Science of Nursing and Health Practices
Science infirmière et pratiques en santé

Promoting Sensitive Mother-Infant Interactions in the Neonatal Intensive Care Unit: Development and Design of a Nursing Intervention Using a Theory and Evidence-Based Approach

Élaboration d'une intervention infirmière suivant une approche basée sur la théorie et les données empiriques pour promouvoir les interactions empreintes de sensibilité maternelle à l'unité de soins intensifs néonatals

Andréane Lavallée, Marilyn Aita, José Côté, Linda Bell et Bénédicte Grou

Volume 5, numéro 1, 2022

URI : https://id.erudit.org/iderudit/1090530ar
DOI : https://doi.org/10.7202/1090530ar

Aller au sommaire du numéro

Éditeur(s)

Réseau de recherche en interventions en sciences infirmières du Québec (RRISIQ)

ISSN

2561-7516 (numérique)

Découvrir la revue

Citer cet article

Lavallée, A., Aita, M., Côté, J., Bell, L. & Grou, B. (2022). Promoting Sensitive Mother-Infant Interactions in the Neonatal Intensive Care Unit: Development and Design of a Nursing Intervention Using a Theory and Evidence-Based Approach. *Science of Nursing and Health Practices / Science infirmière et pratiques en santé*, *5*(1), 48–75. https://doi.org/10.7202/1090530ar

Résumé de l'article

Introduction : La relation mère-enfant, dont les interactions empreintes de sensibilité maternelle en sont l'un des principaux prédicteurs, figure parmi les facteurs pouvant améliorer le développement des nouveau-nés prématurés. En raison de l'immaturité des nouveau-nés prématurés, les interactions mère-enfant précoces et la sensibilité maternelle sont à risque de se développer de façon sous-optimale. Les résultats d'une revue systématique ont montré que les données actuelles sur l'efficacité des interventions parent-enfant favorisant la sensibilité parentale dès l'hospitalisation à l'unité de soins intensifs néonatals (USIN) sont de faible à très faible qualité.

Objectif : L'objectif de cet article est de rapporter le processus de développement d'une nouvelle intervention infirmière, en utilisant une approche basée sur la théorie et les données empiriques, pour améliorer la sensibilité maternelle et le développement neurologique des nouveau-nés prématurés à l'USIN.

Méthodes : Les lignes directrices du Medical Research Council pour le développement et l'évaluation d'interventions complexes en santé ont été utilisées. Ainsi, trois principales étapes ont été suivies : 1- Identification des preuves empiriques existantes ; 2- Identification et développement théorique ; 3- Modélisation des processus et des résultats.

Résultats : Nous avons développé une intervention de participation guidée pour que les mères participent aux soins et au positionnement de leur nouveau-né prématuré : GP_Posit (ou Guided Participation of mothers to the Positioning of their preterm infant). GP_Posit est basée sur la théorie de l'attachement, la théorie de la participation guidée ainsi que la théorie synactive du développement.

Conclusion : Cette intervention est mise à l'essai dans un essai contrôlé randomisé pilote (NCT03677752).

SCIENCE OF NURSING AND HEALTH PRACTICES | SCIENCE INFIRMIÈRE ET PRATIQUES EN SANTÉ

Article de méthodologie et discussion théorique | Theoretical discussion and methodology article

Promoting Sensitive Mother-Infant Interactions in the Neonatal Intensive Care Unit: Development and Design of a Nursing Intervention Using a Theory and Evidence-Based Approach

Élaboration d'une intervention infirmière suivant une approche basée sur la théorie et les données empiriques pour promouvoir les interactions empreintes de sensibilité maternelle à l'unité de soins intensifs néonatals

Andréane Lavallée https://orcid.org/0000-0001-5702-3084, Ph. D., RN, Faculty of nursing, Université de Montréal, Quebec, Canada, Postdoctoral Fellow, Columbia University Irving Medical Center, New York, United States

Marilyn Aita https://orcid.org/0000-0002-6197-8796, Ph. D., RN, Associate professor, Faculty of nursing, Université de Montréal, Centre de recherche du Centre hospitalier universitaire Sainte-Justine, Quebec Network on Nursing Intervention Research, Quebec, Canada

José Côté https://orcid.org/0000-0002-0617-2861, Ph. D., RN, Full professor, Faculty of nursing, Université de Montréal, Centre de recherche du Centre Hospitalier de l'Université de Montréal, Quebec Network on Nursing Intervention Research, Quebec, Canada

Linda Bell, Ph. D., RN, Adjunct professor, School of nursing, Faculty of Medicine and Health Sciences, Université de Sherbrooke, Quebec Network on Nursing Intervention Research, Quebec, Canada

Bénédicte Grou https://orcid.org/0000-0003-3390-5546, M. Sc., RN, Medical Surgical Nurse Manager, Direction des soins infirmiers, Centre hospitalier universitaire Sainte-Justine, Quebec, Canada

Correspondance | Correspondence:
Andréane Lavallée, Ph. D., RN
Faculty of nursing, Université de Montréal
A/S Marilyn Aita, C.P. 6128 Succ. Centre-ville, Montreal, Quebec, Canada, H3C 3J7
andreane.lavallee@umontreal.ca

ISSN 2561-7516

Keywords

nursing science; mother-infant interactions; maternal sensitivity; prematurity; neuro-development; theory

Abstract

Introduction: Sensitive mother-infant interactions are important predictors of long-term mother-infant relationship, which is one factor having a positive impact on infant development. Considering preterm infants' immaturity, mother-infant interactions and maternal sensitivity may not develop optimally. A systematic review showed that current evidence on the effectiveness of parent-infant interventions promoting parental sensitivity in the neonatal intensive care unit (NICU) is of low to very low quality. **Objective:** The objective of this paper is to report the development process of a novel nursing intervention, using a theory and evidence-based approach, to enhance maternal sensitivity and preterm infant neurodevelopment in the NICU. **Methods**: The Medical Research Council's guidance to develop and evaluate complex health interventions, that is an evidence and theory-based approach, was used for this study. Thus, based on the MRC framework, three main steps were conducted: 1- Identifying existing empirical evidence; 2- Identifying and developing theory; 3- Modeling processes and outcomes. **Results**: We developed a guided participation intervention for mothers to participate in their preterm infant's care and positioning ('GP_Posit'). 'GP_Posit' is based upon the Attachment theory, the Guided Participation theory as well as the Synactive theory of development. **Conclusion**: This novel intervention is being tested in a pilot randomized controlled trial (NCT03677752).

Mots-clés

sciences infirmières; interactions mère-enfant; sensibilité maternelle; prématurité; neuro-développement; théorie

Résumé

Introduction : La relation mère-enfant, dont les interactions empreintes de sensibilité maternelle en sont l'un des principaux prédicteurs, figure parmi les facteurs pouvant améliorer le développement des nouveau-nés prématurés. En raison de l'immaturité des nouveau-nés prématurés, les interactions mère-enfant précoces et la sensibilité maternelle sont à risque de se développer de façon sous-optimale. Les résultats d'une revue systématique ont montré que les données actuelles sur l'efficacité des interventions parent-enfant favorisant la sensibilité parentale dès l'hospitalisation à l'unité de soins intensifs néonatals (USIN) sont de faible à très faible qualité. **Objectif** : L'objectif de cet article est de rapporter le processus de développement d'une nouvelle intervention infirmière, en utilisant une approche basée sur la théorie et les données empiriques, pour améliorer la sensibilité maternelle et le développement neurologique des nouveau-nés prématurés à l'USIN. **Méthodes** : Les lignes directrices du *Medical Research Council* pour le développement et l'évaluation d'interventions complexes en santé ont été utilisées. Ainsi, trois principales étapes ont été suivies : 1- Identification des preuves empiriques existantes ; 2- Identification et développement théorique ; 3- Modélisation des processus et des résultats. **Résultats** : Nous avons développé une intervention de participation guidée pour que les mères participent aux soins et au positionnement de leur nouveau-né prématuré : GP_Posit (ou ***G**uided **P**articipation of mothers to the **Posit**ioning of their preterm infant*). GP_Posit est basée sur la théorie de l'attachement, la théorie de la participation guidée ainsi que la théorie synactive du développement. **Conclusion** : Cette intervention est mise à l'essai dans un essai contrôlé randomisé pilote (NCT03677752).

INTRODUCTION

Maternal sensitivity is a predictor of long-term mother-infant attachment (Deans, 2018). It is defined as the mother's ability to recognize, interpret, and respond in an appropriate and timely manner to her infant's behavioral cues (Ainsworth et al., 1978).

Infant vocalizations and facial expressions are specific cues that trigger regions of the mother's brain to select appropriate caregiving behaviors (Young et al., 2017). For instance, maternal sensitivity is a dyadic component of mother-infant interactions that not only depends upon the mother's ability to detect and interpret infant cues but also depends on the infant's ability to demonstrate clear cues (Oxford & Findlay, 2015). Thus, being born preterm may affect maternal sensitivity as preterm infants use behavioral cues that may be difficult to interpret (Neuhauser, 2016). Current evidence points out that preterm infants may be more susceptible to low-sensitive parenting (Jaekel et al., 2015), as they may require higher levels of sensitivity from their mother (Bilgin & Wolke, 2015).

Preterm birth also disrupts the mother-infant closeness that usually occurs naturally after birth (Flacking et al., 2012). However, undisrupted mother-infant closeness after birth should be considered a priority in neonatal care. In fact, higher oxytocin levels during pregnancy, and most importantly early after birth, are associated with early maternal interactive behaviors (Feldman et al., 2007; Sammut et al., 2017). Oxytocin influences maternal sensitivity and attachment (Tharner et al., 2012). Thus, reinstating the mother-infant relationship by promoting closeness (Flacking et al.) and sensitive interactions through specific interventions following preterm birth is essential.

Systematic reviews have shown that mothers of preterm infants are as sensitive as those of term infants (Bilgin & Wolke, 2015) and that mother-preterm infant dyads are not at greater risk of developing an insecure attachment (Korja et al., 2012). Nevertheless, it appears there is no consensus regarding the latter statement as attachment is still reported to be less secure in preterm infants compared to term infants between the ages of 12 and 36 months (Ruiz et al., 2018). Moreover, the early quality of maternal caregiving and the mother-infant relationship have systematically been identified as significant predictors of preterm infants' development (Grunberg et al., 2019; Poehlmann et al., 2012; Stein et al., 2013; Treyvaud et al., 2009; Treyvaud et al., 2016; Wright et al., 2018). In a group of 134 infants, neurodevelopment was significantly better in preterm infants whose mothers were qualified as sensitive (Neri et al., 2017). More specifically, higher levels of maternal sensitivity have been identified as significant predictors of better reading and performances in mathematics at ages seven and eight in children born preterm (Jaekel et al., 2015; Treyvaud et al., 2016). Higher levels of maternal sensitivity also significantly predict larger gray matter volumes and head circumference in preterm infants at the age of eight (Kok et al., 2015). Thus, maternal sensitivity seems to be an important factor having a direct effect upon preterm infants' short-term cognitive and brain development.

Regarding long-term neurodevelopment, impairments are still reported in children born preterm. For example, a recent meta-analysis outlined that preterm children, compared to term children, have significant deficits in mathematics and reading until at least 18 years of age (McBryde et al., 2020). Interestingly, this sample included infants born as late as in 2018, confirming that those deficits remain even in preterm infants who received modern neonatal care (McBryde et al.). Even adults born preterm still report having social difficulties (Pyhala et al., 2017) and score significantly lower at neuropsychological tests (O'Reilly et al., 2020). Thus, preterm infant long-term neurodevelopment is still a contemporary concern. Moreover, considering that early maternal sensitivity has a positive impact upon preterm infants' development, interventions promoting maternal sensitivity during Neonatal Intensive Care Unit (NICU) hospitalization seem necessary. In fact, evidence shows that early interventions implemented during NICU hospitalization enhancing parenting in mothers of preterm infants may act as leverage for plasticity of the preterm infant's brain to enhance

neurodevelopmental outcomes (DeMaster et al., 2019).

Our systematic review (Lavallée et al., 2021) evaluating the effectiveness of parent-infant interventions in the NICU on parental sensitivity concluded that these interventions, compared to standard care, did not enhance short-term maternal sensitivity, i.e., when the preterm infant is at term equivalent age. Similar results were found at up to 6 months of corrected age (CA), and after 6 months of CA. Results were the same for preterm infant neurodevelopment at term equivalent age and after 6 months of CA. However, it is important to consider that these results are based on low to very low quality of evidence. In other words, these results may not entirely be due to the ineffectiveness of the interventions, but rather to implementation failure (i.e., interventions not delivered as planned to all participants, dose of the intervention insufficient, contamination between study groups). Qualitative studies and literature reviews have highlighted that nurses have a central role in guiding mothers to develop their relationship with their hospitalized preterm infant (Fernandez Medina et al., 2018; Fleck, 2016). It is also recognized by parents that nurses play a key role in facilitating parenting in the NICU (Reid et al., 2019). In light of these results, it appears important to develop novel theory and evidence-based nursing interventions to add to this body of knowledge.

OBJECTIVE

Therefore, the objective of this paper is to report the development process of a novel nursing intervention, using a theory and evidence-based approach, to enhance maternal sensitivity and preterm infant neurodevelopment in the NICU. The novel intervention was named 'GP_Posit' because, as it will be discussed below, it mainly focuses on **G**uided **P**articipation of mothers to the **Posit**ioning of their preterm infant.

METHODS

'GP_Posit' was developed following a theory and evidence-based approach (O'Cathain et al., 2019) and more specifically using the Medical Research Council's (MRC) Framework for developing and evaluating interventions (Craig et al., 2013; Craig et al., 2008). The MRC framework was selected because it offers guidance to develop interventions with a well-founded theoretical understanding to reasonably expect a positive effect on selected outcomes (Craig et al., 2013; O'Cathain et al.). The intervention development process is hereafter described following the MRC's three main steps: 1- Identifying existing empirical evidence; 2- Identifying and developing theory; 3- Modeling processes and outcomes.

RESULTS

INTERVENTION DEVELOPMENT PROCESS

Step 1 – Identifying Existing Empirical Evidence

Prior to the development of this intervention, we conducted a systematic review and meta-analysis evaluating the effectiveness of parent-preterm infant interventions, in the NICU, on parental sensitivity (Lavallée et al., 2021). The main conclusion was that there was no significant effect of parent-infant interventions over standard care or basic educational programs. However, we concluded that these results may not have been due to the ineffectiveness of the interventions, but rather due to implementation failure or high risk of bias of included studies. Based on this conclusion, a thorough secondary analysis of the components of the interventions (n=18) was conducted (see Table 1, Appendix A).

This analysis revealed that both educational and active components seem to have their importance in parent-infant interventions with a predominance of a combination of the two components (Meyer et al., 1994; Newnham et al., 2009; Teti et al., 2009; White-Traut & Nelson, 1988; Zelkowitz et al., 2011), or an active component alone (Borghini et al., 2014; Browne & Talmi, 2005; Chiu & Anderson, 2009; Glazebrook et al., 2007; Hane et al., 2015; Hoffenkamp et al., 2015; Ravn et al., 2011; Sahlen Helmer et al., 2019; Twohig et al., 2019; White-Traut et al., 2013). The educational component usually encompasses different topics, and the active-participatory

component relates to maternal participation in various caregiving activities of their preterm infant with direct guidance from a healthcare professional. In the studies including an educational component, most parent-infant interventions were centered around teaching mothers about care activities that may enhance their preterm infant's neurodevelopment. Some interventions aimed at teaching mothers about sensorimotor stimulation (White-Traut & Nelson), multisensorial stimulation (Hane et al.; Milgrom et al., 2013; White-Traut et al.), massage (Teti et al.), developmental care (Glazebrook et al.), or skin-to-skin (Chiu & Anderson; Sahlen Helmer et al.). On the other hand, 50% of the parent-infant interventions included active parent-provided care, and in 75% of those, parents were given specific guidance to do so (Borghini et al; Hoffenkamp et al.; Meyer et al.; Newnham et al.; Ravn et al.; Twohig et al.; White-Traut et al.). In other words, parents participated in caregiving activities of their preterm infant, while being guided by a nurse or another professional.

Step 2 – Identifying and Developing Theory

Knowledge from three theories, i.e., the Attachment Theory (Ainsworth et al., 1978; Bowlby, 1982, 1988), the Synactive Theory of Development (Als, 1982) and the Guided Participation theory (Pridham et al., 1998), was integrated to design this intervention. Each theory contributes to the theoretical foundations of the intervention: the attachment theory offers a comprehensive understanding of the mother-infant relationship which encompasses maternal sensitivity; the Synactive Theory of Development contributes to the conceptualization of the infant's behavior and development as being influenced by its environment; the Guided Participation theory circumscribes the nursing role regarding promotion of the mother-infant relationship.

A) Attachment Theory

The attachment theory was originally introduced by John Bowlby (1982). Bowlby's ideas originated from animal naturalistic observations that he applied to human infants and their mothers. Bowlby first postulated that attachment encompassed a set of intrinsic behaviors in infants that aimed at maintaining proximity with the mother (Bowlby, 1982). Before the infant has gained mobility and can demonstrate approaching behaviors, i.e., behaviors where the infant reaches proximity with their mother, they will first demonstrate signaling behaviors such as crying, smiling and babbling, that normally bring the mother to the infant (Bowlby, 1982). Additionally, Bowlby (1988) suggested that the mother-infant relationship acts as the base for infant development. Our modern conception of the attachment theory is also influenced by Mary Ainsworth's (Ainsworth et al., 1978) work. Ainsworth later worked on the mother-infant relationship where she was able, following observational studies of human infants and their mothers (Ainsworth, 1963, 1967), to define different patterns of attachment and components of the mother-infant relationship (Ainsworth et al., 1978). In fact, Ainsworth introduced the concept of sensitivity where she observed that infants of highly sensitive mothers were more likely to have a secure attachment (Ainsworth, 1963) and a more harmonious mother-infant relationship (Bell & Ainsworth, 1972). Highly sensitive mothers are attuned to their infant's cues, respond promptly and appropriately, and understand the meaning of their most subtle signals (Ainsworth et al., 1978). Infants who have a mother who responds to their needs in such a contingent way feel secure to develop an attachment and to explore their environment (Ainsworth et al., 1978). The attachment theory oriented the aim of the intervention as it was designed to propose mother-infant sensitive interactions during the first months of the infant's life, such as during NICU hospitalization.

B) Synactive Theory of Development

The Synactive Theory of Development was introduced by Als (1982) to allow an understanding of each infant's individuality. Infants' organisms develop according to five subsystems: 1) Autonomic system, 2) Motor system, 3) State-organizational system, 4) Attention and interaction system, and 5) Self-regulatory system. Each of these five subsystems is in interaction with each other and with the environment to reach and maintain a state of stability in the infant's

organism. In fact, even preterm infants have the capacity to interact with their social environment, and this interaction is essential for an optimal development as sensitive caregivers may help preterm infants reach a state of stability. Infants interact using cues that are classified in two categories: stress and stability cues. Stress cues translate a state of instability and call for interventions that may help the infant regain a stability state. On the other hand, stability cues call for minimal handling to maintain this state. The main behavioral stress and stability cues, which are most recognizable for mothers, are presented in Table 2. In other words, the Synactive Theory of Development stresses the importance for mothers and nurses to continuously read infant's behavioral cues as they have the ability of communicating their needs with their environment.

C) Guided Participation Theory

Guidance is the most frequent mode of delivery of mother-infant interventions to enhance maternal sensitivity in previous studies (See Table 1, Appendix A; Borghini et al., 2014; Hoffenkamp et al., 2015; Meyer et al., 1994; Newnham et al., 2009; Ravn et al., 2011; Twohig et al., 2019; White-Traut et al., 2013). Guidance is based on the Guided Participation theory, specific on parenting, which has its origins from the Experiential Learning theory (Pridham et al., 1998). Guidance is more than coaching as it aims to achieve a meaningful goal, or to bring the mother to acquire an autonomous caregiving practice for her preterm infant (Pridham et al., 1998). Experiential learning is based upon pragmatist philosophers including mainly Dewey, Lewin and Piaget's ideas (Miettinen, 2000). Among the pragmatist philosophers, Dewey's strong epistemological foundation is, to its simplest expression, the conception of 'knowing' and 'doing' as being indissociable concepts (Talisse & Aikin, 2011). Dewey gave particular importance to experience as situations where individuals are subject to the requirements of the environment and plan and adapt their actions according to these environmental conditions (Dewey, 2013). Thus, the Guided Participation theory integrates these postulates to support the idea that mothers may gain their maternal role and develop their relationship with their preterm infant while experiencing caregiving activities (Pridham et al., 2018). Caregiving activities are a set of activities relevant to five main categories (Pridham et al., 1998): 1) being with the baby, 2) knowing the baby as a person, 3) giving care to the baby, 4) communicating and engaging with others about infant and parental needs, and 5) problem-solving/decision-making/learning. Thus, guided participation is defined as the dyadic process where a novice (mother) engages in a relationship with an expert (nurse), where the former brings the latter to participate in caregiving activities using guidance, over a period of time (Pridham et al., 1998; Schroeder & Pridham, 2006). Ultimately, mothers develop their relationship with their infant through this caregiving practice (Schroeder & Pridham, 2006).

Step 3 - Modeling processes and outcomes

Based on the theories and empirical evidence, two main intervention components were identified: an 1-educational component, and an 2-active-participatory component (see Table 3). These two components are interconnected and both essential. The intervention developed is hence multifaceted as it includes both educational and active components, the former being educational activities where mothers receive information and the latter where mothers actively participate in caregiving activities.

1-Educational Component

The educational component includes teaching mothers the stress and stability behavioral cues of preterm infants, which is supported by both theory (Ainsworth et al., 1978; Als, 1982) and empirical evidence (Borghini et al., 2014; Browne & Talmi, 2005; Evans et al., 2017; Melnyk et al., 2006; Milgrom et al., 2013; Newnham et al., 2009; Ravn et al., 2011; Teti et al., 2009; Twohig et al., 2019; Zelkowitz et al., 2011). In fact, if mothers are expected to detect and interpret their infant's cues (Ainsworth et al.), and preterm infants interact with cues that are difficult to understand (Neuhauser, 2016), it becomes evident that those specific cues should first be thought to mothers before they may interpret and respond in an appropriate manner.

Table 2

Examples of stress and stability behavioral cues[1]

Sub-system	Stress	Stability
Autonomic	Hiccupping	Smooth respiration
	Sneezing	Stable color
	Yawning	
	Coughing	
Motor	Flaccidity of the trunk and/or extremities	Hand and/or foot clasping
	Hyperextension of arms and/or legs and/or trunk	Hand-to-mouth
	Finger splays	Grasping
	Facial grimacing	Handholding
	Tongue extensions	Sucking
State	Crying	Consolability
	Irritability	Clear sleep state
	Staring	Focused alertness

[1]Based on Als et al. (1986)

Note: The absence of one of the stress cues listed in this table does not necessarily mean the presence of stability; and the absence of the stability cues listed in this table does not necessarily lead to stress.

Table 3

GP_Posit intervention components

1. Educational	
Topics	Stress and stability behavioral cues of preterm infants
	Supine, lateral and prone positioning
2. Active-Participatory	
Caregiving activities	Diapering
	Positioning (supine, lateral and prone)
	Bottle-feeding and/or breastfeeding (optional)

In 'GP_Posit', mothers are additionally being taught how to position their preterm infant in their incubator or crib. Positioning is a central part of preterm infants' care while in the NICU intended to improve their neuromotor development (Lavallée et al., 2018).

2-Active-Participatory Component

In addition to the educational component, the emphasis of the intervention is on the active-participatory component (Pridham et al., 1998).

In 'GP_Posit', mothers actively participate in caregiving activities with their preterm infants while being also guided by a nurse. It is of importance to note that caregiving activities are only the context provided to mothers so they can learn how to interact with their preterm infant with sensitivity. Thus, while providing care to their infant, guidance is given to mothers so they can learn to detect, interpret and respond to their infant's behavioral stress and stability cues. In fact, for preterm infants, caregiving activities are recognized as being stressful (Peng et al., 2014; Pereira et al., 2013), so care should be provided in accordance with their behavioral cues (Lavallée et al., 2019b). In other words, the nurse's role during the sessions is to provide guidance to mothers by encouraging, praising, and supporting them in recognizing behavioral cues when they did or did not recognize or respond to a cue. As stated in Table 3, caregiving activities include diapering, positioning and feeding (optional). When providing care to preterm infants in the NICU, diapering is usually the first manipulation done, followed by positioning. Thus, throughout the intervention sessions, mothers progressively participate in their infant's diapering, then supine, lateral and prone positioning. This progression is based both on the mothers' ability and level of confidence as well as the nurse's judgment.

Nevertheless, the aim is to focus on sensitive mother-infant interactions while doing the caregiving activity and not necessarily go through every caregiving activity during the sessions. However, if both the mother and the nurse consider that the mother easily recognizes, interprets, and responds to most behavioral cues of her infant while doing a specific caregiving activity, they may move onto the next caregiving activity. For infants nearing home discharge and who are learning to feed orally, the caregiving activity could be adapted to bottle or breastfeeding if mothers are already comfortable with positioning.

LOGIC MODELLING

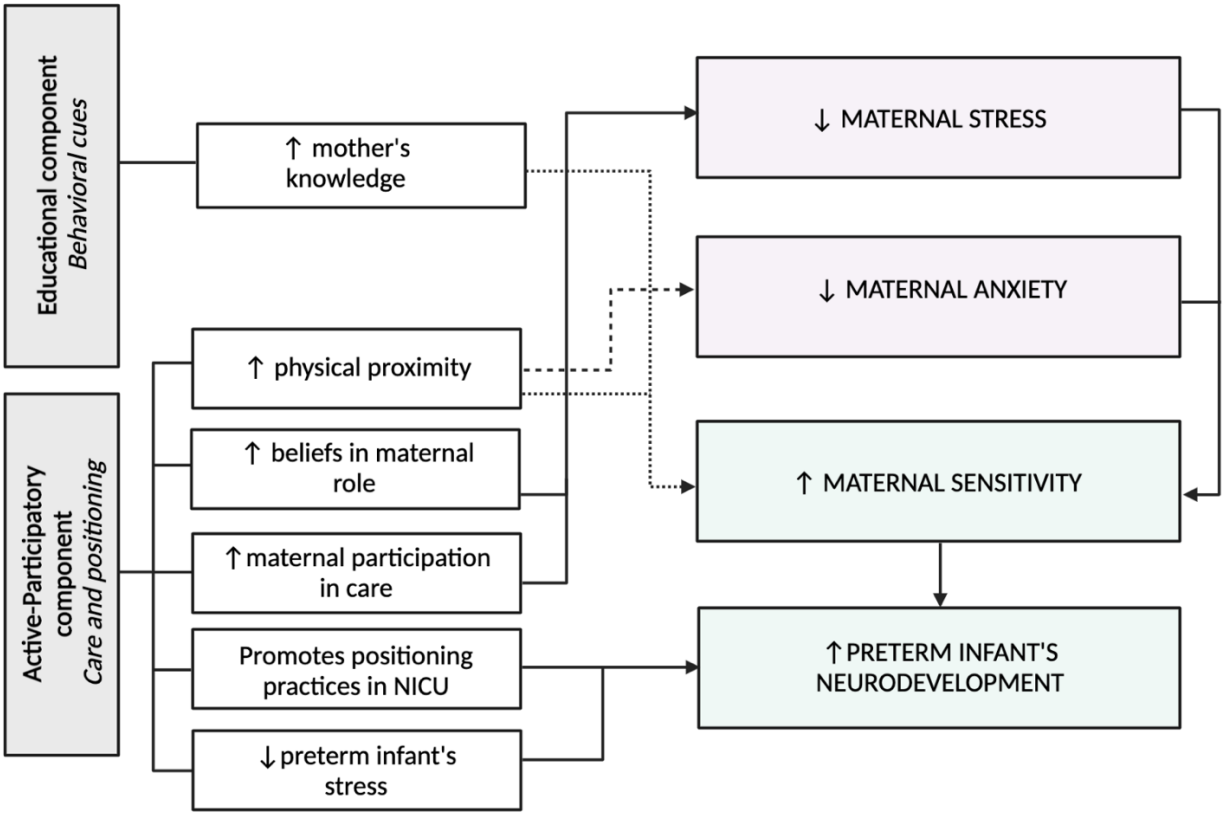
Figure 1 exposes the intricate links between intervention components, mechanisms of action, mediators as well as expected outcomes of 'GP_Posit', based on theories and empirical evidence. These links are described hereafter.

Educational component. The educational component should increase mothers' knowledge about their infant's behavioral cues as well as their beliefs about their competence in recognizing these cues (Als, 1982, 1986; Melnyk et al., 2014; Neuhauser, 2016). Mothers of preterm infants verbalize the need to be educated about these cues (Lee et al., 2009).

Active component. As for active participation in care facilitated by guided participation, this should trigger five mechanisms of action. First, in interventions where touch is involved, the feeling of physical proximity within the dyad increases (Feeley et al., 2016). This also reinstates mother-infant closeness. Guided participation as well as maternal active participation in care increase the feeling of gaining confidence in maternal role and lowering maternal stress (Cleveland, 2008; Smith et al., 2012). Moreover, having mothers participate in their preterm infant's positioning should promote optimal positioning practices for the preterm infant throughout the NICU stay. Finally, as the emphasis in guided participation is primarily to support mothers in interacting with their preterm infant with sensitivity, this entails that they give importance to recognizing in addition to interpreting the stress and stability cues. Respecting preterm infant cues while providing care helps them to co-regulate with their mother and keep their stress to a minimal level (Als, 1982). Also, appropriate positioning of the preterm infant in the NICU allows them to improve autoregulation (Jarus et al., 2011; King & Norton, 2017).

Figure 1

GP_Posit logic model



Increasing mother's knowledge. Mothers being more knowledgeable about their preterm infant's behavioral cues should allow them to be better prepared to detect and interpret these cues which is central to maternal sensitivity (Ainsworth et al., 1978) and to reduce their stress and anxiety (Melnyk et al., 2006).

Increasing physical proximity. Physical proximity between mother and her infant is the base of the attachment theory and contributes to maternal sensitivity (Bowlby, 1982). Mother-infant interventions in the NICU where maternal participation is promoted have been successful in reducing maternal stress (Melnyk et al., 2006). On the opposite, when physical proximity is limited, maternal anxiety increases (Vazquez & Cong, 2014).

Targeting maternal role and participation. Maternal role adjustment is one of the most important sources of stress for mothers in the NICU (Govindaswamy et al., 2019; Roque et al., 2017). Having mothers participate in their infant's care has been identified as an intervention promoting mother's confidence in her maternal role (Govindaswamy et al.) and thus reduces maternal stress and anxiety (Melnyk et al., 2007).

Promoting positioning practices. Preterm infant positioning is an integral part of preterm infant care in the NICU (Lavallée et al., 2019a) for its benefits on neuromotor development (Blauw-Hospers et al., 2007; King & Norton, 2017; Sweeney et al., 2010).

Lowering infant stress. Stress in the NICU is detrimental for the preterm infant's neurodevelopment (Graven & Browne, 2008), so promoting preterm infants' positioning and reducing their stress is expected to enhance this outcome.

Lowering maternal stress and anxiety. A concept analysis of maternal sensitivity identified maternal anxiety as a negative factor hampering maternal sensitivity (Shin et al., 2008). Lowering maternal stress has systematically been identified as favorable to improve maternal sensitivity (Booth et al., 2018; Neuhauser, 2016; Shin et al.). NICU mothers reporting higher levels of stress and anxiety also report lower levels of attachment with their infant (Bonacquisti, Geller & Patterson, 2020) which is why tackling both these outcomes should contribute to increasing maternal sensitivity.

Increasing maternal sensitivity and infant development. Many studies have linked a higher level of maternal sensitivity to improved preterm infant neurodevelopment. For example, enhanced maternal sensitivity predicts larger gray matter volume and head circumference (Kok et al., 2015), improved mental development (Treyvaud et al., 2009), more consistent and symmetric cortical thickness across brain hemispheres (Frye et al., 2010), improved cognitive performances (Banerjee, 2018; Jaekel et al., 2015; Treyvaud et al., 2016) and improved cerebral white matter micro-structural development (Milgrom et al., 2010).

Intervention Structure

Hereafter, we present the intervention structure as per the Better reporting of interventions: template for intervention description and replication (TIDieR) by Hoffmann et al. (2014). The intervention structure includes the name of the intervention, the materials, the procedures, the provider(s), the modes of delivery, where, when and how much (frequency, duration and dose) as well as possibilities for tailoring the intervention.

Materials

'GP_Posit' mainly relies upon the relationship developed between the nurse and the mother which requires no material. However, to support the educational component of the intervention, an informative booklet and web-based modules are used.

Firstly, the informative booklet, developed by the first author, contains pictures of various stress and stability cues so mothers can refer to it between intervention sessions. The booklet also contains pictures of appropriately positioned preterm infants to support mothers if they participate in their preterm infant's positioning in between intervention sessions.

Secondly, the nurse also has access to web-based modules developed by a multidisciplinary team that provides written information as well as pictures and videos adapted for parents of preterm infants that demonstrate appropriate techniques of positioning in the NICU (Luu et al., 2015). The web-based modules were previously pilot tested, and results showed that parents were satisfied, and the positioning module was most liked by parents (Luu et al., 2017). The advantage of the online modules is that mothers may refer to it at any time.

Structure and Procedures

The structure and procedures of the 'GP_Posit' intervention sessions are presented in Table 4.

Provided by Who

'GP_Posit' intervention is meant to be administered by trained neonatal registered nurses as they have the expertise to work with preterm infants and their mothers. In fact, in our systematic review, ≥55% of parent-infant interventions were provided by nurses (Lavallée et al., 2021). For the purposes of 'GP_Posit', nurses should be able to educate mothers about the behavioral cues of their preterm infants and about the appropriate positioning techniques. So, if neonatal nurses have not received training on those topics, they should receive appropriate teaching prior to providing the intervention. Additionally, neonatal nurses should receive training regarding what guided participation entails, their role as expert nurses, as well as how to implement guided participation. Most importantly, the same nurse should always meet with the same mothers throughout the sessions as guided participation is based on the mother-nurse relationship developed over time (Pridham et al., 1998).

Table 4

GP_Posit intervention structure

Sessions	Educational and active intervention components	Content of session
Session 1	Education	Preterm infant development Stress and stability behavioral cues
	Participation	Diapering
Session 2	Education	Supine positioning
	Participation	Diapering + supine positioning
Session 3	Education	Lateral positioning
	Participation	Diapering + lateral positioning
Session 4	Education	Prone positioning
	Participation	Diapering + prone positioning
Session 5+	Participation	Diapering + positioning Feeding (optional)

MODES OF DELIVERY

'GP_Posit' is meant to be delivered through individual sessions, between the nurse and the mother. More than 60% of parent-infant intervention were provided through individual sessions (Table 1, Appendix A). Also, guided participation entails that sessions should be individualized (Pridham et al., 1998).

WHERE

'GP_Posit' will be implemented in a level III NICU of a university hospital center. Sessions are provided at each infant's bedside, in single-family rooms (SFRs) to ensure privacy and a calmer environment (Winner-Stoltz et al., 2018). This is to take into consideration since it has been demonstrated that SFR provide more privacy, promote family-centered care, and ensure a more favorable environment to build trust between nurses and mothers (Doede & Trinkoff, 2020; Winner-Stoltz et al.).

WHEN AND HOW MUCH

In our systematic review, 11 out of the 18 identified interventions were mainly conducted during NICU hospitalization and finished, at the latest, one week after discharge (Browne & Talmi, 2005; Chiu & Anderson, 2009; Glazebrook et al., 2007; Hane et al., 2015; Hoffenkamp et al., 2015; Melnyk et al., 2006; Meyer et al., 1994; Milgrom et al., 2013; Sahlen Helmer et al., 2019; Twohig et al., 2019; White-Traut & Nelson, 1988). Moreover, the average number of sessions that were delivered was 5 sessions throughout the intervention, varying from one to 11 sessions. As for the length of each session, the average reported in interventions from the systematic review was of 62 minutes per sessions, varying from 15 minutes to 2 hours.

Thus, 'GP_Posit' is meant to be implemented as soon as possible after birth and should be performed until the infant reaches 35 weeks of gestational age (GA) or until discharge home. The

intervention will be offered to mothers of preterm infants born at 28 weeks of GA or more, as preterm infants start showing behavioral cues around that age (Fern, 2011). The number of sessions will depend on the age of the infant at birth and age at discharge. For example, mothers of infants born at 31 weeks of GA would participate in four sessions and mothers of infants born at 28 weeks of GA would participate in seven sessions. The sessions should take place weekly, with a duration of 30 to 45 minutes or more depending on time needed for the completion of care. If possible, these sessions should be timed with each preterm infant's care plan in the NICU and should be clustered with other care as suggested (Lavallée et al., 2019b), so that they are not awakened uniquely for the intervention's purposes. Also, for pragmatic considerations, the schedule for the individual sessions should be determined with the mother, according to her availabilities.

TAILORING

Considering the importance of individualizing interventions for preterm infants (Als et al., 1986), the care used to contextualize the mother-infant interaction, essential to elicit maternal sensitivity, could be tailored based on the mother's needs, abilities and level of confidence. For example, the content of each session is planned (see Table 4), but nurses are free to adapt this content depending on specific infant and maternal needs at time of the session.

DISCUSSION

In this paper we presented the development process of a nurse-led guided participation intervention in the NICU designed to enhance maternal sensitivity and preterm infant neurodevelopment. The development of this intervention is novel as it is anchored in an integration of theory and empirical evidence based on the MRC framework and thus brings a unique contribution to the neonatal body of knowledge. The strength of this approach is that it allowed to follow a systematic methodology to develop a thorough understanding of the underpinning processes that predict the effectiveness of the intervention components on selected and meaningful outcomes. Theories to support 'GP_Posit' were identified for their relevance to optimally understand the nurse's role to contribute to maternal sensitivity in the context of NICU hospitalization of preterm infants. In addition to grand theories (Ainsworth et al., 1978; Als, 1982; Pridham et al., 1998), we were also able to build upon strengths and limitations of previous interventions evaluated in randomized controlled trials (RCTs) and identified through our systematic review (Lavallée et al., 2021). Compared to other studies evaluating a parent-infant intervention in the NICU, very few (n=10/18) based their intervention on a theoretical framework, let alone on a thorough intervention development process. This paper is a contribution to the field of nursing interventions by virtue of documenting the entire process, from identification of theories and evidence to intervention modelling.

The nursing intervention 'GP-Posit' is also novel as it incorporates maternal participation to preterm infant positioning in the NICU. Maternal participation to a motor intervention has only been evaluated in one RCT (Øberg et al., 2012) where, compared to standard care, preterm infants who received the motor intervention from their mothers had a significantly better motor performance at term equivalent age (Ustad et al., 2016). Mothers in this study also noted that it empowered them to become competent in providing care and enhanced their feeling of attachment to their preterm infant (Øberg et al., 2018).

CONCLUSION

In the NICU, parents should be recognized as being the primary caregivers of their preterm infant. 'GP_Posit' is a novel multifaceted nursing intervention aiming at building a stronger partnership between mothers and nurses to guide mothers in gaining their maternal role through mother-infant closeness. In other words, based on empirical and theoretical evidence, we hypothesize that mothers participating in 'GP_Posit' will develop stronger maternal sensitivity and that preterm infants will

demonstrate enhanced neurodevelopment. Thus, this intervention has the potential to enhance neonatal nursing care and optimize both mothers' and preterm infants' short- and long-term outcomes. 'GP_Posit' intervention is being piloted according to a prospectively published protocol to evaluate mother's acceptability and satisfaction with the intervention as well as preliminary effects on maternal sensitivity and preterm infant neurodevelopment (Lavallée et al., 2020).

Authors' contribution: AL led this intervention development project as part of her doctoral comprehensive examination. The theoretical underpinnings and components of the novel intervention were then modulated as per MA, JC and LB's expertise both in intervention development (MA, JC, LB) and in the field of mother-infant attachment (LB, MA). BG contributed to the refinement of the intervention's components based on her clinical expertise as a neonatal nurse and clinical nurse specialist. AL wrote the manuscript. MA, JC, LB and BG reviewed, critically appraised and approved the manuscript.

Acknowledgments: AL was supported by a Canadian Institutes of Health Research (CIHR) Fellowship (2018MFE-416125-FAH-CHCH-268206) and the Faculty of Nursing of the *Université de Montréal* for her doctoral studies. AL also acknowledges fellowships received for her doctoral studies from the *Ministère de l'Éducation et de l'Enseignement Supérieur du Québec*, *Ordre des Infirmières et Infirmiers du Québec* and the Quebec Network on Nursing Intervention Research (2016-2018), *Fonds de Recherche du Québec – Santé* in collaboration with the *Fondation des Étoiles* (2018-2019), the TD funds at the *Centre hospitalier universitaire Sainte-Justine* (2015-2017) and the Levinschi foundation at the *Centre hospitalier universitaire Sainte-Justine* (2016-2017; 2019).

Funding: A research allocation from CIHR was available for this study (2018MFE-416125-FAH-CHCH-268206).

Statement of conflict of interest: The authors declare that they have no competing interests.

Ethics certificate number: Not applicable.

Reçu/Received: 5 Nov 2021 **Publié/Published:** Juin 2022

REFERENCES

Ainsworth, M. D. (1961). The development of infant-mother interaction among the Ganda. In B. M. Foss (Ed.), *Determinants of infant behavior* (pp. 67-104). Wiley.

Ainsworth, M. D. (1967). *Infancy in Uganda: Infant care and the growth of love*. Johns Hopkins University Press.

Ainsworth, M. D., Blehar, M. C., Waters, E., & Wall, S. N. (1978). *Patterns of Attachment: A Psychological Study of the Strange Situation*. Lawrence Erlbaum, Hillside.

Als, H. (1982). Toward a Synactive Theory of Development: Promise for the Assessment and Support of Infant individuality. *Infant Mental Health Journal, 3*(4), 229-243. https://doi.org/10.1002/1097-0355(198224)3:4<229::AID-IMHJ2280030405>3.0.CO;2-H

Als, H. (1986). A synactive model of neonatal behavioral organization : framework for the assessment of neurobehavioral development in the premature infant and for support of infants and parents in the neonatal intensive care environment. *Physical & Occupational Therapy in Geriatrics, 6*(3-4), 3-53. https://doi.org/10.1080/J006v06n03_02

Als, H., Lawhon, G., Brown, E., Gibes-Grossman, R., Duffy, F. H., McAnulty, G. B., & Blickman, J. G. (1986). Individualized Behavioral and Environmental Care for the Very Low Birth Weight Preterm Infant at High Risk for Bronchopulmonary Dysplasia : Neonatal Intensive Care Unit Developmental Outcome. *Pediatrics, 78*(6), 1123-1132.

Banerjee, N. (2018). *Are maternal depression, breastfeeding, maternal alcohol intake, and infant biological vulnerability, effect modifiers of confounders of the maternal sensitivity-cognitive development association?* Columbia University.

Bell, S. M., & Ainsworth, M. D. S. (1972). Infant crying and maternal responsiveness. *Child Development, 43*, 1171-1190. https://www.jstor.org/stable/1127506?seq=1

Bilgin, A., & Wolke, D. (2015). Maternal Sensitivity in Parenting Preterm Children: A Meta-analysis. *Pediatrics, 136*(1), e177-193. https://doi.org/10.1542/peds.2014-3570

Blauw-Hospers, C. H., de Graaf-Peters, V. B., Dirks, T., Bos, A. F., & Hadders-Algra, M. (2007). Does early intervention in infants at high risk for a developmental motor disorder improve motor and cognitive development? *Neuroscience and Biobehavioral Reviews, 31*(8), 1201-1212. https://doi.org/10.1016/j.neubiorev.2007.04.010

Bonacquisti, A., Geller, P. A., & Patterson, C. A. (2020). Maternal depression, anxiety, stress, and maternal-infant attachment in the neonatal intensive care unit. *Journal of Reproductive and Infant Psychology, 38*(3), 297-310. https://doi.org/10.1080/02646838.2019.1695041

Booth, A. T., Macdonald, J. A., & Youssef, G. J. (2018). Contextual stress and maternal sensitivity: A meta-analytic review of stress associations with the Maternal Behavior Q-Sort in observational studies. *Developmental Review, 48*, 145-177. https://doi.org/10.1016/j.dr.2018.02.002

Borghini, A., Habersaat, S., Forcada-Guex, M., Nessi, J., Pierrehumbert, B., Ansermet, F., & Muller-Nix, C. (2014). Effects of an early intervention on maternal post-traumatic stress symptoms and the quality of mother-infant interaction: the case of preterm birth. *Infant Behavior & Development, 37*(4), 624-631. https://doi.org/10.1016/j.infbeh.2014.08.003

Bowlby, J. (1982). *Attachment and Loss* (2nd ed., Vol. Volume 1: Attachment). Basic Books.

Bowlby, J. (1988). *A Secure Base: Parent-Child Attachment and Healthy Human Development* Basic Books.

Browne, J. V., & Talmi, A. (2005). Family-based intervention to enhance infant-parent relationships in the neonatal intensive care unit. *Journal of Pediatric Psychology, 30*(8), 667-677. https://doi.org/10.1093/jpepsy/jsi053

Carter, C. S. (2014). Oxytocin pathways and the evolution of human behavior. *Annual Review of Psychology*, *65*(1), 17–39. https://doi.org/10.1146/annurev-psych-010213-115110

Chiu, S. H., & Anderson, G. C. (2009). Effect of early skin-to-skin contact on mother-preterm infant interaction through 18 months: randomized controlled trial. *International Journal of Nursing Studies, 46*(9), 1168-1180. https://doi.org/10.1016/j.ijnurstu.2009.03.005

Cleveland, L. M. (2008). Parenting in the Neonatal Intensive Care Unit. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 37*(6), 666-691. https://doi.org/10.1111/j.1552-6909.2008.00288.x

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2013). Developing and evaluating complex interventions: the new Medical Research Council guidance. *International Journal of Nursing Studies, 50*(5), 587-592. https://doi.org/10.1016/j.ijnurstu.2012.09.010

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., Petticrew, M., & Medical Research Council Guidance. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ, 337*, a1655. https://doi.org/10.1136/bmj.a1655

Deans, C. L. (2018). Maternal sensitivity, its relationship with child outcomes, and interventions that address it: a systematic literature review. *Early Child Development and Care, 190*(2), 252-275. https://doi.org/10.1080/03004430.2018.1465415

DeMaster, D., Bick, J., Johnson, U., Montroy, J. J., Landry, S., & Duncan, A. F. (2019). Nurturing the preterm infant brain: leveraging neuroplasticity to improve neurobehavioral outcomes. *Pediatric Research, 85*, 166-175. https://doi.org/10.1038/s41390-018-0203-9

Dewey, J. (2013). *Experience and Nature*. Read Books Ltd.

Doede, M., & Trinkoff, A. M. (2020). Emotional Work of Neonatal Nurses in a Single-Family Room NICU. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*. https://doi.org/10.1016/j.jogn.2020.03.001

Evans, T., Boyd, R. N., Colditz, P., Sanders, M., & Whittingham, K. (2017). Mother-Very Preterm Infant Relationship Quality: RCT of Baby Triple P. *Journal of Child and Family Studies, 26*(1), 284-295. https://doi.org/10.1007/s10826-016-0555-x

Feeley, N., Genest, C., Niela-Vilen, H., Charbonneau, L., & Axelin, A. (2016). Parents and nurses balancing parent-infant closeness and separation: a qualitative study of NICU nurses' perceptions. *BMC Pediatrics, 16*, 134. https://doi.org/10.1186/s12887-016-0663-1

Feldman, R., Weller, A., Zagoory-Sharon, O., & Levine, A. (2007). Evidence for a neuroendocrinological foundation of human affiliation. *Psychological Science*, *18*(11), 965–970. https://doi.org/10.1111/j.1467-9280.2007.02010.x

Fern, D. (2011). *A neurodevelopmental care guide to positioning & handling the premature, fragile or sick infant*. DF Publishing.

Fernandez Medina, I. M., Granero-Molina, J., Fernandez-Sola, C., Hernandez-Padilla, J. M., Camacho Avila, M., & Lopez Rodriguez, M. D. M. (2018). Bonding in neonatal intensive care units: Experiences of extremely preterm infants' mothers. *Women & Birth: Journal of the Australian College of Midwives, 31*(4), 325-330. https://doi.org/10.1016/j.wombi.2017.11.008

Fleck, P. (2016). Connecting Mothers and Infants in the Neonatal Intensive Care Unit. *Newborn and Infant Nursing Reviews, 16*(2), 92-96. https://doi.org/10.1053/j.nainr.2016.03.007

Frye, R. E., Malmberg, B., Swank, P., Smith, K., & Landry, S. (2010). Preterm birth and maternal responsiveness during childhood are associated with brain morphology in adolescence. *Journal of the International Neuropsychological Society, 16*(5), 784-794. https://doi.org/10.1017/S1355617710000585

Glazebrook, C., Marlow, N., Israel, C., Croudace, T., Johnson, S., White, I. R., & Whitelaw, A. (2007). Randomised trial of a parenting intervention during neonatal intensive care. *Archives of Disease in Childhood Fetal & Neonatal Edition, 92*(6), F438-443. https://doi.org/10.1136/adc.2006.103135

Govindaswamy, P., Laing, S., Waters, D., Walker, K., Spence, K., & Badawi, N. (2019). Needs and stressors of parents of term and near-term infants in the NICU: A systematic review with best practice guidelines. *Early Human Development, 139*, 104839. https://doi.org/10.1016/j.earlhumdev.2019.104839

Graven, S. N., & Browne, J. V. (2008). Sensory Development in the Fetus, Neonate, and Infant: Introduction and Overview. *Newborn and Infant Nursing Reviews, 8*(4), 169-172. https://doi.org/10.1053/j.nainr.2008.10.007

Grunberg, V. A., Geller, P. A., Bonacquisti, A., & Patterson, C. A. (2019). NICU infant health severity and family outcomes: a systematic review of assessments and findings in psychosocial research. *Journal of Perinatology, 39*(2), 156-172. https://doi.org/10.1038/s41372-018-0282-9

Hane, A., Myers, M. M., Hofer, M. A., Ludwig, R. J., Halperin, M. S., Austin, J., Glickstein, S. B., & Welch, M. G. (2015). Family Nurture Intervention Improves the Quality of Maternal Caregiving in the Neonatal Intensive Care Unit: Evidence from a Randomized Controlled Trial. *Journal of Developmental and Behavioral Pediatrics, 36*(3), 188-196. https://doi.org/10.1097/DBP.0000000000000148

Hoffenkamp, H. N., Tooten, A., Hall, R. A., Braeken, J., Eliens, M. P., Vingerhoets, A. J., & van Bakel, H. J. (2015). Effectiveness of hospital-based video interaction guidance on parental interactive behavior, bonding, and stress after preterm birth: A randomized controlled trial. *Journal of Consulting and Clinical Psychology, 83*(2), 416-429. https://doi.org/10.1037/a0038401

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., Altman, D. G., Barbour, V., Macdonald, H., Johnston, M., Lamb, S. E., Dixon-Woods, M., McCulloch, P., Wyatt, J. C., Chan, A. W., & Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ, 348*, g1687. https://doi.org/10.1136/bmj.g1687

Jaekel, J., Pluess, M., Belsky, J., & Wolke, D. (2015). Effects of maternal sensitivity on low birth weight children's academic achievement: a test of differential susceptibility versus diathesis stress [Research Support, Non-U.S. Gov't]. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 56*(6), 693-701. https://doi.org/10.1111/jcpp.12331

Jarus, T., Bart, O., Rabinovich, G., Sadeh, A., Bloch, L., Dolfin, T., & Litmanovitz, I. (2011). Effects of prone and supine positions on sleep state and stress responses in preterm infants. *Infant Behavior and Development, 34*(2), 257-263. https://doi.org/10.1016/j.infbeh.2010.12.014

King, C., & Norton, D. (2017). Does therapeutic positioning of preterm infants impact upon optimal health outcomes? A literature review. *Journal of Neonatal Nursing*. https://doi.org/10.1016/j.jnn.2017.03.004

Kok, R., Thijssen, S., Bakermans-Kranenburg, M. J., Jaddoe, V. W., Verhulst, F. C., White, T., van, I. M. H., & Tiemeier, H. (2015). Normal variation in early parental sensitivity predicts child structural brain development. *Journal of the American Academy of Child and Adolescent Psychiatry, 54*(10), 824-831 e821. https://doi.org/10.1016/j.jaac.2015.07.009

Korja, R., Latva, R., & Lehtonen, L. (2012). The effects of preterm birth on mother-infant interaction and attachment during the infant's first two years. *Acta Obstetricia et Gynecologica Scandinavica, 91*(2), 164-173. https://doi.org/10.1111/j.1600-0412.2011.01304.x

Lavallée, A., Aita, M., Côté, J., Bell, L., & Luu, TM. (2020). A guided participation nursing intervention to theraupeutic positioning and care (GP_Posit) for mothers of preterm infants: protocol of a pilot randomized controlled trial. *Pilot Feasibility Studies, 6*, 77. https://doi.org/10.1186/s40814-020-00601-5

Lavallée, A., De Clifford-Faugère, G., Ballard, A., & Aita, M. (2021). Parent–Infant Interventions to Promote Parental Sensitivity During NICU Hospitalization: Systematic Review and Meta-Analysis. *Journal of Early Intervention, 43*(4), 361–382. https://doi.org/https://doi.org/10.1177/1053815121991928

Lavallée, A., De Clifford-Faugère, G., Garcia, G., Oviedo, ANF., Héon, M., & Aita, M. (2019a). Part 1: Narrative overview of developmental care interventions for the preterm newborn. *Journal of Neonatal Nursing, 25*(1), 3-8. https://doi.org/10.1016/j.jnn.2018.08.008

Lavallée, A., De Clifford-Faugère, G., Garcia, G., Oviedo, ANF., Héon, M., & Aita, M. (2019b). PART 2: Practice and research recommendations for quality developmental care in the NICU. *Journal of Neonatal Nursing*. https://doi.org/10.1016/j.jnn.2019.03.008

Lavallée, A., De Clifford-Faugère, G., Matte, C., & Aita, M. (2018). Effets bénéfiques du positionnement sur le développement du nouveau-né prématuré. *Cahiers de la Puéricultrice, 55*(316), 15-18. https://doi.org/10.1016/j.cahpu.2018.02.003

Lee, S. N., Long, A., & Boore, J. (2009). Taiwanese women's experiences of becoming a mother to a very-low-birth-weight preterm infant: a grounded theory study. *International Journal of Nursing Studies, 46*(3), 326-336. https://doi.org/10.1016/j.ijnurstu.2008.10.004

Luu, T. M., Gosselin, J., Karsenti, T., Côté, S., Walker, D. C., Peckre, P., & Mieux Agir au Quotidien multidisciplinary team. (2015). *Mieux Agir au Quotidien : Comprendre et soutenir le développement de mon enfant*. http://developpementenfant.ca/wp/

Luu, T. M., Xie, L. F., Peckre, P., Cote, S., Karsenti, T., Walker, C. D., & Gosselin, J. (2017). Web-Based Intervention to Teach Developmentally Supportive Care to Parents of Preterm Infants: Feasibility and Acceptability Study. *JMIR Research Protocols, 6*(11), e236. https://doi.org/10.2196/resprot.8289

McBryde, M., Fitzallen, G. C., Liley, H. G., Taylor, H. G., & Bora, S. (2020). Academic Outcomes of School-Aged Children Born Preterm: A Systematic Review and Meta-analysis. *JAMA, 3*(4), e202027. https://doi.org/10.1001/jamanetworkopen.2020.2027

Melnyk, B. M., Crean, H. F., Feinstein, N. F., Fairbanks, E., & Alpert-Gillis, L. J. (2007). Testing the theoretical framework of the COPE program for mothers of critically ill children: an integrative model of young children's post-hospital adjustment behaviors. *Journal of Pediatric Psychology, 32*(4), 463-474. https://doi.org/10.1093/jpepsy/jsl033

Melnyk, B. M., Feinstein, N. F., Alpert-Gillis, L., Fairbanks, E., Crean, H. F., Sinkin, R. A., Stone, P. W., Small, L., Tu, X., & Gross, S. J. (2006). Reducing premature infants' length of stay and improving parents' mental health outcomes with the Creating Opportunities for Parent Empowerment (COPE) neonatal intensive care unit program: a randomized, controlled trial. *Pediatrics, 118*(5), e1414-1427. https://doi.org/10.1542/peds.2005-2580

Melnyk, B. M., Oswalt, K. L., & Sidora-Arcoleo, K. (2014). Validation and psychometric properties of the neonatal intensive care unit parental beliefs scale. *Nursing Research, 63*(2), 105-115. https://doi.org/10.1097/NNR.0000000000000023

Meyer, E. C., Coll, C. T., Lester, B. M., Boukydis, C. F., McDonough, S. M., & Oh, W. (1994). Family-based intervention improves maternal psychological well-being and feeding interaction of preterm infants. *Pediatrics, 93*(2), 241-246.

Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International Journal of Lifelong Education, 19*(1), 54-72. https://doi.org/10.1080/026013700293458

Milgrom, J., Newnham, C., Anderson, P. J., Doyle, L. W., Gemmill, A. W., Lee, K., Hunt, R. W., Bear, M., & Inder, T. (2010). Early sensitivity training for parents of preterm infants: impact on the developing brain. *Pediatric Research, 67*(3), 330-335. https://doi.org/10.1203/PDR.0b013e3181cb8e2f

Milgrom, J., Newnham, C., Martin, P. R., Anderson, P. J., Doyle, L. W., Hunt, R. W., Achenbach, T. M., Ferretti, C., Holt, C. J., Inder, T. E., & Gemmill, A. W. (2013). Early communication in preterm infants following intervention in the NICU. *Early Human Development, 89*(9), 755-762. https://doi.org/10.1016/j.earlhumdev.2013.06.001

Neri, E., Agostini, F., Baldoni, F., Facondini, E., Biasini, A., & Monti, F. (2017). Preterm infant development, maternal distress and sensitivity: The influence of severity of birth weight. *Early Human Development, 106-107*, 19-24. https://doi.org/10.1016/j.earlhumdev.2017.01.011

Neuhauser, A. (2016). Predictors of maternal sensitivity in at-risk families. *Early Child Development and Care, 188*(2), 126-142. https://doi.org/10.1080/03004430.2016.1207065

Newnham, C. A., Milgrom, J., & Skouteris, H. (2009). Effectiveness of a modified Mother-Infant Transaction Program on outcomes for preterm infants from 3 to 24 months of age. *Infant Behavior and Development, 32*(1), 17-26. https://doi.org/10.1016/j.infbeh.2008.09.004

O'Cathain, A., Croot, L., Sworn, K., Duncan, E., Rousseau, N., Turner, K., Yardley, L., & Hoddinott, P. (2019). Taxonomy of approaches to developing interventions to improve health: a systematic methods overview. *Pilot & Feasibility Studies, 5*, 41. https://doi.org/10.1186/s40814-019-0425-6

O'Reilly, H., Johnson, S., Ni, Y., Wolke, D., & Marlow, N. (2020). Neuropsychological Outcomes at 19 Years of Age Following Extremely Preterm Birth. *Pediatrics, 145*(2). https://doi.org/10.1542/peds.2019-2087

Øberg, G. K., Campbell, S. K., Girolami, G. L., Ustad, T., Jørgensen, L., & Kaaresen, P. I. (2012). Study protocol: an early intervention program to improve motor outcome in preterm infants: a randomized controlled trial and a qualitative study of physiotherapy performance and parental experiences. *BMC Pediatrics, 12*(15). https://doi.org/10.1186/1471-2431-12-15

Øberg, G. K., Ustad, T., Jørgensen, L., Kaaresen, P. I., Labori, C., & Girolami, G. L. (2018). Parents' perceptions of administering a motor intervention with their preterm infant in the NICU. *European Journal of Physiotherapy, 21*(3), 134-141. https://doi.org/10.1080/21679169.2018.1503718

Oxford, M., & Findlay, D. (2015). *NCAST Caregiver / Parent-Child interaction Feeding Manual* (2 ed.). Parent-child relationship programs University of Washington School of Nursing.

Peng, N. H., Bachman, J., Chen, C. H., Huang, L. C., Lin, H. C., & Li, T. C. (2014). Energy expenditure in preterm infants during periods of environmental stress in the neonatal intensive care unit. *Japan Journal of Nursing Science, 11*(4), 241-247. https://doi.org/10.1111/jjns.12025

Pereira, F. L., Nogueira de Goes Fdos, S., Fonseca, L. M., Scochi, C. G., Castral, T. C., & Leite, A. M. (2013). Handling of preterm infants in a neonatal intensive care unit (A manipulacao de prematuros em uma Unidade de Terapia Intensiva Neonatal). *Revista da Escola de Enfermagem da USP, 47*(6), 1272-1278. https://doi.org/10.1590/S0080-623420130000600003

Poehlmann, J., Hane, A., Burnson, C., Maleck, S., Hamburger, E., & Shah, P. E. (2012). Preterm infants who are prone to distress: differential effects of parenting on 36-month behavioral and cognitive outcomes. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 53*(10), 1018-1025. https://doi.org/10.1111/j.1469-7610.2012.02564.x

Pridham, K. F., Limbo, R., Schroeder, M., Thoyre, S., & Van Riper, M. (1998). Guided participation and development of care-giving competencies for families of low birth-weight infants. *Journal of Advanced Nursing, 28*(5), 948-958. https://doi.org/10.1046/j.1365-2648.1998.00814.x

Pridham, K. F., Scott, A., & Limbo, R. (2018). Guided Participation Theory for Teaching and Learning in Clinical Practice. In K. Pridham, D. Limbo, & M. Schroeder (Eds.), *Guided Participation in Pediatric Nursing Practice*. Springer Publishing Company.

Pyhala, R., Wolford, E., Kautiainen, H., Andersson, S., Bartmann, P., Baumann, N., Brubakk, A. M., Evensen, K. A. I., Hovi, P., Kajantie, E., Lahti, M., Van Lieshout, R. J., Saigal, S., Schmidt, L. A., Indredavik, M. S., Wolke, D., & Raikkonen, K. (2017). Self-Reported Mental Health Problems Among Adults Born Preterm: A Meta-analysis. *Pediatrics, 139*(4). https://doi.org/10.1542/peds.2016-2690

Ravn, I. H., Smith, L., Lindemann, R., Smeby, N. A., Kyno, N. M., Bunch, E. H., & Sandvik, L. (2011). Effect of early intervention on social interaction between mothers and preterm infants at 12 months of age: a randomized controlled trial. *Infant Behavior and Development, 34*(2), 215-225. https://doi.org/10.1016/j.infbeh.2010.11.004

Reid, S., Bredemeyer, S., & Chiarella, M. (2019). Integrative Review of Parents' Perspectives of the Nursing Role in Neonatal Family-Centered Care. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 48*(4), 408-417. https://doi.org/10.1016/j.jogn.2019.05.001

Roque, A. T. F., Lasiuk, G. C., Radunz, V., & Hegadoren, K. (2017). Scoping Review of the Mental Health of Parents of Infants in the NICU. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 46*(4), 576-587. https://doi.org/10.1016/j.jogn.2017.02.005

Ruiz, N., Piskernik, B., Witting, A., Fuiko, R., & Ahnert, L. (2018). Parent-child attachment in children born preterm and at term: A multigroup analysis. *PloS One, 13*(8), e0202972. https://doi.org/10.1371/journal.pone.0202972

Sahlen Helmer, C., Birberg Thornberg, U., Frostell, A., Ortenstrand, A., & Morelius, E. (2019). A Randomized Trial of Continuous Versus Intermittent Skin-to-Skin Contact After Premature Birth and the Effects on Mother-Infant Interaction. *Advances in Neonatal Care, 20*(3), E48-E56. https://doi.org/10.1097/ANC.0000000000000675

Sammut, E., Sammut, M., Chetcuti, S., & Calleja Agius, J. (2017). The role of oxytocin in maternal-fetal bonding and social interaction. *International Journal of Prenatal & Life Sciences*, 1–17. https://doi.org/10.24946/IJPLS.20.18.00.00.040604

Schroeder, M., & Pridham, K. F. (2006). Development of Relationship Competencies Through Guided Participation for Mothers of Preterm Infants. *Journal of Obstetric, Gynecologic & Neonatal Nursing, 35*(3), 358-368. https://doi.org/10.1111/

Shin, H., Park, Y. J., Ryu, H., & Seomun, G. A. (2008). Maternal sensitivity: a concept analysis. *Journal of Advanced Nursing, 64*(3), 304-314. https://doi.org/10.1111/j.1365-2648.2008.04814.x

Smith, V. C., Steelfisher, G. K., Salhi, C., & Shen, L. Y. (2012). Coping with the neonatal intensive care unit experience: parents' strategies and views of staff support. *Journal of Perinatal and Neonatal Nursing, 26*(4), 343-352. https://doi.org/10.1097/JPN.0b013e318270ffe5

Stein, A., Malmberg, L. E., Leach, P., Barnes, J., Sylva, K., & Team, F. (2013). The influence of different forms of early childcare on children's emotional and behavioural development at school entry. *Child: Care, Health and Development, 39*(5), 676-687. https://doi.org/10.1111/j.1365-2214.2012.01421.x

Sweeney, J. K., Heriza, C. B., Blanchard, Y., & Dusing, S. C. (2010). Neonatal physical therapy. Part II: Practice frameworks and evidence-based practice guidelines. *Pediatric Physical Therapy, 22*(1), 2-16. https://doi.org/10.1097/PEP.0b013e3181cdba43

Talisse, R. B., & Aikin, S. F. (2011). *The Pragmatism Reader: From Peirce through the Present*. Princeton University Press.

Teti, D. M., Black, M. M., Viscardi, R., Glass, P., O'Connell, M. A., Baker, L., Cusson, R., & Reiner Hess, C. (2009). Intervention With African American Premature Infants: Four-Month Results of an Early Intervention Program. *Journal of Early Intervention, 31*(2), 146-166. https://doi.org/10.1177/1053815109331864

Tharner, A., Luijk, M. P. C. M., Raat, H., Ijzendoorn, M. H., Bakermans-Kranenburg, M. J., Moll, H. A., Jaddoe, V. W. V., Hofman, A., Verhulst, F. C., & Tiemeier, H. (2012). Breastfeeding and its relation to maternal sensitivity and infant attachment. *Journal of Developmental and Behavioral Pediatrics*, *33*(5), 396–404. https://doi.org/10.1097/DBP.0b013e318257fac3

Treyvaud, K., Anderson, V. A., Howard, K., Bear, M., Hunt, R. W., Doyle, L. W., Inder, T. E., Woodward, L., & Anderson, P. J. (2009). Parenting behavior is associated with the early neurobehavioral development of very preterm children. *Pediatrics, 123*(2), 555-561 557p. https://doi.org/10.1542/peds.2008-0477

Treyvaud, K., Doyle, L. W., Lee, K. J., Ure, A., Inder, T. E., Hunt, R. W., & Anderson, P. J. (2016). Parenting behavior at 2 years predicts school-age performance at 7 years in very preterm children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 57*(7), 814-821. https://doi.org/10.1111/jcpp.12489

Twohig, A., Segurado, R., McCarthy, A., Underdown, A., McNicholas, F., & Molloy, E. J. (2019). Early intervention to support preterm infant-parent interaction and development: results of a randomised controlled trial on maternal sensitivity,

social-emotional development and parental mental health. *Archives of Disease in Childhood, 103*(Suppl 3), A62-A63. https://doi.org/10.1136/archdischild-2019-epa.147

Ustad, T., Evensen, K. A. I., Campbell, S. K., Girolami, G. L., Helbostad, J., Jørgensen, L., Kaaresen, P. I., & Øberg, G. K. (2016). Early Parent-Administered Physical Therapy for Preterm Infants: A Randomized Controlled Trial. *Pediatrics, 138*(2), e20160271. https://doi.org/10.1542/peds.2016-0271

Vazquez, V., & Cong, X. (2014). Parenting the NICU infant: A meta-ethnographic synthesis. *International Journal of Nursing Sciences, 1*(3), 281-290. https://doi.org/10.1016/j.ijnss.2014.06.001

White-Traut, R. C., & Nelson, M. N. (1988). Maternally administered tactile, auditory, visual, and vestibular stimulation: relationship to later interactions between mothers and premature infants. *Research in Nursing and Health, 11*(1), 31-39. https://doi.org/10.1002/nur.4770110106

White-Traut, R. C., Norr, K. F., Fabiyi, C., Rankin, K. M., Li, Z., & Liu, L. (2013). Mother-infant interaction improves with a developmental intervention for mother-preterm infant dyads. *Infant Behavior and Development, 36*(4), 694-706. https://doi.org/10.1016/j.infbeh.2013.07.004

Winner-Stoltz, R., Lengerich, A., Hench, A. J., O'Malley, J., Kjelland, K., & Teal, M. (2018). Staff Nurse Perceptions of Open-Pod and Single Family Room NICU Designs on Work Environment and Patient Care. *Advances in Neonatal Care, 18*(3), 189-198. https://doi.org/10.1097/ANC.0000000000000493

Wright, N., Hill, J., Sharp, H., & Pickles, A. (2018). Maternal sensitivity to distress, attachment and the development of callous-unemotional traits in young children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 59*(7), 790-800. https://doi.org/10.1111/jcpp.12867

Young, K. S., Parsons, C. E., Stein, A., Vuust, P., Craske, M. G., & Kringelbach, M. L. (2017). The neural basis of responsive caregiving behaviour: Investigating temporal dynamics within the parental brain. *Behavioural Brain Research, 325*(Pt B), 105-116. https://doi.org/10.1016/j.bbr.2016.09.012

Zelkowitz, P., Feeley, N., Shrier, I., Stremler, R., Westreich, R., Dunkley, D., Steele, R., Rosberger, Z., Lefebvre, F., & Papageorgiou, A. (2011). The cues and care randomized controlled trial of a neonatal intensive care unit intervention: effects on maternal psychological distress and mother-infant interaction. *Journal of Developmental and Behavioral Pediatrics, 32*(8), 591-599. https://doi.org/10.1097/DBP.0b013e318227b3dc

Table 1 - **Appendix A**

Components and composition of interventions

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
White-Traut and Nelson (1988)	Directly modifying the interaction between mother and infant via maternally administered intervention.	**RISS** (Rice Infant Sensorimotor Stimulation Technique): mothers provided tactile stimulation (touch or massage), vestibular stimulation (rocking), auditive and visual stimulation (eye-to-eye contact).	• First three days after birth.	• Mothers administered RISS protocol four times • 15 min	Verbal instructions, pictures that illustrated the technique; Demonstration of the technique on a doll, were used for teaching the RISS.	First author (nurse).	Educational and Active
Meyer et al. (1994)	Address the needs of parents and their high-risk infant and improve parenting and family factors likely to affect infant development.	Individualized intervention based on initial interview to identify parent's needs on four domains: ○ NBAS evaluation + strategies thought to parents to support development; ○ Family organisation; ○ Modification of care environment	• Started when infant health was stable and finished before discharge (2 to 8 weeks).	• Number of sessions depended on family needs and duration of hospitalisation • 1 hr to 1 hr 30 min sessions	Individualized family-based intervention.	Pediatrician, nurse and physical therapist.	Educational and Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
		+ guided interaction; ○ Care after discharge.					
Browne and Talmi (2005)	Increase knowledge and contingent mother infant interaction and decrease parental stress.	Individualized demonstration of preterm infant's reflexes, motor capacities and sleep-wake cycles using the APIB. Then, mothers were instructed to interact with their infant using the Mother's Assessment of the Behavior of her Infant (MABI).	• From NICU admission to the week before discharge.	• One session • 45 min	Individual session.	Not reported.	Active
Melnyk et al. (2006)	Strengthen parents' knowledge and beliefs about their preterm infants and their own parenting role and remove barriers that would inhibit them from participating in their infants'	**COPE –** Information given on 1) the appearance and behavioral characteristics of premature infants (infant-behavior information) and how parents can participate in their infants' care, meet their infants' needs, enhance quality of	• From first week after birth to first week post discharge.	• Content was given to parents in four phases • Duration not applicable	Educational-behavioral intervention through audio and written information given to parents.	Not applicable.	Educational

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
	care and interacting with them in a developmentally sensitive manner.	interaction with their infant, and facilitate their infant's development (parent-role information) and 2) activities that assist parents in implementing the experimental information.					
Glazebrook et al. (2007)	Enhance parents' observations of their baby and sensitivity to cues through a series of activities which follow the progression of care from incubator to home.	**Parent Baby Interaction Program (PBIP)**: Tactile, discussion, verbal, observation and developmental care activities.	• From NICU admission to discharge. Option to continue six weeks after discharge.	• Weekly sessions • 1 hr	Individual sessions.	Neonatal nurse.	Active
Chiu and Anderson (2009)	Enhance mother–preterm infant interaction.	Preterm infants placed in skin-to-skin contact (SSC) after birth. SSC was encouraged as long as possible and as frequently as possible.	• From birth to NICU discharge.	• One session + guidance during SSC • Not reported	At birth mothers are encouraged to begin SSC as early, as often, and for as long as possible.	Nurse.	Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
		Guidance provided to recognize hunger cues.					
Newnham et al. (2009)	Enhance the quality of mother–infant interaction by teaching the mothers of low-birth-weight infants to be more sensitive and responsive to their babies' physiological and social cues.	**Modified Mother-Infant Transaction Program (MITP):** psychoeducational intervention on five main topics: 1) becoming acquainted, 2) Recognizing infant disorganisation/stress and availability and then applying those principles during care and play, 3) bath session, where mothers (who bathed their infants) were helped to recognize, and appropriately respond to infant disorganisation and stress, 4) regulate infant responses through play in home setting, and 5) Recognizing temperamental characteristics in infants and parenting	• Weeks before discharge to 3 months CA.	• Nine sessions • 30 min to 1-hr	Verbal instruction, infant observation, practical experience in handling infants and modeling, as well as written materials.	First author (psychologist).	Educational and Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
		to different temperaments					
Teti et al. (2009)	Promote parents' awareness of infant bodily and social cues and parents' sensitivity and confidence in handling their infants. Provide parents with information, via instruction and demonstration, about premature infants' capacities for interacting with the world, how to recognize and respond appropriately to infant cues, and the role of parent–infant interaction in optimizing infant development.	Parentally administered infant massage designed to promote infant development and, in this case, parental knowledge of subtle infant cues and feeling of intimacy toward their infants.	• 20-week intervention from NICU to post-discharge.	• Eight sessions • 1 hr	Not reported.	Not reported.	Educational and Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
Ravn et al. (2011)	Help parents appreciate their infant's unique characteristics, temperament, and developmental potential, make the parents more sensitive and responsive to their infants' physiological and social cues, particularly those that signal stimulus overload.	**MITP:** Interaction guidance focusing on teaching the parents to understand the individuality of an atypical child, to establish a good pattern of interaction and to encourage the parents to enjoy their infants.	• Last week before discharge to 3rd month after discharge.	• Eleven sessions • 1 hr	Individualized interaction guidance.	Neonatal nurses.	Active
Zelkowitz et al. (2011)	Reduce maternal anxiety and enhance maternal sensitivity by intervening at the level of both maternal distress and maternal interactive behavior to promote a better	**CUES**: educational intervention for mothers to ○ recognize signs of their anxiety/distress; ○ use various strategies to alleviate their distress; ○ read their infant's communication cues;	• Starting ~33 days after birth until 6-8 weeks of CA.	• Six sessions • 1 hr	Individual sessions of teaching and one individual of video interaction guidance.	Nurse or psychologist.	Educational and Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
	parenting environment and thereby optimize the child's cognitive and social development.	○ respond sensitively to their infant's cues and distress.					
Milgrom et al. (2013)	Enhance the quality of mother–infant interaction by teaching the mothers of low-birth-weight infants to be more sensitive and responsive to their babies' physiological and social cues.	Enhanced MITP (**PremieStart program**). Mothers trained to increase their sensitivity in recognizing signs of infant stress including "shut-down" mechanisms, alert-available behavior, facial expressions, quality of motor behaviors, posture and muscle tone; how to provide graded stimulation; and how to avoid overwhelming infants; focus on touch, movement and massage; SSC; multi-sensory stimulation; debriefing and	• From first week after birth to first week post discharge.	• Nine weekly sessions and one session post-discharge • 1 hr	Individual psychoeducational intervention.	Psychologists.	Educational

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
		normalizing parental feelings; challenging dysfunctional thoughts, and parental diary keeping.					
White-Traut et al. (2013)	Not reported.	**H-HOPE** (Hospital to Home: Optimizing the Infant's Environment) – combination of guided participation of mothers to Auditory Tactile, Visual and Vestibular-rocking stimulation (**ATVV**)	From 32 weeks of GA to 1-month CA.	ATVV: • Twice daily • 15 min per session Maternal sessions: • 6 sessions	Mothers were thought to administer the ATVV during the maternal sessions. Otherwise, mothers administered ATVV.	Nurse advocate team.	Active
Borghini et al. (2014)	Enhance the quality of parental caregiving as a support to the infant's global development by improving parents' observation and understanding of the specific competencies of their preterm infant	At 33 weeks of GA: joint observation of infant's reactions to various stimuli during standard care procedures. At 4 months CA: 10-min mother-infant free play videotaped followed by video interaction guidance.	• First session at 33 weeks of GA. Three sessions one-week apart during 4th month CA.	• Four sessions • 30-60 minutes	Individual sessions of interaction guidance and video interaction guidance.	Nurse and therapist.	Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
	(particularly interactional competencies) and promote parents' sensitivity and responsiveness towards their infant's behavioral characteristics.						
Hane et al. (2015)	Establish an emotional connection and a Calming Cycle routine between the mother and her premature infant.	**Family Nurture Intervention (FNI):** mothers are involved in calming interventions which is facilitated by a nurture specialist. ○ Scent cloth exchange; ○ Vocal soothing and emotion expression; ○ Eye contact; ○ Skin-to-skin and clothed holding.	• From NICU admission to discharge depending on availabilities of mothers.	• Average of 3.5 sessions/week • ~6hr/week	Guided individual sessions.	Nurture specialists (former nurses).	Active
Hoffenkamp et al. (2015)	Facilitate parental bonding, to enhance the quality of	Parent-infant interaction videotaped during daily moments of caregiving such at	• During first week after birth.	• Three sessions • Duration not reported	Individual sessions of video interaction guidance.	Trained nurses and pedagogic workers.	Active

References	Intervention aims	Intervention description	When?	How much? • Number sessions • Length of sessions	Modes of delivery	Professional delivering intervention	Presence of Educational component and Active Parental role
	parental interactive behavior, and to promote parental well-being using edited video recordings of parent-infant interactions.	bathing, changing and feeding. Video is then reviewed and discussed with the parents.					
Evans et al. (2017)	Prevent severe emotional, behavioral and developmental problems in both children and adolescents.	**Triple P** is an educational intervention covering four main topics: 1) survival skills, 2) partner support, 3) positive parenting, and 4) responding to your baby.	• From NICU hospitalisation to 12 months CA.	• Four sessions • 2 hr • Four post-discharge phone calls • 30 min	Not reported.	Trained facilitators.	Educational
Sahlen Helmer et al. (2019)	Increase time spent in SSC to improve mother-infant interaction.	Continuous skin-to-skin contacts between mother and infant.	• First seven days of life.	• Continuously (>20-hr/day)	Not applicable.	Not applicable.	Active
Twohig et al. (2019)	Not reported.	Reflective interview, observation of infant cues and video interaction guidance.	Not reported.	• Three sessions • 1 hr to 1 hr 30min	Individual sessions.	First author (clinician/researcher)	Active