiveness increases their infants' vocabulary size increases. On the other hand, infants of mothers with high depression scores have lower vocabulary sizes regardless of their mothers' responsiveness levels: low, average, or high. Visual examination of Figure 13 confirms the absence of an interaction effect of depression on the relation between maternal responsiveness and vocabulary when depression levels are high.

[3] A moderation effect can be: (1) *Increasing* (i.e. increasing M *increases* the effect of IV on DV), (2) *Decreasing* (i.e. increasing M *decreases* the effect of IV on DV), or (3) *Reversing* (i.e. increasing M *reverses* the effect of IV on DV).

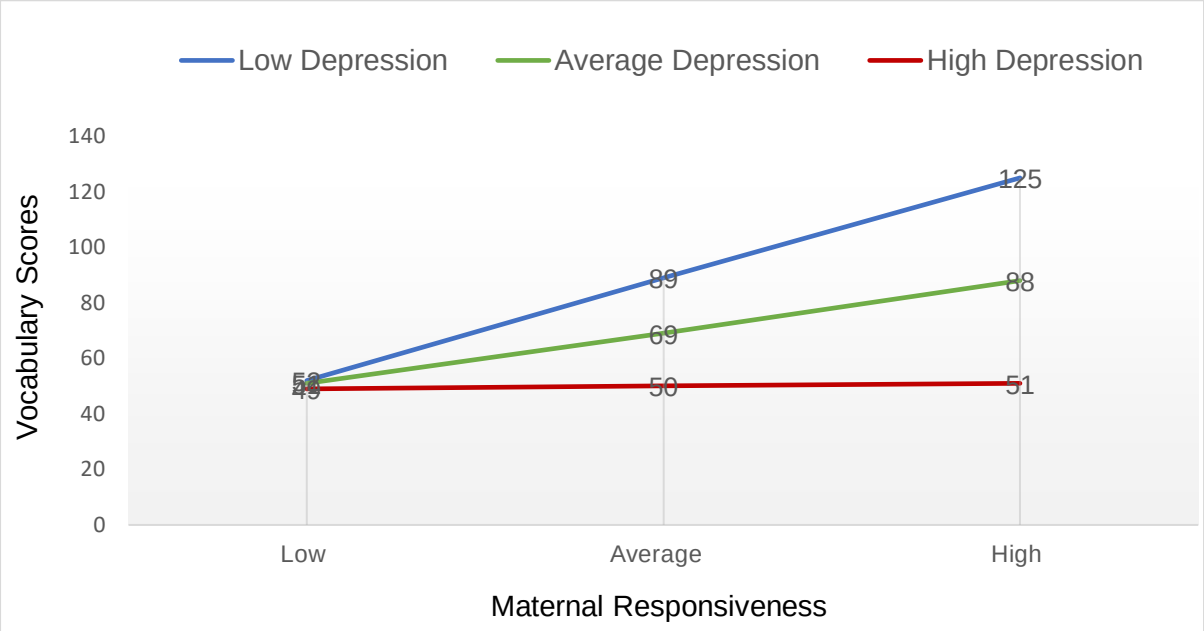

Figure 11. An interaction plot depicting the moderation effect of depression on the relationship between maternal responsiveness and infants' vocabulary scores.

In summary, our initial correlational analyses revealed significant relations between vocabulary size and depression, anxiety, and maternal responsiveness. These independent variables were then entered into a hierarchical multiple regression model with depression and anxiety variables entered in the first step and maternal responsiveness in the second step. The resulting model was significant, explaining 16% of the variance in vocabulary scores. However, maternal responsiveness was the only significant predictor of infant vocabulary size.

To explore maternal depression and anxiety as potential moderators of the relation between maternal responsiveness and vocabulary size, two moderation analyses were conducted. Depression but not anxiety, was revealed as having a *decreasing* moderating effect on the relation between maternal responsiveness and vocabulary size. There was a significant moderation effect of depression on the relation between maternal responsiveness and vocabulary, in the low and average but not the high depression condition. In the high

depression condition, vocabulary scores were low regardless of the levels of maternal responsiveness.

5.3 Discussion

This Chapter investigated the link between maternal responsiveness observed in mother–infant interactions in the first year of infants' lives and their expressive vocabulary size in the second year, as well the moderating effects of maternal emotional health variables on this language outcome. Contrary to predictions, mothers in the risk group did not have significantly lower maternal responsiveness scores or vocabulary scores compared with mothers in the control group. Consistent with predictions, there was a relation between infants' vocabulary size, and maternal responsiveness scores, whereby infants with mothers with higher levels of responsiveness had larger expressive vocabulary sizes. Conversely, infants had smaller expressive vocabulary scores, when their mother reported higher depression and/or anxiety scores. Finally, the severity of mothers' depression (not anxiety) symptoms moderated the effects of maternal responsiveness on infant vocabulary size.

Consistent with the third prediction, the results demonstrated that infant vocabulary sizes at 18 months were larger in the cases where maternal responsiveness levels were higher in mother-interactions recorded at 9 and 12 months. This finding is congruent with previous research (see Chapter 1) that has linked maternal responsiveness with infants' early language abilities such as expressive and receptive language skills (Hudson et al., 2015), and the timing of expressive language milestone achievements, including a 50-word expressive vocabulary size (Tamis-LeMonda et al., 2001). This finding is also true for the entire sample, and in fact, our analyses failed to reveal significant differences in maternal responsiveness between the risk and control groups. There was also an absence of a significant association between maternal responsiveness and mothers' depression and anxiety scores. The use of a

global scale to rate maternal responsiveness may have contributed to this finding as a 5-point scale narrows the range of variability. It is plausible that a more fine-grained and labour-intensive measurement may have been sensitive to group differences in maternal responsiveness that were not detected by a global scale. The validity of the PaRRiS, however, is supported in the findings of a strong association with maternal responsiveness and infant vocabulary.

5.3.1 Depression moderates the effect of maternal responsiveness on vocabulary size.

The moderating effect of maternal depression is a novel finding. While our conceptual framework is accurate in depicting a relation between responsiveness and depression, analyses reported in this Chapter clarified that this is a *moderation* relation. The detrimental nature of the moderation effect was only apparent in the low and average depression conditions. There was an absence of a significant moderation effect in the high depression condition.

These results have several clinical implications for interventions to assist mother–infant dyads in the postnatal period, where infants may be at risk for adverse developmental outcomes. These implications are congruent with research studies suggesting that while medication and psychological treatments can assist in the reduction of maternal depression symptoms (Austin & Priest, 2005; Dennis, 2004; Dennis & Stewart, 2007), they do not necessarily improve the quality of the mother–infant interaction and mitigate the risks to child development (Field, 1998; Murray & Cooper, 2003; Nielsen, Videbech, Hedegaard, Dalby, & Secher, 2000). Both screening and intervention strategies must take into account the levels of maternal responsiveness in addition to maternal depression scores in order to address all levels of inferred risk. As can be seen from the interaction plot presented in Figure

13 above, a mother with low maternal responsiveness may still have an infant who is at-risk for language delay regardless of her level of depression (low, average, or high). Treating these mothers for depression without considering the quality of the relationship with their infant, i.e. maternal responsiveness, is unlikely to mitigate the risk of language delay for these infants. Furthermore, interventions that focus on increasing maternal responsiveness in mothers with low to moderate levels of depression increase the likelihood of gains in infant language acquisition. On the other hand, to promote language acquisition in infants of mothers with high depressive symptoms, interventions need to focus on both improving a mother's mood in addition to their responsiveness to their infant; these are also likely to exist in a two-way relationship where a mother's improved mood may increase her responsiveness to her child and vice versa.

In summary, this Chapter highlights the negative effect that lower levels of maternal responsiveness have on infants' early vocabulary size. It also provides evidence that depression symptoms negatively moderate the effect of maternal responsiveness on vocabulary. The implications of these findings will be detailed further in the General Discussion in Chapter 7. However, for now, one outstanding question remains regarding the role of intervention in promoting maternal responsiveness and potentially mitigating the adverse developmental risks for infants reported in this Chapter. As maternal responsiveness in infancy provides a vital foundation for children's rapidly emerging language abilities (Tamis-LeMonda & Baumwell, 2010), it is pertinent to focus interventions on improving responsiveness levels, especially in at-risk populations. Therefore, Chapter 6 evaluates the efficacy of a short video-feedback intervention in promoting maternal responsiveness in mother–infant interactions.

CHAPTER 6

Promoting Maternal Responsiveness: An Intervention

"Not everything that can be counted counts, and not everything that counts can be counted" Albert Einstein.

6.1 Mother–Infant Dyadic Interventions

While pharmacological and psychological treatments for postnatal depression and anxiety can assist in the reduction of maternal depression symptoms (Austin & Priest, 2005; Dennis, 2004; Dennis & Stewart, 2007), these interventions do not necessarily improve the quality of the mother–infant interaction nor mitigate the risk for insecure attachment (Field, 1998; Murray & Cooper, 2003; Nielsen, Videbech, Hedegaard, Dalby, & Secher, 2000). Focusing treatment on the maternal mood disorder in isolation from the mother–infant interaction, therefore, is unlikely to mitigate the risks of maternal depression for infants' development (see Gunlicks and Weissman, 2008 for a review). An increasing body of research, however, suggests that interventions that specifically focus on improving the quality of the mother–infant relationship can mitigate developmental risks for children (Newman, Sivaratnam, & Komiti, 2015). For example, mother–infant dyadic interventions with mothers with postnatal depression have shown improvements in attachment security, child cognitive ability, and emotional regulation (e.g., Cicchetti et al., 2000; Cohen et al., 1999: Paris, Herriott, Holt, Gould, 2011; Goodman et al., 2014). Dyadic interventions are designed to target the mediation processes that link maternal depression with adverse developmental outcomes for children.

The overall objective of this Chapter is to test the efficacy of a video-feedback intervention, using both quantitative and qualitative methods, that aims to promoted maternal responsiveness and wellbeing in mother–infant interaction. Aside from obtaining a quantitative measure of maternal responsiveness, conducting interviews with mothers enabled

us to illuminate the mothers behind the numbers observed in the findings presented in the previous chapters. It also provided mothers with the opportunity to give individual meaning to the statistics reported in the longitudinal study and to share their experiences of an intervention aimed at promoting maternal responsiveness.

Over the last two decades, video feedback interventions have been used as a single approach or in combination with other approaches to increase maternal sensitivity and promote attachment between mothers and their infants (Juffer, Bakermans-Kranenburg, & van Ijzendoorn, 2005, 2008; Kennedy, Landor, & Todd, 2011). A meta-analysis of 29 studies in this field by Fukkink (2008) found significant post-intervention improvements in parenting behaviours, parental sensitivity, confidence and attitudes as well as child development (Fukkink, 2008). Shorter programmes also appeared to be more effective in improving parenting skills compared with longer ones (Fukkink, 2008). In addition, a meta-analysis of 51 attachment-focused interventions has found that interventions that included video-feedback were more effective in improving parental sensitivity than those interventions that did not (Bakermans-Kranenburg, van Ijzendoorn, & Juffer, 2003).

Video Interaction Guidance (VIG) is one example of a short video feedback intervention (three to four sessions) that has been used successfully with mother–infant dyads to promote a mother's sensitivity to her baby's communication cues. It is delivered by an accredited VIG practitioner who guides the mother through a process of viewing and reflecting upon video clips of herself interacting with her infant. VIG has a strength-based theoretical premise, and it is supported by two major theoretical concepts: (1) intersubjectivity, which is at the core of the attuned interactions and is modelled by the VIG practitioner in interactions with the mothers, and 2) mediated learning, which refers to the way in which the VIG practitioner guides or scaffolds the learning environment for mothers (Barlow, Sembi, & Underdown, 2016). The use of video technology is not new to mother–

infant interventions, but the VIG approach is unique in that it only draws mothers' attention to and reflects upon successful elements of communication with her infant (James et al., 2013). As a dyadic intervention, therefore, VIG is well suited to women with depression symptoms who may be vulnerable to negative thought processes around their parenting skills.

While feedback interventions have been used in a variety of contexts, research exploring their efficacy with mother–infant dyads with postnatal depression and anxiety is limited, and it has yielded inconsistent findings. Van Doesum and colleagues (2008) found that mothers with depression who participated in a video-feedback treatment (N = 37) improved in maternal sensitivity compared to a control group (N = 36), and their infants showed higher levels of attachment and social competence. In contrast, a randomised control study with clinically depressed mothers in a perinatal inpatient psychiatric unit (N = 74) found no improvements to mothers' parenting confidence or their perceptions of their infants' behaviour as a result of participating in video-feedback treatment (Bilszta, Buist, Wang, & Zulkefli, 2012). The generalisability of this finding, however, is limited by the small number of in-patient sessions attended by some mothers who were discharged before treatment completion, i.e. some mothers only participated in one session. Finally, a pilot study using video observation and interview data to explore the effectiveness of VIG with 6 mothers diagnosed with post-natal depression identified three core elements that improved the mother–infant interaction and mothers' self-image. These included: (1) mothers' experiences of their own coping, (2) mutual engagement with their infants, and (3) recognition of their suffering (Vik & Hafting, 2006).

In summary, there are only a few studies examining the effectiveness of the VIG intervention with mothers with postnatal depression and anxiety. This is despite the fact that up to 30% of mothers report elevated depression or anxiety symptoms in the postnatal period and the risks to infant development. In addition, there are no studies to date using both

qualitative and quantitative data to explore the individual experiences of mothers who participate in VIG interventions. The inclusion of participant interview data in a program evaluation study enables mothers to speak directly about what they found helpful and unhelpful about their experiences with the VIG intervention. It also compliments statistical findings through illuminating the people behind the numbers and putting individual meaning to statistics associated with quantitative methodologies (Patten, 2002). In addition to exploring whether the VIG is *effective*, interviews with VIG participants can explore whether it is *acceptable* to them, providing direction for its future application.

The aim of this explorative component of this thesis is to evaluate the efficacy of an intervention to promote maternal responsiveness in a small number of mother–infant dyads with infants who may be at risk for language delay due to maternal depression and anxiety. To achieve this, both quantitative and qualitative methodologies were employed. This enabled a more comprehensive means of examining the effectiveness of the VIG intervention than either approach in isolation (Creswell & Clark, 2011). The first aim of this Chapter was to evaluate the effectiveness of VIG in improving the quality of the mother–infant interaction. Due to ethical considerations, all mother-infant dyads in the risk group were given the opportunity to participate in the VIG intervention. A sub-set of mothers who took part in the longitudinal study, self-selected to the intervention group and the remainder were allocated to a comparison group. Pre- and post-intervention measures of maternal responsiveness using behavioural observations were obtained. The second aim of this Chapter was to evaluate the mechanisms of change through which VIG improves the quality of mother–infant interactions. This was explored through self-reported measures of maternal reflective functioning and parental confidence, and face-to face interviews with mothers. The small number of mother-infant dyads was well suited to qualitative evaluation methodologies that supported the exploratory quantitative evaluation measures. Both aimed to provide clinical

direction to enhance the efficacy and acceptability of VIG for at-risk mother–infant dyads due to depression and anxiety in the postnatal period.

6.2 Method

6.2.1 Design.

The quantitative component of this Chapter (Part A) involved the assessment of maternal responsiveness using behavioural observations of the mother–infant play sessions conducted as part of the longitudinal study (see Chapter 5) at 9, 12-, and 18-month assessments (see Figure 1, for study timeline). A sub-group of mothers (n = 8) from the risk group was assigned to an intervention group, and they participated in a short video feedback intervention administered between the 9- and 12-month sessions. This schedule allowed for a test of immediate intervention effects at 12 months, and longer-term retention of those effects at 18 months through maternal responsiveness ratings. A second sub-group (n = 8) was selected and assigned to a comparison group. This group completed the three maternal responsiveness assessments but did not participate in the intervention, which allowed for a direct test of the stability of our dependent variable (maternal responsiveness).

To address the second aim of identifying the source for the changes in maternal responsiveness that take place as a result of the VIG intervention, mothers completed self-reported measures of maternal reflective functioning and parenting sense of competence at their assessments. In addition, mothers from the intervention group also participated in the qualitative component of the study (Part B), which involved a face-to-face interview with researchers following their completion of the intervention.

6.2.2 Participants.

A subsample of mother–infant dyads (N = 16) from the risk group of the longitudinal study participated in the evaluation of the VIG intervention. All mothers in the evaluation

study, therefore, had a current diagnosis of depression and anxiety or elevated symptoms in the perinatal period. Mother–infant dyads were allocated to an intervention group (n = 8, 4 female infants) on the basis of their availability to participate in additional home and laboratory visits. For ethical reasons, all mothers who self-reported elevated depression and/or anxiety symptoms were offered the opportunity to participate in the VIG intervention, rather than randomly allocated to a group with no treatment. Mother–infant dyads who declined participation were allocated to a comparison group (n = 8, 4 female infants). At the time of recruitment all mothers in the evaluation study ranged in age from 26 to 40 years (M = 32.50, SD = 4.18) (see Appendices O and P for detailed demographic information of mother–infant dyads).

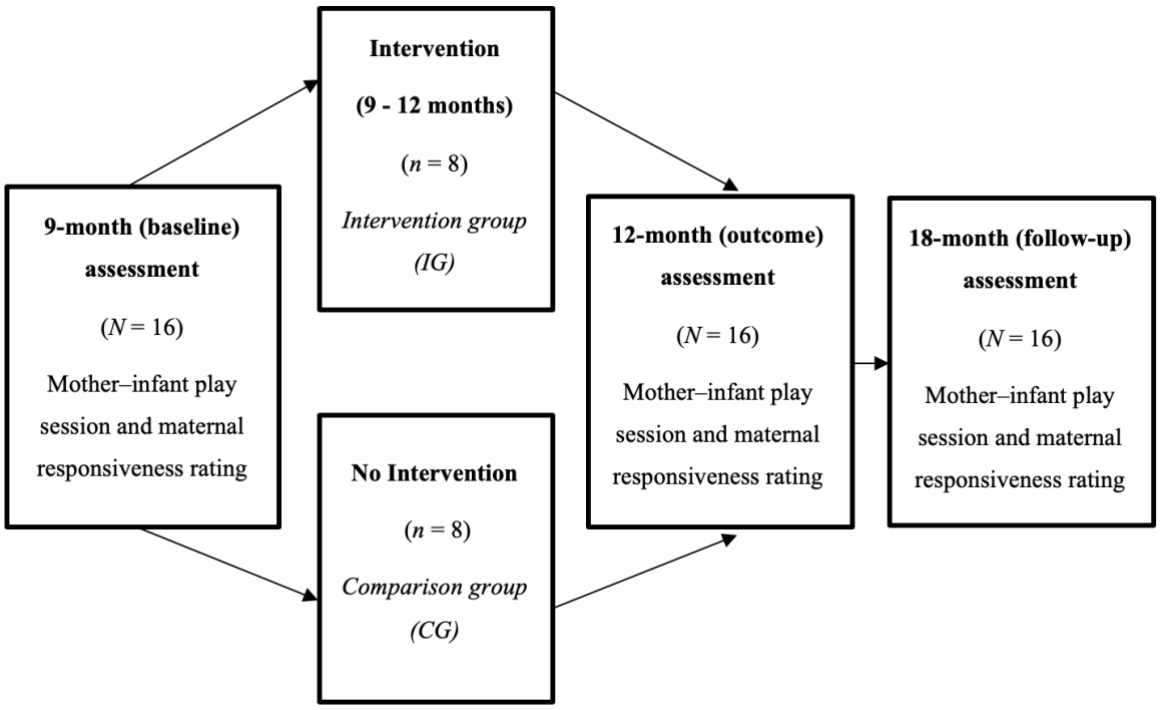

Figure 11. Quantitative methods time line for the infant age showing the assessment and intervention schedule by mother–infant intervention versus comparison group.

Table 16.

Maternal depression and anxiety scores by intervention versus comparison group.

Infant age and maternal depression and anxiety descriptive statistics			Total sample (N = 16)	Intervention group (n = 8)	Comparison group (n = 8)
9-months:	Depression	Range	0 - 21	0 - 20	0 - 21
		Mean (SD)	8.88 (7.68)	9.50 (7.84)	8.25 (8.00)
	Anxiety	Range	21 - 55	21 - 55	23 - 46
		Mean (SD)	35.25 (9.45)	34.63 (11.17)	35.88 (8.10)
12-months:	Depression	Range	0 - 27	0 - 27	1 - 19
		Mean (SD)	10.13 (8.63)	13.29 (10.40)	7.37 (6.12)
	Anxiety	Range	23 - 50	23 - 46	25 - 50
		Mean (SD)	33.80 (8.50)	34.71 (9.62)	33.00 (8.00)
18-months:	Depression	Range	0 - 26	0 - 26	0 - 20
		Mean (SD)	8.56 (8.29)	10.63 (9.13)	6.50 (7.35)
	Anxiety	Range	20 - 62	20 - 62	23 - 44
		Mean (SD)	34.44 (12.73)	35.50 (16.38)	33.38 (8.73)

Note. Depression = CESD-R scores; Anxiety = STAI scores.

6.3 Quantitative Evaluation Procedure

6.3.1 Mother–infant play sessions and maternal responsiveness ratings.

Videos of mother–infant play sessions were obtained through visits to the laboratory at 9, 12 and 18 months (see Section 5.1.2.1). The 9-month assessment was used as the baseline, and the 12-month assessment was used to assess the intervention effects. To ensure

that the improvements in maternal responsiveness were not due to a halo effect, an additional follow-up mother–infant play session was included at 18-months of age.

The Parental Responsiveness Rating Scale (PaRRiS) was employed as a rating tool for each mother–infant interaction for each play session (see Section 5.1.2.3 and Appendix L for details). Each video was rated by a blind-rater who was unaware of participants' group allocation or depression and anxiety scores.

6.3.2 Self-reported maternal measures.

To provide measures on mothers' reflective functioning abilities, and parenting confidence pre- and post-intervention, mothers completed the Parental Reflective Functioning Questionnaire – 1 (PRFQ-1), and Parenting Sense of Competence (PSOC) when their infants were 9 and 12 months (see Appendices G and I for details).

6.3.3 VIG Intervention.

Mother–infant dyads in the intervention group participated in the VIG intervention using a combination of home and lab visits. The intervention included: (a) a goal setting conversation, (b) three brief (10 minutes) filming sessions of the mother–infant interaction, and (c) three shared review sessions (30 minutes) (refer to Kennedy et al., 2011 for detailed instructions for administration of the accredited VIG intervention). A goal setting conversation between the VIG practitioner (lead author) and each mother enable participants to consider goals in relation to the interaction with their baby. Examples of the goals identified by the mothers included: "To be more sensitive to my baby's cues" and "to grow in confidence when playing with my baby".

6.3.3.1 Mother–infant play sessions for VIG filming.

During the initial visit to the laboratory when the infants were 9 months of age, mother–infant dyads were invited to participate in a brief play session (5 to 10 minutes) in a

child-friendly interview. The mothers were informed that the play session would be video recorded. Mothers were asked to ignore the VIG practitioner while the play session was video-recorded (using a tablet). Mothers were encouraged to play with their baby as naturally as they would do at home. This play session was the same one used for the maternal responsiveness ratings.

The second filming sessions was conducted at the participants' home or in the laboratory setting, according to each mother's preference. Mothers were filmed interacting with their baby in either a free play session or during a normal daily activity such as feeding their infant. The final play session was conducted in the laboratory session, and was the same video used for the 12-month maternal responsiveness ratings. The video files of each of the three filming sessions were saved for later analysis.

6.3.2.2 Video analyses.

After each filming session, the VIG practitioner analysed the video recording offline and selected three to four still shots or short clips (10 - 20 seconds each). Clip selection was guided by the mother's interaction goal and the VIG principles of attuned interactions. The selected clips contained micro-moments of successful communication (Kennedy, 2011). For example, these included clips where the mother was attentive to her baby through her eye gaze and friendly posture and/or demonstrated that she has received her baby's initiative through imitating the baby's vocalisations. The selected clips and still shots were later reviewed together with the mothers at a shared review session, either in a return visit to the mother's home, or in the laboratory.

6.3.2.3 VIG shared review sessions.

While reviewing the clips together, the VIG practitioner guided the mother in her reflections around the attuned behaviours exemplified in the short clips. The practitioner used the mother's interaction goal and the VIG principles to reflect on the video clips. The VIG

principles include: being attentive, encouraging initiatives, receiving initiatives, developing attuned interactions, guiding and deepening discussion. The shared review session provided an opportunity for mothers to view themselves interacting with their infant, and for the practitioner to prompt mothers to consider what their baby might be feeling in the video clip or still shot (Barlow et. al., 2016).

6.4 Results

The first aim of this Chapter was to examine the effect of participation in a video feedback intervention program on the quality of the mother–infant interaction, as measured by ratings of maternal responsiveness. Observer-based methods were used to assign ratings of maternal responsiveness during mother–infant play sessions pre- (x1) and post-intervention (x2). Patterns in ratings over three time points (9-, 12- and 18-months) were compared between groups to report on both short-term and longer-term treatment effects.

6.4.1 Evaluation of maternal responsiveness.

6.4.1.1 Evidence for short-term treatment effects.

Maternal responsiveness ratings are provided for all three assessments for mother–infant dyads in the comparison and intervention groups. Firstly, findings in the *comparison group* demonstrated stability in the dependent variable, maternal responsiveness, between infant ages of 9 and 12 months (see Figure 13). There was no change in maternal responsiveness scores for any of the mothers in the comparison group. Half of the women's maternal responsiveness ratings in the comparison group were below average (Average = 3) at both the 9- and 12-month assessments.

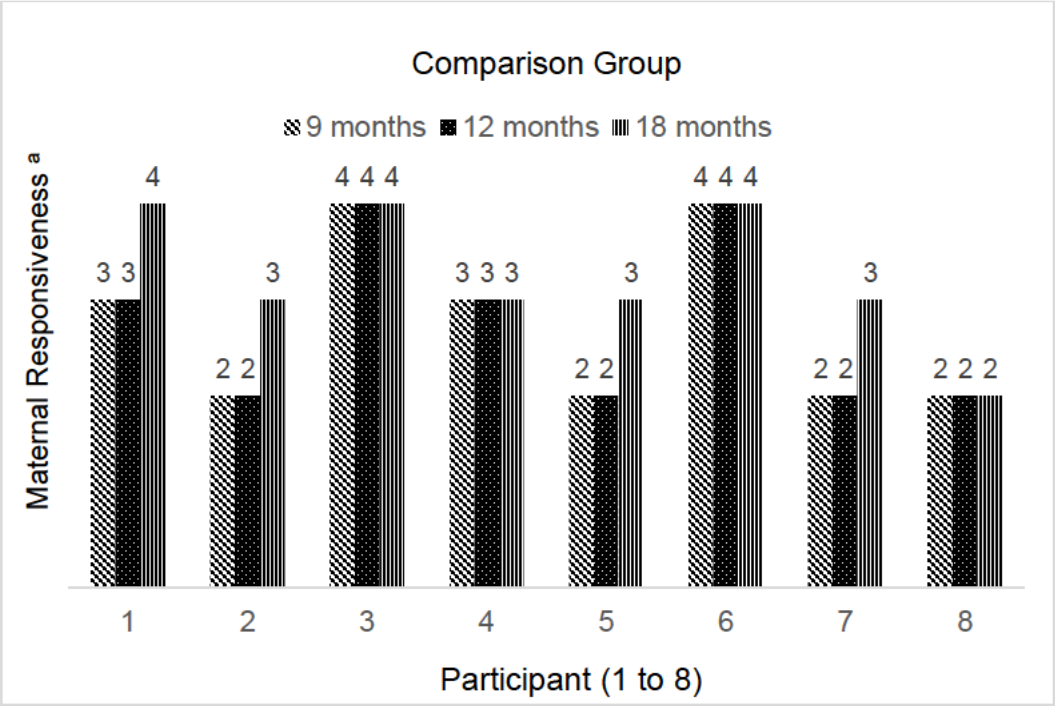

Figure 12. Comparison group 9-month, 12-month and 18-month maternal responsiveness ratings for each mother–infant dyad (n = 8) ([a] Rating: 1 = Very Low; 2 = Low; 3 = Moderate (Average); 4 = High; 5 = Very High).

In contrast with the comparison group, half of the women in the *intervention group* showed an increase in their maternal responsiveness ratings at their 12-month outcome assessment (see Figure 14). A pattern of improvement is evident for mothers whose baseline scores were below average scores (P1, P4, P8) and for one mother with an average baseline score (P2). Before the intervention, approximately one third of the group scored below average on maternal responsiveness ratings. At the 12-month outcome assessment, only one woman's score was below average.

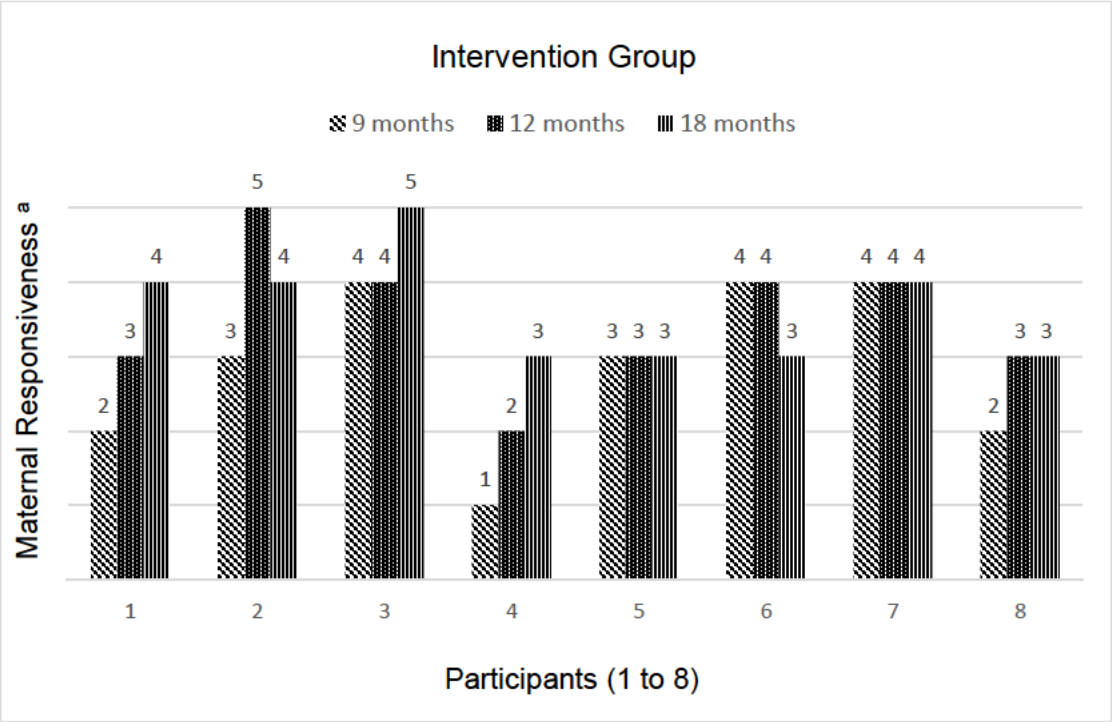

Figure 13. Intervention group 9-month (pre-VIG), 12-month (post-VIG) and 18-month (follow-up) maternal responsiveness ratings for each mother–infant dyad (n = 8) (Note. [a] 1 = Very Low; 2 = Low; 3 = Moderate (Average); 4 = High; 5 = Very High).

In the intervention group, a short-term treatment effect is present for half of the women despite signs a deterioration in psychological well-being for two of the three mothers with below average baseline scores. One mother (P4) improved her maternal responsiveness scores over time, despite corresponding and clinically significant increases to her depression and anxiety scores: 9-months (Depression = 9; Anxiety = 33); 12-months (Depression = 17; Anxiety = 44); and 18-months (Depression = 26; Anxiety = 59). A second mother with below average baseline ratings (P8), also increased her post-intervention rating despite a clinically significant increase to her anxiety scores: 9-months (Depression = 11; Anxiety = 35); 12-months (Depression = 13; Anxiety = 41).

6.4.1.2 Evidence for longer-term treatment effects.

Maternal responsiveness ratings at the 18-month follow-up assessment demonstrated longer-term treatment effects for mothers in the *intervention group*. For example, maternal responsiveness ratings continued to increase for two mothers with below average baseline ratings (P1, P4). Mothers with average or higher responsiveness ratings at the 12-month assessment demonstrated improvement (P3), maintenance (P5, P7, P8) or reduction (P2, P6) in their 18-month scores. After 6-months following the completion of the intervention, there were no women with below average maternal responsiveness ratings.

Mothers in the comparison group again demonstrated a different pattern in their 18-month maternal responsiveness ratings, with half maintaining and the other half increasing their score. At the 18-month assessment, one woman obtained a below average maternal responsiveness rating.

In summary, a pattern of short-term treatment effect was evident in maternal responsiveness for all mothers who participated in the VIG intervention and whose baseline scores were below average (n = 3), and one mother whose baseline score was average. All mothers with below average baseline scores demonstrated longer-term treatment effects, with no mothers remaining in the lower categories of maternal responsiveness at the 18-month assessment. In contrast, there was no change in maternal responsiveness (9- vs. 12-month assessment) for mothers in the comparison group. However, there was an increase in maternal responsiveness (12- vs.18-month assessment) for approximately half of the mothers across both intervention and comparison groups.

6.4.2 Evaluation of mechanisms of change.

The second aim of the study was to identify the reasons underlying the effectiveness of VIG in improving the quality of the mother–infant interaction. Self-reported measures were the primary approach to data analysis and reporting. All mothers completed measures of

maternal reflective functioning and parenting confidence. Data for these dependent variables were subject to preliminary analyses to determine any between group differences in scores and any within group differences over time (pre- and post- intervention).

Table 17.

Descriptive and inferential statistics for maternal reflective functioning (df = 13) and parental confidence (df = 14) measures by mother–infant intervention versus comparison group.

	M (SD)			
Maternal measures	Intervention	Comparison	*t*	*p*
PRFQ Subscales [a]				
9-month Baseline Assessment				
Interest and curiosity	5.40 (.67)	5.01 (.49)	-1.27	.228
Pre-mentalising	5.90 (.26)	6.09 (.49)	.96	.335
Certainty of mental states	2.47 (.21)	2.29 (.44)	-1.06	.309
12-month Outcome Assessment				
Interest and curiosity	5.58 (.58)	4.88 (.51)	-2.45	.029 *
Pre-mentalising	5.90 (.44)	6.16 (.35)	1.26	.231
Certainty of mental states	2.58 (.32)	2.46 (.55)	-.50	.626
PSOC Subscales [b]				
9-month Baseline Assessment				
Satisfaction	3.65 (.97)	3.88 (1.02)	.46	.653
Efficacy	4.58 (.99)	4.03 (.70)	-1.28	.222
Interest	4.79 (1.11)	4.71 (.68)	-.18	.859
12-month Outcome Assessment				
Satisfaction	4.06 (1.08)	4.06 (.94)	.00	1.0
Efficacy	4.65 (1.06)	4.38 (.82)	-.58	.571
Interest	4.88 (1.45)	4.63 (.65)	-.45	.663

Note. *p <.05. PRFQ = Parental Reflective Functioning Questionnaire, items of the Pre-mentalising subscale were reverse coded so that higher scores indicate increased reflective functioning.; PSOC = Parental Sense of Competence.

[a] Completed PRFQ = 15 (VIGG, n = 8; CG, n = 7).

[b] Completed PSOC = 16 (VIGG, n = 8; CG, n = 8).

6.4.2.1 Maternal reflective functioning.

Descriptive and inferential statistics for maternal measures pre- and post- intervention are provided in Table 17. In summary, independent-samples *t*-tests showed a group difference in one parental reflective functioning variable (interest and curiosity in the child's mental state), only at the post-intervention assessment between the intervention (M = 5.58, SD = .58) and comparison groups (M = 4.89, SD = .51), $t(13) = -2.45$, $p = .029$, $d = 1.26$. However, this difference was not significant when the Bonferroni correction for multiple comparisons was used to adjust the *p*-value to .025 (i.e. each measure was subject to two sets of analyses, one for the 9-month and one for 11-month data collection point). There were no group differences on the other reflective functioning and confidence variables. In addition, paired *t*-tests showed no statistical group differences from pre- to post-intervention for the intervention group.

6.4.2.2 Parenting Sense of Competence.

An Australian normative sample for parental sense of confidence (Gilmore & Cuskelly, 2009) was used to compare pre- and post-intervention scores on three subscales: Satisfaction, Efficacy, and Interest in the parenting role. See Table 18 for details of the Australian norms and the number of mothers above the mean pre- and post-intervention (intervention vs. comparison group). In summary, mothers who participated in the VIG intervention demonstrated an increase in their interest or engagement in the parenting role, with two more mothers above the norm after completion of the intervention. This pattern was reversed in the comparison group, with one less mother above the norm at the 12-month assessment. This treatment effect was not evident in mothers' satisfaction and efficacy in the parental role.

Maternal responsiveness at 9-months was positively correlated with one maternal reflective functioning variable, interest and curiosity (IC) in their infant's mental state (r =

.60, $p < .05$) at 9-months (Table 19). Maternal responsiveness at 12 months of age was also positively correlated with the same reflective functioning variable (IC) at 12 months of age ($r = .56$, $p < .05$). Thus, mothers with higher indices of interest and curiosity in their infants' mental states also had higher levels of maternal responsiveness scores. Maternal responsiveness was not correlated with the other two variables of mothers' reflective functioning (pre-mentalising and certainty of mental states) or the maternal confidence variables (satisfaction, efficacy, and interest).

Table 18.

Parenting Sense of Competence (PSOC) Australian Normative data (n = 586) (Gilmore & Cuskelly, 2009): Number of mothers (intervention vs. comparison group) above the mean pre- and post- VIG intervention.

PSOC Subscales [a]	Norm. Mean (SD)	Intervention Group [b]		Comparison Group [b]	
		Pre-VIG	Post-VIG	9-months	12-months
Satisfaction: In the parental role.	3.79 (.97)	5	5	5	5
Efficacy: Perceived ability in the parental role.	4.41 (.81)	4	5	3	4
Interest: Engagement in the parental role.	5.49 (.73)	3	5	2	1

Note. [a] Completed PSOC, $N = 16$ (IG, $n = 8$; CG, $n = 8$); [b] Mothers (n) above the normative mean; VIG = Video Interaction Guidance.

In summary, the quantitative evaluation procedures showed that mothers who participated in the intervention improved in their maternal responsiveness scores following the intervention. These improvements tended to be evident in mothers with below average

baseline levels of responsiveness and were generally retained over time. With regards to mechanisms of change, findings point towards a positive impact of VIG participation upon mothers' interest and curiosity in their infants' mental state. However, caution should be employed with interpretation as the significant group difference on interest and curiosity did not reach statistical significance. However, results indicate a positive shift in mothers' level of engagement in their parenting role.

Table 19.

Pearson correlations maternal responsiveness, and mothers' reports of reflective functioning variables and parenting confidence variables (9-months/12-months).

Variable	PRFQ, 1: Interest and curiosity	PRFQ, 2: Pre-mentalising	PRFQ, 3: Certainty of mental states	PSOC, 1: Satisfaction	PSOC, 2: Efficacy	PSOC, 3: Interest
MR, 9-m	.604*	-.021	.284	-.120	-.100	.324
MR, 12-m	.563*	-.030	.234	-.027	-.002	.457
PRFQ, 1	1/1	-.131/-.040	.337/-.031	-.074/.036	.020/-.019	.173/.158
PRFQ, 2		1/1	-.736**/-.476	.424/.775**	.289/.348	.458/.458
PRFQ, 3			1/1	-.045/-.725**	-.055/-.451	-.311/-.484
PSOC, 1				1/1	.687**/.622*	.355/.697*
PSOC, 2					1/1	.534*/.447
PSOC, 3						1/1

Note. * $p < .05$; ** $p < .01$; MR = Maternal Responsiveness; PRFQ = Parental Reflective Functioning Questionnaire (Subscales, 1, 2, 3); PSOC = Parenting Sense of Confidence (Subscales 1, 2, 3).

6.5 Qualitative Evaluation Procedure

The qualitative component of this Chapter aimed to further evaluate the VIG intervention using interviews with mothers from the intervention group. The purpose of these

interviews was to provide clinical direction to enhance the effectiveness and acceptability of VIG for mothers with signs of postnatal depression and anxiety.

6.5.1 Data collection.

Mothers participated in semi-structured interviews with researchers when infants were 12 months of age. All semi-structured interviews were conducted at the laboratory, with two interviewers present including the principal interviewer (external to the VIG process, co-researcher) and the VIG practitioner (candidate). The interview was audio recorded and later transcribed verbatim. The semi-structured interview used a core set of open-ended questions exploring mothers' experience with the VIG intervention and the ways in which mothers ascribed meaning to those experiences (see Appendix C). An example question included, “What was it like for you to be videoed? Did you feel that being videoed with your baby impacted on your usual interactions with your baby?” Probing questions were also used to explore and expand on initial responses.

6.5.2 Approach to data analysis.

The qualitative component of this research was conducted under a social constructionist paradigm (Burr, 2015). Constructivist research assumes that human experiences, meanings, and realities are impacted by a range of discourses operating in society that are embedded in social, cultural, and political settings (Braun & Clarke, 2006). In this context, discourse refers to a pattern of words, values, and symbols that join together to describe categories, practices, and mother’s experiences (Lupton, 2003). The transcriptions of interviews with mothers were examined using a thematic analysis (Braun & Clarke, 2006), with a discursive focus (Edley, 2001) using deductive and inductive approaches. First, written transcripts of the interviews were carefully analysed by the first researcher and data were categorised into two broad subject areas, which included: (i) helpful effects of VIG

participation, and (ii) unhelpful effects of VIG participation. Second, the transcripts were read again, and reflective memos were added to the transcripts by both the first and second researcher. The interactive process involved discussions between the first and second researcher as emergent themes and discourses were explored. Written transcripts from the eight participants were also compared with each other as an additional method of assessing and re-assessing patterns of maternal responses against the developing themes.

6.6 Interview themes

Two primary themes—*validation* and *increased awareness*—were identified as reasons for the effectiveness of VIG in improving the quality of the mother–infant interaction.

The first theme refers to a sense of *validation* that most mothers experienced during the VIG intervention. This validation came through two primary sources: (a) the VIG practitioner as an external witness, and (b) the video clips as evidence of their own positive communication skills with their child. The second theme refers to an *increased awareness* that mothers experienced through their participation in the VIG intervention. This awareness related to both (a) attuned interactive behaviours, and (b) the bond they have with their infant. The third theme, *negative effects,* refers to feelings of self-doubt and guilt experienced by a minority of mothers during the VIG intervention.

6.6.1 Theme one: Validation.

6.6.1.1 Sub-theme A: The VIG practitioner as an external witness.

When asked about their experiences of VIG, most mothers reported a sense of validation as a positive outcome. This theme emerged as a source of reassurance due to the doubt that mothers felt about their mothering i.e. that they may not be doing a ‘good’ job

when interacting with their infants. The first source of validation came through the VIG practitioner. Table 20 presents detailed examples of this sub-theme.

In reflecting on what was helpful about their VIG experience, all mothers reported that the shared review sessions provided some feedback from an external witness, which functioned to "validate" their interaction skills. This in turn increased their confidence and the self-perception that they were doing a "good job" when interacting with their infant. For one mother (P2), what was important was not only that she was able to resist a pull to the polarising extreme of "I'm not a terrible mother", but that the external validation through her VIG practitioner also reassured her that "you're doing a good job". The "almost authority validation" (P5) of these mothers was in part due to the privileged status of the VIG practitioner's knowledge. The women's accounts were built on a scientific repertoire (Gilbert & Mulkay, 1984) that construed the practitioner's knowledge as objective and elevated over these mothers' own insider knowledge about themselves.

Table 20.

Examples of Theme One, Subtheme A: The VIG practitioner as an external witness.

Theme One	Subtheme A	Examples
Validation	The VIG practitioner as an external witness	What would I see about myself? Oh, that I'm not a terrible mother. Not that I think that I am—but, I mean, it's nice having the comfort of someone else going, "You're not a terrible mother, you're doing alright there" (P2). It never hurts to have external validation (P4). She [the VIG practitioner] showed me the stills which were moments of engagement and stuff. Yeah, it's validation that we're doing okay, because, you know, you spend a lot of time just the two of you, and you want to make sure you're not doing anything odd . . . It's almost authority validation to be honest. I had no idea what I was doing. I'd never changed a nappy before I had a baby, so we're going okay (P5). Positive reinforcement of the things I'm doing – acknowledging that I'm doing a good job. It's just stuff you don't really think about when you're rushing around at home but then, for someone else to notice something, you know . . . I think it feels good. It's been very positive. I think it's definitely helped (P1). Yeah . . .just, I guess the act of having the conversation with [the VIG practitioner] around it was helpful. So not just seeing it [but] having the conversation with someone else around that (P3). Sometimes, I don't get to sit and reflect. It's being able to sit and reflect that's really nice (P7).

The feedback given through the VIG intervention appeared even more validating given that mothers do not typically receive external feedback on their interaction with their infant ("because you don't get feedback when you're mothering otherwise", P7). The lack of

feedback may be due in part to the isolation that mothers can feel ("just the two of you", P5) and the anxiety of being in a new role for which they can feel ill equipped ("in the beginning days, I had no idea what I was doing", P5). Having the presence of "another" was important in the validation process, and therefore, may identify an important component of the intervention's effectiveness. It addressed both the social isolation that mothers can experience in the postnatal period, but also assisted with maintaining self-boundaries and an openness to a larger system beyond that of the maternal self and mother–infant systems (Rubin, 1984). The simple opportunity to "sit and reflect and watch" (P7) in the presence of another person provided mothers with validation concerning their communication skills, that may have resulted in their increased use.

6.6.1.2 Subtheme B: The video clips as evidence.

The second source of validation for mothers was provided through the video clips that were selected by the VIG practitioner and shown to mothers in the shared review sessions (see Table 21 for examples).

Mothers reported that the tangible visible evidence of the video clips provided proof or "video evidence" (P7) of their interaction skills that many of the mothers "didn't notice at the time" (P5). The additional value of the video clip is that a mother could then replay and visually "see" herself interacting in a positive manner with her baby. This potentially functioned to reinforce her positive communication skills, her perception of those skills and the ease with which she adopted them when interacting with her infant (see extract below).

> So, I think VIG helped yeah alleviate the self-deprecating part of me. It is, it's really validating. Every time I had [the VIG practitioner] come in and show me, or I went and saw the videos, after that I just kind of, I'd just feel so calm about and relaxed about my mothering. Yeah and it's getting easier like every time we've had one of these feedbacks. I feel better about myself for longer or better about my mothering for longer (P7).

Table 21.

Examples of Theme One, Subtheme B: The video clips as evidence.

Theme One	Subtheme B	Examples
Validation	The video clips as evidence	Just kind of seeing myself with [my baby] and you know I'm doing a good job. Not just doing an okay job, not just you know coping, but actually doing really well. I think seeing myself and seeing how comfortable I look makes me feel more comfortable (P6).
		And when you can see it [the video] like that you can actually appreciate how far she's come and how far you've helped her to come, and how far you've come as well (P3).
		Just getting that confirmation like seeing it – because you can't really ask your friends to video you (P8).
		It's really reassuring to be able to have this kind of video evidence. Yes, these are examples of what you've done and that was really good because you don't get feedback when you're mothering otherwise (P7).
		The VIG actually picked up on moments… and I don't really see that when I'm… you know he might be in my lap and I don't see the expression on his face because he's facing the other way (P5).

The internalised "self-depreciating part" of one mother (P7) was challenged through seeing herself in the video clips. It helped her to connect with a sense of being a good enough mother and thus alleviated her negative self-perceptions. The validation that came through watching the videos with an external witness helped her feel "calm" and "relaxed" as a

mother. This VIG experience helped her to sustain the associated positive feelings she felt about herself and her mothering with each shared review session.

6.6.2 Theme two: Increased awareness.

6.6.2.1 Subtheme A: Increased awareness of attuned interaction behaviours.

The majority of mothers reported that through their VIG participation, they gained an increased awareness of positive or attuned interaction behaviours (see Table 22 for examples).

Table 22.

Example of Theme Two, Subtheme A: Increased awareness of attuned interactions.

Theme Two	Subtheme A	Examples
Increased awareness	Attuned interaction behaviours	I found understanding the principles a bit more helpful. I found it did make me a lot more conscious and self-aware of what I was doing. I found all of that very helpful. Yeah it probably did make me do them more, because I was more conscious of it (P4) It helps with the confidence that I'm… It didn't necessarily change a huge amount of what I was doing, but the confidence in what I was doing was good. And it also made me a bit more aware when I was doing the things that, like guiding or communicating with her, just being aware (P7).

These positive reflections identify one reason why VIG participation resulted in improvements to the quality of the mother–infant interaction. For example, increased awareness had an impact on the frequency with which mothers adopted attuned behaviours when interacting with their baby (P4) and/or the "confidence" they felt during their interactions with their infant (P7).

6.6.2.2 Subtheme B: Increased awareness of the mother–infant bond.

Another reason for the treatment effects observed through VIG participation is a reported awareness of the bond mothers had with their infants and the role they both have in contributing to that bond through their interactions. This contributed to increased motivation to engage with their infants, which may be one theme that contributed to increases in maternal responsiveness following VIG participation (see Table 23 for examples).

Table 23.

Example of Theme Two, Subtheme B: Increased awareness of the mother–infant bond.

Theme Two	Subtheme B	Examples
Increased awareness	The mother–infant bond	And I think the first time when we videoed, I remember thinking 'Oh no I'm not doing anything'. And then when we watched it back and it really was in the kind of quietest moments that we really saw the connection between [my baby] and myself, and so that has allowed me to really kind of cultivate those kinds of little interactions where you know… From a zoomed out maybe we're not doing very much, but we really are connecting on a very deep level, and it was very affirming to see that (P6). But just to see the delight on his face when he made me happy. Like a big smile on his face that he made mummy happy. Yeah, that's a really good feeling… That he's enjoying the time with me, yeah. I've always been anxious that he just wouldn't like me, but he does (P5).

Through the VIG intervention, one mother's initial assessment of her role in the mother–infant interaction as "not doing very much" was challenged as she subsequently became aware that "we really are connecting on a very deep level" (P6). This had the impact

of motivating a desire to nurture or "cultivate those little kinds of interactions". Similarly, another mother (P5) described seeing the "the delight" in her baby's face, which suggested to her that her baby "likes" her. She was becoming aware of how she was contributing to their shared relationship when interacting with her infant, but also how her infant was also contributing. The ability to see her baby's positive responses to her heightened this mother's awareness of the two-way relationship she shared with her son regarding communication ("he is maybe trying to tell me something") and physical touch ("he put his hand on mine"). She was reassured that even though she may not feel "tuned in", she is "tuned in" through the "bond" she shares with her baby, a "connection" that she could see by "watching it" on video.

In comparison, participation in the VIG intervention also heightened one mother's awareness of times of "disconnection" during her interactions with her infant:

> Then you can, with the language [the VIG practitioner has] given me … being able to say that's why that's good. And then, sometimes, if I'm disconnected with her and she's like, "I want to play" and you go, "Okay, alright, okay" … get down on her level and play with her. So, there's that feedback as well (P7).

The vocabulary or "language" acquired through the VIG process provided this mother with a new perspective on her interactions with her infant, enabling her to construct a version of this reality as lived rather than merely describe it. In this sense, she was equipped to interpret, modify, and re-establish the connection with her child (Beebe et al, 2010; Jaffe et al, 2001). This new awareness and ability to repair and potentially restore synchronicity during interactions offers further evidence for the effectiveness of VIG participation in improving the quality of mother–infant interaction.

6.6.3 Theme 3: Negative effects.

Three mothers provided valuable information regarding the negative effects they associated with their experience of VIG. Despite their VIG participation, two mothers (P4

and P7) reported that the clips were "just … a snippet of your life" rather than the reality of the complexity of their interactions with their infants (see Table 24).

Table 24.

Examples of Theme Three: Negative Effects.

Theme Three	Examples
Negative Effects	I think the thing about it that was … that didn't work necessarily as well … is that because you are being videoed, you are kind of conscious of what you are doing, and so you kind of want to make a good impression. Whereas … so, like, I mean…it's how I interact with her normally, but it might be more so than I might otherwise do (P4). I can't think of a lot of negatives. I mean, the only mild negative is, again, it's just it's a snippet of your life and it's hard and I suppose—as I was talking before—connecting that this is just play time. Play time isn't all the time and coping with the bits in between when they're not happy (P7).

The validation that mothers experienced by interacting with the VIG practitioner and viewing video clips was vulnerable to "doubt" as these two mothers wondered if the content of the shared reviews were the truth or merely an exception. For example, they expressed concerns that the attuned interactions in the video clips may be "more so than I might otherwise do" (P4) or just a mere "snippet of your life" (P7) — the video clips may be "good" but the VIG practitioner had not seen what happens during interactions at home. For example, when P7 stated that "playtime isn't all the time" and spoke about "coping with the bits in between", the "in between" interactions remain unseen by the VIG practitioner. Engaging mothers in conversations about interactions "outside" the video clips may serve to

build mothers' confidence in their interaction skills that can persist beyond the "snippets" reviewed with the practitioner.

In the process of VIG participation, one woman (P2) ended up feeling guilty as she reflected on her interactions with her infant:

> Well, one negative which I didn't tell you … It started then to make me feel guilty sometimes if I looked at my phone; I'd be like, "Oh no, I'm not showing you that I'm interested in what you're doing, I'm looking at my email". But it would make me more conscious that when I was doing things that were not consistent with the attunement principles … but … I think it's important that [my baby] doesn't just see … I don't know, some Stepford Mother who you know appears to be perfect … because it's not a realistic expectation of me, and it's certainly not something that he should aspire to … he gets an absolute ton of attention … so, if I need to look at my work emails a couple of times of day when I'm off with him, that is completely fine (P2).

Increased "awareness" became a two-edged sword as feelings of guilt emerged: "It started then to make me feel guilty" (P2). For this mother, awareness of the VIG principles initially exacerbated her own unrealistic expectations that she should be providing ideal interactions with her infant at all times ("Oh no, I'm not showing you that I'm interested in what you're doing, I'm looking at my email"). However, this mother also positioned herself more broadly against the pressure of being a perfect "Stepford Mother", concluding that this is "not a realistic expectation of me, and it's certainly not something that (my baby) should aspire to". This mother did not disclose her feelings of guilt during the VIG intervention itself but during the research interview. However, through negotiation with her own expectations, she was able to see the value of "good enough mothering" (which included "good enough" attunement with her baby).

6.7 Discussion

Participation in the VIG intervention was found to be effective in increasing the quality of the mother–infant interaction, particularly for mothers with lower than average initial maternal responsiveness scores. Participation was also associated with positive shifts in mentalising and engagement in the parental role. To compliment these findings, the interview data in the qualitative component of this Chapter provided in-depth detail and individual meaning with regard to what was helpful and less helpful about participating in the VIG intervention for this sample of mothers. This included a sense of validation, increased awareness and some negative feelings such as doubt and guilt. The interview data accounted for individual variation in mothers' experience of the intervention, potentially highlighting ways in which it can be modified to improve its application and effectiveness with mothers with elevated depression and anxiety scores.

6.7.1 Maternal responsiveness.

Findings from the present study suggest that participation in a VIG intervention in the first year of life is associated with improvements to maternal responsiveness for mothers who have symptoms of depression and anxiety. These improvements are congruent with other studies examining the effectiveness of video-feedback intervention with at-risk mother–infant dyads. For example, Robert and Kennedy (2009) compared maternal sensitivity scores using the CARE-index measure through a VIG intervention (n = 8) and 'treatment as usual' group (n = 15) in a court-ordered residential treatment facility for families with child-protection concerns. Parent–child dyads in the treatment group demonstrated an increase in their post-intervention CARE-Index score that was not observed in the control group.

Interventions that are specifically designed for mother–infant dyads, with the aim of mitigating the developmental risks for infants that are associated with postnatal depression

have shown positive results (Field, 2010). Van Doesum and colleagues (2008), for example, found that mothers with depression who participated in eight- to 10-sessions of a video-feedback treatment (vs. control group) showed a significant improvement in maternal sensitivity. The present study extends these findings by suggesting that even as few as three sessions can be effective in improving maternal responsiveness. In addition, there was an improvement or maintenance in maternal responsiveness for mothers with below baseline average scores despite deterioration in maternal depression and anxiety symptoms. These findings highlight the potential benefit of early mental health screening for mothers and support to access dyadic video-feedback interventions. As a short-term intervention, VIG presents a cost-effective approach to improving the quality of the mother–infant interaction and potentially mitigating adverse developmental risks for children who have mothers with depression and/or anxiety.

6.7.2 Mechanisms of change.

A relationship between mentalising and maternal responsiveness was identified in the present study, although it should be interpreted with caution due to the small sample size. In contrast, there was an absence of an association between maternal responsiveness and parenting confidence variables. This may suggest that improvements to mentalising (as opposed to confidence) are more likely to be associated with the improvements in maternal responsiveness observed in the present study. While these relationships are not causal, they are consistent with studies indicating that the PRFQ subscales are sensitive to treatment effects associated with mothers' participation in psychosocial interventions (Ashton, O'Brien-Langer, & Silverstone, 2016; Paris et al., 2015). Suchman and colleagues (2010), for example, found positive changes in reflective functioning abilities in mothers who were engaging in substance abuse ($N = 47$) that were also associated with positive changes in mothers' caregiving behaviours. While these findings point to reflective functioning as a

mechanism of change contributing to treatment effects, details concerning how increases in reflective functioning might translate into parental behavioural changes remain inconclusive (Katznelson, 2014). In the present study, however, the shared review sessions provided opportunity for mothers to view their interactions with their infant, together with prompts from the practitioner to consider what their infant might be feeling in the video clip. This may have contributed to an increased curiosity in their infants' mental state and the mothers' ability for reflective functioning (Barlow et al., 2016).

Overall, mothers' parental sense of confidence did not appear to change as a result of participating in the VIG intervention. This finding is similar to an Australian inpatient study with clinically depressed mothers (N = 74), where no improvement on parenting confidence was observed between the video intervention group and two comparison treatment groups (Bilszta et al., 2012). This finding is in contrast, however, to a meta-analysis of video-feedback interventions that identified increased parenting confidence as a significant post-intervention improvement (Fukkink, 2008). However, findings from the present study pointed to treatment effects on the interest variable of PSOC, whereby maternal engagement in the parenting role appeared to shift in a positive direction for mothers who engaged in the VIG process.

6.7.3 Mothers' experiences of VIG.

Validation of the mothers' skills in interacting with their infants came through both the VIG practitioner and the video clips. This appeared to be associated with positive feelings about themselves and their relationship with their infant. Positive feelings and self-efficacy may have indirectly resulted in improvements in mothers' actual parenting and interaction behaviours (Teti & Gelfand, 1991). The act of simply watching themselves interacting with their infant, and observing positive responses from their infant, may have contributed to a range of meta-cognitive insights associated with mothers' reports of greater confidence. This

is especially likely for cases that presented a discrepancy between mothers' doubts about their interaction skills and what they saw as positive interactions on video (Barlow et al., 2016). These benefits of participation, together with the absence of any attrition from the study, highlight the potential of VIG as an acceptable (as well as effective) dyadic intervention for mothers with signs of depression and anxiety.

While having the VIG practitioner as an external witness was helpful in affirming and supporting these women's awareness and responsiveness when interacting with their infant, there was also a risk of the practitioner being elevated to an "expert witness". This, together with the VIG's approach in confining therapeutic conversations to positive video clips to draw mothers' attention to successful elements of communication (James et al., 2013), may provide a context in which mothers may construct the witnessed "successful elements" as exceptions. This was evident for some of these mothers' narratives questioning whether the video clips were the "real story" that contributed to ongoing feelings of "doubt" for two of the women. Despite experiencing these feelings of doubt, however, both of these mothers demonstrated improvement in maternal responsiveness after participating in VIG. It does not appear, therefore, that this negative effect undermined improvements to the quality of interactions through VIG participation.

In addition to validation through the VIG practitioner and video clips, increased awareness was identified as an important theme contributing to the success of the VIG intervention. Awareness of infant's communication cues, and the ability to "see" attunement principles in action, provided mothers with motivation to both engage in communication with her baby, and gave her an ability to repair the communication process when "disconnection" occurred. These skills may have contributed to positive changes observed in the present study, both regarding maternal responsiveness and mentalising. These skills are important in mitigating the risks associated with maternal depression. Awareness of infants'

communication cues and the ability to repair the communications process following disconnection, supports infants' psychological and social development (Grant, Mcmahon, Reilly, & Austin, 2010). Evidence also suggests that when mothers accurately interpret and respond to their infant's communication cues, they are scaffolding their infant's ability to regulate their emotions, handle social processes and manage physiological stress (Feldman, 2007).

6.7.4 Clinical directions.

The fact that one mother was recruited into feelings of guilt as part of her experience with VIG, may point to the unique context of the mother–infant interaction and vulnerability towards negative feelings, especially for women who experience PND (Blegen et al., 2010). The VIG intervention has been successfully employed in a variety of settings such as educational institutions and workplaces (Kennedy et al., 2011). However, these settings are unlikely to be dominated by the perfect mother discourse and expectations that relationships receiving intervention should be "exclusively dyadic" and "time-consuming" (Hays, 1998). Tailoring VIG specifically for mothers of young infants, through acknowledgement of the intense nature of the mother–infant interaction together with the social expectations around motherhood, may reduce the risk that VIG may exacerbate unrealistic expectations and associated feelings of guilt.

Mother–infant video feedback interventions such as VIG have the potential to validate the communicative skills of mothers, as well as increase their awareness of attuned interaction abilities and interest in their infants' mental states. Unlike the more common social and professional focus on the negative aspects of parenting (Savvidou, Bozikas, Hatzigeleki, & Karavatos, 2003), a strength of VIG is the focus on positive and successful elements of communication. Additional therapeutic interventions that focus on maternal identity formation (e.g., narrative therapy) could complement this strength through the

promotion of conversations around moments "outside" of the video clips that may minimise the risk of mothers constructing those witnessed "successful elements" of communication as exceptions. These conversations may serve to prevent mothers from being recruited into feelings of doubt regarding their significant role when interacting with their infant that can persist beyond the shared video clips and handle the contingencies of a complex social reality (Geertz, 1973).

There are several methodological considerations, such as the small sample size, the self-selected intervention group and therefore absence of a control group, that limit the degree to which these findings can be generalised. While further VIG evaluations with larger samples and randomised controlled trial are required, these findings point to a value of a global measure of maternal responsiveness as a cost-effective measure for evaluating the effectiveness of the VIG intervention. Our findings also align with previous evidence for the effectiveness of this approach that has demonstrated that it is correlated with the outcomes of more time-intensive measures of responsiveness (Down et al, 2014), and it can be used by health visitors and nurses to identify at-risk mother–infant dyads who may benefit interventions aimed at improving the quality of the parent-child interaction (Levickis, McKean & Law, 2018). However, the improvement in maternal responsiveness scores for half of the mother in the comparison group (18- vs. 12-month assessment scores), may suggest that it was easier for mothers to obtain higher scores on a global scale when their infants were using more expressive language than when they were non-verbal.

6.7.6 Conclusion.

The present study provides evidence for the value of video-feedback interventions in improving the quality of the mother–infant interaction in cases where there are signs of maternal depression and anxiety and low maternal responsiveness. The VIG intervention seems especially valuable for mother–infant dyads in which mothers' maternal

responsiveness levels fall within the low category. As indicated by the findings reported in Chapter 5, these are the dyads in which infants are at-risk for developing smaller vocabulary sizes. Findings from this Chapter support the potential for VIG to mitigate the risks of infant language delay by targeting maternal responsiveness. It is noted, however, that the present evaluation is exploratory, and it did not include statistical analyses (due to small sample size). With this caution in mind, these preliminary findings set the bases for future studies with a larger sample sizes and randomised group allocation. Qualitative data supported the benefits of VIG participation. Mothers' positive reflections about feeling more confident and aware of what they are doing well that emerged in the interviews could further mitigate these risks. Mothers who believe in their mothering abilities are more likely to establish a sensitive relationship with their infants (Teti & Gelfand, 1991) and persevere with it when parenting tasks become challenging (Bloomfield et al., 2005). The positive effects of VIG highlight the benefit of early dyadic interventions for mothers who have low maternal responsiveness or lack confidence in their mothering abilities.

CHAPTER 7

General Discussion

Mother–infant interactions are generally an infant's first social and linguistic experience, and are therefore influential in their development (Papoušek, 2007; Tamis-LeMonda, Bornstein & Baumwell, 2001). Maternal emotional health concerns such as elevated depression and anxiety symptoms are one environmental factor that has been linked with adverse developmental outcomes including infants' early language abilities (Kaplan et al., 2014; Reck et al., 2018). One proposed pathway by which maternal depression and anxiety symptoms influence children's language abilities is maternal responsiveness. Maternal responsiveness is an indicator of the quality of mother–infant interactions, whereby mothers who have high indicators respond promptly, contingently, and appropriately to their infants' communication cues, (Bornstein & Tamis-LeMonda, 1989). As a reminder to the reader, these factors can be schematised in a conceptual framework of the mother–infant communication feedback loop and the pathway through which maternal emotional health influences infant development. This framework is depicted in Figure 1, Chapter 1, and the findings of this thesis have allowed us to assess its individual components as well as their relations represented by the arrows in the diagram.

The first objective of this thesis was to examine the mechanisms through which maternal depression and anxiety influence infant language development via the quantity and quality of mother–infant interactions. Its second objective was to evaluate the effectiveness of a video feedback intervention aimed at promoting maternal responsiveness. This was achieved through a longitudinal study that followed mother–infant dyads from ages 6 to 18 months and consisted of four main components. The first component involved home recordings of infants' home language environment (adult speech quantity and conversation turns) and the volume of infant vocalisations at both 6 and 12 months of age. The second

component involved the assessment of infants' emerging lexical abilities at 18 months of age. The third component consisted of behavioural observations of mother–infant play sessions at 9 and 12 months that were rated for maternal responsiveness. The final component involved the evaluation of a short intervention aimed at promoting maternal responsiveness within mother–infant interactions. The study design included measures of the mother–infant interaction and developmental outcomes between groups and across time.

The first section of this Chapter provides an overview of the findings from each of the four components of the longitudinal study. The next section discusses the key findings in relation to the existent literature. This includes reflections concerning the clinical implications for screening and interventions with mother–infant dyads affected by maternal depression. The final section of this Chapter involves a reflection about its strengths and limitations, and it proposes a direction for future research inspired by this work.

7.1 Main Findings

7.1.1 Summary of main findings.

To commence our examination of the conceptual framework of the relation between maternal emotional health variables and infants' early lexical abilities, we investigated maternal speech input to the infant represented as the top arrow of the mother–infant feedback loop. Specifically, this first component of the longitudinal study examined the effects of maternal depression and anxiety on the quantity of adult words and conversational turn counts and the volume of infant vocalisations during day-to-day mother–infant interactions (Chapter 3). For this purpose, the LENA system was used to obtain day long home audio recordings when the infants were 6 and 12 months of age. Confirming our predictions, it was found that mother–infant dyads in the risk group took fewer conversational turns than controls and infants in the risk group produced fewer vocalisations than controls.

There was no group difference, however, in the number of adult words. Additional examination revealed that the group difference in vocalisation counts was only present when infants were vocalising in conversation with their primary caregiver (i.e. mother) but not when the infants vocalised alone.

These findings are the first evidence demonstrating differences in the home language environments of mother–infant dyads where the mother is affected by depression and/or anxiety compared to controls. In addition, both conversational turn counts and infant vocalisation counts at 12 months but not 6 months were significant predictors of infants' future vocabulary size assessed at 18 months of age. While there was no group difference in vocabulary size at 18-months of age, vocabulary scores were negatively correlated with maternal anxiety and depression scores. Conversational turns and infant vocalisations were stronger predictors of infants' 18-month vocabulary size than depression and anxiety measures. These results suggest that variability in mothers' emotional health influences infants' home language experience, their concurrent tendency to produce vocalisations, and their later vocabulary size.

To continue the investigation of our conceptual framework, Chapter 4 focused on infants' early lexical abilities. This second component of the study involved an examination of infants' lexical processing efficiency and expressive vocabulary size, which were measured at the age of 18 months as the outcome variables of this longitudinal study. While maternal depression and anxiety have been previously linked to early expressive language measures, this study is the first to examine the effect of maternal depression on lexical processing skills. As we predicted, there was a significant group difference in lexical processing skills and vocabulary size. These results suggest that variability in mothers' emotional health influences infants' lexical processing efficiency in addition to their vocabulary size at 18 months.

The conceptual framework proposed for this study includes maternal responsiveness as its core construct. It is proposed to be the mechanism underlying the observed relations between mothers' emotional health and their communicative behaviours, which in turn yield an effect on infants' language development. These relations were the focus of Chapter 5. This third component of the longitudinal study was achieved through video-recordings of mother–infant play sessions and maternal responsiveness ratings collected when the infants were 9 and 12 months. As expected, maternal responsiveness scores were a significant predictor of infant vocabulary size at 18 months. A regression analysis revealed that maternal responsiveness was a stronger predictor of infant vocabulary size than mothers' depression and anxiety scores. Most importantly, we provided evidence for moderation effect of depression on maternal responsiveness and infants' vocabulary, whereby increasing depression scores were observed to moderate (i.e. decrease) the effect of maternal responsiveness on infant vocabulary size. These findings align with the conceptual framework by identifying an interaction between maternal depression and responsiveness, which has an impact on infants' vocabulary growth. It also highlights the need to consider mothers' levels of responsiveness in addition to depression when designing interventions to mitigate the risk for adverse child developmental outcomes such as language delays.

As the final component of this thesis, Chapter 6 reports an assessment of an intervention motivated by the findings of Chapter 5. This intervention targeted maternal responsiveness and not maternal emotional health with the objective of mediating the effects of depression and anxiety on the nature of mother–infant interactions in the infants' first year of life. A subset of mothers who took part in the longitudinal project completed three sessions of a Video Interaction Guidance, and their maternal responsiveness ratings were used to examine the outcome of the intervention in comparison to a group who also took part in the project but did not participate in the intervention. Mothers who joined the intervention with

low maternal responsiveness levels demonstrated improvements pre- and post- intervention compared to the comparison group. Improvements to mothers' awareness of attuned interactions, their capacity to mentalise or reflect on their child's mental states, and overall engagement in the parenting role were identified as the mechanisms through which VIG was effective in improving maternal responsiveness.

7.1.2 Effects of maternal depression and anxiety on the quantity of social interactions that support vocabulary growth.

The use of multiple approaches to data collection in this thesis provided us with the opportunity to make a comprehensive assessment of the constructs necessary to test our conceptual framework. The use of home recordings provided us with a first glimpse into the naturalistic interactions between mothers with depression and/or anxiety and their infants in the home environment. Analyses of the home recordings yielded novel findings concerning deficits that infants were experiencing in the quantity of back-and-forth conversational turn counts if their mother had depression and/or anxiety compared to controls. Though home recordings have not been conducted with this population group before, the present results are consistent with recent studies with typically-developing infants. That is, the social aspect of language exposure (i.e. conversational turns and not adult words) were found to be a stronger predictor of infants' future language abilities (Gilkerson et al., 2018; Romeo et al., 2018; Zimmerman et al., 2009). However, our results are the first to identity a deficit in the number of conversational turn counts in depressed and/or anxious mother–infant dyads, which is theoretically congruent with previous observations that maternal depression and anxiety can be associated with withdrawn interaction styles (Cohn et al., 1986). Interventions are therefore warranted to encourage mother–infant engagement and increase the number of conversational turns in daily interactions.

An additional novel finding yielded by analysing these home recordings, is the significant group difference in the number of infant vocalisations whereby infants in the risk group vocalised significantly less than controls. These results differ from those found in home recordings involving typically developing children and infants with hearing impairment (Iyer & Oller, 2008), and studies examining the effects of variations in SES status on vocalization counts (Dwyer et al., 2019). What is perhaps striking, is that a group difference in the volume of vocalisations was evident already at 6 months of age. While these differences may be found across a wide range of infant vocalisations recorded by the LENA device, this age marks the first productions of variegated babbling, which is also a significant predictor of later language ability. It is not surprising, therefore, that the quantity of infant vocalisations recorded here at 6 months predicted infants' vocabulary size at 18 months.

7.1.3 Depression has an impact on infants' lexical abilities

Chapter 4 assessed infants' lexical abilities using measures of lexical processing efficiency and parental reports of expressive vocabulary size. While they are both highly correlated, the LWL task measures the speed with which infants are able to access lexical representations whereas the communicative inventory measures infants' overall lexical knowledge. Previous research has already reported a relation between infants' vocabulary size at 12 months and mothers' depression and anxiety symptoms (Kaplan et al., 2014; Reck et al., 2018). However, this thesis is the first to establish this link to online measures of infants' word recognition and lexical processing efficiency. This finding is important as it shows that adverse developmental effects associated with maternal depression commence early, and that intervention strategies may also need to be considered early. In addition, the correlation between lexical processing and vocabulary size in the present dataset also provides additional confidence in interpreting these results due to the construct validity between the two measures. That is, despite the high validity and reliability of communicative

inventories (Fenson et al., 2000), they can be subject to parental factors. It is possible that mothers with depression and anxiety could have underestimated their infants' vocabulary knowledge. The use of the two measures here indicates that this was not the case.

While invaluable in research settings, in clinical settings eye-tracking technology is neither a time- nor cost-effective approach to assessing early lexical abilities. As such and due to the clinical focus of this thesis, the remainder of the analyses reported in this study considered vocabulary size as the primary outcome measure. One of the advantages of using parental reports like the CDI in clinical settings is the ease with which they can be employed by health professionals. Findings from the thesis point to the CDI as a potential screening tool to identify infants who may be at risk for later language delays associated with maternal depression and anxiety symptoms.

7.1.4 The quantity and quality of interactions matter in supporting vocabulary growth.

The inclusion of laboratory visits into this longitudinal study design in addition to the home recordings, provided the opportunity to observe and rate the quality of the mother–infant interactions using both verbal and non-verbal indicators of maternal responsiveness. The laboratory recordings supplied additional information about the quality of interactions within the context of the back-and-forth conversational turn counts captured by the home recordings. This included components of the mother–infant interaction not captured on audio, such as the promptness and developmental appropriateness of maternal responses and the proportion of time mothers were following their baby's lead or attempting to redirect their baby away from their focus of attention.

In Chapter 3, we proposed that the reduced quantity of back-and-forth interactions and infant vocalisations in the risk compared to the control group may be related to reduced maternal responsiveness and the contingency of maternal responses in the risk group. If

mothers were responding less contingently to their infants' vocalisations due to depression symptoms (Biringen, Emde, Brown, Lowe, Myers, & Nelson, 2000), this could lead to a reduction in overall infant vocalisation quantity during mother–infant conversations, which is what was found in this study. Infants' vocalisations, even when pre-linguistic, appear to serve a social function and are influenced by how mothers respond to them (Goldstein, Schwade & Bornstein, 2009). The current interpretation of the findings in Chapter 3 is focused on the role of the mother in mother-infant interactions. It is acknowledged, however, that infants with a presumed history of interacting with mothers with low levels of responsiveness, could also have low levels of responsiveness contributing to lower turn-taking and vocalisation counts. Clarifying whether the lower number of turns and infant vocalisation counts in the risk group was driven by mothers or their infants remains a question for future research.

The value of using both laboratory and home approaches to the measurement of the social aspects of communication can be seen through the dovetailing of findings concerning the significant predictors of early vocabulary size in this longitudinal study. Both the conversational turn count measure (Chapter 3) and maternal responsiveness ratings (Chapter 5) were significant predictors of infant vocabulary size. Both these measures reflect different aspects of the *quality* of early interactions. Regular mother–infant interactions form the foundation for language acquisition, building a communication foundation long before infants start producing language (Golinkoff et al., 2015). However, high levels of maternal responsiveness within the context of those interactions, is also important in predicting and supporting language acquisition (Hudson et al., 2015; Tamis-LeMonda & Bornstein, 2002).

This thesis has shown that both the quantity and quality of mother–infant interactions are influenced by maternal depression and anxiety, which in turn influence emerging language abilities. Together, these findings support the theoretical importance of the early social context in the process of language acquisition, not just for mother–infant dyads where

mothers experience depression symptoms or exhibit concerns about their emotional health in general, but for all caregivers and their infants (e.g., Kuhl, 2007). The clinical implication of these findings is that both pathways need to be considered when targeting interventions for mother–infant dyads in which the infant is at-risk of language delay.

7.1.5 Depression moderates the relationship between maternal responsiveness and vocabulary: Clinical implications.

One of the clear implications arising from this longitudinal study is that maternal responsiveness plays a significant role in predicting early lexical abilities in the infant, over and above mothers' depression and anxiety symptoms. A mother's degree of responsiveness to her infant was shown to be a stronger predictor of infant vocabulary size than her emotional health. However, contrary to our predictions, there were no significant differences between the control and risk groups in this study in the level of maternal responsiveness, nor were there correlations between maternal responsiveness and mothers' depression and anxiety scores. If our analysis stopped at this point, it could appear that these important constructs were not related to each other despite empirical and theoretical literature pointing to the contrary (Edwards & Hans, 2016; Foster, Garber, & Durlak, 2008).

Further analysis was required to examine the interactions between these variables in order to reveal the important manner in which depression is *indeed* related to maternal responsiveness, as they interact together to predict infants' vocabulary development. An especially novel finding in this thesis is the observation that depression, when mild to moderate, moderates (i.e. reduces) the effect of maternal responsiveness on vocabulary size. When depression symptoms were high, there was a negative impact on infants' language acquisition regardless of differing levels of maternal responsiveness. This suggests that interventions that focus on maternal responsiveness (e.g., VIG) should not be considered as a standalone treatment for mothers with high depressive symptoms, which could result in little

impact on their child's language acquisition. Instead, maternal depression and maternal responsiveness should be examined together for future research and clinical purposes.

Due to the interaction captured between depression and maternal responsiveness levels with regards to their impact on infant vocabulary, it would seem pertinent to consider both depression *and* responsiveness together when screening mother–infant dyads for developmental risk in the postnatal period. In Western Societies, it is not uncommon for community services to use self-reported depression and psychosocial tools to screen for early signs of risk for adverse developmental outcomes for infants. Findings from the present study, however, show that screening mother–infant dyads for depression in isolation from maternal responsiveness will not provide a complete picture of the potential risks to infant's developmental trajectory. From the visual representation of the moderation effect presented in Chapter 5, it is clear that both the level of depression *and* the level of maternal responsiveness matter with regards to vocabulary size growth, i.e. both constructs have a negative impact on vocabulary size, but the interaction of both depression *and* responsiveness together explains additional variance in vocabulary size. The moderation analysis in this thesis supports the importance of screening for maternal responsiveness in the postnatal period in addition to assessments of maternal emotional health.

Provided this type of screening to all new mothers with concerns about their mental health would require a tool that can be administered rapidly, without incurring additional costs to the clinicians, and without the requirement of additional extensive training. While an evaluation of assessment tools was not the focus of this thesis, our results support the utility of PaRRiS (Hudson et al., 1992; Hudson et al., 2015) as a global measure of maternal responsiveness. We demonstrate that in a research setting, the PaRRiS was able to detect variations in maternal responsiveness levels in the first year of life that were also predictive of vocabulary size assessed during infants' second year (Chapter 5). In a clinical context, the

PaRRiS provided evidence of a treatment effect through pre- and post- intervention responsiveness ratings (Chapter 6), which supports findings from other studies examining the utility of the PaRRiS as a screening tool in a variety of community settings (Down et al., 2015; Levickis et al., 2018).

In summary, findings from the first three components of this thesis identify significant difference in the quantity and quality of mother–infant interactions that are related to mothers' depression and anxiety symptoms during the postnatal period. These deficits in the number of conversational turns, the volume of infant vocalisations, and maternal responsiveness in the first year of life all predicted infants' emerging language abilities in the second year of life, specifically their lexical processing efficiency and vocabulary size. Taken together these findings suggest that it is not the depression and/or anxiety per se that lead to adverse outcomes in infants' lexical abilities, but it is the potential impact of these symptoms on the social aspects of infants' early language experiences. Maternal responsiveness, as a strong predictor of infant vocabulary, becomes the focal point for interventions, particularly for mothers with low to moderate depressive symptoms. Mothers may not be able to reduce their depression and anxiety symptoms, but they can improve their levels of responsiveness if they receive support in the form of an intervention. However, mothers with higher depressive symptoms need more comprehensive support to assist them to reduce depressive symptoms (at least to a moderate level), so that improvements in their responsiveness have potential to be protective of their child's language acquisition.

7.1.6 The VIG is effective in promoting maternal responsiveness.

The inclusion of an intervention into this study's design provided additional value for the research participation of mothers in the risk group. Rather than only studying mothers with high levels of depression and anxiety and low levels of responsiveness, this study aimed to provide these mothers with an opportunity to build on their strengths and promote

wellbeing in the relationship with their infants. The inclusion of an interview component provided mothers with the opportunity to give a voice to their lived experience not only in the relationship to their infants, but in their experience of an intervention, which was designed to help them. Maternal responsiveness ratings showed that the VIG intervention was effective in enhancing maternal responsiveness for mother–infant dyads who needed it most, those who were rated low on the maternal responsiveness scale. However, interview data revealed that the experience of VIG participation was beneficial in ways that could not be measured statistically. Feedback from mothers suggested that the time given to reflect on their interaction with their infants, observe themselves doing well, together with the opportunity to reflect with someone trained about it, helped them feel better and more confident about their mothering. This, in turn, could positively influence their mood and interactive behaviours. Research has established a strong link between self-beliefs and actual parenting competence (see Jones & Prinz, 2005 for a review) with maternal self-efficacy beliefs associated with positive interactions between a mother and her infant (Bohlin & Hagekull, 1987).

7.7 Methodological Considerations and Directions for Future Research

Using both a categorical and continuous approach to group allocation in this thesis provides a means of balancing some of the challenges associated with depression and anxiety measurement such as their high co-morbidity. A significant advantage of this continuous approach to study depression and anxiety in the prenatal period is that it has enabled the inclusion of data from mothers with elevated but still subclinical levels of symptomatology. Where some components of the longitudinal study did not yield significant group differences (e.g., vocabulary scores), there were significant correlations with mothers' depression and anxiety scores, and infants' early lexical abilities, that were consistent with the existent literature (Kaplan et al. 2014; Reck et al., 2018). This suggests, that in this sample, the degree

of self-reported symptoms, as opposed to the presence of a diagnosis, was more relevant for the assessment of infants' lexical abilities.

This longitudinal study represents the first in-depth examination of the quantity of speech input and quality of mother–infant interactions, where infants have mothers with depression and anxiety. It is also the first to examine the relationship among maternal depression and anxiety and infants' emerging lexical processing abilities. The longitudinal design of this thesis, which involved careful planning and implementation including recruitment strategies and the overall approach to engaging mother–infant dyads who may be at-risk due to emotional health symptoms, allowed for a comprehensive and detailed assessment of the interaction of the abovementioned factors in individual mother–infant dyads across the infants' first year of life. Longitudinal studies can pose some challenges with regards to participant retention, especially when working with special population groups and in the context of the postnatal time period (a stressful time for families). Having a flexible approach to data collection and incorporating both home and laboratory visits assisted with participant retention in this study (96%). This together with flexibility offered to mothers with regards to scheduling appointments contributed to a near perfect retention rate. Providing mothers with acknowledgement and respect concerning the value of their contribution to this research (especially during the post-intervention interviews) encouraged mothers to consider themselves as co-researchers rather than mere participants. Engaging mothers with depression and anxiety symptoms into research when they may already feel overwhelmed by the demands of parenting can be challenging. Conducting the first data collection point in the comfort of participants' home, seemed to provide the participants with an easy initial point of contact with both the study and the researcher that seemed to aid rapport building. Therefore, incorporating home visits into future longitudinal research designs may help to address this potential obstacle to participant engagement.

The present sample size is not small for an infancy study, especially when employing a longitudinal design. However, the confidence with which findings can be generalised to clinical populations would increase with a larger and more diverse sample. A related limitation of the thesis is the substantial proportion of mothers who were university educated, thus limiting the representativeness of this sample to a wider and more diverse population of mothers. A next logical step to continuing the clinical application of this work is to engage a larger sample with more diversity within the sample group. A larger sample size would also enable further exploration of the key variables of interest in the prediction of early lexical abilities. For example, a moderation analysis was selected in this thesis to explore interactions between maternal responsiveness and depression symptoms, as this is the analysis suitable for this sample size. Future studies including a larger sample size could employ additional analyses such as structural equation modelling, in order to further delineate and specify the relations and interactions between maternal emotional health and responsiveness. Furthermore, replication of the study with a clinical sample group, as opposed to a community sample, would enable a group comparison of mothers with depression versus mothers who may meet criteria for different diagnostic categories under the broader category of anxiety disorder.

As with any approach to the measurement of naturalistic interactions, there are limitations as well as strengths associated with the use of the LENA system. One of the limitations of quantitative measures of language input, such as the adult word count calculated by LENA is that it does not capture variations in the lexical diversity of input such as diversity in vocabulary, phrases, and clauses that the mothers used when addressing their infant (Huttenlocher et al., 2010). It also does not provide information about the complexity of input in regards to grammatical structure and linguistic content (Warren et al., 2010). For example, mothers may have been providing a large number of words to their infant but may

simply be repeating the same number of limited words. Language quality refers to the lexical diversity, complexity and richness of speech input (d'Apice et al., 2019), and exposure to this type of diverse adult speech is another important predictor of children's language abilities (Pan, Rowe, Singer, & Snow, 2005; Rowe, 2012). As with more recent studies with typically developing children (e.g., d'Apice et al., 2019), future research could add to the current findings by extracting 5-minute speech segments from the LENA recording, during times (morning and afternoon) that represent the highest number of conversational turn counts. Transcribing these segments and analysing them for lexical and grammatical diversity as markers of language quality would enable an examination of the impact of maternal depression and/or anxiety on the quality of language input to infants.

Our findings that infants in the risk group produce fewer vocalisations than control infants suggest that the infants of mothers with depression and/or anxiety could be contributing to the lower number of conversational turn counts in this group. A next step from this work is to examine infants' input, or *infant responsiveness* in the mother–infant communication loop. This extension will allow for the identification of the driving source for the group difference in conversational turn counts found in this thesis. That is, whether they are driven primarily by the mothers, the infants, or by both partners in the mother–infant communication feedback loop. This could point to new directions in the design of mother–infant interventions targeted at dyads displaying signs of maternal depression and anxiety in the postnatal period.

7.8 Conclusion

Findings from this thesis identify significant differences in the quantity and quality of mother–infant interactions that are related to mothers' depression and anxiety symptoms during the postnatal period. These deficits in the number of back-and-forth conversational turns, the volume of infant vocalisations, and maternal responsiveness in the first year of life,

all predict infants' emerging language abilities in the second year of life. Maternal depression and anxiety symptoms reduce infants' lexical abilities at 18 months of age as represented by deficits in infants' lexical processing efficiency as well as expressive vocabulary size. However, maternal responsiveness is a strong predictor of vocabulary above and beyond mothers' self-reported anxiety and depression scores.

These findings suggest that it is not the depression and/or anxiety per se that lead to the adverse outcomes in infants' lexical abilities, but it is the way in which their symptoms may impact negatively on the social aspects of infants' early language experiences. This is particularly evident in the finding that depression scores reduce the impact of maternal responsiveness on vocabulary size. This has significant clinical implications with regards to tailoring approaches to mother–infant screening and interventions on the basis of maternal responsiveness levels as well as depression scores. Enhancing maternal responsiveness, in addition to psychological treatments for PND, could further mitigate risks for language delay. This possibility was supported by our evaluation of the video guidance intervention that was shown to be effective in improving maternal responsiveness levels for mothers who started with below average scores. This work has defined specific pathways for future research to continue examining the complex relationships within early mother–infant interactions, maternal depression and anxiety symptoms, and infants' early linguistic abilities. It is anticipated that outcomes from this work will continue to lead to improvements to research-informed intervention programmes designed to maximise infants' primary social context in their first two years of life.

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APPENDICES

Appendix A

Family Background Information Sheet

MARCS BABY LAB ***Family Information Sheet***

(All information is strictly confidential.

Infant's date of birth: _____ Mother's Age (today): ____ Father/ Partner's Age (today): _____

* Mother's Name: _____ * Father/ Partner's Name: _____

* Mother's Occupation: _____ * Father/ Partner's Occupation: _____

* Mother's Education: (Please circle both secondary and tertiary level completed)

Secondary Education: Year 10 Year 11 Year 12

Tertiary Education: TAFE University Masters Ph.D. Other_____

*Father/ Partner's Education: (Please circle both secondary and tertiary level completed)

Secondary Education: Year 10 Year 11 Year 12

Tertiary Education: TAFE University Masters Ph.D. Other_____

1. Were there any complications of Pregnancy _____
   and/or Labour/Delivery _____
2. Is your infant your first born? Yes ☐ No ☐ If "no", how many other children do you have? _____
3. (a) Have you been diagnosed with either Depression Yes ☐ No ☐ or Anxiety? Yes ☐ No ☐
   Is your diagnosis past, current or both: _____ Please describe: _____
   _____
   (b) Are you receiving current treatment for your depression/anxiety? Yes ☐ No ☐ Please describe:
   e.g. Medication _____Counselling: _____
4. Was your infant: Fullterm 38-42 weeks ☐ Premature ≤ 37 weeks ☐……weeks Post-mature >42 weeks ☐
5. What was your infant's (a) Birthweight? _____ kg (b) Apgar score? _____ (0-10)
6. Did your infant complete the newborn hearing screen? Passed ☐ Concerns ☐ _____
7. Do you have any concerns about your infant's hearing? Yes ☐ No ☐ Please describe:
   _____
8. Has your infant had any medical/other problems? Yes ☐ No ☐ Please describe:
   _____
9. In your child's family is there a history of:
   (a) Hearing impairment/deafness Yes ☐ No ☐
   If yes, relation to child? _____Type/Degree? _____
   (b) Reading, speech, and/or language problems in the family (i.e. Dyslexia) Yes ☐ No ☐
   If yes, relation to child? _____Type/Degree? _____
10. What is the primary language spoken in your home? _____
    Mother's first language _____ Partner's first language _____
    (a) Please list any other languages/accents (including English accents) that are spoken in your home:
    1. _____ Hours/week spoken? _____
    2. _____ Hours/week spoken? _____

11. How is your baby's health today?

1st Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

2nd Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

3rd Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

4th Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

5th Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

6th Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

7th Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

8th Visit:_____ [Date: __/__/__] Recent Ear Infection? Y ☐ How long ago?.....

12. Has your infant ever had an ear infection? Yes ☐ No ☐ If yes, how many? _____

You can help Baby Science! Even your $30 can make a huge difference.

If you would like to help Baby Science further and donate your $30 travel money or a portion of your travel money, please indicate below:

1st Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
2nd Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
3rd Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
4th Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
5th Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
6th Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
7th Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐
8th Visit:	$30 ☐	$20 ☐	$10 ☐	Not this time ☐

THANK YOU FOR YOUR SUPPORT!

Appendix B

Centre for Epidemiologic Studies Depression Scale - Revised

Below is a list of the ways you might have felt or behaved Please check the boxes that tell me how often you have felt this way in the past week

	Not at all or less than one day in the last week	1-2 days in the last week	3-4 days in the last week	5-7 days in the last week	Nearly every day for 2 weeks
1. My appetite was poor					
2. I could not shake off the blues					
3. I had trouble keeping my mind on what I was doing					
4. I felt depressed					
5. My sleep was restless					
6. I felt sad					
7. I could not get going					
8. Nothing made me happy					
9. I felt like a bad person					
10. I lost interest in my usual activities					
11. I slept much more than usual					
12. I felt like I was moving too slowly					
13. I felt fidgety					

14. I wished I were dead
15. I wanted to hurt myself
16. I was tired all the time
17. I did not like myself
18. I lost a lot of weight without trying to
19. I had a lot of trouble getting to sleep
20. I could not focus on the important things

Appendix C

State Trait Anxiety Inventory

A number of statements which people have used to describe themselves are given below. Read each statement and then tick the appropriate box to the right of the statement to indicate:

HOW YOU FEEL RIGHT NOW, in this moment.

At the present time…..	Not at all	Somewhat	Moderately so	Very much
I feel calm				
I feel secure				
I am tense				
I am regretful				
I feel at ease				
I feel upset				
I am presently worrying over possible misfortunes				
I feel rested				
I feel anxious				
I feel comfortable				
I feel self-confident				
I feel nervous				
I am jittery				
I feel ‘high strung’				
I am relaxed				
I feel content				
I am worried				
I feel over excited and rattled				
I feel joyful				
I feel pleasant				

Appendix D

Risk Management Plan

Risk Indicator	*Action*
Elevated anxiety scores (STAI = or > 40) OR Elevated depression scores (EPDS = or > 10 and/or CESD-R = or >16)	A phone call from the principle investigator to screen for risk and response needs. Mother's will be screened using the following questions: I've noticed that your overall score in this questionnaire that looks at mood/anxiety that you scored higher on these questions. Could you let me know a bit about what contributed to you scoring this question an (for example, always?) How long have you been feeling like this? Is this concerning for you or not? If concerning, how? If not concerning, why not? Are you receiving any assistance in managing these feelings or have you discussed these feelings with your General Practitioner? Mothers will be offered details of general resources (e.g. Beyond Blue and LifeLine) and specific resources in their local area (e.g. Clinical Psychologists). Any indicators of risk to self or others will be followed up with additional questions and possible actions below.

Risk indicator	*Action.*
Any indication of risk to self or others e.g., Positive responses to questions identifying thoughts of self-harm and/or death (i.e. EPDS, Q10; CESD-R, Q 14 & 15).	A phone call from principal investigator that will include the following risk screening questions in addition to the above: ▪ I am wondering if it is Okay if I ask you some further questions about your mood. I don't have any particular idea about whether or not you are having these experiences but if you are it is very important that I know so that I can help you in any way at this time if needed. ▪ I was wondering if there are times that you might wonder whether life is worth living. Have you ever felt like this in the past? If so, when and did you take any steps at the time to harm yourself? ▪ Have there been any times that you might have been at risk of harming others including your baby? If so, what were those thoughts and did you have a plan or take any steps? ▪ In the unlikely event that a mother is at risk of self-harm, suicide, or harm to others (including her baby), she will be informed that the researcher needs to contact her supervisor to discuss the best ways to support the mother at this time. The researcher will then contact Dr. Conti to discuss appropriate interventions which could include the following; contacting The Mental Health Crisis NSW phone number and if required arranging transportation to the local accident and emergency department. In such an event any action taken will be reported by the supervisor to the ethics officer.

Appendix E

The Australian English Development Inventory

Australian English Developmental Vocabulary Inventory - OZI

(adapted from Fenson et al., 1993, for research purposes)

Although children understand many more words than they say, we are here particularly interested in the words your child says.
Please go through the list and mark the words you have heard your child use by clearly ticking the box that belongs to the word.

If your child uses a different or incomplete pronunciation of a word (for example,'raffe' instead of 'giraffe' or 'sketti' instead of 'spaghetti'), mark the words anyhow as we are interested in the vocabulary of your child, not in his/her articulation.

You are also welcome to add words your child says that are not yet included. Please use the comments space provided at the end of the questionnaire.

Remember that this is a catalogue of all words used by many different children at different ages. As the individual development can vary greatly, you don't need to be worried if your child only knows a few of the words at this stage.

Wordlist

1. Sound Effects and Animal Sounds

baa baa	0	meow	0	uh oh	0
choo choo	0	moo	0	vroom/broom	0
cockadoodledoo	0	ouch	0	woof woof	0
grr	0	quack quack	0	yum yum	0

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2. Animals (real or toy)

animal	0	donkey	0	owl	0
ant	0	duck	0	penguin	0
bear	0	elephant	0	pig	0
bee	0	fish	0	pony	0
bird	0	frog	0	possum	0
bug	0	giraffe	0	puppy	0
bunny/rabbit	0	goose	0	sheep	0
butterfly	0	horse	0	snake	0
(pussy)cat	0	kangaroo/roo	0	spider	0
cockroach	0	koala	0	tiger	0
cow	0	lamb	0	turkey	0

crocodile	0	lion	0	turtle	0
deer	0	monkey	0	wombat	0
dog	0	mouse	0	zebra	0

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3. Vehicles (real or toy)

(air)plane	0	fire truck/engine	0	tractor	0
bicycle/bike	0	helicopter	0	train	0
boat	0	motorbike	0	three wheeler/tricycle	0
bus	0	pram	0	truck	0
car	0	stroller	0		

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4. Toys

ball	0	crayon	0	present/pressie	0
balloon	0	doll	0	puzzle	0
bat	0	game	0	story	0
block/brick	0	glue	0	teddy bear	0
book	0	pen	0	toy	0
bubbles	0	play dough	0		

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5. Food and Drink

apple	0	fish	0	pineapple	0
banana	0	food	0	pizza	0
beans	0	grapes	0	popcorn	0
biscuit/bikkie	0	hamburger	0	potato	0
bread	0	ice	0	(potato) chip/crisps	0
butter	0	ice cream	0	pudding	0
cake	0	jam	0	pumpkin	0
carrot	0	jelly	0	raisin	0
cereal	0	juice	0	salt	0
cheese	0	lolly	0	sandwich	0
chicken	0	mango	0	soup	0
chocolate	0	meat	0	spaghetti	0
chewing gum/chewie	0	milk	0	strawberry	0
coffee	0	muffin	0	toast	0
coke	0	noodles	0	(tomato) sauce	0
cordial	0	nuts	0	tuna	0
corn	0	orange	0	vanilla	0
custard	0	pancake	0	vegemite	0
doughnut	0	pasta	0	vitamins	0
drink	0	peanut butter	0	water	0
egg	0	peas	0	yoghurt	0

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6. Clothing

beanie	0	jacket	0	shoe(s)	0
belt	0	jeans	0	shorts	0
bib	0	jumper	0	slipper(s)	0
boot(s)	0	nappy	0	sock(s)	0
button	0	necklace	0	sunglasses/sunnies	0
coat	0	pyjamas/jamies	0	thongs	0
dress	0	pants	0	underpants/undies	0
hat	0	shirt	0	zipper	0

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7. Body Parts

ankle	0	face	0	mouth	0
arm	0	finger(s)	0	nail(s)	0
belly button/navel	0	foot/feet	0	neck	0
breasts*	0	hair	0	nose	0
bottom*	0	hand	0	shoulder	0
cheek	0	head	0	stomach/tummy	0
chin	0	knee	0	tooth/teeth	0
ear	0	leg	0	toe(s)	0
eye	0	lips	0	tongue	0

** or word used in your family*

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8. Small Household Items (49 items)

basket	0	garbage/rubbish	0	plate	0
bin	0	glass	0	purse/wallet	0
blanket	0	hammer	0	radio	0
bottle	0	jar	0	serviette/napkin	0
box	0	keys	0	scissors	0
bowl	0	knife	0	soap	0
broom	0	lamp	0	spoon	0
brush	0	light	0	tape	0
bucket	0	medicine	0	telephone/phone	0
camera	0	money	0	tissue	0
can	0	mop	0	toothbrush	0
clock	0	mug	0	towel	0
comb	0	newspaper/paper	0	tray	0
cot	0	photo	0	vacuum cleaner	0
cup	0	picture	0	watch	0
dish	0	pillow	0		
fork	0	plant	0		

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9. Furniture and Rooms

bathroom	0	drawer	0	room	0
bath (tub)	0	fridge	0	shower	0
bed	0	garage	0	sink	0
bedroom	0	high chair	0	stairs	0
bench	0	kitchen	0	table	0
chair	0	living/lounge room	0	TV	0
computer	0	oven/stove	0	veranda/porch	0
couch/lounge/sofa	0	play pen	0	wardrobe	0
crib	0	potty	0	washing machine	0
door	0	rocking chair	0	window	0

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10. Outside Things

backyard	0	pool	0	stick	0
cloud	0	rain	0	stone	0
flag	0	rock	0	street	0
flower	0	roof	0	sun	0
footpath	0	sandpit	0	swing	0
garden	0	shed	0	tree	0
grass	0	shovel	0	wall	0
hose	0	sky	0	water	0
ladder	0	slide	0	waves	0
lawn mower	0	sprinkler	0	wind	0
moon	0	star	0		

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11. Places to Go

barbecue	0	home/house	0	playground	0
beach	0	movies	0	school/kindie/preschool	0
bush	0	outside	0	shop	0
church/mosque*	0	park	0	show	0
city	0	party	0	yard	0
country	0	petrol station	0	work	0
farm	0	picnic	0	zoo	0

*or equivalent

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12. People

aunt	0	doctor	0	nurse	0
baby	0	fireman	0	people	0
babysitter	0	friend	0	person	0
boy	0	friend's name	0	pet's name	0
brother	0	girl	0	police(man)	0

child/kid	0	grandma/nanna*	0	postman	0
child's own name	0	grandpa/pop*	0	sister	0
clown	0	lady	0	teacher	0
cowboy	0	man	0	uncle	0
daddy*	0	mummy*	0		

**or word used in your family*

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13. Games and Routines

bath	0	hi	0	please	0
breakfast	0	hide and seek/hidie	0	shh/shush/hush	0
call (phone)	0	lunch	0	shopping	0
dinner	0	nap	0	snack	0
give me five!	0	night night	0	thank you	0
goodbye/bye bye	0	no/don't	0	wait	0
go potty	0	patty cake/pat-a-cake	0	want to	0
hello	0	peekaboo	0	yes	0

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14. Action Words

bite	0	drive	0	hug	0	read	0	sweep	0
blow	0	drink	0	hurry	0	ride	0	swim	0
break	0	drop	0	jump	0	rip	0	swing	0
bring	0	dry	0	kick	0	run	0	take	0
build	0	dump	0	kiss	0	say	0	talk	0
bump	0	eat	0	knock	0	scratch	0	taste	0
buy	0	fall	0	know	0	see	0	tear	0
call	0	feed	0	lick	0	shake	0	tell	0
carry	0	find	0	like	0	share	0	think	0
catch	0	finish	0	listen	0	show	0	throw	0
chase	0	fit	0	look	0	shut	0	tickle	0
clap	0	fix	0	love	0	sing	0	touch	0
clean	0	get	0	make	0	sit	0	wake	0
climb	0	give	0	open	0	sleep	0	walk	0
close	0	go	0	paint	0	slide	0	wash	0
cook	0	hate	0	pick	0	smell	0	watch	0
cover	0	have	0	play	0	smile	0	wipe	0
cry	0	hear	0	pour	0	spill	0	wish	0
cuddle	0	help	0	pretend	0	splash	0	work	0
cut	0	hide	0	pull	0	stand	0	write	0
dance	0	hit	0	push	0	stay	0		
draw	0	hold	0	put	0	stop	0		

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15. Descriptive Words

all gone	0	full	0	orange	0
asleep	0	gentle	0	poor	0
awake	0	good	0	pretty	0
bad	0	green	0	quiet	0
better	0	happy	0	red	0
big	0	hard	0	sad	0
black	0	heavy	0	scared	0
blue	0	high	0	sick	0
broken	0	hot	0	sleepy	0
brown	0	hungry	0	slow	0
careful	0	hurt	0	soft	0
clean	0	last	0	sticky	0
cold	0	little	0	stuck	0
cute	0	long	0	thirsty	0
dark	0	loud	0	tiny	0
dirty	0	mad	0	tired	0
dry	0	nasty	0	wet	0
easy	0	naughty	0	white	0
empty	0	new	0	windy	0
fast	0	nice	0	yellow	0
fine	0	noisy	0	yucky	0
first	0	old	0	yummy	0

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Word Forms: Nouns / Verbs in Past Tense

Please mark any of the following words your child uses.

children	0	men	0	teeth	0
feet	0	mice	0		

ate	0	fell	0	made	0
blew	0	flew	0	ran	0
bought	0	got	0	sat	0
broke	0	had	0	saw	0
came	0	heard	0	took	0
drank	0	held	0	went	0
drove	0	lost	0		

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Word Endings: Noun / Verb Errors

Young children often place the wrong endings on words. For example, a child might say "Auntie goed home". Errors like this are often a sign of progress in language. Please mark all errors you recently noticed in your child's speech.

blockses	0	mans	0	sockses	0
childrens	0	mens	0	teeths	0
childs	0	mices	0	toeses	0

feets	0	mouses	0	tooths	0
foots	0	shoeses	0		

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ated	0	comed	0	goed	0	ranned	0
blewed	0	doed	0	gotted	0	runned	0
blowed	0	dranked	0	haved	0	seed	0
bringed	0	drinked	0	heared	0	satted	0
buyed	0	eated	0	holded	0	sitted	0
breaked	0	falled	0	losed	0	taked	0
broked	0	flied	0	losted	0	wented	0
camed	0	getted	0	maked	0		0

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Has your child begun to combine words yet, such as "nother cracker" or "doggy bite"?

not yet	0	sometimes	0	often	0

If you answered 'not yet', please go to section "Additional Questions".
If you answered 'sometimes' or 'often', please continue with "Sentence Examples".

Sentence Examples

Please list three of the longest sentences you have heard your child say recently.

1. _____

2. _____

3. _____

Additional Questions

1. Does anyone speak to your child in a language other than English? Yes/No
   If yes, which language(s)?
   On average, how many hours per week would your child hear the language(s)?

Language: _____ Hours per week: _____

Language: _____ Hours per week: _____

Language: _____ Hours per week: _____

2. Has your child ever had any hearing problems? Yes/No

   If yes, please specify: _____

3. Was your child born full term? Yes/No

   If no, how many weeks premature? _____

Thank you very much for your time and effort.

This space is provided for comments from your side:

_____

_____

_____

_____

_____

_____

_____

Appendix F

Longitudinal Study Participation Sheet and Consent Form

Project Title: First sounds and first steps: An examination of the mother-infant interaction and infants' early development

Project summary: The project is examining how mothers' speech and other interactive behaviours influence infant development. You and your child are invited to participate in a study conducted by Mrs Ruth Brookman, PhD Candidate in the MARCS Institute for Brain, Behaviour and Development. This study will form the basis for the degree of Doctor of Philosophy at Western Sydney University. The project is under the supervision of Dr. Marina Kalashnikova, Professor Denis Burnham, and Dr. Janet Conti.

How is the study being paid for?

The study is being sponsored by the MARCS Institute at Western Sydney University.

What does the study involve?

If you choose to take part in this study, you will be asked to fill out online questionnaires about you and your child that you complete at home. Some additional data will be collected at home using equipment provided to you by the research team. The Language Environment Analysis (LENA) system will be explained to you to enable you to record your child's language experience at home. On other occasions date will be collected during visits to the Baby lab.

Home visit: Someone from the research team will contact you to arrange a suitable time to visit you and your baby when he/she is 6 months of age. The LENA will be dropped off to you and picked up a week later to enable you to choose a recording day that best suits you. The LENA is simple to use and allows a recording to be made that is representative of your

child's typical day. The LENA consists of a small recording unit that is worn in a vest provided for your baby. It can record up to 16 hours of continuous speech data at home, while you and your family go about your usual daily activities. Speech data is then transferred onto a computer, where software automatically conducts analysis on it without researches listening to the content. Later in the project, you will be invited to participate in an additional home recording when your baby is 12 months of age.

BabyLab visits: There will also be a BabyLab visit at the MARCS Institute when your baby is 9 months of age. During this visit you and your baby will be invited to participate in a play session in which you will be recorded talking to your baby. Later in the project, as your child gets older, there is also the opportunity to attend the BabyLab on two further occasions for short developmental and language tests.

How much time will the study take?

The study involves participation over a time period of about 12 months including home visits and visits to the MARCS BabyLab. The first session will include a visit from the researcher taking approximately one hour. This will include time to fill in some paper work and demonstrate the recording equipment you will use at home. There will be another home recording at 12 months. Both of these home recording sessions will involve your child wearing a small recording device for two consecutive days. The BabyLab visits will take approximately 40 minutes. You will be invited to bring your baby to the BabyLab when they are 9 -, 12- and 18- months of age.

Will the study involve any discomfort for me or my child?

The study is not intended to involve any discomfort to you or your child. However, should you or your child experience any discomfort please contact the researcher. You are able to discontinue your participation in the study at any time.

During the home recording it is possible that you may feel uncomfortable with the content of private conversations being recorded. Please note that you can easily pause the recording at any time in order to protect your privacy.

The infant vest containing the small recording device should not involve any discomfort for your child. However, if your child does appear distressed wearing the vest, it can quickly and easily be removed by unfastening the snap fasteners at the back of the vest

If you do experience any distress associated with your participation in the study, please contact Lifeline on 131 114, Should you require parenting advice or support contact Karitane Care Line on 1300 227 464 or Tresillian Parent Helpline on 1800 367 357.

Will the study benefit me?

While there may not be any specific immediate benefits to any individual, your involvement in the research will likely contribute to a better understanding of the mother-infant interactions infant's social and communication development.

You will be compensated $30 for your travel expenses at each BabyLab visit and your child will receive a small gift and certificate to acknowledge their participation.

Will anyone else know the results? How will the results be disseminated?

Researchers will only have access to the raw data you provide. All aspects of the study, including your identity, will remain confidential and anonymous. The data collected from the study will be stored securely electronically and in paper files at the MARCS Institute at Bankstown for five years. The research team will have access to the data for that time for the purposes of publications and conference presentations.

The findings of the research will be published as a doctoral thesis by Ruth Brookman and in publications, conferences and the MARCS BabyLab newsletter. Excerpts from the recordings may be used also be used for illustrative purposes in teaching, conference presentations or in

various relevant electronic media but neither you nor your child will be identified in the recordings.

If you would like to know about the results, we can send them to you once the study is completed. In addition, the First Sounds First Steps newsletter will inform you about the project as it progresses.

Confidentiality

Personal information gathered in the course of the study is confidential and will be securely stored. No personal information will be given to any persons other than the researchers unless it is made anonymous. De-identified data from the study will be made available for future research and maybe stored in online research servers or databases.

During the study everything you say and do will remain confidential unless the researcher is concerned about your safety or the safety of others. In these instances the researcher will need to consult with other professionals and take steps to ensure the safety of all parties involved.

Can I withdraw from the study?

Participation is entirely voluntary: you are not obliged to be involved and, if you do participate, you can withdraw at any time without giving any reason and without any consequences.

Can I tell other people about the study?

Yes please, you can tell other people about the study and they can contact the BabyLab Coordinator (Rachel Lee on 9772 6313) to register their interest.

What if I require further information?

When you have read this information, we will discuss it with you further and answer any questions you may have. If you would like to know more information or if you have concerns about what has been recorded at any time during your participation in the study please contact us. We will be happy to discuss it with you:

Ms Ruth Brookman, Principal Investigator (02) 9772-6660, r.brookman@westernsydeny.edu.au

Dr Marina Kalashnikova, Principal Supervisor (02) 9772 6142;
m.kalashnikova@westernsydney.edu.au

What if I have a complaint?

This study has been approved by Western Sydney University Human Research Ethics Committee. The approval number is (yet to be determined). If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel 02 4736 0883 Fax 02 4736 0013 or email humanethics@westernsydney.edu.au.

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

CONSENT FORM for RESEARCH PARTICIPATION

Project Title: First sounds and first steps: An examination of the mother-infant interaction and infants' early development

1. I agree to take part in the study, as described in the Information Sheet.
2. I have read the Information Sheet for Research Participants. This Information Sheet tells me what the research is for, and what participants do in the study.
3. I have had a chance to ask questions. I was given complete answers to my questions.
4. I can withdraw from the study at any time. If I withdraw from the study, I understand that the University of Western Sydney will not discriminate against me in the future.

5. The results can be published and the results can be presented. I will be identified only by an identification code. My name will not be used in research presentations or publications.
6. I agree to be contacted for participation in future research projects. YES / NO
7. I consent to the de-identified data from the study to be made available for future research that maybe stored in online research servers or databases.
8. If I have questions, I can contact:

Ms Ruth Brookman, (02) 9772-6535, r.brookman@westernsydeny.edu.au

Dr Janet Conti, Supervisor: (02) 9772 6345, j.conti@westernsydney.edu.au

Dr. Marina Kalashnikova, Researcher in Infancy Studies, (02) 9772 6142; m.kalashnikova@uws.edu.au

I am keeping a copy of this information sheet and consent form

Name (please PRINT) _____

Signature: _____

Date: _____

Signature of Person Obtaining Consent _____

Note: This study has been approved by Western Sydney University Human Research Ethics Committee. The Approval number is H11703. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel (02) 4736 0883 Fax (02) 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Appendix G

Parenting Sense of Competence Scale

Please rate the extent to which you agree or disagree with each of the following statements.

Strongly Disagree	**Somewhat Disagree**	**Disagree**	**Agree**	**Somewhat Agree**	**Strongly Agree**
1	2	3	4	5	6

1. The problems of taking care of a child are easy to solve once you know how your actions affect your child, an understanding I have acquired. 1 2 3 4 5 6

2. Even though being a parent could be rewarding, I am frustrated now while my child is at his / her present age. 1 2 3 4 5 6

3. I go to bed the same way I wake up in the morning, feeling I have not accomplished a whole lot. 1 2 3 4 5 6

4. I do not know why it is, but sometimes when I'm supposed to be in control, I feel more like the one being manipulated. 1 2 3 4 5 6

5. My mother was better prepared to be a good mother than I am. 1 2 3 4 5 6

6. I would make a fine model for a new mother to follow in order to learn what she would need to know in order to be a good parent. 1 2 3 4 5 6

7. Being a parent is manageable, and any problems are easily solved. 1 2 3 4 5 6

8. A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one. 1 2 3 4 5 6

9. Sometimes I feel like I'm not getting anything done. 1 2 3 4 5 6

10. I meet by own personal expectations for expertise in caring for my child. 1 2 3 4 5 6

11. If anyone can find the answer to what is troubling my child, I am the one. 1 2 3 4 5 6

12. My talents and interests are in other areas, not being a parent. 1 2 3 4 5 6

13. Considering how long I've been a mother, I feel thoroughly familiar with this role. 1 2 3 4 5 6

14. If being a mother of a child were only more interesting, I would be motivated to do a better job as a parent. 1 2 3 4 5 6

15. I honestly believe I have all the skills necessary to be a good mother to my child. 1 2 3 4 5 6

16. Being a parent makes me tense and anxious. 1 2 3 4 5 6

17. Being a good mother is a reward in itself. 1 2 3 4 5 6

Appendix H

The intimate Bond Measure

This questionnaire lists some attitudes and behaviours which people reveal in their close relationships. Please judge your partner's attitudes and behaviour towards you in recent times and tick the most appropriate box for each item.

		very true	moder-ately true	Some-what true	not at all true
1.	Is very considerate of me	3	2	1	0
2.	Wants me to take his/her side in an argument	3	2	1	0
3.	Wants to know exactly what I'm doing & where I am	3	2	1	0
4.	Is a good companion	3	2	1	0
5.	Is affectionate to me	3	2	1	0
6.	Is clearly hurt if I don't accept his/her views	3	2	1	0
7.	Tends to try to change me	3	2	1	0
8.	Confides closely in me	3	2	1	0
9.	Tends to criticize me over small Issues	3	2	1	0
10.	Understands my problems and worries	3	2	1	0
11.	tends to order me about	3	2	1	0
12.	Insists I do exactly as I'm told	3	2	1	0

13.	Is physically gentle and considerate	3	2	1	0
14.	Makes me feel needed	3	2	1	0
15.	Wants me to change in small ways	3	2	1	0
16.	Is very loving to me	3	2	1	0
17.	Seeks to dominate me	3	2	1	0
18.	Is fun to be with	3	2	1	0
19.	Wants to change me in big ways	3	2	1	0
20.	Tends to control everything I do	3	2	1	0
21.	Shows his/her appreciation of me	3	2	1	0
22.	Is critical of me in private	3	2	1	0
23.	Is gentle and kind to me	3	2	1	0
24.	Speaks to me in a warm and friendly voice	3	2	1	0

Very true scores 3, *Moderately true* scores 2, *Somewhat true* scores 1, and *Not at all true* scores 0. Add scores from items 1, 4, 5, 8, 10, 13, 14, 16, 18, 21, 23 & 24 to get the total score for *Care*. Add scores from items *2, 3, 6, 7, 9, 11, 12, 15, 17, 19, 20 & 22* to get the total score for *Control*.

care total: _____ ***control total: _____***

Wilhelm, K. & Parker, G. (1988) *The development of a measure of intimate bonds* Psychological Medicine, 18, p. 225-234

Appendix I

Parental Reflective Functioning Questionnaire

Listed below are a number of statements concerning you and your baby. Please read each item and decide whether you agree or disagree and to what extent.

Use the following rating scale from 1 to 7, where 1 means that you strongly disagree and 7 means you strongly agree with statement. The midpoint, if you are neutral or undecided, is 4.

Strongly Disagree	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Strongly Agree**

My child and I can feel differently about the same thing.	1	2	3	4	5	6	7
When I get angry with my child, I always know the reason why.	1	2	3	4	5	6	7
I am often curious to find out how my child feels.	1	2	3	4	5	6	7
How I am feeling can affect how I understand my child's behavior.	1	2	3	4	5	6	7
My child knows when I am having a bad day and does things to make it worse.	1	2	3	4	5	6	7
I like to think about the reasons behind the way my child behaves and feels.	1	2	3	4	5	6	7
I try to see situations through the eyes of my child.	1	2	3	4	5	6	7
I always know why my child acts the way he or she does.	1	2	3	4	5	6	7
My child sometimes gets sick to keep me from doing what I want to do.	1	2	3	4	5	6	7
I believe that how I think about my child will change over time.	1	2	3	4	5	6	7
My child can react to a situation very differently than I think he or she will.	1	2	3	4	5	6	7

I find it hard to actively participate in make believe play with my child.	1	2	3	4	5	6	7
At times, it takes several tries before I understand what my child needs or wants.	1	2	3	4	5	6	7
When my child is fussy he or she does that just to annoy me.	1	2	3	4	5	6	7
Now that I am a parent, I realize how my parents could have misunderstood my reactions when I was a child.	1	2	3	4	5	6	7
No matter how sick my child is, I can always tolerate him or her.	1	2	3	4	5	6	7
How I see my child changes as I change.	1	2	3	4	5	6	7
My behavior towards my child cannot be explained by how I was raised.	1	2	3	4	5	6	7
I can always predict what my child will do.	1	2	3	4	5	6	7
I wonder a lot about what my child is thinking and feeling.	1	2	3	4	5	6	7
Often, my child's behavior is too confusing to bother figuring out.	1	2	3	4	5	6	7
I can sometimes misunderstand the reactions of my child.	1	2	3	4	5	6	7
When my child is misbehaving it's a sign that he or she does not love me.	1	2	3	4	5	6	7
I believe that how my parents raised me affects how I raise my child.	1	2	3	4	5	6	7
My child cries around strangers to embarrass me.	1	2	3	4	5	6	7
I pay attention to what my child is feeling.	1	2	3	4	5	6	7
I can completely read my child's mind.	1	2	3	4	5	6	7
Understanding why my child behaves in a certain way helps me not to be upset with him or her.	1	2	3	4	5	6	7
I believe there is no point in trying to guess what my child feels.	1	2	3	4	5	6	7
I often think about how I felt when I was a child.	1	2	3	4	5	6	7
I try to understand the reasons why my child misbehaves.	1	2	3	4	5	6	7

I always know what my child wants.	1	2	3	4	5	6	7
I hate it when my child cries and/or talks to me when I am on the phone with someone.	1	2	3	4	5	6	7
The only time I'm certain my child loves me is when he or she is smiling at me.	1	2	3	4	5	6	7
I'm certain that my child knows that I love him or her.	1	2	3	4	5	6	7
The best way to know your child loves you is when he or she is well-behaved.	1	2	3	4	5	6	7
My child's temperament is what it is, and there is little that I can do about that.	1	2	3	4	5	6	7
I always know why I do what I do to my child.	1	2	3	4	5	6	7
At times I get confused about what my child is feeling.	1	2	3	4	5	6	7

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

Appendix J

Maternal Postnatal Attachment Scale

These questions are about your thoughts & feelings about your baby. Please tick one box only in answer to each question.

I **When I am caring for the baby, I get feelings of annoyance or irritation:**

- ☐ Very frequently
- ☐ Frequently
- ☐ Occasionally
- ☐ Very rarely
- ☐ Never

2 **When I am caring for the baby I get feelings that the child is deliberately being difficult or trying to upset me:**

- ☐ Very frequently
- ☐ Frequently
- ☐ Occasionally
- ☐ Very rarely
- ☐ Never

3 **Over the last two weeks I would describe my feelings for the baby as:**

- ☐ Dislike
- ☐ No strong feelings towards the baby
- ☐ Slight affection
- ☐ Moderate affection
- ☐ Intense affection

4 **Regarding my overall level of interaction with the baby I:**

- ☐ Feel very guilty that I am not more involved
- ☐ Feel moderately guilty that I am not more involved
- ☐ Feel slightly guilty that I am not more involved
- ☐ I don’t have any guilty feelings regarding this

5 **When I interact with the baby I feel:**

- Very incompetent and lacking in confidence
- Moderately incompetent and lacking in confidence
- Moderately competent and confident
- Very Competent and confident

6 **When I am with the baby I feel tense and anxious:**

- Very frequently
- Frequently
- Occasionally
- Almost never

7 **When I am with the baby and other people are present, I feel proud of the baby:**

- Very frequently
- Frequently
- Occasionally
- Almost never

8 **I try to involve myself as much as I possibly can PLAYING with the baby:**

- This is true
- This is untrue

9 **When I have to leave the baby:**

- I usually feel rather sad (or it's difficult to leave)
- I often feel rather sad (or it's difficult to leave
- I have mixed feelings of both sadness and relief
- I often feel rather relieved (and it's easy to leave)
- I usually feel rather relieved (and it's easy to leave)

10 **When I am with the baby:**

- I always get a lot of enjoyment/satisfaction
- I frequently get a lot of enjoyment/satisfaction
- I occasionally get a lot of enjoyment/satisfaction
- I rarely get a lot of enjoyment/satisfaction

11 **When I am not with the baby, I find myself thinking about the baby:**

- Almost all the time

- Very frequently
- Frequently
- Occasionally
- Not at all

12 **When I am with the baby:**

- I usually try to prolong the time I spend with him/her
- I usually try to shorten the time I spend with him/her

13 When I have been away from the baby for a while and I am about to be with him/her again, I usually feel:

- Intense pleasure at the idea
- Moderate pleasure at the idea
- Mild pleasure at the idea
- No feelings at all about the idea
- Negative feelings about the idea

14 **I now think of the baby as:**

- Very much my own baby
- A bit like my own baby
- Not yet really my own baby

15 **Regarding the things that we have had to give up because of the baby**

- I find that I resent it quite a lot
- I find that I resent it a moderate amount
- I find that I resent it a bit
- I don't resent it at all

16 **Over the past three months, I have felt that I do not have enough time for myself or to pursue my own interests:**

- Almost all the time
- Very frequently
- Occasionally
- Not at all

17 **Taking care of this baby is a heavy burden of responsibility. I believe this is:**

- Very much so
- Somewhat so
- Slightly so
- Not at all

18 **I trust my own judgement in deciding what the baby needs:**

- Almost never
- Occasionally
- Most of the time
- Almost all the time

19 **Usually when I am with the baby:**

- I am very impatient
- I am a bit impatient
- I am moderately patient
- I am extremely patient

Appendix K

Short Temperament Scale for Infants

For each question, please circle the number which best describes your baby's behaviour at the present time. If any question does not apply to your infant or cannot be answered, just draw a line through it.

Almost Never	**Rarely**	**Variable – usually does not**	**Variable – usually does**	**Frequently**	**Almost always**
1	2	3	4	5	6

1. The baby is fretful on waking up and/or going to sleep (frowns, cries)..... 1 2 3 4 5 6
2. The baby accepts straight away any change in place or position of feeding, or person giving the feed..... 1 2 3 4 5 6
3. The baby is shy (turns away or clings to mother) on meeting another child for the first time..... 1 2 3 4 5 6
4. The baby continues to fret during nappy change in spite of efforts to distract him/her with game, toy or singing, etc..... 1 2 3 4 5 6
5. The baby amuses self for 1/2 hour or more in cot or playpen (looking at mobile, playing with toy, etc)..... 1 2 3 4 5 6
6. The baby moves about a lot (kicks, grabs, squirms) during nappy changing and dressing..... 1 2 3 4 5 6
7. The baby makes happy sounds (coos, smiles, laughs) when being changed or dressed..... 1 2 3 4 5 6
8. The baby is pleasant (smiles, laughs) when first arriving in unfamiliar places (friend's house, shop)..... 1 2 3 4 5 6
9. The baby gets sleepy at about the same time each evening (within 1/2 hour)..... 1 2 3 4 5 6
10. The baby accepts regular procedures (hair brushing, face washing, etc) at any time without protest..... 1 2 3 4 5 6
11. The baby moves a lot (squirms bounces, kicks) while lying awake in cot..... 1 2 3 4 5 6
12. For the first few minutes in a new place or situation (new shop or home) the baby is fretful..... 1 2 3 4 5 6
13. The baby continues to cry in spite of several minutes of soothing..... 1 2 3 4 5 6

14.	The baby keeps trying to get a desired toy, which is out of reach, for 2 minutes or more.....	1	2	3	4	5	6
15.	The baby greets a new toy with a loud voice and much expression of feeling (whether positive or negative).....	1	2	3	4	5	6
16.	The baby's first reaction (at home) to approach by strangers is acceptance.....	1	2	3	4	5	6
17.	The baby wants daytime naps at differing times (over 1 hour difference) from day to day.....	1	2	3	4	5	6
18.	The baby cries when left to play alone.....	1	2	3	4	5	6
19.	The baby's daytime naps are about the same length from day to day (less than 1/2 hour difference).....	1	2	3	4	5	6
20.	The baby displays much feeling (strong laugh or cry) during changing or dressing.....	1	2	3	4	5	6
21.	The baby wants and takes feedings at about the same time (within 1 hour) from day to day.....	1	2	3	4	5	6
22.	The baby is content (smiles, coos) during interruptions of milk or solid feeds.....	1	2	3	4	5	6
23.	The baby accepts within a few minutes a change in place of bath or person giving the bath.....	1	2	3	4	5	6
24.	The baby's time of waking in the morning varies greatly (by 1 hour or more) form day to day.....	1	2	3	4	5	6
25.	The baby reacts strongly to strangers: laughing or crying.....	1	2	3	4	5	6
26.	The baby's period of greatest activity comes at the same time of day.....	1	2	3	4	5	6
27.	The baby is irritable or moody throughout a cold or stomach virus.....	1	2	3	4	5	6
28.	The baby can be distracted from fretting or squirming during a procedure (nail cutting, hair brushing, etc) by a game, singing, TV, etc.....	1	2	3	4	5	6
29.	The baby's first reaction to seeing doctor or Infant Welfare Sister is acceptance (smiles, coos).....	1	2	3	4	5	6
30.	The baby lies still during procedures like hair brushing or nail cutting.....	1	2	3	4	5	6

Appendix L

Parental Responsiveness Scale

Rating Definitions

1 = very low

Parent rarely responds in a developmentally appropriate way either verbally or non-verbally to any of Child's gestures or verbalisations AND Parent attempts to redirect Child's behaviour, rather than following Child's interests.

2 = low

Parent responds occasionally in a developmentally appropriate way either verbally or non-verbally to Child's gestures or verbalisations AND/OR Parent spends more time attempting to redirect Child's behaviour than following Child's interest.

3 = moderate (average)

Parent spends some time responding in a developmentally appropriate way either verbally or non-verbally to Child's gestures or verbalisations, and some time ignoring them AND/OR Parent spends equal time following Child's interest and redirecting Child's behaviour.

4 = high

Parent often responds in a developmentally appropriate way either verbally or non-verbally to Child's gestures or verbalisations AND/OR Parent spends more time following Child's interest than redirecting Child's behaviour.

5 = very high

Parent frequently responds in a developmentally appropriate way either verbally or non-verbally to Child's gestures or verbalisations AND Parent rarely attempts to redirect Child's focus from the current activity but follows Child's interests.

Note: Specification of extent of parental directiveness: 'redirecting the child's behaviour' refers to redirecting the child's attention away from their current play and interests at that point in time.

Appendix M

Maternal Self-Efficacy

Based on self-efficacy theory (Bandura, 1977), for mothers to feel a sense of self-efficacy in the parenting role, they should possess confidence in their parenting abilities. For example, in a study with high risk mother–infant dyads (e.g., due to pre-maturity, low birth weight etc), mothers who reported a high knowledge of infant development and high self-efficacy, were rated as more sensitive when responding to their infants during play sessions (Hess, Teti, & Hussey-Gardner, 2004). Maternal self-efficacy also mediates the relationship between maternal depression and parenting competence (Teti & Gelfand, 1991), and it has been found to mediate the relationship between parental anxiety and engagement with their pre-school aged children (Giallo et al., 2012). There are a number of factors that influence mothers' perceived self-efficacy. For example, maternal emotional health, socio-marital support, and infant temperament (Leahy-Warren, Mccarthy, & Corcoran, 2012).

The Parenting Sense of Competence Scale (PSOC). Mothers' self-efficacy was examined using the PSOC, which has been identified as the most commonly used tool for measuring parental self-efficacy (Jones & Prinz, 2005). The original scale consists of 17 items developed by Gibaud-Wallston (1978) to measure parents' satisfaction with the parenting and their self-efficacy in the parenting role. The final item of the PSOC is often omitted on the basis of Johnston and Mash's (1989) finding that Item 17 did not load onto any factor. Several changes were subsequently made to the scale by Johnston and Mash, including renaming the original subscales to the 'Efficacy' and 'Satisfaction' subscales, and modifying items to be suitable for parents with older children as well as those with infants. Gilmore and Cuskelly (2009) identified a third theme, 'Interest' in their study using a large Australian normative sample of mothers (n = 586) and fathers (n = 615), from which they obtained normative data.

The Satisfaction subscale (Items 2, 3, 4, 8, 9, 16) examines parents' satisfaction in the parental role. The Efficacy Subscale (Items 6, 10, 11, 13, 15) looks at their perceived capability levels in their parental role. Finally, the Interest subscale (Items 12, 14, 17) measures mothers' degree of engagement in the parenting role (Gilmore & Cuskelly, 2009). The PSOC asks parents to rate the extent to which they agree with statements concerning their sense of competence, using a 6-point Likert scale (e.g. from "Strongly disagree" to "Strongly agree"). Eight items are reverse coded so that higher scores indicate a positive experience of patenting. Examples of items include: "My talents and interests are in other areas, not being a parent" and "Being a parent is manageable, and any problems are easily solved". The efficacy and satisfaction subscales of the PSOC demonstrate good internal consistency (Cronbach's alpha = .76 and .75 respectively), test-retest reliability (.73) and acceptable discriminant and factorial validity (see Crncec, Barnett, & Matthey, 2010).

The PSOC was completed online by mothers at times that were convenient to them. Completed questionnaire data was available mothers at 9 months (n = 49), 12 months (n = 44) and 18 months (n = 48). Table 25 provides descriptive and inferential statistics comparing control and risk groups on the three subscales of the PSOC i.e. Satisfaction, Efficacy, and Interest in the parenting role. Independent *t*-tests confirmed that there were significant differences between the control and risk groups on the Satisfaction Scale at the 9-month time point. Mothers in the Control group reported higher levels of satisfaction in the parenting role compared with the risk group. This difference was no present at the later assessment time points. At the 12-month assessment mothers in the Control group reported significantly higher levels of Efficacy in the parenting compared with those in the risk group. There were no significant differences between on any of the subscales at the 18-month assessment.

Table 25.

Descriptive and inferential statistics for maternal self-reported measures of parental competence by mother–infant control versus risk group.

	M (SD)				
Maternal measures	Control	Risk	*t*	*df*	*p*
PSOC Subscales [a]					
9-month Assessment (N)	n = 23	n = 19			
Satisfaction	4.18 (.82)	3.61 (.90)	2.140	40	.038*
Efficacy	4.20 (1.07)	4.24 (.92)	-.136	40	.893
Interest	3.83 (2.19)	3.86 (1.46)	-.057	40	.955
12-month Assessment (N)	n = 24	n = 22			
Satisfaction	4.33 (.623)	3.94 (.96)	1.601	44	.117
Efficacy	4.93 (.73)	4.46 (.72)	2.148	44	.037*
Interest	5.13 (1.19)	4.68 (.83)	1.502	44	.140
18-month Assessment (N)	n = 24	n = 24			
Satisfaction	4.49 (.63)	4.19 (.83)	1.373	46	.177
Efficacy	4.93 (.70)	4.76 (.66)	.848	46	.401
Interest	5.24 (.72)	4.90 (.75)	1.570	46	.123

Note. [a] PSOC = Parental Sense of Competence. *p < 05

Appendix N

Relationship with Partner

Parenting practices and behaviours are influenced by how supported mothers feel in the maternal role. For example, early research (Cutrona & Troutman, 1986) found that mothers with higher levels of perceived social support during pregnancy, reported more confidence as parents and less depression symptoms when their infants' were three months of age. Social support can take different forms but appears to be especially meaningful when it is offered from intimate partners in the home setting. For example, Leahy-Warren (2005) found that new mothers identified their husbands/partners as providing the highest levels of instrumental (practical) support (84%), emotional support (85%) and appraisal support (77%) around the quality of mothers' care for their infants. The participants' own mothers and community nurses were perceived as offering the majority of informational support (77%). A lack of significant support from an intimate partner, therefore, has the potential to undermine mothers' confidence and the quality of her interactions with her infant.

The Intimate Bond Measure (IBM). The quality of the support available to mothers through their partner was assessed using the IBM, which is a 24-item scale that assesses the intimacy between a couple on two dimensions; Care and Control. The Care dimension of the IBM consists of 12 questions that reflect the emotional and physical care expressed between partners with respect to warmth, consideration, affection and companionships. The Control dimension consists of 12 questions that reflect the expression of domination, instructiveness, criticism, authoritarian attitudes and behaviours between partners. The forced response options are on a 4-point Likert Scale from zero to three (0 = absolutely no 1 = relatively no, 2 = somewhat yes, and 3 = yes). An example of a question in the Care subscale is "Is very considerate of me". An example question from the Control subscale is "Wants to know exactly what I am doing and where I am". The total score of the IBM ranges from 0 to 36.

High scores reflect a tendency to Care or Control, respectively. The cut-off point for dysfunctional intimacy is < 25 (Care) and > 12 (Control) (Boyce, Hickie, & Gordon, 1991). Internal consistency for the Care index of the IBM is 0.94, and for the Control index is 0.89. Test-retest reliability for the Care and Control subscales are 0.80 and 0.89, respectively (Wilhelm & Parker, 1990).

The IBM was completed online by mothers and completed questionnaire data was available mothers at 6 months (n = 40), 9 months (n = 51), 12 months (n = 46) and 18 months (n = 48). Table 26 provides descriptive statistics and results of independent samples t-tests comparing control and risk groups on the two subscales of the IBM i.e. Care and Control. Independent t-tests confirmed that there were no significant differences between the control and risk groups on either of the IMB subtests at any of the four assessment time points.

Table 26.

Descriptive and inferential statistics for maternal self-reported measures of partner relationship by mother–infant control versus risk group.

	M (SD)				
Maternal measures	Control	Risk	*t*	*df*	*p*
IBM Subscales [a]					
6-month Assessment (N)	*n* = 22	*n* = 18			
Care	28.82 (8.42)	28.50 (6.12)	.134	38	.894
Control	6.32 (7.91)	6.82 (8.69)	-.194	38	.846
9-month Assessment (N)	*n* = 29	*n* = 22			
Care	30.34 (6.55)	29.05 (6.27)	.714	49	.476
Control	4.59 (4.42)	5.73 (6.24)	-.765	49	.448
12-month Assessment (N)	*n* = 25	*n* = 21			
Care	31.60 (3.54)	29.33 (6.64)	1.405	29	.170
Control	5.56 (5.55)	6.05 (6.79)	-.268	44	.790
18-month Assessment (N)	*n* = 24	*n* = 24			
Care	30.46 (5.50)	29.54 (6.57)	.524	46	.603
Control	4.46 (4.6)	5.79 (5.6)	-.897	46	.374

Note. [a]IBM = Intimate Bond Measure.

*$p < 05$

Appendix O

Reflective Functioning

The concept of reflective functioning was introduced by Fonagy (1991) and refers to the ability to imagine mental states in oneself and others. Depression symptoms, such as low mood and negative thinking, can impair maternal responsiveness by reducing a mother's ability to reflect on the mental state of her child ("mentalise"). Research on the reflective functioning is in its infancy, however, there is a strong body of evidence suggesting that a mother's ability to reflect on their own mental state and the mental state of their child, is associated with their infants later attachment security (Fonagy & Target, 2005; Slade, Grienenberger, Bernbach, Levy, & Locker, 2005). Demonstrating genuine interest and curiosity in the inner world of an infant, is considered to be a significant marker of genuine reflective functioning. (Slade, 2005). As a parenting skill, reflective functioning can be compromised by depression symptoms (Corinna Reck et al., 2004), which may interfere with a mother's ability to respond to her infant's cues (Cicchetti & Toth, 1998).

Parental Reflective Functioning Questionnaire-1 (PRFQ-1). Mothers' ability to reflect on the mental state of their infants was assessed using the PRFQ-1, which is a 39 item questionnaire designed to measure parental reflective functioning or mentalizing in parents (Luyten et al., 2009). The PRFQ-1 is designed for parents of children aged 0-3 years, when a large portion of a child's communication is non-verbal and mental states are inferred from a child's behaviour. The PRFQ-1 consists of three subscales including; 1. Interest and Curiosity in the infant's mental states (IC; e.g., "I am curious to find out how my child feels"), 2. Pre-Mentalizing (PM; e.g., "When my child is fussy he or she does that just to annoy me"), and, 3. Certainty of Mental States (CM; e.g., "I always know what my child wants") (Paris, Herriott, Holt, & Gould, 2015). All items are measured on a 7-point Likert scale from "1" ("Strongly disagree") to "7" ("Strongly agree"), with "4" indicating a neutral response. The

PRFQ-1 predicts attachment and has good internal consistency and discriminate validity (Luyten et al., 2009).

The PRFQ-1 was completed during visits to the BabyLab at both the 9-month and 12-month assessments. The following completed questionnaire data was available; 9-months (*n* = 51) and 12-months (*n* = 51). Table 27 provides descriptive statistics and results of independent samples *t*-tests comparing control and risk groups on the three subscales of the PRFQ-1 i.e. Interest and Curiosity, Pre-Mentalising, and Certainty of Mental States. Independent t-tests confirmed that there were no significant differences between the control and risk groups on any of the PRFQ-1 subtests.

Table 27.

Descriptive and inferential statistics for maternal self-reported measures of parental reflective functioning and mother–infant attachment by control versus risk group.

	M (SD)				
Maternal measure	Control	Risk	*t*	*df*	*p*
PRFQ Subscales [a]					
9-month Assessment (N)	*n* = 19	*n* = 17			
Interest and curiosity	5.18 (.42)	5.22 (.59)	-.250	34	.804
Pre-mentalising	5.98 (.41)	5.92 (.31)	400	34	.692
Certainty of mental states	2.25 (.47)	2.37 (.32)	-.835	34	.410
12-month Assessment (N)	*n* = 21	*n* = 20			
Interest and curiosity	5.22 (.59)	5.24 (.60)	-.107	39	.915
Pre-mentalising	6.01 (.40)	5.90 (.39)	.833	39	.410
Certainty of mental states	2.36 (.40)	2.53 (.42)	-1.374	39	.177

Note. [a] PRFQ = Parental Reflective Functioning Questionnaire. Pre-mentalising subscale items were reverse coded so higher scores indicate increased reflective functioning.

Appendix P

Mother–Infant Attachment

Attachment refers to the emotional connection between a mother and her child and is reflected in the quality of the mother–infant interaction (Bowlby, 1969). This affective bond is primarily formed in the first year of life in the context of the mother–infant dyad (Beebe et al., 2010; Bowlby, 1969; Schore, 2001, 2003). According to Ainsworth, there are four styles or classifications of attachment: secure, insecure-avoidant, insecure-resistant and insecure-disorganised (Ainsworth, Blehar, Waters, & Wall, 1978). These are determined by the pattern of infant behaviour in response to the Strange Situation Test, involving episodes of play, separation and reunion with their caregiver (Ainsworth et al., 1978). Attachment theory has more recently moved away from an initial focus on patterns of typical development of attachment to models of risk associated with disruptions to early caregiver relationships (Newman et al., 2015). Infants with depressed mothers, for example, are more likely to have an insecure attachment style (Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001). In addition, infants who have mothers who provide responses to them that are inconsistent, insensitive, intrusive or rare, are also likely to develop an insecure attachment style (Ainsworth, 1979; Howard Steele, Steele, & Croft, 2008). Alternatively, infants who have emotionally available mothers are likely to develop a secure attachment style, and in turn expect their mother to respond appropriately to their cues. Secure attachment styles are associated with positive developmental outcomes in areas of cognition, social and emotional development.

Maternal Postnatal Attachment Scale (MPAS). Mothers' self-reporting concerning the quality of her attachment with her infant was assessed with the MPAS, which is a 19-item questionnaire designed to measure mothers' attachment thoughts and feelings towards her baby (Condon & Corkindale, 1998). The MPAS has three subscales; 1. quality of

attachment, 2. Absence of hostility, and 3. Pleasure in interaction. Scale items range from two to five forced choice options. To score the MPAS, adjustments are made to account for the different response options for the 19-times, before summing the items to obtain a total MPAS score. Examples of items include "I try to involve myself as much as I possibly can when playing with the baby" (1= This is True; 2= This is untrue) and "When I am caring for the baby, I get feelings of annoyance or irritability" (Rating 1 to 5; 1 = very frequently; 5 = Never). The scale has good psychometric properties (Condon & Corkindale, 1998). Evidence for content validity has been obtained through significant correlations with MPAS scores and the Attachment Q-sort (Feldstein, Hane, Morrison, & Huang, 2004).

The MPAS was completed online by mothers. The following completed questionnaire data was available; 6-months (n = 40), 9-months (n = 51), 12-months (n = 48) and 18-months (n = 48). Table 4 provides descriptive and inferential statistics comparing control and risk groups on the three subscales of the MPAS. Independent t-tests identified significant differences between the control and risk groups on the Quality of Attachment and Absence of Hostility subscales. Results indicated that the mothers in the Control group reported significantly higher levels of the Quality of Attachment and the Absence of Hostility in relationship with their infants. There were no significant differences between the control and risk groups on any of the Pleasure in Interaction subscale.

Table 28.

Descriptive and inferential statistics for mother–infant attachment measure by control versus risk group.

	M (SD)				
Maternal measures	Control	Risk	*t*	*df*	*p*
MPAS Subscales [a]					
6-month Assessment (N)	*n* = 22	*n* = 18			
Quality of attachment	42.46 (2.45)	39.40 (3.69)	3.128	38	.003**
Absence of hostility	19.23 (2.60)	17.27 (3.49)	2.029	38	.049*
Pleasure in interaction	21 (3.38)	21.33 (2.28)	-.357	38	.723
9-month Assessment (N)	*n* = 29	*n* = 22			
Quality of attachment	42.25 (2.50)	39.41 (3.19)	3.561	49	.001**
Absence of hostility	19.18 (2.88)	16.11 (3.56)	3.414	49	.001**
Pleasure in interaction	21.62 (2.40)	20.27 (4.34)	1.414	49	.164
12-month Assessment (N)	*n* = 27	*n* = 21			
Quality of attachment	41.70 (2.84)	38.73 (4.59)	2.753	46	.008**
Absence of hostility	19.31 (2.92)	17.04 (3.02)	2.632	46	.012*
Pleasure in interaction	21.41 (3.00)	19.86 (4.04)	1.526	46	.134
18-month Assessment (N)	*n* = 24	*n* = 24			
Quality of attachment	41.87 (2.72)	40.08 (3.10)	2.128	46	.039*
Absence of hostility	19.13 (2.80)	17.24 (3.58)	2.037	46	.047*
Pleasure in interaction	20.54 (3.39)	21.08 (2.92)	-5.94	46	.556

Note. [a] MPAS = Maternal Postnatal Attachment Scale. *p < 05; **p < 01.

Appendix Q

Infant Temperament

As the mother–infant interaction is dyadic, factors such as infant temperament have the potential to impact upon the quality of the mother–infant interaction. Temperament refers to a set of traits that characterise an individual's behaviours and is usually used to describe individual differences between infants and children (Goldsmith et al., 1987; Prior, Sanson, Smart, & Oberklaid, 1983). Infant temperament may influence mother–infant interactions through maternal perceptions of the infant, maternal self-efficacy and actual parenting behaviours (Cutrona & Troutman, 1986). For example, mothers who perceive their infant as inconsolable, are more likely to feel incompetent and insecure in their parenting role, and therefore lower on self-efficacy (Cutrona & Troutman, 1986; Teti & Gelfand, 1991). An infant perceived by mothers to have a difficult temperament can increase maternal stress, challenge the coping resources of mothers and potentially compromise the frequency and quality of the interactions she has with her baby.

Short Temperament Scale for Infants (STSI). In the present project, infant temperament was assessed using the STSI (Sanson, Prior, Garino, Oberklaid, & Sewell, 1987). The STSI is a 30-item self-reported measure on which mothers could rate their infants (< 12 months) temperament. The STSI was developed on the basis of a New York longitudinal study of temperament (Thomas, Chess, Birch, Hertzig, & Korn, 1963), and measurement tool (Carey & McDevitt, 1978), and it has since been validated for use in Australian samples of infants aged 4–8 months (Sanson et al., 1987). Mothers are required to rate their infants' behaviour in everyday situations using a 6-point rating scale (1= almost never; 6 = almost always). Five dimensions of temperament are generated including; Approach (items 2, 3, 8, 12, 16, 23, 29), Rhythmicity (items 9, 17, 19, 21, 24, 26), Cooperation (Items 4, 7, 19, 21, 24, 26), Activity-Reactivity (Items 6, 11, 14, 15, 20, 25) and

Irritability (Items 1, 5, 13, 18, 27). An example question is: “My baby accepts regular procedure (hair brushing, face washing etc) at any time without protest”. An overall continuous easy-difficult temperament scale ranging from one-to-6 is generated by combining the Approach, Cooperation and Irritability dimensions. Higher scores indicate more difficult temperament. Infants who obtain a score greater than 1 SD (>3.14) above the mean are categorised as “difficult”. The STSI has good psychometric properties with reliability ranging from .57 to .76 (Sanson et al., 1987).

The STSI was completed online by mothers when their infants were 6 months of age (see Table 29). Completed questionnaire data was available for 40 infants (21 Control, 19 Risk). Independent samples *t*-tests identified a significant group difference on the Irritability Dimension between the control (M = 3.08, SD = .49) and risk groups (M =3.54, SD = .74), $t(37) = -2.283$, $p = .028$, $d = .73$. There were no significant group differences in the other dimensions of the STSI and on the Easy - Difficult scale.

Table 29.

Descriptive and inferential statistics for infant temperament by control versus risk group.

	M (SD)				
STSI Dimensions	Control (n = 21)	Risk (n = 19)	t	df	p
Approach	2.19 (.79)	2.09 (.73)	.391	37	.698
Rhythmicity	2.75 (.62)	2.72 (1.05)	.110	29.06	.913
Cooperation	2.30 (.77)	2.48 (.77)	-.737	37	.466
Activity - Reactivity	3.88 (.68)	4.20 (.74)	-1.439	37	.158
Irritability	3.08 (.49)	3.54 (.74)	-2.283	37	.028*
Easy - Difficult scale	2.52 (.52)	2.70 (.57)	-1.033	37	.308

Note. Approach (High scores = Shy, not approaching); Rhythmicity (High scores = not rhythmic); Cooperation (High scores = uncooperative); Activity – Reactivity (high scores = high activity and reactivity); Irritability (High scores = irritable). * $p < .05$.

Appendix R

Maternal Characteristics by Mother–Infant Intervention Versus Comparison Group

Maternal characteristics	Total sample (N = 16)	Intervention group (n = 8)	Comparison group (n = 8)
Maternal age (years)			
Range	26 - 40	26 - 36	27 - 40
Mean (SD)	32.50 (4.18)	31.13 (3.31)	33.8 (4.70)
Maternal education level: *n*			
Diploma or trade	1	1	0
Undergraduate degree	11	6	5
Masters degree	4	1	3
Maternal employment at 9 months: *n*			
Nil paid work	7	1	6
Part-time paid work	8	7	1
Full-time paid work	1	0	1
Maternal employment at 12 months: *n*			
Nil paid work	4	0	4
Part-time paid work	11	8	3
Full-time paid work	1	0	1
Maternal employment at 18 months *n*			
Nil paid work	1	0	1
Part-time paid work	12	7	5
Full-time paid work	3	1	2

Appendix S

Infant Characteristics by Mother–Infant Intervention Versus Comparison Group

Infant characteristics	Total sample (*N* = 16)	Intervention group (*n* = 8)	Comparison group (*n* = 8)
Birth weight (kg)			
Range	2.99 - 4.89	3.14 - 4.10	2.99 - 4.89
Mean (SD)	3.62 (.53)	3.43 (.32)	3.81 (.64)
Birth order: *n*			
First-born	10	6	4
Later-born	6	2	4
Childcare (hours/week)			
9 months: *n*			
Less than 10	13	6	7
10 – 20	2	1	1
20 – 30	0	0	0
30 – 40	1	1	1
12 months: *n*			
Less than 10	10	3	7
10 – 20	3	3	0
20 – 30	1	1	0
30 – 40	2	1	1
18 months: *n*			
Less than 10	6	3	3
10 – 20	4	2	2
20 – 30	3	2	1
30 – 40	3	1	2

Appendix T

Video Interaction Guidance Information Sheet and Consent Form

Project Title: First sounds and first steps: An examination of the mother-infant interaction and infants' early development

Project summary: The project is examining how mothers' speech and other interactive behaviours influence infant development.

You and your child are invited to participate in a study conducted by Mrs Ruth Brookman, PhD Candidate in the MARCS Institute for Brain, Behaviour and Development. This study will form the basis for the degree of Doctor of Philosophy at Western Sydney University. The project is under the supervision of Dr. Marina Kalashnikova, Professor Denis Burnham, and Dr. Janet Conti.

How is the study being paid for?

The study is being sponsored by the MARCS Institute at Western Sydney University.

What does the study involve?

If you choose to take part in this study, you will be asked to participate in a brief, evidence-based intervention using the Video Interaction Guidance (VIG) technique to promote sensitivity and well-being in your interaction with your infant.

The VIG intervention involves:

1) A goal setting conversation with you and the researcher,
2) Brief (3 x 15 mins) filming sessions of a play session between you and your infant. These sessions will take place approximately once month apart. They will occur either at your home or at the MARCS BabyLab, and;

3) Video playback sessions (3 x 45 mins). The video feedback sessions will involve viewing brief film segments with the researcher of the play sessions that are relevant to the goals you want to work on when interacting with your baby. The film clips will only include successful communication elements in your interaction with your baby. There will be opportunity in the feedback sessions to reflect on why they were successful.

How much time will the study take?

The study involves participation over approximately a 3 month period including 3 x 15 minute filming sessions and 3 x 45 minute video feedback sessions. Sessions will occur at either the MARCS BabyLab or your home.

Will the study involve any discomfort for me?

The study is not intended to involve any discomfort. However, should you experience any discomfort you are able to discontinue the recording and/or feedback sessions at any time without giving any reason and without any negative consequences. Following termination of the session you will be given the opportunity to debrief with the interviewer if required.

While it is not anticipated that you will experience any discomfort, if you do experience any distress associated with your participation in the study, please contact Lifeline on 131 114, Should you require parenting advice or support contact Karitane Care Line on 1300 227 464 or Tresillian Parent Helpline on 1800 367 357.

Will the study benefit me?

While there may not be any specific immediate benefits to any individual, your involvement in the research will likely contribute to a better understanding of the communication elements that can promote attunement and well-being in interaction between you and your baby.

You will be compensated $30 for your travel expenses at time at each visit.

Will anyone else know the results? How will the results be disseminated?

Researchers will only have access to the raw data you provide. All aspects of the study, including your identity, will remain confidential and anonymous. The data collected from the study will be stored securely electronically and in paper files at the MARCS Institute at Bankstown for five years. The research team will have access to the data for that time for the purposes of publications and conference presentations.

The findings of the research will be published as a doctoral thesis by Ruth Brookman and in publications, conferences and the MARCS BabyLab newsletter. Excerpts from the recordings may be used also be used for illustrative purposes in teaching, conference presentations or in various relevant electronic media but neither you nor your child will be identified in the recordings. If you would like to know about the results, we can send them to you once the study is completed. In addition, the First Sounds First Steps newsletter will inform you about the project as it progresses.

Confidentiality

Personal information gathered in the course of the study is confidential and will be securely stored. No personal information will be given to any persons other than the researchers unless it is made anonymous. De-identified data from the study will be made available for future research and maybe stored in online research servers or databases.

During the study everything you say and do is confidential unless the researcher is concerned about your safety or the safety of others. In these instances, the researcher will need to consult with other professionals and take steps to ensure the safety of all parties involved.

Can I withdraw from the study?

Participation is entirely voluntary: you are not obliged to be involved and, if you do participate, you can withdraw at any time without consequences.

Can I tell other people about the study?

Yes please, you can tell other people about the study and they can contact the BabyLab Coordinator (Rachel Lee on 9772 6313) to register their interest.

What if I require further information?

When you have read this information, we will discuss it with you further and answer any questions you may have. If you would like to know more information or if you have concerns about what has been recorded at any time during your participation in the study please contact us. We will be happy to discuss it with you:

Ms Ruth Brookman, Principle Investigator. (02) 9772-6660, r.brookman@westernsydeny.edu.au

Dr Marina Kalashnikova, Principle Supervisor: (02) 9772 6142, m.kalashnikova@westernsydney.edu.au

What if I have a complaint?

This study has been approved by Western Sydney University Human Research Ethics Committee. The approval number is (yet to be determined). If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel 02 4736 0883 Fax 02 4736 0013 or email humanethics@westernsydney.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

CONSENT FORM for RESEARCH PARTICIPATION

1. I agree to take part in the study, as described in the Information Sheet.
2. I have read the Information Sheet for Research Participants. This Information Sheet tells me what the research is for, and what participants do in the study.
3. I have had a chance to ask questions. I was given complete answers to my questions.

4. I can withdraw from the study at any time. If I withdraw from the study, I understand that the University of Western Sydney will not discriminate against me in the future.
5. The results can be published and the results can be presented. I will be identified only by an identification code. My name will not be used in research presentations or publications.
6. I agree to be contacted for participation in future research projects. YES / NO
7. I consent to the de-identified data from the study to be made available for future research that maybe stored in online research servers or databases.
8. If I have questions, I can contact:

Ms Ruth Brookman, (02) 9772-6535, r.brookman@westernsydeny.edu.au

Dr. Marina Kalashnikova, Researcher in Infancy Studies: (02) 9772 6142; m.kalashnikova@uws.edu.au

I am keeping a copy of this information sheet and consent form.

Name (please PRINT) _____

Signature: _____

Date: _____

Signature of Person Obtaining Consent:_____

Note: This study has been approved by Western Sydney University Human Research Ethics Committee. The Approval number is H11703. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel (02) 4736 0883 Fax (02) 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Appendix U

Qualitative Interview Information Sheet and Consent Form

Project Title: First sounds and first steps: An examination of the mother-infant interaction and infants' early development

Project summary: The project is examining how mothers' speech and other interactive behaviours influence infant development.

You and your child are invited to participate in a study conducted by Mrs Ruth Brookman, PhD Candidate in the MARCS Institute for Brain, Behaviour and Development. This study will form the basis for the degree of Doctor of Philosophy at Western Sydney University. The project is under the supervision of Dr. Marina Kalashnikova, Professor Denis Burnham, and Dr. Janet Conti.

How is the study being paid for?

The study is being sponsored by the MARCS Institute at Western Sydney University.\

What does the study involve?

If you choose to take part in this study, you will be asked to participate in qualitative research interview that aims to obtain an account of your experience as a mother. You will be given the option of being interviewed in your home or at the MARCS BabyLab. The interview will be semi-structured and involve asking you questions that move between:

- Experience (e.g. Can you tell me about …?)
- Meaning (What does … mean to you?)
- Identity (e.g. How does … have you seeing yourself as a person)
- Positioning on experience/identity conclusion (e.g. is this OK for you or not? Why?)

Interview questions will be followed by open-ended prompts to generate an account of your unique experience as a mother. The interviews will be audio recorded and later transcribed removing any information that could disclose your identity. In addition, a transcript of the interview will be given to you to read to ensure there is no identifying information. Researchers will later analyse the transcript to draw information and themes around your experience as a mother.

How much time will the study take?

The interview will take approximately 60 minutes

Will the study involve any discomfort for me?

The study is not intended to involve any discomfort. However, should you experience any discomfort you are able to discontinue the interview at any time without giving any reason and without any consequences. Following termination of the interview you will be given the opportunity to debrief with the interviewer if required.

While it is not anticipated that you will experience any discomfort, if you do experience any distress associated with your participation in the study, please contact Lifeline on 131 114, Should you require parenting advice or support contact Karitane Care Line on 1300 227 464 or Tresillian Parent Helpline on 1800 367 357.

Will the study benefit me?

While there may not be any specific immediate benefits to any individual, your involvement in the research will likely contribute to a better understanding of the women's experience as new mothers. You will be compensated $30 for your travel expenses and time.

Will anyone else know the results? How will the results be disseminated?

Researchers will only have access to the raw data you provide. All aspects of the study,

including your identity, will remain confidential and anonymous. The audio recording of the interview will be destroyed following the transcription and review of the transcript by you ensures that it contains no identifying information. Copies of the transcript will be stored securely electronically and in paper files at the Bankstown Campus of Western Sydney University. The research team will have access to the data for that time for the purposes of publications and conference presentations.

The findings of the research may be published as a doctoral thesis by Ruth Brookman and in publications, conferences and the MARCS BabyLab newsletter. Excerpts from the recordings may be used also be used for illustrative purposes in teaching, conference presentations or in various relevant electronic media but neither you nor your child will be identified in the recordings.

If you would like to know about the results, we can send them to you once the study is completed. In addition, the First Sounds First Steps newsletter will inform you about the project as it progresses.

Confidentiality

Personal information gathered in the course of the study is confidential and will be securely stored. No personal information will be given to any persons other than the researchers unless it is made anonymous. De-identified data from the study will be made available for future research and maybe stored in online research servers or databases.

During the study everything you say and do is confidential unless the researcher is concerned about your safety or the safety of others. In these instances, the researcher will need to consult with other professionals and take steps to ensure the safety of all parties involved.

Can I withdraw from the study?

Participation is entirely voluntary: you are not obliged to be involved and, if you do participate, you can withdraw at any time without giving any reason and without any consequences.

Can I tell other people about the study?

Yes please, you can tell other people about the study and they can contact the BabyLab Coordinator (Rachel Lee on 9772 6313) to register their interest.

What if I require further information?

When you have read this information, we will discuss it with you further and answer any questions you may have.

If you would like to know more information or if you have concerns about what has been recorded at any time during your participation in the study please contact us. We will be happy to discuss it with you:

Mrs Ruth Brookman, Principle Investigator. (02) 9772-6660, r.brookman@westernsydeny.edu.au

Dr Janet Conti, Supervisor: (02) 9772 6345; j.conti@westernsydney.edu.au

Dr. Marina Kalashnikova, Principle supervisor: (02) 9772 6142; m.kalashnikova@uws.edu.au

What if I have a complaint?

This study has been approved by Western Sydney University Human Research Ethics Committee. The approval number is (yet to be determined). If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel 02 4736 0883 Fax 02 4736 0013 or email humanethics@westernsydney.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

CONSENT FORM for RESEARCH PARTICIPATION

Project Title: First sounds and first steps: An examination of the mother-infant interaction and infants' early development

9. I agree to take part in the study, as described in the Information Sheet.
10. I have read the Information Sheet for Research Participants. This Information Sheet tells me what the research is for, and what participants do in the study.
11. I have had a chance to ask questions. I was given complete answers to my questions.
12. I can withdraw from the study at any time. If I withdraw from the study, I understand that the University of Western Sydney will not discriminate against me in the future.
13. The results can be published and the results can be presented. I will be identified only by an identification code. My name will not be used in research presentations or publications.
14. I agree to be contacted for participation in future research projects. YES / NO
15. I consent to the de-identified data from the study to be made available for future research that maybe stored in online research servers or databases.
16. If I have questions, I can contact:

Ms Ruth Brookman, (02) 9772-6535, r.brookman@westernsydeny.edu.au

Dr Janet Conti, Supervisor: (02) 9772 6345; j.conti@westernsydney.edu.au

Dr. Marina Kalashnikova, Supervisor: (02) 9772 6142; m.kalashnikova@uws.edu.au

I am keeping a copy of this information sheet and consent form

Name (please PRINT) _____

Signature: _____

Date: _____

Signature of Person Obtaining Consent _____

Note: This study has been approved by Western Sydney University Human Research Ethics Committee. The Approval number is H11703. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel (02) 4736 0883 Fax (02) 4736 0013 or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Appendix V

Qualitative Interview Questions and Prompts

Interview questions aimed to scaffold between the following:

- Experience (e.g., Can you tell me about …?)
- Meaning (What does … mean to you?)
- Identity (e.g., How does … have you seeing yourself as a person)
- Positioning on experience/identity conclusion (e.g., is this OK for you or not?)
    - Interview will be augmented with a timeline for narrative/discourse

Core Questions

- Can you tell me about your experiences a mother?
- How has having your baby impacted upon your life? Your relationships? How you see yourself as a person? Is seeing yourself in this way helpful or not?
- As you look back on your experiences as a mum, which events stand out in your mind? How has *** affected how you see yourself as a person? As a mother? Is this helpful or not? Why?
- How has your life changed with becoming a mother? What have you been most pleased about? Why? What does this say to you about what matters for you as a mother?
- What have you been least pleased about in terms of how your life has changed becoming a mother? Why? What does this say to you about what your hopes are about being a mother?

Additional questions

- Has our conversation today been helpful or unhelpful or both? Why?

- What has stood out for you from our conversation today?
- What might be important for us not to forget as we analyse this interview?
- Is there anything important you have connected with about yourself as a mother from our conversation today?
- Is there any further way that we can support you at this time?
- How might you identify whether you might want support in the future?

Appendix W

Written Instructions for Participant Home LENA Recordings

LENA RECORDER
DAY-LONG RECORDINGS (x 1)

Recording Checklist

If unclear call Ruth: 0425 225 387

1. Choose a day when you are going to be at home most of the day
2. Start recording as soon as your baby wakes (see "Set up and "recording" instructions over the page)
3. Fill in the Home Recording Diary
4. Record for the entire day (at LEAST 12 hrs)
5. Finish the recording at the end of the day. If you haven't reached 12 hrs of recording, leave the LENA on until it exceeds 12 hrs (see "Finish" instructions over the page)

IMPORTANT:

1. The LENA is NOT waterproof.

2. So during daytime **naps** or **bathing**, please **remove the LENA vest (containing the DLP)**. Leave the vest close by your baby but out of their reach, so it continues to record.

Begin recording when your baby awakes in the morning and continue recording throughout the day until they go to bed at night.

PAUSING: If you need to pause recording at any time for privacy reasons, simply press the **REC** button once to pause recording (the screen will display PAUSED), then press **REC** again to resume recording (**check** that the screen is displaying RECORDING again).

Continued overleaf...

1. SETUP

a. Press power button for 5 seconds to turn DLP on

The screen will flash, then show V2.17.03, then display SLEEPING

b. Check battery power in top left corner of screen.

If there is less than 3 bars the DLP needs recharging. Charge overnight.

2. RECORDING

a. Press REC button for 5 seconds to start recording

The screen will display RECORDING and the time

b. Put DLP into LENA vest

Make sure mic is facing out and snap fasteners on vest pocket are closed. Then put the vest on your baby, fastening snaps on back of the vest

3. FINISH

a. Take DLP out of vest

b. Press REC button for 5 seconds to stop recording

Screen will display PAUSED and the time

c. Press power button for 5 seconds to turn DLP off

Appendix X

Home Recording Diary

Time	Main activity	Comments
5am		
6am		
7am		
8am		
9am		
10am		
11am		
12 midday		
1pm		
2pm		
3pm		
4pm		
5pm		
6pm		
7pm		

8pm		
9pm		
10pm		