Early intervention of parent-infant interactions in preterm infants: A systematic review

Stacey Osborne

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Early Intervention of Parent-infant Interactions in Preterm Infants: A Systematic Review

Stacey Osborne

A report submitted in Partial Fulfilment of the Requirements for the Award of Bachelor of Speech Pathology Honours, Faculty of Health, Engineering and Science

Edith Cowan University

Submitted November, 2015

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Abstract

**Background:** Every year approximately 15 million babies are born preterm. These infants are at an increased risk of language, and other developmental delays due to their immature brain development and higher incidence of brain abnormalities. They also have poorer health outcomes in the early stages of life which may go on to hinder successful parent-infant interactions. Successful parent-infant interactions are important for infant developmental outcomes such as language, cognition and behaviour. While interventions targeting the promotion of positive interactions have been found to have positive effects in a number of populations to date, interactions involving preterm infants have not been explored. Given the vulnerability of this population to language and other developmental delays, it is of value to know whether early interventions in this area will be useful to this population as well.

**Objectives:** This review sets out to answer the following question – “Is early parent-based intervention targeting parent-infant interactions effective for later language development in preterm infants?”

**Methods:** This study is a systematic review which follows the conventions set out by the Cochrane Collaboration. Seven electronic databases were searched (CINAHL, Cochrane, ERIC, MEDLINE, PsychINFO, PubMed, & Scopus) by two independent reviewers who also assessed studies for eligibility. Eligibility criteria were: Randomised control trials (RCT) or controlled cohort studies that looked at interventions targeting parent-infant interaction in parents of preterm infants, and in which intervention occurred within the first three years of life.

**Main results:** Eight RCTs were identified as being eligible for the review. Primary outcomes identified within the studies included parent-infant interaction, parental mental health, and infant’s language, cognitive and behavioural outcomes. Six of the studies were included in data synthesis which showed that early intervention targeting parent-infant interactions had positive outcomes for decreasing parental stress, anxiety and depression, and better outcomes in infant’s language and cognitive development. The interventions were found to have little effect on infant’s behavioural outcomes.

**Authors’ conclusions:** Although the review suggests that early intervention that targets parent-infant interactions is effective in promoting later language development, none of the included studies looked specifically at this outcome. Further research is needed into interventions that specifically target language development as a result of parent-infant interactions, to provide further evidence.

Supervisors: Abigail Lewis and Natalie Ciccone
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Parent-Infant Interactions

Parent-infant interaction, particularly between the child and their mother who is often the primary caregiver, is important for infant development. Research into these interactions found that they have significant effects on the development of attachment, social-emotional development, cognitive development (Lotzin, et al., 2015), language development (Topping, Dekhinet, & Zeedyk, 2013), their ability to read the intentions of others, and their capability for empathy (Baker & McGrath, 2011).

Synchrony in parent-infant interactions, or dyadic synchrony, consists of three essential components. These are (i) a maintained, shared focus of attention; (ii) temporal coordination between parent and infant movements; and (iii) contingency of responses toward specific behaviours (Baker & McGrath, 2011; Harrist & Waugh, 2002). In order for the interaction to be successful, the engagement must be maintained, with both partners contributing to the interaction through mutual attention and visual tracking (Harrist & Waugh, 2002). Temporal coordination is the rhythm or pacing seen in dyadic synchrony in terms of body movements, facial expressions and vocal rhythm (Baker & McGrath, 2011; Harrist & Waugh, 2002), and contingency within these rhythms and behaviours increases the chance of further behaviours occurring which will allow the interaction to continue (Baker & McGrath, 2011; Harrist & Waugh, 2002). Harrist & Waugh (2002) also note the importance of caregiver attunement in successful interactions where the caregiver is able to read their infant’s subtle cues, and adjust their behaviour accordingly.

Parent-infant interactions and language development

Dyadic synchrony changes as the child grows from infancy to toddlerhood to early childhood (Harrist & Waugh, 2002). Synchrony during infancy and toddlerhood facilitates
language acquisition and improves communicative competence as the child grows (Harrist & Waugh, 2002). The review by Harrist and Waugh (2002) provides evidence that joint attention between the caregiver and child makes language more meaningful by providing children with a predictable reference. They also found that dyadic synchrony was important for development of social skills in early childhood. A review by Topping and colleagues (2013) describes the way in which parent-infant interactions contribute to language development. They found that the *quality* of the parent-infant interaction is more important than the *quantity*. Contingency, or ensuring that the child was orientated towards receiving and processing the interaction, was important for vocabulary growth and influenced the age at which children start talking. During elaborative discussions, parents highlight interesting aspects by varying their intonation, and provide logical explanations which help children build connections between objects, events and concepts. Children who were engaged in these elaborative discussions with their parents had improved receptive vocabulary, emergent literacy, and verbal narrative skills at four years of age (Topping, et al., 2013).

Early literacy skills have also been linked to parent-child interactions. The review by Topping and colleagues (2013), found that children who participate in joint book reading with their parents, or educational activities such as learning the alphabet, numbers, and letters have increased receptive and expressive vocabulary development, phonemic skills, print concept knowledge, reading skills, and written language skills at preschool age. Positive results between parent-infant interactions and early literacy skills were also found in a study by Dodici, Draper & Peterson, (2003). In this study, the researchers rated the quality of parent-infant interactions based on (i) infant/toddler language; (ii) parent language; (iii) emotional tone; (iv) joint attention; (v) parental guidance; and (vi) parental responsiveness. They found that better quality parent-infant interactions were related to better receptive vocabulary, symbolic representation and phonemic analysis at two, and five years of age.
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Baker and McGrath (2011) identified several characteristics which were found to contribute to successful mother-infant interactions. On behalf of the parent, characteristics that contribute to the interaction in a positive way include maternal sensitivity, responsiveness toward the infant, a happy or unstressed emotional state and good family support. The infant on the other hand contributes to the interaction through having an easy temperament with positive moods and emotions, a healthy wellbeing and maturation of biological rhythms (e.g. sleep-wake cycles). Characteristics that were judged to have a negative impact on the interaction include parental stress and depression, and poor infant wellbeing, such as that often accompanying premature birth (Baker & McGrath, 2011).

Preterm Birth

Preterm or premature birth is defined as the birth of a live infant before 37 weeks of gestation (World Health Organization [WHO], 2014). Sub-categories of preterm birth also exist, based on gestational age (GA) at birth. These sub-categories include extremely preterm (< 28 weeks), very preterm (28 to < 32 weeks) and moderate to late preterm (32 to <37 weeks) (WHO, 2014).

Every year throughout the world, approximately 15 million babies (> one in ten) are born prematurely. Of these infants, over one million will die due to complications of their preterm birth (March of Dimes, PMNCH, Save the Children & WHO, 2012). In 2012, nearly 30,000 babies (9%) born in Australia were preterm (Hilder, Zhichao, Parker, Jahan, & Chambers, 2014), with preterm birth being the second highest (16.5%) cause of perinatal death (Hilder, et al., 2014). In the number of live births recorded in Australia in 2012, 0.3% of preterm births were extremely preterm, 0.7% were very preterm and 6.8% were moderate to late preterm (Hilder, et, al., 2014).
Outcomes of Preterm Birth

Preterm infants are at an increased risk of developmental delays in cognitive functioning, motor development and language development, and also of disability, hearing and vision impairments, and behavioural problems (Bhutta, Cleves, Casey, Cradock, & Anand, 2002; Cusson, 2003; Smith, DeThorne, Logan, Channell, & Petrill, 2014; Teti, et al., 2009). Preterm infants are born with immaturely developed brains (Saigal & Doyle, 2008), and Magnetic Resonance Imaging (MRI) studies of preterm infants have shown a higher incidence of brain abnormalities when compared to term infants, which contribute to these developmental differences (Northam, et al., 2012; Reidy, et al., 2013; Rushe, et al., 2004). The effects of these developmental delays can persist through adolescence and into adulthood. For example, research by Roth and colleagues (2001), found that the neurodevelopmental status of a preterm child at one year of age was significantly related to overall intelligence quotient (IQ) score at 14-15 years old. These findings were replicated by Lee and colleagues (2011), who observed that preterm children and adolescents had significantly lower scores on performance and verbal IQ, and receptive and expressive language skills, than full term controls. Language ability in adults who were born preterm has not been widely researched, however language and learning difficulties which arise from preterm birth can impact on the ability to find and keep jobs, and participate in higher education (Allen, Cristofalo, & Kim, 2010).

As well as these developmental outcomes, the economic outcomes of preterm birth have also been researched. A study by Petrou, Abangma, Johnson, Wolke and Marlow (2009) showed that in the United Kingdom (UK), infants who were born extremely preterm (20-25 weeks GA) cost on average 2476 pounds more than their full term classmates in terms of health, social care and education costs in 2006-2007. Another study looking at the economic costs of moderate to late preterm infants (32-36 weeks GA) indicate that even those infants
born at 36 weeks GA still incur higher economic costs than those born full term (Khan, et al., 2015). This study found that the average difference in cost for health and social care for moderate to late preterm infants over the first two years of life was 4657 pounds more than their full term counterparts in 2010-2011 (Khan, et al., 2015).

**Language development in preterm infants**

Studies looking at language development in preterm infants suggest that these infants are at an increased risk of language delay or disorder when compared to their full-term peers (Barre, Morgan, Doyle, & Anderson, 2011; van Noort-van der Spek, Franken, & Weisglas-Kuperus, 2011). Language delay implies that language is developing at a slower rate when compared to typically developing children of the same age. Whereas language disorder is defined as the “impaired comprehension and/or use of spoken, written and/or other symbol systems” (ASHA, 1993, p. 1). Children with language delay may catch up to their peers, but may also have residual language disorders meaning the distinction between delay and disorder is not clear cut (Fogle, 2013).

Although general research findings show that language development is delayed to some extent in preterm infants (Barre, et al., 2011; Foster-Cohen, Edgin, Champion, & Woodward, 2007; Reidy, et al., 2013; van Noort-van der Spek, et al., 2011), three studies went on to investigate the incidence for risk of language disorder in this population. Using the Bus Story (Renfrew, 2010), Briscoe, Gathercole, and Marlow (1998) identified 31% of their preterm cohort (n = 26; \( M \) age = 43.6 months) was at risk for specific language impairment (SLI). Van Lierde, Roeyers, Boerjan, and De Groote (2009) used the Dutch version of the Reynell Developmental Language Scales (Edwards, et al., 1997) and found that in their preterm cohort (n = 15, \( M \) age = 3.3 years), 20% were identified as having a language problem, and 13% were identified as having a language disorder. Sansavini and others (2010) found that 34% of their preterm group (n = 64) were at risk of language disorder at 3;6 years
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compared to their full term peers, when using mean length of utterance (MLU) scores calculated from 27 repeated sentences. Together, these three studies indicate that approximately one third of preterm children are at risk for language delay or disorder.

Although this research shows that preterm infants are at increased risk for language delays, other studies have found that preterm infants perform within the normal range, however their results tend to fall at the lower end of the scale (Foster-Cohen, et al., 2007; Holm & Crosbie, 2010; Smith, et al., 2014). Further research of language development in preterm children is summarised in Appendix A.

Mastery of early cognitive domains such as memory, processing speed, attention, and representational competence are required for later language development in infancy (Rose, Feldman, & Jankowski, 2004). Therefore looking at cognitive abilities in preterm infants can help researchers predict later language abilities in this population, and identify areas of weaknesses. These weaknesses can then be targeted in therapy, allowing language development to commence. A systematic review of early intervention programs looking at cognitive outcomes in preterm infants found that cognition improved to a clinically important level at infant and preschool age (0-5 years) for the intervention groups (Orton, Spittle, Doyle, Anderson, & Boyd, 2009). Although this systematic review didn’t report on language outcomes specifically, these positive outcomes in terms of cognition may lead to better language development.

Impact of preterm birth on parent-infant interaction

The organs of preterm babies, particularly the brain and lungs, are immature, thus increasing the risk of health problems in this population (Saigal & Doyle, 2008). Research has found that because of this increase in health risk, mothers of preterm infants experience higher rates of psychological distress and depression, than mothers of term babies (Davis,
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Edwards, Mohay, & Wollin, 2003; Singer, et al., 1999). The increased psychological stress experienced by mothers of preterm infants has been linked to differences in the mother-infant interactions in this population (Forcada-Guex, et al., 2011; Korja, et al., 2008; Muller-Nix, et al., 2004). On the Care Index mothers of preterm infants who are affected by maternal depression and anxiety have been found to be more controlling or unresponsive when interacting with their child, when compared to mothers of full term infants (Forcada-Guex, et al., 2011; Muller-Nix, et al., 2004). The Care Index identifies controlling mothers as those who display overt or covert hostility, and unresponsive mothers as those who display facial, vocal or physical withdrawal from the infant (Forcada-Guex, et al., 2011). The infants in these dyads were found to be compliant (wary infants with inhibited behaviour), difficult (infants who show overt forms of resistance to maternal behaviour) or passive (infants who tend to display limited contact with the mother). Preterm infants in less favourable dyads have been found to display more behavioural problems compared to full term, and have immature social skills (Forcada-Guex, et al., 2006). In light of the importance parent-infant interaction plays in language development, early intervention targeting these disordered dyads in the preterm population could be beneficial.

Early Intervention

Early intervention is focused on intervention in the first three years of life, with family playing a key role in therapy (ASHA, 2008). The goal of early intervention is to “prevent or minimize the physical, cognitive, emotional, and resource limitations of young children disadvantaged by biological or environmental risk factors” (Blackman, 2002). The plasticity of the brain in the early years of development provides a strong rationale for intervention in the early years of life while the brain is still developing (Blackman, 2002).

A review by Benzies, Magill-Evans, Hayden and Ballantyne (2013) found that early intervention programs aimed at preterm infants employed components of psychosocial
support, parent education, and therapeutic interventions targeting the infant. Early intervention has resulted in improved infant behavioural (Nordhov, Ronning, Ulvund, Dahl, & Kaaresen, 2011), cognitive, and motor outcomes (Orton, et al., 2009; Park, Maitra, Achon, Loyola, & Rincon, 2014), and parent outcomes (Zhang, Kurtz, Lee, & Liu, 2014). Early language intervention in the general infant population has also been found to be effective in the treatment of language delay and disorder, and provide positive language, social and academic outcomes (Kaiser & Roberts, 2011; Roberts & Kaiser, 2011). The levels of evidence provided by these studies varies from case studies (level 4 evidence) to systematic reviews (level 1 evidence) (Oxford Centre for Evidence Based Medicine, 2011), indicating the need for further research into some of these areas. However as one third of preterm infants are at risk of developing language delay or disorder, the positive effects seen in these studies may indicate that intervention in the early years of life may be effective in decreasing the incidence, and long term effects of language disorder in this population.

**Parent-based intervention**

Parent-based interventions utilise therapy techniques which sees the parents act as the primary therapist. Kaiser (1993) recommends the involvement of parents in language intervention because (i) parents are their children’s first teachers; (ii) parent-implemented interventions promote generalisation of newly learned language; (iii) interactions with an invested caregiver may be critical to facilitating a child’s social communication; and (iv) there are benefits to the child and parent beyond those resulting from targeted language improvements. A review by Roberts and Kaiser (2011), found that parent-implemented language interventions generally have significant, positive effects on children’s language development, and are effective to use as a therapy approach for language intervention.

Parent-based interventions have been used in treating a variety of disorders and disabilities including Autism Spectrum Disorders (ASD) (Grela & McLaughlin, 2006;
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McConachie & Diggle, 2007), cerebral palsy (Pennington & Noble, 2009; Pennington, Thomson, James, Martin, & McNally, 2009), Down syndrome (Meadan, Angell, Stoner, & Daczewitz, 2014), fragile X syndrome (Oakes, Ma, McDuffie, Machalicek, & Abbeduto, 2015), cleft palate (Scherer, D’Antonio, & McGahey, 2008), and language delay or disorder (Buschmann, et al., 2009; Colmar, 2014; Roberts & Kaiser, 2012; van Balkom, Verhoeven, van Weerdenburg, & Stoep, 2010). Again, the levels of evidence provided by these studies varies from case studies (level 4 evidence) to systematic reviews (level 1 evidence) (Oxford Centre for Evidence Based Medicine, 2011), however all found generally positive outcomes for these types of therapies.

Two specific programs that have been designed to improve parent-infant interactions and language development in ASD and language delay (LD) are the DIR-Floortime program (for ASD), and the Hanen It Takes Two to Talk (for LD). Both of these programs use the principles of observing the child, and letting the child lead the interaction, and also getting down to the child’s level to maintain face-to-face interactions (Liao, et al., 2014; Manolson, 1992; Pajareya & Nopmaneejumruslers, 2011). The Hanen program also emphasises that parents keep their language simple, but grammatically one step ahead of their child’s development in order to stimulate the child’s zone of proximal development, while centring their language on what the child is focusing on (Manolson, 1992). Both of these programs are implemented by the parent following training by a clinician. Given the findings from research into parent-based interventions outlined previously, involving parents in early intervention with the preterm population may improve parent-infant interactions, and promote improved language development in the percentage of this population found to be at risk.

Why it is important to do this review

Parent-infant interactions are important for infant development, particularly for language development. Research indicates that due to their immature brain development at
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birth, preterm infants may be at risk of language disorders and other developmental delays. Research also indicates that parent-infant interactions observed in preterm infant dyads can be disordered, which may have a further impact on language development. Early intervention targeting parent-infant interactions may be beneficial in this reducing the incidence of developmental delays in this population. Intervention which is implemented by the parent has been found to be an effective form of intervention in other infant populations, however as far as the author is aware; no reviews have been conducted that looked specifically at interventions focusing on parent-infant interactions to improve language outcomes in the preterm infant population. Therefore a review in this area is important for establishing the evidence base.

Aims

This systematic review will aim to answer the following research question:

Is early parent-based intervention targeting parent-infant interactions effective for later language development in preterm infants?

Methods

Study Design

A systematic review was used for this project as they provide the highest level of evidence in the evidence hierarchy (Oxford Centre for Evidence Based Medicine, 2011), and so that it may fill a knowledge gap relating to the effectiveness of parent-infant interactions and language outcomes in the preterm infant population. Systematic reviews provide evidence for the effectiveness, appropriateness and feasibility of particular healthcare interventions, thus allowing clinicians to use high quality evidence based practise (Evans, 2003). They achieve this by using a strict criteria, explicit methodology and systematic presentation and synthesis of study findings to answer particular research questions (Higgins, Green &
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Cochrane Collaboration, 2008). Systematic reviews aim to evaluate and interpret the available research evidence in order to answer these specific research questions (Glasziou, Irwig, Bain & Colditz, 2001). This systematic review followed the methodology established by the Cochrane Collaboration (Higgins, et al., 2008).

During this review, two database searches were undertaken as no results were returned during the first search. Additional search terms came to light during the first search which led to a second database search being conducted. During each search, parallel database searches were conducted by two independent researchers.

Search 1: Inclusion/Exclusion Criteria and Search Terms

The following inclusion and exclusion criteria were used by two independent reviewers to determine eligibility for inclusion within the review. Any discrepancies for inclusion or exclusion of a study between the two reviewers were discussed and a consensus reached for each study.

The inclusion criteria for the first database search were as follows:

- Controlled cohort studies, randomised control trials, studies level 3 and above in the evidence hierarchy; (Oxford Centre for Evidence-based Medicine, 2011)
- Participants are preterm infants born < 37 weeks gestation
- Participants have a language delay or disorder and are 0-3 years of age at the time the intervention is being implemented
- The intervention is focused solely on improving language development
- The intervention is implemented by the parents or caregivers
- Outcomes are assessed using standardised assessments or measures
- The studies are published after 2005 and written or translated into the English language.
Exclusion criteria were:

- Case reports, or level of evidence < level 3 (Oxford Centre for Evidence-based Medicine, 2011)
- Participants are older than 3 years of age at the time the intervention is being implemented
- Participants were born > 37 weeks gestation
- Interventions solely implemented by a clinician
- The interventions include components of other therapies (e.g. physiotherapy, occupational therapy)
- The studies were published prior to 2005
- The studies were published in a language other than English.

During this systematic review, search strings were used to search several electronic databases which were accessed through the Edith Cowan University (ECU) library. Search terms were identified through preliminary reading of appropriate literature. The first database searches occurred between 15th – 18th September 2015. The databases searched were:

- CINAHL
- Cochrane
- ERIC
- MEDLINE
- ProQuest Central
- PsychINFO
- PubMed
Within the database searches, key words were used in combination together with the search terms AND/OR and the wildcard symbol (*). The search terms used in the first search were:

**Search 1**: infan* OR neonate* OR baby OR babies OR newborn* OR child* OR toddler*

**Search 2**: preterm OR premature OR low birth weight OR low birthweight OR low birth-weight

**Search 3**: speech patholog* OR speech language patholog* OR speech therap* OR speech language therap* OR speech-language therap* OR speech-language OR speech-language-hearing

**Search 4**: language OR speech OR communicat* OR cognit* OR attachment* OR attun* OR develop* OR interact* OR relationship*

**Search 5**: treatment stud* OR RCT* OR random* control* trial* OR group stud* OR cohort stud*

The search results obtained by each reviewer were compared and combined, and once duplicate articles were removed, a final list of studies was made. All studies returned by both reviewers’ searches were included in the final list irrespective of any discrepancies between the results. Returned studies were either screened on their title and/or abstract, or the full text read to determine whether or not the study met the inclusion criteria. This search returned no studies which could be included in the review. Whilst hand searching studies returned during the first search, the term “early intervention” was seen to feature prominently in several reference lists. It was therefore decided that database searching should be repeated with “early
intervention” included as a search term to try and capture more literature which may have been missed during the first search.

**Search 2: Inclusion/Exclusion Criteria and Search Terms**

After several trial searches, a new, modified list of search terms was identified to use in the repeated search. Due to time constraints, only seven of the original databases used were searched. These were:

- CINAHL
- Cochrane
- ERIC
- MEDLINE
- PsychINFO
- PubMed
- Scopus

The second round of searching took place between the 25th September and the 1st of October 2015 and used the following search terms:

*Search 1*: infan* OR neonate* OR baby OR babies OR newborn* OR child* OR toddler*

*Search 2*: preterm OR premature OR low birth weight OR low birthweight OR low birth-weight

*Search 3*: early intervention

*Search 4*: language OR speech OR communicat* OR cognit* OR attachment* OR attun* OR develop* OR interact* OR relationship*

*Search 5*: treatment stud* OR RCT* OR random* control* trial* OR group stud* OR cohort stud*
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As with the previous search, no studies were identified that explicitly met the inclusion criteria. After consultation between the two independent reviewers, it was decided to focus the review on studies which contained interventions focused on improving parent-infant interaction as this has been found to be fundamental to language development (Topping, et al., 2013). With this change in focus, the inclusion and exclusion criteria were modified to ensure studies with this focus were captured. To ensure that a maximal number of studies were identified, it was also decided to include studies published in all years.

The modified inclusion criteria used by the two independent reviewers were as follows:

- Controlled cohort studies, randomised control trials, studies level 3 and above in the evidence hierarchy; (Oxford Centre for Evidence-based Medicine, 2011)
- Participants are preterm infants born < 37 weeks gestation
- Participants are 0-3 years at the time of intervention implementation
- Intervention has a component which focuses on improving parent-infant interaction
- The intervention is implemented by the parents or caregivers
- Outcomes are assessed using standardised assessments or measures

Exclusion criteria used by the two independent reviewers were:

- Case reports, or level of evidence < level 3 (Oxford Centre for Evidence-based Medicine, 2011)
- Participants are older than 3 years at the time of intervention implementation
- Participants were born > 37 weeks gestation
- Interventions implemented by a clinician
- Studies published in a language other than English.
Studies returned in the second search were then assessed for bias by three independent reviewers using the Cochrane Collaboration’s Risk of Bias (RoB) tool (Higgins & Altman, 2008) and the Physiotherapy Evidence Database (PEDro) Scale (PEDro, 1999) (see Appendix B). These tools assess studies for potential bias based on broad items such as random allocation, allocation concealment, blinding, outcome data and selective reporting, however the PEDro scale breaks some of these items into smaller criterion to allow a more in-depth analysis of the studies. The Cochrane RoB tool has been found to have poor inter-rater reliability (Armijo-Olivo, et al., 2014; Hartling, et al., 2013), whilst the PEDro scale has been found to have good inter-rater reliability scores (Maher, Sherrington, Herbert, Moseley, & Elkins, 2003). As this review is following the conventions of the Cochrane Collaboration, the RoB tool was still used despite its reported poor reliability. However, by using these rating tools in unison, a more accurate picture of bias was obtained, and inter-rater reliability was increased. Any differences were resolved through discussion and a consensus reached for each study.

Following bias assessment, the included studies were then subjected to a quality assessment. The GRADE (Grades of Recommendation, Assessment, Development and Evaluation Working Group) approach was used for assessing the quality of evidence provided by this review. The GRADE approach looks at five factors which may impact the quality of evidence; these are (i) limitation in the design and implementation; (ii) indirectness of evidence; (iii) unexplained heterogeneity or inconsistency of results; (iv) imprecision of results; and (v) high probability of publication bias (Schunemann, et al., 2008). Quality assessment was undertaken by the author alone.
Data Synthesis

Data synthesis was performed by following instructions for performing effect size (Hedges $g$) calculations in Borenstein, Hedges, and Higgins (2009), and using Microsoft Excel. Effect sizes were calculated using the means and standard deviations reported in the studies. One study reported effect sizes using Hedges $g$, therefore these values were used in analysis. Forest Plots were created using a free Forest Plot Tool (Bailey, 2009). Meta-analysis was not able to be conducted given the heterogeneous nature of the study’s aims, methods and outcome measures.

Results

Results of Search 1

The first search found four studies from CINAHL, 21 from MEDLINE, 10 from PsychINFO, 17 from PubMed, 46 from Web of Science, 108 from Cochrane, 281 from ProQuest Central, 3 from Scopus, and no results were returned from ERIC. After removal of duplicate studies, this first search strategy returned a final list of 403 studies. Figure 1 shows the steps taken in identifying appropriate studies to be included in this review. All were reviewed by two independent reviewers and excluded as the studies either reported on irrelevant topics (e.g., pregnancy or feeding difficulties) or did not meet inclusion criteria (e.g., children were school aged). Through this search, several studies were identified that did not meet all inclusion criteria, but were identified as studies which could be used for hand searching (e.g. studies which focused on assessment of parent-infant interaction, not intervention).
Results of Search 2

Following implementation of the new search terms, the second search returned 51 studies from CINAHL, nine from ERIC, 123 from MEDLINE, 54 from PsychINFO, 311 from PubMed, 86 from Cochrane and 102 from Scopus. After removal of duplicate studies, a final list of 479 studies was obtained. After applying inclusion and exclusion criteria, eight randomised control trials were identified as being appropriate for inclusion in the review. Characteristics of these studies can be found in Appendix B. Figure 2 depicts the steps taken during the second round of database searching.

Figure 1: Flow diagram of steps taken during first search strategy
Included Studies

Participants. The number of participants in the included studies ranged from 83 (Barrera, et al., 1986) to 985 (Brooks-Gunn, et al., 1992). The mean gestational ages of preterm infants included across the eight studies ranged from 27 weeks (Milgrom, et al., 2013; Spittle, et al., 2010) to 35 weeks (Benzies, et al., 2013). All participants were recruited into the study at, or shortly after birth with intervention commencing within the hospital setting or soon after the family had returned home.

In seven of the studies, the mother and infant were the primary targets of therapy. Although father’s characteristics (e.g. age, education level) were given in four of the studies (Barrera, et al., 1986; Olafsen, et al., 2006; Ravn, et al., 2012; Wu, et al., 2014); there was little mention of fathers’ involvement in therapy apart from Ravn who indicated that fathers
were included in intervention “wherever possible”. The remaining three studies made no
mention of fathers at all. Alternatively, Benzies and colleagues (2013) focused their study on
father-infant interactions, with intervention occurring without the mother present.

Six of the studies involved twin pairs within the study cohort (Brooks-Gunn, et al.,
1992; Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012; Spittle, et al., 2010; Wu,
et al., 2014). All twins were randomly assigned to the same intervention group within the
studies, apart from Wu and colleagues, who only included the first born twin or multiple into
the study. Although both twins were included in the groups and received the intervention or
control conditions, Brooks-Gunn, and Ravn randomly selected the data from only one twin of
each pair to include in analysis. The studies by Milgrom and Spittle included both sets of data
in their statistical analysis by analysing the data for independence, while Olafsen made no
mention of how twin data was handled.

**Designs.** All studies included in this review were randomised controlled trials (RCT)
with infants and families randomly allocated to control or intervention groups (Table 1).
Barrera, Rosenbaum and Cunningham (1986) compared two preterm intervention groups to a
preterm and full term control group. Olafsen and colleagues (2006) compared a preterm
intervention group to a preterm and full term control group. Four studies (Brooks-Gunn,
Liaw, & Klebanov, 1992; Milgrom, et al., 2013; Ravn, et al., 2012; Spittle, et al., 2010)
compared a preterm control group to a preterm intervention group. The remaining two studies
compared two preterm intervention groups to a preterm control group (Benzies, et al., 2013;
Wu, et al., 2014). The interventions outlined within the studies targeted the areas of parent-
infant interaction, parental stress and depression, and infant developmental outcomes for
language, cognition, behaviour and motor control.
### Table 1:
Interventions and groups used within the eight included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Preterm control</th>
<th>Preterm intervention group 1</th>
<th>Preterm intervention group 2</th>
<th>Full term control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrera, Rosenbaum &amp; Cunningham (1986)</td>
<td>No treatment</td>
<td>Developmental programming intervention</td>
<td>Parent-infant intervention</td>
<td>No treatment</td>
</tr>
<tr>
<td>Benzie, et al. (2013)</td>
<td>Information only</td>
<td>Two home visits</td>
<td>Four home visits</td>
<td>-</td>
</tr>
<tr>
<td>Brooks-Gunn, Liaw &amp; Klebanov (1992)</td>
<td>Standard care</td>
<td>Home visits and child care at CDC</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Milgrom, et al. (2013)</td>
<td>Standard care</td>
<td>PremieStart program (adaptation of the MITP)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ravn, et al. (2012)</td>
<td>Standard care</td>
<td>MITP</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spittle, et al. (2010)</td>
<td>Standard care</td>
<td>VIBeS Plus</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wu, et al. (2014)</td>
<td>Usual care</td>
<td>Clinic based intervention program</td>
<td>Home based intervention program</td>
<td>-</td>
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</tbody>
</table>
**Interventions.** Three of the included studies (Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012) used the Mother Infant Transaction Program ([MITP] Rauh, Nurcombe, Achenbach, & Howell, 1990), or a modified version of it, for the intervention group (Table 1). The MITP has five specific aims. They are:

1. To enable mothers to appreciate their infant’s uniqueness
2. To sensitise mothers to their infant’s cues
3. To teach mothers to respond appropriately to their infant’s cues
4. To enable mothers to imbed their sensitivity and contingent responsiveness to everyday tasks
5. To enhance mother’s enjoyment of their baby

The MITP comprises seven daily sessions which take place in the hospital in the week leading up to the family’s discharge. These are then followed up by four home visits over the following three months. The topics covered within the MITP include homeostasis, the motor system, state regulation, social interaction, daily care, mutual enjoyment through play, and infant temperamental patterns (Rauh, et al., 1990). Ravn and colleagues (2012) used the original MITP program in their study without any modifications. Olafsen and colleagues (2006) used a modified version of the MITP in their study that added an additional session in which parents were able to discuss their experiences to prevent any adverse feelings from interfering with learning during the intervention. They also encouraged more active parental participation within the sessions. Milgrom and colleagues (2013) used the Premie Start program which is an adaptation of the MITP. In the Premie Start program, the sessions were conducted weekly over nine weeks whilst the infant was still in hospital, and were followed up by only one home visit. This modification was made to increase the number of opportunities the mothers had to apply the techniques learnt while in a supportive environment. The second modification consisted of the inclusion of additional topics of (i)
focusing on touch, movement and massage; (ii) multi-sensory stimulation; (iii) debriefing and normalising parental feelings; and (iv) challenging dysfunctional thoughts and parental diary keeping.

The studies by Benzies (2013), Barrera (1986), Brooks-Gunn (1992), and Spittle (2010) all provided acceptable amounts of information regarding their intervention strategies. The therapists in the study by Benzies and colleagues (2013) provided intervention to fathers with verbal feedback on behaviours that foster infant development after reviewing a video of the infant and father playing together. The therapist reinforced the fathers’ strengths and provided them with further suggestions and information about infant communication. The study by Barrera and others (1986) describes both their developmental programming intervention and parent-infant intervention with the main details of the interventions, but point readers to where further information if required. In both intervention groups each participant received an individualised program aimed at fostering infant development, or parent-infant interactions, as well as specific education to further develop these skills. Spittle and colleagues (2010) only provide main details for their intervention, but point readers to further information. The intervention used in this study was comprised of parent education about infant self-regulation and techniques for improving postural stability, coordination and strength. The intervention also contained a component aimed at supporting parents’ mental health and parent-infant interaction. The study by Brooks-Gunn and others (1992) provided the least amount of intervention information, but did provide references where additional information could be found. This intervention consisted of home visits, parent groups and infant child care.

The final study by Wu and colleagues (2014) provided minimal information on their intervention programs. The study indicates that parents receive education, support and interaction activities, but not further information is provided.
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Table 2 summarises the intervention characteristics. The therapists involved in the interventions included neonatal nurses, psychologists, physio/physical therapists, and unspecified trained therapists. In six of the studies (Barrera, et al., 1986; Benzies, et al., 2013; Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012; Spittle, et al., 2010) the therapists’ role was to provide the parents with education, training and support, which the parents then implemented with their infant. The infants in the study by Brooks-Gunn and others (1992) received parent-implemented therapy, but also attended child care at a child development centre (CDC) five days per week from 12 months to 36 months corrected age, where they received further therapy input. The study by Wu and colleagues (2014) involved therapy focused on (i) modulation of the neonatal intensive care unit (NICU) and home; (ii) teaching of child developmental skills; (iii) feeding support; (iv) massage; (v) parent support and education; and (vi) interaction activities. These elements targeted the child, parent or dyad, however it is unclear if the interventions are parent- or therapist-lead, or a combination of both.

All of the interventions were implemented either wholly or partly in the family home, while four of the studies (Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012; Wu, et al., 2014) had components which were implemented in the hospital. The study by Brooks-Gunn and others (1992) involved a component of therapy that was implemented at a CDC. The intervention lengths ranged from nine weeks to three years (Table 2).

Study Outcomes

Although this review set out to determine the efficacy of parent-infant interaction on language development, none of the included studies specifically targeted language development, however six of the studies include language outcomes, while the remaining two report cognitive outcomes.
<table>
<thead>
<tr>
<th>Study</th>
<th>Mode of delivery</th>
<th>Therapist</th>
<th>Therapy environment</th>
<th>Intervention schedule</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrera, Rosenbaum &amp; Cunningham (1986)</td>
<td>Parent implemented</td>
<td>“Infant-parent therapist”</td>
<td>Home</td>
<td>Weekly, fortnightly and monthly sessions over 1 year</td>
<td>4, 8, 12, and 16 months</td>
</tr>
<tr>
<td>Benzie, et al. (2013)</td>
<td>Parent implemented</td>
<td>“Trained visitors”</td>
<td>Home</td>
<td>1, 2 or 4 sessions over 7 months</td>
<td>8 months</td>
</tr>
<tr>
<td>Brooks-Gunn, Liaw &amp; Klebanov (1992)</td>
<td>Parent and therapist implemented</td>
<td>Not stated</td>
<td>CDC and home</td>
<td>Daily and weekly sessions over 3 years</td>
<td>12, 24 and 36 months of age</td>
</tr>
<tr>
<td>Milgrom, et al. (2013)</td>
<td>Parent implemented</td>
<td>Psychologists</td>
<td>NICU and home</td>
<td>9 session over 9 weeks (NICU) 1 home visit</td>
<td>Term equivalent age, and 6 months of age</td>
</tr>
<tr>
<td>Olafsen, et al. (2006)</td>
<td>Parent implemented</td>
<td>Neonatal Nurses</td>
<td>NICU and home</td>
<td>7 sessions over 2 weeks (NICU) 4 sessions over 3 months (home)</td>
<td>12 months of age</td>
</tr>
<tr>
<td>Ravn, et al. (2012)</td>
<td>Parent implemented</td>
<td>Neonatal Nurses</td>
<td>NICU and home</td>
<td>7 sessions over 10 days (NICU) 4 sessions over 3 months (home)</td>
<td>Various measures assessed at 1 month post-discharge, and 6, 9, and 12 months of age</td>
</tr>
<tr>
<td>Spittle, et al. (2010)</td>
<td>Parent implemented</td>
<td>Psychologist and Physiotherapist</td>
<td>Home (or hospital if couldn’t be done at home)</td>
<td>9 sessions over 1 year</td>
<td>2 years of age</td>
</tr>
<tr>
<td>Wu, et al. (2014)</td>
<td>Unclear</td>
<td>Nurse and Physical Therapist</td>
<td>Hospital, Home and Clinic</td>
<td>5 sessions in the NICU 8 sessions over 1 year (home)</td>
<td>Various measures assessed at 1, 6, 12, 18, and 24 months of age</td>
</tr>
</tbody>
</table>
All interventions included a proportion of therapy aimed at improving parent-infant interaction, and assessed both parent and infant outcomes. Parent-infant interaction was one of the primary outcomes in the studies by Barrera (1986) and Benzies (2013), and a secondary outcome in the studies by Milgrom (2013) and Wu (2014). Parent-infant interaction was measured via observation of a videotaped play session between the parent and infant in these four studies. A variety of assessments were used to assess parent-infant interaction including the use of informal coding of the videotaped play interactions, and formal coding using the Parent Child Interaction Teaching Scale and the Preterm Mother-Infant Interaction Scale (Table 3).

The primary outcomes for six of the eight studies were the infant’s cognitive development along with language or communication, behaviour, and motor outcomes (Barrera, et al., 1986; Brooks-Gunn, et al., 1992; Milgrom, et al., 2013; Ravn, et al., 2012; Spittle, et al., 2010; Wu, et al., 2014). The Bayley Scales of Infant and Toddler Development was used in four of these studies to measure infant cognitive and language outcomes (Barrera, et al., 1986; Brooks-Gunn, et al., 1992; Spittle, et al., 2010; Wu, et al., 2014), while infant behaviour was measured using a variety of assessments (Table 3). The primary outcome of the study by Olafsen and colleagues (2006) was joint attention.

Parental depression and stress was a primary outcome in the study by Ravn (2012) and a secondary outcome in the studies by Benzies (2013) and Spittle (2010). The Parenting Stress Index was used in two of the studies (Benzies, et al., 2013; Ravn, et al., 2012). Ravn, also used the Centre for Epidemiological Studies Depression Scale, whilst Spittle used the Hospital Anxiety and Depression Scale.
Table 3: Assessments used across studies to measure outcomes

<table>
<thead>
<tr>
<th>Study</th>
<th>Outcome Measures</th>
</tr>
</thead>
</table>
| **Barrera, Rosenbaum & Cunningham (1986)** | • Bayley Scales of Infant and Toddler Development *a*  
• Infant and Toddler Temperament Questionnaire *c*  
• The Caldwell HOME Inventory *a*  
• Coding of video-taped mother-child play using a response-class matrix *b* |
| **Benzies, et al. (2013)**          | • Parent Child Interaction Teaching Scale *a*  
• Parenting Stress Index *a*  
• What Being the Parent of a Baby is Like *c* |
| **Brooks-Gunn, Liaw & Klebanov (1992)** | • Bayley Scales of Infant and Toddler Development *a*  
• Stanford-Binet Intelligence Scale *a*  
• Peabody Picture Vocabulary Test *a*  
• Visual Motor Integration Test *c* |
| **Milgrom, et al. (2013)**          | • Short Term Medical Data *b*  
• Short Temperament Scales for Infants *c*  
• Infant-Toddler Checklist of the Communication and Symbolic Behaviour Scales *a*  
• Preterm Mother-Infant Interaction Scale *c* |
| **Olafsen, et al. (2006)**          | • The Early Social Communication Scales *a* |
| **Ravn, et al. (2012)**             | • Infant Behaviour Questionnaire *a*  
• Pictorial Infant Communication Scales (Norwegian translation)  
• The Centre for Epidemiological Studies Depression Scale *c*  
• Breastfeeding reports *b*  
• Parenting Stress Index (Norwegian translation) *a* |
| **Spittle, et al. (2010)**          | • Bayley Scales of Infant and Toddler Development *a*  
• Infant-Toddler Social and Emotional Assessment *a*  
• Hospital Anxiety and Depression Scale *a* |
| **Wu, et al. (2014)**               | • Bayley Scales of Infant and Toddler Development *a*  
• Child Behaviour Checklist for Ages 1.5-5 years *a*  
• Toy-Behind-Barrier Procedure *b*  
• Free-Play procedure *b* |

*a* = formal assessments (assessments that are norm referenced and/or contain reliability and validity data)  
*b* = informal assessment (based on observations/self-reported data)  
*c* = insufficient details found to determine classification
Infant temperament was a primary outcome in the study by Ravn (2012), and a secondary outcome in the studies by Barrera (1986) and Milgrom (2013). The assessments used to evaluate infant temperament include the Infant and Toddler Temperament Questionnaire, the Short Temperament Scales for Infants and the Infant Behaviour Questionnaire (Table 3).

**Bias Assessment**

Risk of bias was assessed within the studies using both the Cochrane RoB tool and the PEDro scale. Table 4 and 5 provide a summary for the risk of bias across all studies for both scales, while figure 3 and 4 show the results as percentages. The PEDro scale and Cochrane RoB tool assess similar quality criterions (allocation, blinding, and outcome data), although some of these criterions are divided into individual factors within the PEDro scale, meaning the PEDro scale looks at 11 criterion, whilst the Cochrane RoB only considers six criteria (Higgins & Altman, 2008; PEDro, 1999).

**Allocation.** All studies included in this review had adequately described their methods of sequence generation, indicating low risk of bias for this domain. However allocation concealment was found to be a moderate source of bias for some of the included studies as they did not describe concealment methods. When consulting the Cochrane RoB tool, four of the studies were found to have unclear allocation concealment (Barrera, et al., 1986; Benzies, et al., 2013; Brooks-Gunn, et al., 1992; Wu, et al., 2014), while only three had inadequate allocation concealment as judged by the PEDro scale (Barrera, et al., 1986; Benzies, et al., 2013; Brooks-Gunn, et al., 1992). Wu stated that “random sequence was concealed” but provided no extra information. According to the PEDro scale, this is adequate; however the Cochrane RoB tool has more strict criteria for a low bias rating, and so this lack of information on how the random sequence was concealed was deemed inadequate.
### Table 4
Cochrane Risk of Bias tool summary

<table>
<thead>
<tr>
<th>Study</th>
<th>Adequate sequence generation</th>
<th>Allocation concealment</th>
<th>Blinding of participants, personnel and/or outcome assessors</th>
<th>Incomplete outcome data addressed</th>
<th>Free of selective outcome reporting</th>
<th>Other bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrera, et al. (1986)</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Benzies, et al. (2013)</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Milgrom, et al. (2013)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Olafsen, et al. (2012)</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Ravn, et al. (2012)</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Spittle, et al. (2010)</td>
<td>✓</td>
<td>✓</td>
<td>?</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Wu, et al. (2014)</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>

✓ = low risk of bias, × = high risk of bias, ? = unclear
INTERVENTION FOR PARENT-INFANT INTERACTION

Table 5

Summary of PEDro Scale

<table>
<thead>
<tr>
<th>Study</th>
<th>Criterion 1</th>
<th>Criterion 2</th>
<th>Criterion 3</th>
<th>Criterion 4</th>
<th>Criterion 5</th>
<th>Criterion 6</th>
<th>Criterion 7</th>
<th>Criterion 8</th>
<th>Criterion 9</th>
<th>Criterion 10</th>
<th>Criterion 11</th>
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<tbody>
<tr>
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<td>(1986)</td>
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<td>et al., (1992)</td>
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<td>(2006)</td>
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<tr>
<td>Wu, et al.</td>
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</tbody>
</table>

Criterion 1: eligibility criteria were specified; Criterion 2: subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received); Criterion 3: allocation was concealed; Criterion 4: the groups were similar at baseline regarding the most important prognostic indicators; Criterion 5: there was blinding of all subjects; Criterion 6: there was blinding of all therapists who administered the therapy; Criterion 7: there was blinding of all assessors who measured at least one key outcome; Criterion 8: measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; Criterion 9: all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by “intention to treat”; Criterion 10: the results of between-group statistical comparisons are reported for at least one key outcome; Criterion 11: the study provides both point measures and measures of variability for at least one key outcome
✓ = yes, ✗ = no
**Figure 3:** Cochrane Risk of Bias tool summary shown as percentage of total studies

**Figure 4:** PEDro Scale summary shown as percentage of total studies

**Criterion 1:** eligibility criteria were specified; **Criterion 2:** subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received); **Criterion 3:** allocation was concealed; **Criterion 4:** the groups were similar at baseline regarding the most important prognostic indicators; **Criterion 5:** there was blinding of all subjects; **Criterion 6:** there was blinding of all therapists who administered the therapy; **Criterion 7:** there was blinding of all assessors who measured at least one key outcome; **Criterion 8:** measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups; **Criterion 9:** all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by “intention to treat”; **Criterion 10:** the results of between-group statistical comparisons are reported for at least one key outcome; **Criterion 11:** the study provides both point measures and measures of variability for at least one key outcome
INTERVENTION FOR PARENT-INFANT INTERACTION

**Blinding.** The study by Benzies and colleagues (2013) was the only study in which participants and the therapist were blinded. Milgrom and colleagues (2013) state that “intervention mothers were explicitly requested not to discuss details of the study with staff or other mothers in the NICU” (p. 756) in order to reduce the likelihood of between-group contamination, however the study does not indicate that the participants were blinded to group allocation. Unblinded participants can lead to attrition bias being created if participants choose to leave the study based on the group into which they were randomised. Unblinded participants may also introduce bias when self-report outcome assessments are used, such as those used in several of the included studies (Higgins & Altman, 2008). Blinding of therapists in interventions studies such as those included in this review, is difficult, although this was achieved in the study by Benzies by using external, trained therapists who were not informed of the study hypotheses or protocols. In all studies except for that by Ravn and others (2012), the outcome assessors were blinded to group allocation, therefore this was deemed an area of low bias across studies. Ravn indicates that the researcher was blinded to group allocation, however it is unclear if it was the researcher who administered the outcome measures, and if not, whether was the assessor blinded. This may increase the risk of detection bias in this study.

**Outcome data.** The handling of incomplete outcome data, such as that caused by attrition within the studies was found to be a high risk of bias across all studies. Only one study indicated they used “intention to treat” principles to overcome missing data (Milgrom, et al., 2013), while Ravn and others (2012) indicated that “all mothers allocated to the intervention group participated in all the intervention sessions” (p. 3), both of which satisfy the PEDro criteria for low bias (criterion 9). All other studies neglected to mention how missing data was handled, which may introduce attrition bias to their results. Only two studies indicated that group characteristics did not differ after attrition (Brooks-Gunn, et al., 1992;
INTERVENTION FOR PARENT-INFANT INTERACTION

Wu, et al., 2014), therefore the risk of introduced attrition bias in these studies is reduced. On the other hand, the study by Barrera and others (1986) had a 25% attrition rate, therefore the risk of attrition bias in this study may be high. Although Ravn satisfied the criteria for criterion 9, they did not meet the criteria for criterion 8, as less than 85% of participants’ data was available for analysis. The study by Wu and colleagues (2014) also failed to meet this criterion. All studies were found to have low risk of reporting bias, with low risk identified for selective outcome reporting, and all but two studies (Barrera, et al., 1986; Brooks-Gunn, et al., 1992) reporting between-group statistical comparisons and appropriate measures of variability.

Effects of interventions

Six of the eight studies (Benzies, et al., 2013; Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012; Spittle, et al., 2010; Wu, et al., 2014) were included for data synthesis and measurement of effect size statistics (Hedges’ $g$). The remaining two studies were unable to be included due to the authors not reporting appropriate statistical data. The studies were combined to examine the effect of the various interventions on the areas of (i) parent-infant interaction; (ii) parental stress, anxiety and depression; (iii) infant communication and language; (iv) infant cognitive development; and (v) infant temperament and behaviour. Effect sizes which are below 0.3 are generally considered to be small, while those above 0.5 are considered to be moderate, and those above 0.8 are considered to be large (Verhagen & Ferreira, 2014). Effect sizes are considered to be statistically significant if the confidence intervals do not cross the zero line (Verhagen & Ferreira, 2014).

Parent-infant interaction. Three studies (Benzies, et al., 2013; Milgrom, et al., 2013; Wu, et al., 2014) assessed the effect of intervention on parent-infant interactions (Table 6 & Figure 5). Overall, a small, positive effect was seen across studies for this outcome ($g_s = -0.22 - 0.65; M = 0.26$). Only one significant effect was found among these outcomes; the fathers
who received four home visits in the study by Benzies scored significantly higher than those
who were in the comparison group on parent outcomes (n = 65; g = 0.65; 95% CI: 0.13, 1.16).
The parent outcomes looked at sensitivity to infant cues, response to infant distress, and
behaviours that foster infant social-emotional, and cognitive growth (Benzies, et al., 2013).
The child outcomes (clarity of cues and responsiveness to caregiver) for this same comparison
approached significance, but did not reach statistical difference (n = 65; g = 0.46; 95% CI: -
0.05, 0.97). The remaining results all indicate a positive effect towards the two intervention
groups compared to the comparison group (Table 6 & Figure 5). The smallest effect size was
seen in the comparison of the two home visit group with the comparison group in terms of the
child outcomes (n = 88; g = 0.02; 95% CI: -0.39, 0.44).

Milgrom and colleagues (2013) found a significant difference between the
intervention and control groups for mother’s synchronicity (p < 0.05), however after
computing effect sizes, although the difference approached significance, it did not reach it (n
= 104; g = 0.38; 95% CI: -0.00, 0.77). Although no other significant effects were found in this
study, the results show a positive effect towards the intervention in terms of overall infant
soothability (n = 104; g = 0.07; 95% CI: -0.31, 0.45), however the effect favoured the control
group in terms of overall infant stress (n = 104, g = -0.22, 95% CI: -0.60, 0.16).

The study by Wu and others (2014) found overall positive effects which favoured the
intervention groups (Table 6 & Figure 5). The clinic based intervention program (CBIP)
produced slightly better results than the home based intervention program (HBIP) in terms of
parent-infant interactive behaviours. The comparison between the CBIP and the control group
approached significance in favour of the intervention group (n = 92; g = 0.36; 95% CI: -0.04,
0.77), while the HBIP produced a smaller effect size in comparison to the control (n = 91; g =
0.26, 95% CI: -0.15, 0.67).
### Table 6:
Effect size (Hedges g) for parent-infant interaction

<table>
<thead>
<tr>
<th>Interventions/Controls</th>
<th>n</th>
<th>M (SD)</th>
<th>n</th>
<th>M (SD)</th>
<th>Effect Size</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. 2HV (Parent outcomes)</td>
<td>23</td>
<td>41.61 (4.03)</td>
<td>46</td>
<td>40.00 (3.77)</td>
<td>0.41</td>
<td>[-0.09, 0.91]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 2HV vs. Comparison (Parent outcomes)</td>
<td>46</td>
<td>40.00 (3.77)</td>
<td>42</td>
<td>38.83 (4.33)</td>
<td>0.29</td>
<td>[-0.13, 0.70]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. Comparison (Parent outcomes)</td>
<td>23</td>
<td>41.61 (4.03)</td>
<td>42</td>
<td>38.83 (4.33)</td>
<td>0.65*</td>
<td>[0.13, 1.16]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. 2HV (Child outcomes)</td>
<td>23</td>
<td>18.70 (3.42)</td>
<td>46</td>
<td>17.46 (2.74)</td>
<td>0.41</td>
<td>[-0.09, 0.91]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 2HV vs. Comparison (Child outcomes)</td>
<td>46</td>
<td>17.46 (2.74)</td>
<td>42</td>
<td>17.40 (2.38)</td>
<td>0.02</td>
<td>[-0.39, 0.44]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. Comparison (Child outcomes)</td>
<td>23</td>
<td>18.70 (3.42)</td>
<td>42</td>
<td>17.40 (2.38)</td>
<td>0.46</td>
<td>[-0.05, 0.97]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Mother's synchronicity)</td>
<td>54</td>
<td>2.45 (.91)</td>
<td>50</td>
<td>2.08 (1.02)</td>
<td>0.38</td>
<td>[-0.00, 0.77]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Overall infant stress)</td>
<td>54</td>
<td>1.50 (.82)</td>
<td>50</td>
<td>1.68 (.79)</td>
<td>-0.22</td>
<td>[-0.60, 0.16]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Infant's soothability)</td>
<td>54</td>
<td>2.88 (1.09)</td>
<td>50</td>
<td>2.80 (1.09)</td>
<td>0.07</td>
<td>[-0.31, 0.45]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. HBIP (Synchronous dyadic behaviour)</td>
<td>47</td>
<td>0.44 (.24)</td>
<td>46</td>
<td>0.42 (.28)</td>
<td>0.08</td>
<td>[-0.33, 0.48]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. SC (Synchronous dyadic behaviour)</td>
<td>47</td>
<td>0.44 (.24)</td>
<td>45</td>
<td>0.35 (.25)</td>
<td>0.36</td>
<td>[-0.04, 0.77]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - HBIP vs. SC (Synchronous dyadic behaviour)</td>
<td>46</td>
<td>0.42 (.28)</td>
<td>45</td>
<td>0.35 (.25)</td>
<td>0.26</td>
<td>[-0.15, 0.67]</td>
</tr>
</tbody>
</table>

2HV – Two home visit group; 4HV – Four home visit group; SC – Standard care; CBIP – Clinic based intervention program; HBIP – Home based intervention program

Note. * = Positive effect of treatment (where 0.0-0.3 has a small effect, 0.3-0.5 has a moderate effect and 0.5-1 has a large effect)
Figure 5: Forest Plot depicting parent-infant interaction outcomes across three RCT's.
**Parental stress, anxiety and depression.** Three of the studies (Benzies, et al., 2013; Ravn, et al., 2012; Spittle, et al., 2010) examined parental stress, anxiety and depression outcomes in parents following intervention (Table 7 & Figure 6). The overall effect sizes suggest that the interventions used had an overall positive effect on parental stress, anxiety and depression (gs = -0.40 - 0.89, M = 0.22). The VIBes Plus program used in the study by Spittle, significantly reduced parental anxiety (n = 90; g = 0.89; 95% CI: 0.46, 1.32), and depression (n = 90; g = 0.63; 95% CI: 0.20, 1.05), while the MITP program had a significant effect on reducing parental depression one month post-discharge in the study by Ravn (n = 87; g = 0.43; 95% CI: 0.01, 0.85). All of these results are consistent with the statistical analysis presented within the respective studies. Although the MITP was found to have positive effects on parental depression, the results were less favourable in relation to parental stress scores at six months (n = 78; g = -0.40; 95% CI: -0.85, 0.04), and at 12 months (n = 80; g = -0.16; 95% CI: -0.59, 0.28). The interventions used by Benzies showed little effect on parental stress scores, which reflects the statistical results reported in the study.
Table 7:
Effect size (Hedges g) for parental stress, anxiety and depression outcomes

<table>
<thead>
<tr>
<th>Interventions/Controls</th>
<th>n</th>
<th>M (SD)</th>
<th>n</th>
<th>M (SD)</th>
<th>Effect Size</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. 2HV (Parenting stress)</td>
<td>23</td>
<td>103.52 (18.37)</td>
<td>46</td>
<td>106.46 (15.51)</td>
<td>0.18</td>
<td>[-0.32, 0.67]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 2HV vs. Comparison (Parenting stress)</td>
<td>46</td>
<td>106.46 (15.51)</td>
<td>42</td>
<td>107.12 (20.46)</td>
<td>0.04</td>
<td>[-0.38, 0.45]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. Comparison (Parenting stress)</td>
<td>23</td>
<td>103.52 (18.37)</td>
<td>42</td>
<td>107.12 (20.46)</td>
<td>0.18</td>
<td>[-0.32, 0.68]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Depression at 1 month)</td>
<td>43</td>
<td>8.30 (5.10)</td>
<td>44</td>
<td>10.90 (6.70)</td>
<td>0.43*</td>
<td>[0.01, 0.85]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Stress at 6 months)</td>
<td>40</td>
<td>59.80 (11.50)</td>
<td>38</td>
<td>55.00 (12.10)</td>
<td>-0.40</td>
<td>[-0.85, 0.04]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Stress at 12 months)</td>
<td>41</td>
<td>197.20 (32.50)</td>
<td>39</td>
<td>192.30 (28.20)</td>
<td>-0.16</td>
<td>[-0.59, 0.28]</td>
</tr>
<tr>
<td>Spittle, et al., 2010 - VIBes Plus vs. SC (Anxiety)</td>
<td>47</td>
<td>5.00 (3.30)</td>
<td>43</td>
<td>8.10 (3.60)</td>
<td>0.89*</td>
<td>[0.46, 1.32]</td>
</tr>
<tr>
<td>Spittle, et al., 2010 - VIBes Plus vs. SC (Depression)</td>
<td>47</td>
<td>3.30 (2.60)</td>
<td>43</td>
<td>5.20 (3.40)</td>
<td>0.63*</td>
<td>[0.20, 1.05]</td>
</tr>
</tbody>
</table>

2HV – Two home visit group; 4HV – Four home visit group; MITP – Mother Infant Transaction Program; SC – Standard care

Note. * = Positive effect of treatment (where 0.0-0.3 has a small effect, 0.3-0.5 has a moderate effect and 0.5-1 has a large effect)
Figure 6: Forest Plot depicting parental stress, anxiety and depression outcome

Benzies, et al., 2013 - 2HV vs 4HV (Parenting stress)

Benzies, et al., 2013 - Comparison vs 2HV (Parenting stress)

Benzies, et al., 2013 - Comparison vs 4HV (Parenting stress)

Ravn, et al., 2012 - SC vs MITP (Depression at 1 month)

Ravn, et al., 2012 - SC vs MITP (Stress at 6 months)

Ravn, et al., 2012 - SC vs MITP (Stress at 12 months)

Spittle, et al., 2010 - SC vs VIbes Plus (Anxiety)

Spittle, et al., 2010 - SC vs VIbes Plus (Depression)
**Infant communication and language.** Five out of the eight studies (Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012; Spittle, et al., 2010; Wu, et al., 2014) examined infant communication and language outcomes (Table 8 & Figure 7). The general trend seen in the effect sizes across the studies favours the intervention groups ($g = -0.09 - 0.74; M = 0.20$). The MITP (or modified versions) were used in three of these studies (Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012) and although each of these studies used different measures, and assessed different aspects of language and communication, these results all show a positive trend, therefore providing good evidence for the use of the MITP in preterm infants. The biggest effect size among these three studies was the outcome for responding to social interaction (RSI) in the Olafsen study ($n = 140; g = 0.74; 95\% CI: 0.38, 1.09$), indicating significantly better results for the intervention group on this measure. The outcomes of initiating joint attention (IJA) and initiating object requesting (IOR) in the Olafsen study also produced statistically significant effect sizes (IJA: $[n = 140; g = 0.48; 95\% CI: 0.13, 0.83]$), IOR: $[n = 140; g = 0.34; 95\% CI: 0.00, 0.69]$). These results are corroborated in their study, however Olafsen reported significant effects for responding to joint attention (RJA) in the study article, but this was not seen after analysing for effect size ($n = 140; g = 0.16; 95\% CI: -0.19, 0.50$). In comparison, the study by Ravn also looked at joint attention, however only generated small effect sizes that leaned towards favouring the intervention group (IJA: $[n = 82; g = 0.08; 95\% CI: -0.35, 0.51]$, RJA: $[n = 82; g = 0.08; 95\% CI: -0.35, 0.51]$). A statistically significant effect size was also seen for the study by Milgrom who assessed infant communication using the Communication and Symbolic Behaviour Scales ($n = 91; g = 0.42; 95\% CI: 0.00, 0.83$), which was also reported in their study.

The studies by Spittle and others (2010) and Wu and colleagues (2014) both used the Bayley Scales of Infant Development to assess language outcomes in their infants. The effect seen in the study by Spittle favours the control group ($n = 115; g = -0.09; 95\% CI: -0.46, 0.27$), while positive effects were seen in the Wu study in favour of the clinic based intervention (CBIP vs. HBIP: $[n = 98; g = 0.25; 95\% CI: -0.15, 0.64]$, CBIP vs. SC: $[n = 95; g = 0.26; 95\% CI: -0.14, 0.66]$).
### Table 8: Effect size (Hedges g) for infant’s communication and language outcomes

<table>
<thead>
<tr>
<th>Interventions/Controls</th>
<th>n</th>
<th>M (SD)</th>
<th>n</th>
<th>M (SD)</th>
<th>Effect Size</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Infant communication - CSBS)</td>
<td>46</td>
<td>19.7 (6.8)</td>
<td>45</td>
<td>17.1 (5.5)</td>
<td>0.42*</td>
<td>[0.00, 0.83]</td>
</tr>
<tr>
<td>Olafsen, et al., 2006 - MITP vs. SC Preterm (IJA)</td>
<td>71</td>
<td>NR</td>
<td>69</td>
<td>NR</td>
<td>0.48*</td>
<td>[0.13, 0.83]</td>
</tr>
<tr>
<td>Olafsen, et al., 2006 - MITP vs. SC Preterm (RJA)</td>
<td>71</td>
<td>NR</td>
<td>69</td>
<td>NR</td>
<td>0.16</td>
<td>[-0.19, 0.50]</td>
</tr>
<tr>
<td>Olafsen, et al., 2006 - MITP vs. SC Preterm (IOR)</td>
<td>71</td>
<td>NR</td>
<td>69</td>
<td>NR</td>
<td>0.34*</td>
<td>[0.00, 0.69]</td>
</tr>
<tr>
<td>Olafsen, et al., 2006 - MITP vs. SC Preterm (RR)</td>
<td>71</td>
<td>NR</td>
<td>69</td>
<td>NR</td>
<td>0.12</td>
<td>[-0.22, 0.47]</td>
</tr>
<tr>
<td>Olafsen, et al., 2006 - MITP vs. SC Preterm (RSI)</td>
<td>71</td>
<td>NR</td>
<td>69</td>
<td>NR</td>
<td>0.74*</td>
<td>[0.38, 1.09]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (IJA)</td>
<td>42</td>
<td>13.2 (3.5)</td>
<td>40</td>
<td>12.9 (3.7)</td>
<td>0.08</td>
<td>[-0.35, 0.51]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (IBR)</td>
<td>42</td>
<td>12.1 (4.1)</td>
<td>40</td>
<td>12.3 (4.1)</td>
<td>-0.05</td>
<td>[-0.48, 0.38]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (RJA)</td>
<td>42</td>
<td>9.2 (2.3)</td>
<td>40</td>
<td>9.0 (2.8)</td>
<td>0.08</td>
<td>[-0.35, 0.51]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Infant communication - PICS)</td>
<td>42</td>
<td>35.5 (8.5)</td>
<td>40</td>
<td>34.2 (8.8)</td>
<td>0.03</td>
<td>[-0.39, 0.46]</td>
</tr>
<tr>
<td>Spittle, et al., 2010 - VIBes Plus vs. SC (Language - Bayley Scales)</td>
<td>58</td>
<td>96.4 (16.1)</td>
<td>57</td>
<td>97.0 (16.0)</td>
<td>-0.09</td>
<td>[-0.46, 0.27]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. HBIP (Language - Bayley Scales)</td>
<td>50</td>
<td>94.5 (11.1)</td>
<td>48</td>
<td>91.6 (12.0)</td>
<td>0.25</td>
<td>[-0.15, 0.64]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. SC (Language - Bayley Scales)</td>
<td>50</td>
<td>94.5 (11.1)</td>
<td>45</td>
<td>91.6 (11.0)</td>
<td>0.26</td>
<td>[-0.14, 0.66]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - HBIP vs. SC (Language - Bayley Scales)</td>
<td>48</td>
<td>91.6 (12.0)</td>
<td>45</td>
<td>91.0 (11.0)</td>
<td>0.00</td>
<td>[-0.40, 0.40]</td>
</tr>
</tbody>
</table>

SC – Standard care; MITP – Mother Infant Transaction Program; CBIP – Clinic based intervention program; HBIP – Home based intervention program; IJA – Initiating joint attention; RJA – Responding to joint attention; IOR – Initiating object requesting; RR – Responding to requesting; RSI – Responding to social interaction; IBR – Initiating behaviour request; NR – Not reported

* = Positive effect of treatment (where 0.0-0.3 has a small effect, 0.3-0.5 has a moderate effect and 0.5-1 has a large effect)
Figure 7: Forest Plot depicting infant communication and language outcomes across four RCTs
**Infant cognitive development.** Only two of the studies included in data synthesis (Spittle, et al., 2010; Wu, et al., 2014) looked at infant cognitive development (Table 9 & Figure 8). Both studies utilised the Bayley Scales of Infant Development to assess this outcome. All effect sizes obtained show a positive trend towards the intervention groups, and the clinic based intervention over the home based intervention ($g = 0.19 - 0.51; M = 0.31$). The biggest effect size was seen for the comparison of the clinic based intervention program with standard care ($n = 95; g = 0.51; 95\% CI: 0.10, 0.91$). These results are replicated in the reported data in the studies.

Table 9:

Effect size (Hedges $g$) for infant’s cognitive outcomes as assessed with the Bayley Scales of Infant Development

<table>
<thead>
<tr>
<th>Interventions/Controls</th>
<th>n</th>
<th>$M$ (SD)</th>
<th>n</th>
<th>$M$ (SD)</th>
<th>Effect Size</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spittle, et al., 2010 - VIBes Plus vs. SC (Cognition - Bayley Scales)</td>
<td>58</td>
<td>99.0 (12.8)</td>
<td>57</td>
<td>95.6 (12.6)</td>
<td>0.27</td>
<td>[-0.10, 0.63]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. HBIP (Cognition - Bayley Scales)</td>
<td>50</td>
<td>100.4 (7.9)</td>
<td>48</td>
<td>97.9 (10.3)</td>
<td>0.27</td>
<td>[-0.12, 0.67]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. SC (Cognition - Bayley Scales)</td>
<td>50</td>
<td>100.4 (7.9)</td>
<td>45</td>
<td>96.0 (9.4)</td>
<td>0.51$^*$</td>
<td>[0.10, 0.91]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - HBIP vs. SC (Cognition - Bayley Scales)</td>
<td>48</td>
<td>97.9 (10.3)</td>
<td>45</td>
<td>96.0 (9.4)</td>
<td>0.19</td>
<td>[-0.21, 0.60]</td>
</tr>
</tbody>
</table>

SC – Standard care; CBIP – Clinic based intervention program; HBIP – Home based intervention program; SC – Standard care

*Note.* $^*$ = Positive effect of treatment (where 0.0-0.3 has a small effect, 0.3-0.5 has a moderate effect and 0.5-1 has a large effect)
Figure 8: Forest Plot depicting infant cognitive outcomes as assessed on the Bayley Scales of Infant Development
Infant temperament and behaviour. Four studies (Benzies, et al., 2013; Wu, et al., 2014; Milgrom, et al., 2014; Ravn, et al., 2012) looked at infant behaviour and temperament outcomes (Table 10 & Figure 9). Overall, the trend across all studies tends to favour the control groups \((g = -0.46 - 0.25; M = -0.08)\). Only one significant effect size was found across the studies, which favours the control group and looks at the infant’s activity level in the Ravn study \((n = 82; g = -0.46; 95\% \text{ CI:} -0.89, -0.02)\). All positive effect sizes obtained only indicate small effects, (Milgrom, et al., cooperation score: \([n = 92; g = 0.17; 95\% \text{ CI:} -0.23, 0.58]\), Milgrom, et al., activity score: \([n = 92; g = 0.20; 95\% \text{ CI:} -0.21, 0.60]\), Ravn, et al., approach score: \([n = 82, g = 0.25; 95\% \text{ CI:} -0.18, 0.68]\), Ravn, et a., soothability score: \([n = 80; g = 0.11; 95\% \text{ CI:} -0.32, 0.54]\)) and are outweighed by the lack of effect the interventions had on other behaviour and temperament outcomes. These results are also demonstrated statistically within the individual studies themselves.
## INTERVENTION FOR PARENT-INFANT INTERACTION

### Table 10:
Effect size (Hedges g) for infant temperament and behaviour outcomes

<table>
<thead>
<tr>
<th>Interventions/Controls</th>
<th>n</th>
<th>M (SD)</th>
<th>n</th>
<th>M (SD)</th>
<th>Effect Size</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. 2HV (temperament and behaviour)</td>
<td>23</td>
<td>89.96 (16.65)</td>
<td>46</td>
<td>93.52 (14.83)</td>
<td>-0.23</td>
<td>[-0.72, 0.27]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 2HV vs. Comparison (temperament and behaviour)</td>
<td>46</td>
<td>93.52 (14.83)</td>
<td>42</td>
<td>93.26 (13.43)</td>
<td>0.02</td>
<td>[-0.40, 0.43]</td>
</tr>
<tr>
<td>Benzies, et al., 2013 - 4HV vs. Comparison (temperament and behaviour)</td>
<td>23</td>
<td>89.96 (16.65)</td>
<td>42</td>
<td>93.26 (13.43)</td>
<td>-0.22</td>
<td>[-0.73, 0.28]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. HBIP (behaviour)</td>
<td>50</td>
<td>43.60 (23.00)</td>
<td>48</td>
<td>44.70 (24.80)</td>
<td>-0.05</td>
<td>[-0.44, 0.35]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - CBIP vs. SC (behaviour)</td>
<td>50</td>
<td>43.60 (23.00)</td>
<td>45</td>
<td>49.30 (25.60)</td>
<td>-0.23</td>
<td>[-0.63, 0.17]</td>
</tr>
<tr>
<td>Wu, et al., 2014 - HBIP vs. SC (behaviour)</td>
<td>48</td>
<td>44.70 (24.80)</td>
<td>45</td>
<td>49.30 (25.60)</td>
<td>-0.18</td>
<td>[-0.59, 0.22]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Temperament - approach)</td>
<td>47</td>
<td>3.40 (.39)</td>
<td>45</td>
<td>3.50 (.50)</td>
<td>-0.22</td>
<td>[-0.63, 0.18]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Temperament - rhythmicity)</td>
<td>47</td>
<td>3.70 (.55)</td>
<td>45</td>
<td>3.80 (.57)</td>
<td>-0.18</td>
<td>[-0.58, 0.23]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Temperament - cooperation)</td>
<td>47</td>
<td>2.30 (.51)</td>
<td>45</td>
<td>2.20 (.63)</td>
<td>0.17</td>
<td>[-0.23, 0.58]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Temperament - activity)</td>
<td>47</td>
<td>3.80 (.53)</td>
<td>45</td>
<td>3.70 (.47)</td>
<td>0.20</td>
<td>[-0.21, 0.60]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Temperament - irritability)</td>
<td>47</td>
<td>3.40 (.36)</td>
<td>45</td>
<td>3.40 (.48)</td>
<td>0.00</td>
<td>[-0.41, 0.41]</td>
</tr>
<tr>
<td>Milgrom, et al., 2013 - Premie Start vs. SC (Temperament - easy difficulty)</td>
<td>47</td>
<td>3.00 (.31)</td>
<td>45</td>
<td>3.00 (.34)</td>
<td>0.00</td>
<td>[-0.41, 0.41]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Behaviour - activity)</td>
<td>42</td>
<td>3.90 (.60)</td>
<td>40</td>
<td>4.20 (.70)</td>
<td>-0.46</td>
<td>[-0.89, -0.02]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Behaviour - distress)</td>
<td>42</td>
<td>3.70 (.70)</td>
<td>40</td>
<td>3.70 (.70)</td>
<td>0.00</td>
<td>[-0.43, 0.43]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Behaviour - approach)</td>
<td>42</td>
<td>2.90 (.80)</td>
<td>40</td>
<td>2.70 (.80)</td>
<td>0.25</td>
<td>[-0.18, 0.68]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Behaviour - attention)</td>
<td>42</td>
<td>3.40 (.08)</td>
<td>40</td>
<td>3.70 (1.00)</td>
<td>-0.33</td>
<td>[-0.76, 0.10]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Behaviour - smiling)</td>
<td>42</td>
<td>4.90 (.80)</td>
<td>39</td>
<td>5.10 (1.00)</td>
<td>-0.22</td>
<td>[-0.65, 0.21]</td>
</tr>
<tr>
<td>Ravn, et al., 2012 - MITP vs. SC (Behaviour - soothability)</td>
<td>41</td>
<td>5.10 (.80)</td>
<td>39</td>
<td>5.00 (1.00)</td>
<td>0.11</td>
<td>[-0.32, 0.54]</td>
</tr>
</tbody>
</table>

2HV – Two home visit group; 4HV – Four home visit group; CBIP – Clinic based intervention program; HBIP – Home based intervention program; SC – Standard care; MITP – Mother infant Transaction Program
Figure 9: Forest plot depicting infant temperament and behaviour outcome
Discussion

The aim of this review was to consider the effectiveness of early intervention within the first three years of life, which targets parent-infant interaction for parents of preterm infants, to reduce the incidence of language delay or disorder in this population. Eight randomised controlled trials were identified after meeting the inclusion criteria, and were included in this review. Although the studies were judged to be too heterogeneous for meta-analysis, six of these studies were deemed appropriate for data synthesis.

Quality of results

The GRADE approach was used for assessing the quality of evidence provided by this review. After consulting the outcomes, the level of evidence supplied by these studies was deemed to be of high quality, due to all studies included being RCTs with no serious limitations. Although the author acknowledges that the quality of the evidence may be influenced by attrition and reporting bias within the studies, caused by inadequate allocation concealment, non-blinding of participants, and outcome data not being addressed appropriately, as assessed by the Cochrane RoB tool and PEDro scale.

Effects of interventions

All interventions used within the studies targeted parent-infant interactions to some degree. The main outcomes assessed across the studies were parent-infant interaction, parental stress, anxiety and depression, and infant language, cognitive and behavioural development. Overall, this review shows that therapy targeted at parent-infant interactions has small-moderate, positive effect sizes for improving parent-infant interactions, reducing parental stress, anxiety and depression, and improving infant language and cognitive development. Overall, these same therapies were found to have no effect on infants’ temperament and behavioural development, with most outcomes favouring the control groups.
**Parent-infant interactions.** The four studies that looked at parent-infant interactions all used video-recording of a play or routine situation to assess this outcome (Barrera, et al., 1986; Benzies, et al., 2013; Milgrom, et al., 2013; Wu, et al., 2014). The three which were included for data synthesis showed an overall positive effect of intervention on parent-infant interaction. The specific behaviours used to indicate parent-infant interaction, and the methods used to code these behaviours varied greatly across these studies making it difficult to compare this outcome between the studies. The study by Benzies used a formal assessment (Parent Child Interaction Teaching Scale), while the remaining three used informal coding and assessing the interaction. Using a formal assessment would allow Benzies’ study to be compared to other studies that also used this outcome measure, making it easier to identify intervention effects. However by using an informal measure such as the one used by Barrera (informal coding), they were able to look at more specific interactive behaviours such as vocalisation, smiling, interactive play and looking away, which might not be assessed on a formal measure. Adding to the difficulty of comparing interaction outcomes between these studies is the fact that all four of the studies used vastly different intervention strategies. Following this, it would be difficult to determine which elements of the interventions are responsible for the positive effects without further research being conducted.

**Parental stress, anxiety and depression.** Three studies that assessed parental mental health outcomes were included for data synthesis (Benzies, et al., 2013; Ravn, et al., 2012; Spittle, et al., 2010). Overall, the results present a positive effect towards reducing parental stress, anxiety and depression among parents in the intervention groups. Both measures of parental mental health (anxiety and depression) in the Spittle study produced moderate-large effect sizes indicating that the VIBes Plus intervention is effective for improving mental health in parents of preterm infants. The use of a psychologist in the implementation of the
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VIBes Plus program may be responsible for the large effect sizes seen in parent mental health in this study.

The studies by Benzies and others (2013) and Ravn and colleagues (2012) showed less positive effects in terms of parental mental health outcomes. The study by Ravn showed significant results in reducing parental depression at one month post discharge, however no effect on parental stress at six and 12 months of infant age. These differences may be due in part to two different assessment measures being used for these outcomes, as well as the natural decrease in stress as the parents settle more into the role of being parent to a preterm infant over time. The intervention used by Benzies produced only small effects in favour of the intervention groups. Both the studies by Benzies and Ravn targeted parent-infant interaction as the primary outcome, and only assessed parental mental health as an incidental outcome. The therapy did not contain elements that were specifically targeted at reducing stress and depression which may explain the marked difference in outcomes seen between these studies and that by Spittle and others (2010). The studies by Benzies and Ravn both used the Parenting Stress Index (PSI) (Abidin, 1995) to assess parenting stress, although the interventions used were vastly different, making the results difficult to compare.

Infant language development. Overall, the effect sizes indicate that therapies aimed at improving parent-infant interactions led to better language and communication development, which supports the aim of this review. Three studies which looked at infant language development (Milgrom, et al., 2013; Olafsen, et al., 2006; Ravn, et al., 2012) utilised the MITP program. Interestingly, two of these also looked at measures of joint attention, (Olafsen, et al., 2006; Ravn, et al., 2012) which is an early precursor to language development (Paul & Norbury, 2012). Using the Early Social Communication Scales (ESCS) (Mundy, et al., 2003), Olafsen found considerable significant differences between their control and intervention groups, however this was not replicated in the study by Ravn who used the
Pictorial Infant Communication Scales (PICS) to assess joint attention. Differences in these findings may be attributed to several differences in assessment methods. Firstly, the ESCS is a formal assessment which is administered by trained observers, whilst the PICS is a parent-reported measure. As the parents are not trained observers, they may not be accurately recording all instances of the target behaviours. The target behaviours in the informal, parent-reported measure are also likely to be broader, and therefore not picking the more subtle signs of joint attention as assessed by the trained administerers in the ESCS. Another reason these findings may differ is the environment in which the assessment is administered. The PICS is a parent-report measure which presumably is administered during the infant’s daily activities with the mother. The ESCS on the other hand is administered during an interaction between the infant and clinician at a table with the mother observing. This more structured environment may encourage more incidences of joint attention due to it being specifically elicited, and the limited number of distractions present. In order to get a clearer understanding of the influence the MITP has on joint attention, further research should be conducted using the same or similar assessment situations and outcome measures which can be more easily compared. Additionally, Milgrom used the Premie Start program (modified version of the MITP) for intervention, and utilised the Infant-Toddler Checklist of the Communication and Symbolic Behaviour Scales Developmental Profile (CSBS) (Wetherby & Prizant, 2002). Positive outcomes were found for this intervention using this outcome measure. The CSBS also assesses some measures of joint attention, providing further evidence for the MITP producing positive outcomes for joint attention. The CSBS also assesses infant comprehension and word use, indicating that the MITP also has positive outcomes on these measures. Overall, the MITP appears to have positive trends towards being a successful intervention program for improving language development in preterm infants.
Language outcomes were also assessed in the studies by Spittle and others (2010) and Wu and colleagues (2014). Although both of these studies used different interventions, both used the Bayley Scales of Infant and Toddler Development (Bayley, 2005) to assess language outcomes. The results of the forest plot (Figure 7), indicate that CBIP used by Wu produced small positive outcomes in relation to language development, compared to the VIBes Plus program used by Spittle, which favoured the control group for language outcomes. Both interventions were delivered with similar intensities, (8 and 9 sessions over the first year of life) however neither study provides sufficient detail for the intervention methodologies to be compared in the scope of this review. Therefore it is difficult to determine which component of Wu’s intervention made it more successful for improving infant language development.

**Infant cognitive development.** Along with language outcomes, Spittle and others (2010) and Wu and colleagues (2014) also measured cognitive outcomes using the Bayley Scales. However unlike the language outcomes, the effect size for cognitive development was positive for both studies. The intervention used by Spittle is partly implemented by a physiotherapist and has a focus on postural stability, coordination and strength which has been found to be important in the development of cognitive abilities (Wijnroks & van Veldhoven, 2003). Adequate postural control is required for learning and goal-orientated behaviour such as visual exploration and reaching, which in turn are important for the infant’s later cognitive development as they explore their environment (Wijnroks & van Veldhoven, 2003). This focus towards physiotherapy in the Spittle study may therefore account for the positive outcomes in cognitive development, and lower outcomes seen in language development. As with language development, Wu does not provide enough information on the intervention protocols to ascertain the features which may be specifically contributing to cognitive development.
**Infant behavioural development.** Infant behavioural outcomes were the only outcomes assessed across studies which showed little or no effect of intervention. Four studies (Benzies, et al., 2013; Milgrom, et al., 2013; Ravn, et al., 2012; Wu, et al., 2014) assessed behavioural outcomes following intervention. The only notable positive effects were seen following the MITP/Premie Start programs in the studies by Milgrom and Ravn for the measures of cooperation, activity, approach, and infant soothability, although all remaining outcomes in both studies favoured the control groups. The studies by Benzies and Wu showed no positive effects on behaviour and temperament, and used very different methodologies compared to each other and the MITP. These four studies also used a range of both formal and informal outcome measures which measure a variety of different behaviours, thus making comparisons between interventions difficult. These results suggest that therapy targeted at parent-infant interventions have no effect on behavioural outcomes in preterm infants.

**Studies not included in data synthesis.** The studies by Barrera and colleagues (1986) and Brooks-Gunn and others (1992) were unable to be included in data synthesis due to having no appropriate reported data. However the findings of these studies are still important to consider. Barrera reports that both of their intervention programs significantly improved infant’s mental development (language and cognition) as assessed using the Bayley Scales. Their study also found that their intervention programs had positive effects on the infant’s home environment, indicating an enriched, home environment. Despite strong intervention effects on language and cognitive development, little difference was found in relation to parent-infant interaction among intervention and control groups.

The study by Brooks-Gunn only set out to assess infant’s cognitive development over the course of three years. At 24 months of age, the study reported positive intervention effects for better vocabulary development, visual-motor skills and receptive language skills, compared to the control children. At 36 months of age, positive intervention effects were seen
for vocabulary development, receptive language, reasoning, visual-motor skills, and spatial skills. Although effect sizes could not be calculated for these studies, the reported findings indicate that both interventions provide positive outcomes for language development in preterm infants.

**Intensity of intervention.** Across the studies, interventions were administered at differing intensities. Research looking at how often and how much therapy is needed in speech pathology in order to achieve results has been inconclusive (Baker, 2012). Each client is an individual, and will respond in their own way to different types of therapy. Each client will also have different notions and expectations on what an acceptable level of change is when deciding to end or continue therapy. The concept of ‘intensity’ can also differ across settings and disorders, with one clinician denoting weekly sessions as being intensive, while another clinician in a different setting considers daily sessions to be intensive. These factors in combination make deciding on therapy schedules difficult for the clinician. The studies by Olafsen and others (2006), and Ravn and colleagues (2012) encompassed a combination of intense and non-intense therapy where the first block of sessions occurred over a short space of time whilst the participants were in the NICU, with less frequent home visits following. The studies by Benzies and others (2013), Milgrom and others (2013), Spittle and others (2010), and Wu and others (2014) had less frequent sessions which were spaced out over the course of the year. While Barrera and others (1986), and Brooks-Gunn and others (1992) had a high intensity schedule at intervention start, with sessions becoming less frequent (particularly in Barrera) as the year progressed. The differences in intervention intensity may therefore account for some of the differences seen in the outcomes reported by the studies, and in the effect sizes calculated, depending how individual clients responded to the therapy. In order to help close this knowledge gap, it would be good for future research to look at how the intensity of a particular intervention affects outcomes in development of preterm infants.
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**Efficacy of parent-infant interactions in other populations**

Although minimal research was found relating to therapies targeting parent-infant interactions and language outcomes in preterm infants, this is an area which has been extensively researched in the field of ASD and toddlers with language delay. As previously mentioned, the It Takes Two to Talk and DIR-Floortime programs, both use parent-based language interventions to foster positive parent-infant interactions and language development. The theoretical background used by both these programs may increase the effectiveness of the programs, indicating that a strong theoretical background should be present when designing therapy for preterm infants. These programs have reported positive outcomes not only for language development, but also for social-emotional development and reduction of parental stress (Liao, et al., 2014; Manolson, 1992; Pajareya & Nopmaneejumruslers, 2011). Further research should try to identify what elements may contribute to making these two programs successful, and determine if they will have the same effectiveness with the preterm infant population.

**Methodology of this review**

This review started out to answer a different research question, however no studies were found which answered at that question. Although systematic reviews can still be written even when no studies were found, as this was an honours project, it was decided to modify the question in light of the studies which were returned, in order to be able to write a complete systematic review. The literature which was returned during the first search posed a new focus which looked at parent-infant interactions instead of parent-based interventions targeting language development. The returned literature also introduced some new search terms which would be used in the next search strategy. So although this systematic review did not follow the conventions of writing up the original results of the first search, all other methodologies were correctly followed.
Limitations

The author acknowledges several limitations in relation to conducting this review.

1) As this review formed an honours thesis, there was limited time to identify all appropriate search terms or search a wider set of databases. This may have introduced bias into the review as extra search terms were identified during the writing phase which may have found further studies if identified earlier. During further reading during the writing process, more potential studies were identified however limited time prevented them from being investigated and included in the review. As such, the author recommends a more in-depth search approach be taken in future to identify all appropriate studies to further add to the evidence on this topic.

2) The number of studies returned during this systematic review was small, and the studies very heterogeneous, which then impacted on the quality of evidence and number of conclusions being able to be drawn from this review.

3) Both the author and independent reviewers were not formally trained in undertaking systematic reviews. This may have further led to errors in the search strategy, bias and quality rating, and also data synthesis.

4) As the author did not contact the authors of the included studies to obtain more information on intervention protocols or outcome data, some comparisons between studies could not be made and were therefore excluded from some analysis (e.g., data synthesis).

Conclusions

Implications for practice. The results of this review suggest that therapy aimed at improving parent-infant interaction is a promising intervention strategy for improving the language outcomes of preterm infants. These programs were also beneficial in improving
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infant’s cognitive development as well as reducing parental stress, anxiety and depression. However because the intervention programs and assessment outcomes used were so varied, direct comparisons between the studies is difficult. The MITP (including Premie Start) and the interventions used by Wu and colleagues (2014) appeared to be the most effective with the MITP improving parent-infant interaction, parental mental health and infant language outcomes, whilst the intervention used by Wu improved parent-infant interaction, and infant’s language and cognitive outcomes.

Two interesting findings were identified during this review. Firstly, apart from the study by Brooks-Gunn and others (1992), all interventions took place within the first few months, or the first year of life. Although it is important for parent-infant interaction to be targeted as early as possible, to ensure positive early developmental skills, children’s language development really begins to arise at around one to two years of age. It would therefore be beneficial for preterm infants to have follow-up intervention at these ages, in addition to the early intervention, to decrease the incidence of language delays seen in this population at school age. This later intervention could continue to foster parent-infant interactions and language development by teaching parents strategies to use in everyday routines and situations, similar to those seen in the Hanen and Floortime programs.

The second interesting finding identified was that the predominant types of therapists involved in designing and implementing the interventions were psychologists, nurses, and physiotherapists. The findings of this review which indicate that targeting parent-infant interaction is beneficial for language development suggest that speech pathologists should have more of an input in therapies which contain components of parent-infant interaction when working with younger children and infants who were born preterm, in order to enhance language outcomes. It also suggests that targeting parent-infant interaction may be an
appropriate intervention strategy for speech pathologists to use when working with preterm infants and their families.

**Implications for research.** Through doing this review, many interesting and positive outcomes were found for improving infant development and parental mental health. Although this review set out to research interventions which improve language development in preterm infants, little information which specifically answers this question could be gained from this review. Future research which looks at improving parent-infant interactions, and also providing parents with specific techniques which are known to foster language development could improve upon the already positive language outcomes found in some of the studies included in this review. The timing of when interventions are implemented (e.g., at birth, or between 1-3 years) may also bring interesting findings for the best time to provide therapy in this population.

Research should also look at different intervention schedules and how the intensity of the intervention affects outcomes in this particular population. Different intervention types may also be looked at, with language outcomes being measured using the same outcome assessment to help researchers identify the particular aspects of interventions which may be allowing one intervention to be more successful over the other.

In relation to established programs such as It Takes Two to Talk, and Floortime, future research should be undertaken to see if these types of programs are appropriate for, and effective in the preterm population for improving parent-infant interactions and language development outcomes.

The methodology of the included articles showed high bias in relation to allocation concealment, blinding of participants and therapists, and appropriate analysis of outcome data. Blinding of participants and therapists in behavioural interventions is often difficult
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(Page & Persch, 2013), therefore these are areas which may continue to receive high bias ratings in future research. However the use of appropriate allocation concealment procedures and appropriate statistical data analysis in future research projects may lower bias ratings and provide higher quality evidence.
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References


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### Appendix A

**Further research on language development in preterm infants**

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Design</th>
<th>Participants</th>
<th>Mean GA of preterms (SD)</th>
<th>Language Measures</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Cusson, 2003                  | Longitudinal study - infants followed from birth until 26 months corrected age (CA) | 43 mothers and their preterm infants                                         | 30.94 weeks (2.61)       | * Bayley Scales of Infant Development  
* Reynell Developmental Language Scales                                           | * Infant development at 26 months CA was within normal limits using the Bayley scales.  
* At 26 months CA, both receptive and expressive language were delayed 3-5 months (mean = 23 months, mean = 21 months, respectively) |
| Lee, Yeatman, Luna, & Feldman, (2011) | Cohort study                        | * 65 preterm infants (split into ≤ 27 weeks GA, and ≥ 28 weeks GA)  
* 35 full term                                                                 | 28.8 weeks (2.7)               | * Wechsler Abbreviated Scale of Intelligence  
* Comprehensive Evaluation of Language Fundamentals – Fourth Edition (CELF-4) | * Children born preterm performed worse in all domains of cognitive, language, and reading function than their full term controls  
* Significant group differences                                                |
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<table>
<thead>
<tr>
<th>Foster-Cohen, Edgin, Champion, &amp; Woodward, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal study – preterm group was studied throughout the perinatal period, at term, and within two weeks of their first and second (corrected)</td>
</tr>
<tr>
<td>* 90 very preterm children (split into &lt; 28 weeks GA, and 28-33 weeks GA)</td>
</tr>
<tr>
<td>* 105 full term control children</td>
</tr>
<tr>
<td>28 weeks (range: 23-33)</td>
</tr>
<tr>
<td>* Peabody Picture Vocabulary Test</td>
</tr>
<tr>
<td>* Test for Reception of Grammar – Version Two (TROG-2)</td>
</tr>
<tr>
<td>* Woodcock-Johnson III Tests of Achievement (WJ-III)</td>
</tr>
<tr>
<td>* The Basic Reading Skills Cluster</td>
</tr>
<tr>
<td>* Bayley Scales of Infant Development</td>
</tr>
<tr>
<td>* CDI-Words and Sentences form of the MacArthur-Bates Communicative Development Inventory</td>
</tr>
<tr>
<td>* Systematic Analysis of Language Transcripts (SALT)</td>
</tr>
</tbody>
</table>

were found in all domains except receptive vocabulary.

* Language and reading skills were associated with prematurity independent of the effects of gender, SES and IQ.

* Decreasing GA was associated with smaller vocabulary size, decreased word use, and delayed
<p>| Guarini, et al., 2010 | Cohort study | * 68 monolingual Italian preterms, without cerebral damage (mean age = 8;0 at time of study) | * 26 monolingual Italian full term control children (mean age = 7;10 at time of study) | 30.44 weeks (2.22) | * Test di Comprensione Grammaticale per Bambini (grammar comprehension) | * Test di Vocabolario Figurato (lexical production) | * Valutazione delle competenze metafonologiche (phonological awareness) | * Prova di lettura MT per la scuola elementare – 2 (reading comprehension) | * Batteria per la valutazione della dislessia e della disortografia evolutiva (accuracy and speed of word) | * Preterm group presented with difficulties in grammar comprehension, lexical production and phonological awareness, although differences were no longer significant when Bonferroni correction was applied. | * Preterm children were slower in all reading abilities, and made more errors in story reading | * Preterm group showed difficulties in writing accuracy | * Results show that difficulties |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Participants</th>
<th>Measures</th>
<th>Results</th>
</tr>
</thead>
</table>
| Holm & Crosbie, 2010   | Cohort study      | * 196 children born preterm who were free of identified intellectual, motor or sensory disorders  
* 168 full term controls  
* Age range at participation = 5-12 years | * Kaufman Brief Intelligence Test  
* Wechsler Preschool and Primary Scale of Intelligence – Third Edition – Australian Standardisation  
* Wechsler Intelligence Scale for Children – Fourth Edition – Australian Standardisation  
* CELF-4  
* British Picture Vocabulary Scale – Second Edition  
* Diagnostic Evaluation of Articulation and Phonology (DEAP)  
* Auditory discrimination and non-word reading | * The preterm cohort scored significantly lower on all measures except for reading comprehension.  
* When compared to standardised assessment means, the preterm cohort was within normal range except for spelling and speech.  
* Significantly more preterm children fell below the normal range for reading accuracy, core language, spelling, phonological awareness and speech. |
| Reidy, Morgan, Thompson, Inder, Doyle, & Anderson, 2013 | Cohort, longitudinal study. Participants were assessed at 2, 5, and 7 years. | * 198 preterm children without severe congenital abnormalities *70 full term controls | 27.4 weeks (1.9) | * NEPSY-II * CELF-4 * Test of Language Competence – Expanded Edition | * Preterm group scored significantly lower than the full term group on all language subdomains (phonological awareness, semantics, grammar, discourse, pragmatics) | non-word repetition tasks * Neale Analysis of Reading Ability – Third Edition – Australian Standardisation * South Australian Spelling Test * Sutherland Phonological Awareness Test (SPAT) * Queensland University Inventory of Literacy – Nonword Spelling |
Smith, DeThorne, Logan, Channell, Petrill, 2014

| Cohort, longitudinal study. Participants were assessed at approx. 7, 8, and 10 years | * 57 preterm children | * 57 age and gender matched full term controls | 29.8 weeks (1.7) | * Conversational samples | * SALT | * Word frequency analysis | * Computerised language analysis (CLAN) | * Coding of Elaborated Noun Phrases | * Developmental Sentence Scoring (DSS) | * Stanford-Binet Intelligence Scale | * Test of Narrative Language | * CELF-4 | * The premature group produced the target structures less frequently than the full term group | * Group means for the premature group were in the lower end of the normal range |
# Appendix B

## Bias rating scales

**Cochrane Risk of Bias Tool** (Higgins & Altman, 2008)

<table>
<thead>
<tr>
<th>Adequate sequence generation</th>
<th>Allocation concealment</th>
<th>Blinding of participants, personnel and outcome assessors</th>
<th>Incomplete outcome data addressed</th>
<th>Free of selective outcome reporting</th>
<th>Other bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study title</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PEDro Scale** (Physiotherapy Evidence Database 1999)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility criteria were specified</td>
<td></td>
</tr>
<tr>
<td>Subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)</td>
<td></td>
</tr>
<tr>
<td>Allocation was concealed</td>
<td></td>
</tr>
<tr>
<td>The groups were similar at baseline regarding the most important prognostic indicators</td>
<td></td>
</tr>
<tr>
<td>There was blinding of all subjects</td>
<td></td>
</tr>
<tr>
<td>There was blinding of all therapists who administered the therapy</td>
<td></td>
</tr>
<tr>
<td>There was blinding of all assessors who measured at least one key outcome</td>
<td></td>
</tr>
<tr>
<td>Measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups</td>
<td></td>
</tr>
<tr>
<td>All subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by “intention to treat”</td>
<td></td>
</tr>
<tr>
<td>The results of between-group statistical comparisons are reported for at least one key outcome</td>
<td></td>
</tr>
<tr>
<td>The study provides both point measures and measures of variability for at least one key outcome</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix C
### Characteristics of included studies

**Barrera, et al., 1986**

| Methods | Study design: RCT  
|         | Randomisation: Infants randomly assigned according to sex, birth weight, socioeconomic status, and pre- and post natal complications  
|         | Allocation concealment: Unclear  
|         | Blinding: Outcome assessors  
|         | Family visited at home periodically (mean = 23 visits) over the first year of life by infant-parent therapist |

| Participants | 83 infants  
|             | Inclusion criteria (preterms): birth weight < 2000g and < 37 weeks GA; discharge from hospital at least 2 weeks prior to enrolment; infant's prognosis for survival after discharge judged to be good by a paediatrician; infant's family living within geographic region funded by services.  
|             | Inclusion criteria (full terms): birth weight > 2500g and > 37 weeks GA; infant having no serious prenatal or perinatal complications; infant's family living within the same geographic region  
|             | Characteristics: mean GA for preterm intervention and control groups was 33 weeks; mean GA for full term control group was 40 weeks. |

| Interventions | Two preterm intervention programs were used (developmental programming and parent-infant interventions), with two control groups (preterm and full term groups)  
|               | Full term control (N = 24): No treatment  
|               | Preterm control (N = 21): No treatment  
|               | Developmental programming intervention (N = 16): improve the child's developmental level of functioning in cognition, communication, gross and fine motor development, socioemotional skills and self-help skills  
|               | Parent-infant intervention (N = 22): improve the interaction between parent and child rather than to teach specific developmental skills. Enhance parent's observation skills, and sensitivity and mutual responsivity. |

| Outcomes | Assessment of infant: Bayley Mental and Motor Scales of Infant Development; Infant and Toddler Temperament Questionnaires  
|          | Home environment: The Caldwell HOME inventory used to assess the physical and social environment  
|          | Parent-child interactions: Coding of video-taped mother-child free play period at home  
|          | Infants randomly assigned for home assessment at 4, 8, 12 and 16 months corrected age |

| Notes | High number of dropouts across study (25% attrition rate). Unclear how infants were randomly assigned to assessment groups. |
# Benzies, et al., 2013

## Methods

<table>
<thead>
<tr>
<th>Study design: RCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomisation: randomised allocation sequence generated by a biostatistician</td>
</tr>
<tr>
<td>Allocation concealment: Unclear</td>
</tr>
<tr>
<td>Blinding: Participants, therapists and outcome assessors</td>
</tr>
<tr>
<td>Father was visited at home 1-4 times between infant age 4-7 months</td>
</tr>
</tbody>
</table>

## Participants

<table>
<thead>
<tr>
<th>113 fathers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion criteria: first time, biological father of a health, singleton, late preterm (34-36 weeks GA) infant; 18 years or older; speaking English to infant at least 50% of interactions; cohabiting with the infant's mother; living within 100km of the university</td>
</tr>
<tr>
<td>Characteristics: mean GA for all groups was 35 weeks. There was no significant differences between groups at baseline for father's age, education level, household income and infant gender</td>
</tr>
</tbody>
</table>

## Interventions

<table>
<thead>
<tr>
<th>Three intervention groups: one visit (comparison group), two visit and four visit (intervention groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison group (N = 42): Fathers video-taped during play interactions when infant 4 months old. No feedback given. Discussed information about age-appropriate play - no handout given. Fathers received phone call when infant 6 months to discuss play activities</td>
</tr>
<tr>
<td>Two visit group (N = 46): Fathers video-taped during play interaction when infant 4 months and 6 months old with feedback given on behaviours that fostered development. Information handouts given and discussed.</td>
</tr>
<tr>
<td>Four visit group (N = 23): Fathers video-taped during play interactions when infant 4 months and 6 months old with feedback given on behaviours that foster development, and information handouts given and discussed. Fathers also visited at 5 months and 7 months old where information handouts given and discussed</td>
</tr>
</tbody>
</table>

## Outcomes

<table>
<thead>
<tr>
<th>Parent Child Interaction Teaching Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenting Stress Index-3</td>
</tr>
<tr>
<td>What Being the Parent of a Baby is Like</td>
</tr>
<tr>
<td>Baseline measures for all assessments collected at 4 months corrected age with outcome visits at 8 months corrected age</td>
</tr>
</tbody>
</table>

## Notes
**Methods**  
Study design: RCT  
Randomisation: Infants randomly assigned after hospital discharge using an adaptive randomisation method that maintained balance for birth weight group, gender, maternal education, maternal ethnic background, primary language spoken at home and infant participation in other studies  
Allocation Concealment: Unclear  
Blinding: Outcome assessors  
Intervention included both parent education and therapist-lead interventions

**Participants**  
985 infants  
Inclusion criteria: Infants were ≤ 2500g at birth  
Exclusion criteria: living more than 45 minutes from the centre; hospital discharge before or after the recruitment period; GA of > 37 weeks; maternal or infant condition precluding participation in the intervention  
Characteristics: Mean birth weight of intervention group = 1819.37g; mean birth weight of follow-up group = 1781.33g. No average GA given.

**Interventions**  
Two preterm groups - intervention and follow-up group  
Intervention (N = 377): Intervention lasted from discharge from the neonatal nursery until 36 months CA. Intervention group received paediatric follow-up (40 weeks postconceptional age and at 4, 8, 12, 18, 24, 30 and 36 months) as well as home visits, child care at a child development centre and parent group meetings. Follow-up (N = 608): Paediatric follow-up (40 weeks postconceptional age and at 4, 8, 12, 18, 24, 30 and 36 months) - medical, developmental, and social assessments with referral for paediatric care and other services as needed

**Outcomes**  
Bayley Scales of Infant Development - 12 and 24 months CA  
Stanford-Binet Intelligence Scale - at 36 months CA  
Peabody Picture Vocabulary Test-Revised - at 36 months CA  
Visual Motor Integration Test - at 36 months CA

**Notes**  
Attrition rate given, but no information on which group dropouts occurred from
### Methods

**Study design:** RCT  
**Randomisation:** A computer-generated, variable-length permuted block randomised allocation sequence was prepared by an independent person  
**Allocation concealment:** Ensured by a centralised system of sequentially numbered, sealed, opaque envelopes  
**Blinding:** Outcome assessors  
**Sessions:** Conducted weekly in the NICU followed by one home visit

### Participants

- **109 mothers (123 infants)**  
  - **Inclusion criteria:** Infants born < 30 weeks GA  
  - **Exclusion criteria:** Insufficient spoken and written English; triplets or higher multiples; infants/mothers judged to be too severely medically ill to participate by their attending physicians; maternal drug and alcohol abuse/dependence; residing > 100km from Melbourne  
  - **Characteristics:** Mean GA for both intervention and control groups was 27 weeks

### Interventions

- **Two preterm groups - control and intervention**  
  - **Control (N = 55):** best practice procedures for the care of preterm infants  
  - **Intervention (N = 54):** PremieStart programme (adaptation of the MITP) used to improve parent-infant interactions and provide psychoeducation

### Outcomes

- **Preterm Mother-Infant Interaction Scale (PREMIIS) used to code videotaped interactions at term equivalent age**  
- **Collection of Short Term Medical Data at term equivalent age**  
- **Short Temperament Scales for Infants - administered at 6 months CA**  
- **The Infant-Toddler Checklist of the Communication and Symbolic Behaviour Scales Developmental Profile - administered at 6 months CA**

### Notes

- Some unexplained changes in number of infants for some data collected.  
  - Analysis of main outcomes followed “intention to treat” principles
**Intervention for Parent-Infant Interaction**

Olafsen, et al., 2006

| Methods | Study design: RCT  
|         | Randomisation: Randomisation occurred using computer-generated random numbers and stratified by gestation  
|         | Allocation Concealment: Allocation made by sealed opaque envelopes, identified by stratification group and consecutively numbered  
|         | Blinding: Outcome assessors  
|         | One hour daily sessions on seven consecutive days in hospital, followed by four home visits at 3, 14, 30 and 90 days after discharge |

| Participants | 140 infants  
|              | Inclusion criteria: Infants born preterm and weighing < 2000g; infants were without congenital abnormalities; mother's native language was Norwegian  
|              | Exclusion criteria: Triplets  
|              | Characteristics: Preterm control and preterm intervention groups had a mean GA of 30 weeks; full term control group had a mean GA of 39 weeks |

| Interventions | Three groups - Full term control, preterm control and preterm intervention  
|               | Full term control (N = 74): Standard care (routine clinical examination on the third day of life)  
|               | Preterm control (N = 69): Standard care (examination, offer of training in baby massage, and discharge consultation)  
|               | Preterm intervention (N = 71): Modified version of the MITP to improve parent-infant interactions |

| Outcomes | The Early Social Communication Scales - administered at 12 months |

| Notes | Some videos not coded but no information given about which group videos belonged to |
**Ravn, et al., 2012**

| **Methods** | Study design: RCT  
| Randomisation: Computer generated random numbers  
| Allocation concealment: Sealed, consecutively numbered envelopes  
| Blinding: Researchers blinded to group allocation  
| Seven sessions given in hospital followed by four home visits |

| **Participants** | 118 preterm infants  
| Inclusion criteria: Parents of preterm infants born 30-36 weeks GA; parents could speak, read and write Norwegian, no history of drug/alcohol abuse or severe psychiatric disorders, hospital stays of minimum eight days were anticipated  
| Exclusion criteria: Infants with congenital anomalies, neurological sequelae, hearing loss or chromosomal disorders  
| Characteristics: Mean GA for all infants was 33 weeks |

| **Interventions** | Two groups - control and intervention (MITP)  
| Intervention group (N = 56): Mothers given seven intervention sessions which were carried out 7-10 days before discharge from hospital. This was followed-up by four home visits during the first three months. Aim of intervention is to help parents appreciate their infant and foster parent-infant relationship  
| Control group (N = 50): Standard care given |

| **Outcomes** | The Centre for Epidemiological Studies Depression Scale – one month post discharge, and at 6 and 12 months  
| Breastfeeding reports based on WHO breastfeeding categories – at 6, 9 and 12 months  
| Norwegian translation of the Parenting Stress Index – short version administered at 6 months, long version administered at 12 months  
| Infant Behaviour Questionnaire – administered at 6 and 12 months  
| Norwegian translation of the Pictoral Infant Communication Scales – at 12 months |

| **Notes** | Unclear if outcome assessors were blinded |
### Spittle, et al., 2010

<table>
<thead>
<tr>
<th>Methods</th>
<th>Study design: RCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Randomisation: Allocation sequence was computer generated independently</td>
</tr>
<tr>
<td></td>
<td>Allocation concealment: Assignments concealed through use of opaque envelopes</td>
</tr>
<tr>
<td></td>
<td>Blinding: Outcome assessors</td>
</tr>
<tr>
<td></td>
<td>Nine home visits over the first year of life conducted by a psychologist and physiotherapist</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participants</th>
<th>120 preterm infants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inclusion criteria: Infants born &lt; 30 weeks GA; no major congenital brain anomalies</td>
</tr>
<tr>
<td></td>
<td>Exclusion criteria: Living outside 100km radius of hospital; parents not able to speak English</td>
</tr>
<tr>
<td></td>
<td>Characteristics: Mean GA of infants in both groups was 27 weeks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Preterm control group and preterm intervention group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (N = 59): Standard care given</td>
</tr>
<tr>
<td></td>
<td>Intervention group (N = 61): VIBeS Plus intervention. Nine home visits over the first year of life conducted by psychologist and physiotherapist. Education of parents about infant self-regulation, techniques for improving postural stability, coordination and strength, and support parents mental health and parent-infant relationship</td>
</tr>
</tbody>
</table>

| Outcomes         | Bayley Scales of Infant and Toddler Development III – assessed at 2 years CA |
|------------------| Infant-Toddler Social and Emotional Assessment – assessed at 2 years CA |
|                  | Hospital Anxiety and Depression Scale – assessed when child 2 years CA |

| Notes            | Unclear if parent outcome assessors blinded |
**Methods**

- **Study design:** RCT
- **Randomisation:** Computer generated random numbers
- **Allocation concealment:** Unclear
- **Blinding:** Outcome assessors
- Intervention was carried out at home or in the clinic over the first year of life

**Participants**

- **161 Infants**
- **Inclusion criteria:** Birth weight < 1500g and GA < 37 weeks; admission to the study hospital within 7 days of birth; singleton birth or the first child of twins or multiples; absence of congenital anomalies or severe neonatal disease
- **Exclusion criteria:** Not stated
- **Characteristics:** Mean GA for all infants was 29-30 weeks

**Interventions**

- **Three groups of preterm infants - HBIP, CBIP (intervention groups) and UCP (control group)**
  - **Home based intervention program (N = 56):** Infants received in-hospital and after-discharge interventions. After-discharge interventions carried out at home and focused on child-, parent- and dyad-focused services and neonatal clinic visits
  - **Clinic based intervention program (N = 54):** Infants received in-hospital and after-discharge interventions. After-discharge interventions carried out in the clinic and focused on child-, parent- and dyad-focused services and neonatal clinic visits
  - **Usual care program (N = 51):** Standard developmental care - child-focused, in-hospital interventions and neonatal clinic visits

**Outcomes**

- **Toy-Behind-Barrier Procedure at 12 months of age**
- **Free-Play procedure at 12 months of age**
- **Bayley Scales of Infant and Toddler Development-III at 24 months of age**
- **Child Behaviour Checklist for Ages 1.5-5 at 24 months of age**

**Notes**

"The random sequence was concealed..." (pp. 2386), but doesn't state how