

**The origins of individual differences in maternal sensitivity:
A Review**

Catherine Jones¹, Rebecca Pearson² and Jonathan Evans²

¹University of Exeter

²School of Social and Community Medicine, University of Bristol

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Abstract

Components and consequences of maternal sensitive responsiveness have been studied thoroughly. In contrast, less attention has been directed to the possible determinants, i.e., the question of why some mothers demonstrate greater sensitivity than others and the factors which might enhance or disrupt this maternal responsiveness. This review provides a comprehensive account of the empirical research to date that has attempted to explain individual differences in maternal sensitivity, with a focus on predisposing maternal characteristics and maternal factors which according to proposed models, are thought to enhance or disrupt the development/expression of maternal sensitivity.

Introduction

Research on early mother-infant interaction has highlighted the nature of this reciprocal relationship to be crucial for the child's psychological growth and development. Maternal sensitivity has been identified as an important mediator in determining the quality of this interaction (Crittenden & Bonvillian, 1984) and is defined as a mother's ability to perceive and accurately interpret her infant's signals and communications, then respond appropriately, effectively and consistently (Ainsworth, Blehar, Waters, & Wall, 1978; Karl, 1995). The link first proposed by Ainsworth and co-workers (1978) between maternal sensitivity and organised infant attachment outcomes (secure, avoidant, resistant) has been replicated many times (Belsky, Fish, & Isabella, 1991) (Goldberg, Perrotta, Minde, & Corter, 1986; Smith & Pederson, 1988), although not entirely consistently (Rosen & Rothbaum, 1993; Ward & Carlson, 1995). The quality of the infant-mother attachment is defined in terms of the infant's ability to use the mother as a secure base from which to explore, and as a comfort in times of distress. A secure attachment is considered to reflect children's confidence in the mother's emotional availability and responsiveness and to promote a positive and trusting orientation toward the mother, themselves, and the world in general. In turn, insensitive and relatively unresponsive maternal care is expected to lead to the development of insecure attachment and lack of confidence in the mother's emotional ability and responsiveness, which is considered to foster a negative and mistrusting orientation. The precise behaviours that constitute maternal sensitivity remain open to interpretation and its operationalization has turned out to be problematic (see below). This may at least partly explain why in many studies the associations between maternal sensitivity and attachment have not been found to be as strong as had been expected (De Wolff & van Ijzendoorn, 1997; Goldsmith & Alansky, 1987). Attempts have been made to develop the concept of sensitivity

further; however, there tends to be a lack of consensus among researchers as to which behaviours are constitutive elements of maternal sensitivity (Meins, Fernyhough, Fradley, & Tuckey, 2001). Recognised factors include sensitivity, mutuality, synchrony, emotional support, attitude, stimulation (De Wolff & van Ijzendoorn, 1997) and infant temperament (Porter & Hsu, 2003).

Although maternal sensitivity is considered to be not a characteristic of the mother but rather a dyadic factor (Meins, et al., 2001; Mills-Koonce, et al., 2007) it is generally considered that mothers are responsible for creating and making mutual attunement in a dyadic interaction through a process of perception, interpretation and response (Karl, 1995). The capacity to engage in this process varies across individuals and populations. It is thereby striking how little is known about the origins of individual differences in maternal sensitivity, particularly as such information would inform the development of interventions to enhance sensitivity. From a theoretical perspective the factors must be diverse including predisposing factors such as personal history, that shapes conscious and unconscious schemas of motherhood and her adult attachment style, cultural values that affect goals for child rearing, belief systems about the responsibilities of parents are likely to influence the development of her maternal sensitivity as well as experiences during pregnancy (e.g. attachment to foetus, wellbeing and birth experience) and enhancing/disrupting factors postpartum (e.g. breastfeeding, infant responsiveness, depression etc). For example, there exists mixed evidence to suggest that breastfeeding may contribute to the development of the range of sensitive maternal behaviours, through proposed physiological and psychological mechanisms. Maternal characteristics such as low self-esteem, depression, negative mood, and anxiety have been shown to have a negative impact on the mother-infant interaction (Beck, 1995; Hart, Field, & Nearing, 1998). These findings have not always been consistent, and much of variance in maternal sensitivity remains unexplained. In an effort to guide future

research, a comprehensive account of the findings to date which have investigated the relationship between maternal specific factors and maternal sensitivity. Firstly, the challenge facing researchers in defining and measuring maternal sensitivity is briefly discussed. The main section of this report reviews research which has directly tested for an association between maternal predisposing factors (e.g. attachment style, education, age) with maternal sensitivity and then factors which are proposed to enhance or disrupt developing or existing maternal sensitivity (e.g. mother-foetus attachment, breastfeeding, depression, maternal identity). It is important to note that a significant proportion of the variance in maternal sensitivity can be explained by infant characteristics (e.g. infant temperament)(Bornstein, Hendricks, Haynes, & Painter, 2007) and the reciprocal relationship between mother and child; however a detailed consideration of these factors was beyond the scope of this review. The focus therefore was on maternal characteristic and attributes.

Method of literature review

A structured search strategy was adopted, as described below, and researcher discretion was used to determine whether articles were relevant for the purposes of this review. Articles including measurements of maternal sensitivity AND/OR maternal responsiveness were considered, however for those using maternal responsiveness the appropriateness/sensitivity of the response must have been considered (rather than e.g. frequency contiguity etc.). The studies cited were assembled from a systematic search using the PubMed and ISI Web of Knowledge databases entering combinations of the key terms: “maternal responsiveness” AND/OR “maternal sensitivity” AND/OR “sensitive mothering” refined to the title/abstract of the publication. The limits applied to the search included original articles that studied human participants and were written in English. With these

limits applied the search returned (not accounting for duplicates): PubMed = 584 articles, Web of knowledge = 782 articles.

The following inclusion criteria were then used to screen each article: (a) original research, (b) studies that clearly delineated the measurement of maternal sensitivity, maternal responsiveness or sensitive mothering (c) studies where maternal sensitivity, maternal responsiveness or sensitive mothering was the outcome variable, measured postpartum (d) the research directly tested the association of a single or multiple maternal factor with maternal sensitivity or responsiveness. As a result 24 articles were retained and reviewed in detail. For ease of exposition, the literature review was divided into two main sections: predisposing maternal characteristics and enhancing/disrupting maternal characteristics (prenatal and postnatal). Table 1 presents a summary of the empirical studies forming the main body of this review.

Defining and measuring maternal sensitivity

Maternal sensitivity is a strikingly broad concept involving a variety of interconnected affective and behavioural caregiving attributes such as warmth, maternal responsiveness (defined as positive verbal or non-verbal behaviour directed at the infant), appropriate and contingent responses (Thompson, 1997). Maternal qualities such as affect, timing, flexibility, acceptance, conflict negotiation, maternal awareness of the infant's cues and appropriate responsiveness may represent important dimensions of maternal sensitivity (van Doesum, Hosman, Riksen-Walraven, & Hoefnagels, 2007). A number of researchers view the construct as unclear, in that the measurement is variable and there is a lack of agreement as to which of the above dimensions constitutes maternal sensitivity (Meins, et al., 2001). Cross-cultural differences in exactly how these dimensions/behaviours are accomplished, provide added complexity when attempting to reach a definition (Shin, Park, Ryu, & Seomun, 2008). Furthermore, maternal sensitivity is used interchangeably with the terms maternal

responsiveness (De Wolff & van Ijzendoorn, 1997; Drake, Humenick, Amankwaa, Younger, & Roux, 2007) and maternal competency (Pauli-Pott, Mertesacker, & Beckmann, 2004) with little consistency. For instance, some researchers have used the definition of maternal sensitivity to define maternal responsiveness (Amankwaa & Pickler, 2007; Paavola, Kunnari, & Moilanen, 2005) (Drake, et al., 2007) while others have considered a mother's reduced interactional competence as reflecting less maternal sensitivity (Pauli-Pott, et al., 2004). For the purposes of this review we use the term maternal sensitivity to include maternal sensitive responsiveness under this term.

The parameters associated with maternal sensitivity measurement e.g. definitions, measures, setting, context, duration, and frequency of assessment are variable across studies (De Wolff & van Ijzendoorn, 1997). Examples of the measurements used in the literature include: System for Coding Interactions and Family Functioning (SCIFF) (Kaczynski, Lindahl, Malik, & Laurenceau, 2006), the Ainsworth Sensitivity Scale (Tharner, et al.), Thorpe Interaction Measure (TIM) (Thorpe, Rutter, & Greenwood, 2003) the Maternal Infant Responsiveness Instrument (MIRI) (Amankwaa & Pickler, 2007) the Maternal Behaviour Q-Set (MBQS): (Bigelow, Littlejohn, Bergman, & McDonald; Pederson & Moran, 1995) and the specific subscales of the Coding Interactive Behaviour global rating scale (Feldman & Eidelman, 2003; Kim, et al., 2011). A large number of studies in this area have used custom-made measurement tools which have often not been tested for their validity and are occasionally crude and subjective measures of what is a multi-faceted and complex construct. While broad composite scores provide a general measure of maternal behaviour, they do not allow examination of the nuances of mother-infant relations. The distinction between general responsiveness and contingency can help scientists to tackle a major methodological difficulty in the domain of maternal sensitivity; defining specific dimensions of sensitivity and finding valid and reliable measures of them that can be used in replication studies

(Gutman, Brown, & Akerman, 2009). This difficulty is highlighted by Horowitz, Logsdon & Anderson (2005) and illustrated by the finding of Owens, Shaw and Vondra (1998), who used self-reported maternal responsiveness, the highchair observational task and a free play observational task (Horowitz, Logsdon, & Anderson, 2005). It was found that any associations detected varied according to the measure used. This could help explain why some correlation studies find significant associations with maternal sensitivity, whereas others, looking at the same variables but using different measures, do not. Methodological issues notwithstanding, one might be encouraged by the consistent finding that maternal sensitivity is associated with later infant attachment security (Ainsworth, 1979; Bigelow, et al., 2010; Pederson, Gleason, Moran, & Bento, 1998) with sensitivity to distress appearing to be particularly important (Leerkes, 2009). The fact that these studies all used different measures of maternal sensitivity and still found consistent associations with attachment security indicates that this is a robust observation. Observational measures which break down maternal sensitivity into several dimensions, have proved capable of detecting subtle aspects of maternal sensitivity such as remoteness-intrusiveness, and 'negating' behaviours that are discordant or incontinent with the child's behaviour (Murray, Fiori-Cowley, Hooper, & Cooper, 1996). These more sensitive scales offer researchers the chance to explore the construct of maternal sensitivity more closely but in many instances, potential associations or determinants have been studied in isolation, and few investigations have evaluated multiple influences simultaneously so that unique associations or determinants are rarely identified. Unique associations or contributions that any one might have with parenting or child development remain infrequently explored, where family systems theorists emphasize the importance of considering together the possible independence and interdependence of multiple factors (Bornstein, et al., 2007).

Predisposing maternal characteristics

Maternal sensitivity in the new mother is a multidimensional set of responses to infant cues that are influenced by the mother's early life experiences. Main and colleagues (1985) found that mothers who had positive recollections of parental acceptance and care during childhood displayed more sensitive, responsive, and warm behaviours in interactions with their own children. In addition, maternal self-efficacy and the ability of mothers to respond to their children's cues and bids for attention have been related to the mothers own remembered relationships with their parents (Crockenberg & Leerkes, 2003), reflecting what is known as the intergenerational cycle (Belsky, et al., 2005). Likewise, Ward and Carlson (2008) demonstrated that sensitive maternal behaviours were characteristic of adolescents with secure mental representations of attachment (Ward & Carlson, 1995). Mothers with a history of care and acceptance from their parents during childhood were more sensitive to their own 2-year-old children when they expressed fear than were mothers with a history of low care (Burrous, et al., 2009). This is consistent with prediction and with the attachment theory perspective that early experiences with caregivers influence the development of internal working models which affect the manner in which one responds to subsequent events (Bowlby, 1969 1982). Mothers with a childhood history of care are likely to be more empathic, less likely to interpret their distressed infant as rejecting them, and may have a repertoire of sensitive behavioural responses through modelling that increases the likelihood that they will deliver a timely, comforting, and reassuring response to their toddlers' expressions of fear (Fonagy, Steele, Moran, Steele, & Higgitt, 1993). Corroborating evidence from a recent fMRI study showed that a mother's self-report of early experiences with her own mother has been associated with maternal brain responses to infant cries at the first postpartum period (Kim et al., 2011). These factors, in turn, may play a role in both the mother's brain activations and parenting behaviours. Likewise, a prospective study (which

removes the limitation of relying on retrospective reports) demonstrated mothers who experienced consistent and positive care in childhood are also more likely to provide warm and sensitive parenting to their children (Belsky, et al., 2005). Interestingly, a recent study demonstrated that mothers who possessed a specific genotype (serotonin transporter 5-HTPLPR), known to have direct effects on behaviour in non human primates, displayed greater levels of maternal sensitivity (Mileva-Seitz, et al.2011). It was suggested these associations may be related to underlying neural and cognitive differences as predispositions of responsiveness which then interact with environmental factors.

Authors	Study type	Predictor of interest (measure)	Outcome (measure)	Infant age at assessment of maternal sensitivity	N	Findings
PREDISPOSING						
Belsky, Jaffee, Sligo, Woodward, & Silva, 2005	Longitudinal	Childhood experience of being parented (PARI)	Maternal sensitivity (video coding based on NICHD Early Child Care Research Network scale)	3 years	146	Positive experience of being parented predicted maternal sensitivity
Ward & Carlson, 1995	Longitudinal	Maternal attachment (Adult attachment interview – AAI)	Maternal sensitivity (video interaction coding, Crittenden 1984)	3 & 9 months	94	Secure mental representations of attachment predict greater maternal sensitivity
Coppola, Cassibba, & Costantini, 2007	Group comparison	Maternal attachment (AAI)	Maternal sensitivity (EAS)	3 months	40	Secure mental organisation predicted greater sensitivity
LeCuyer-Maus, 2000	Retrospective	Experience of maternal caregiver (Parental bonding instrument)	Maternal sensitivity (Ainsworth sensitivity scale)	12 months	61	Positive relationship history predicted greater sensitivity

Mileva-Seitz, et al.2011	Experimental (Gene-environment interaction)	1) Early family experiences 2) Maternal genotype 5-HTTLPR	Maternal sensitivity (Ainsworth sensitivity scale)	6 months	166	Presence of maternal gene 5-HTTLPR predicts individual differences in maternal sensitivity.
Burrous, Crockenberg, & Leerkes, 2009	Retrospective /correlational	Experience of maternal caregiver (Parental bonding instrument)	Maternal sensitivity (non-validated measure)	2.5 years	52	Maternal history of care and acceptance from their parents showed greater sensitivity (mediated by maternal anger)
ENHANCING/ DISRUPTING (pre/post natally) Maternal Psychological						
Siddiqui & Hagglof, 2000	Longitudinal	Maternal-foetus attachment (prenatal attachment inventory)	Maternal sensitivity (video interaction coding, non-validated)	12 weeks	100	Greater maternal – foetal attachment predicts greater maternal sensitivity
Shin, Park, & Kim, 2006	Cross - sectional	1) Maternal-foetal attachment 2) Self identity as mother	Maternal sensitivity (Maternal sensitivity scale, Han 2002 – self report)	6 weeks	196	Greater maternal-foetal attachment and identity as a mother positively associated with maternal sensitivity

Musser, Kaiser-Laurent, & Ablow, 2012	fMRI/ correlational	Neural activation	Maternal sensitivity (Coding Scheme for Structured Mother–Infant Play Interactions)	18 months	22	Cry-related brain activation in right frontal pole and inferior frontal gyrus predicts greater maternal sensitivity.
Pearson, et al., 2012	Longitudinal	Prenatal maternal Depression	Maternal sensitivity (Thorpe Interaction measure)	12 months	872	Prenatal depression associated with postnatal sensitivity (survives adjustment for maternal, perinatal, infant variables)
Leerkes, 2009	Longitudinal	1)Goals about infant crying 2)Emotional reaction to distress	Maternal sensitivity	Prenatal (12 weeks) & postnatal (6 months)	101	Pre- and postnatal goals in relation to infant distress and emotional reactions to infant distress significantly predicted maternal sensitivity
Demers, Bernier, Tarabulsy, & Provost	Experimental (ANOVA)	Mind Mindedness (coding interaction)	Maternal sensitivity (MBSQ)	18 months	69 (adolescents) 29 (adults)	Positive association in adults but not adolescents
Koren-Karie, Oppenheim, Dolev, Sher, & Etzion-Carasso, 2002	Experimental (ANOVA)	Maternal insightfulness	Maternal sensitivity (Ainsworth sensitivity scale)	12-17 months	129	Positive maternal insightfulness predicted greater maternal sensitivity

Bornstein, et al., 2007	Cross sectional	Internal attributions of parenting failures	Maternal sensitivity (Emotional availability scale)	20 months	254	Greater internal attributions predict greater sensitivity
Musser, Ablow, & Measelle 2012	Longitudinal	1) Maternal depression 2) Parasympathetic regulation	Maternal sensitivity (Coding Scheme for Structured Mother–Infant Play Interactions)	5 months	95	Great levels of depression negatively associated with maternal sensitivity (adjusted for SES, education, age). Parasympathetic regulation not associated.
Murray, et al., 1996	Longitudinal	Maternal depression	Maternal Sensitivity (video interaction coding, non-validated)	6 weeks	112	Negative association (responses more negating and less affirming)
Maternal behavioural						
Tharner, et al., 2012	Prospective	Breastfeeding duration	Maternal sensitivity (Ainsworth sensitivity scale)	14 months	675	Positive association (adjusted for SES, parity, maternal age)
Kim, et al., 2011	fMRI/correlational	1) breast vs formula feeding 2) neural activation	Maternal sensitivity (Coding interactive behaviour)	4 months	17	1) Trend of breastfeeding vs formula and higher MS 2) Neural activation specifically associated with greater MS
Pearson, Lightman, & Evans, 2011	Longitudinal	Breast vs formula feeding	Maternal attentional sensitivity to infant distress	Prenatal & postnatal (3 & 6 months)	51	Breastfeeding associated with greater sensitivity compared to formula feeding (controlled for sensitivity during pregnancy).

Drake, et al., 2007	Cross-sectional	breastfeeding duration	Maternal sensitivity (Maternal Instrument responsiveness Index (MIRI))	4 months	180	No association between breastfeeding and maternal sensitivity
Bigelow, et al., 2010	RCT	Skin to skin contact	Maternal sensitivity (MBSQ)	6 months	12	Positive association
Maternal social						
Kivijarvi, Raiha, Virtanen, Lertola, & Piha, 2004	Experimental (ANOVA)	Social support experience	Maternal sensitivity (The Parent-Child Early Relational Assessment (PCERA))	3 & 12 months	56	Mothers experience of social support significantly predicted great maternal sensitivity.
Shin, et al., 2006	Cross sectional	Social support (satisfaction)	Maternal sensitivity (self report)	6 weeks	196	Mothers experience of social support significantly predicted great maternal sensitivity.
Goldstein, Diener, & Mangelsdorf, 1996	Correlational	Social support (satisfaction)	Maternal sensitivity (Sensitivity responsivity factor, Isabella 1993)	3 months	67	Larger support networks and greater satisfaction predicted greater maternal sensitivity.

There is evidence to suggest that high levels of education and socioeconomic status are also significant factors for responsive parenting (Magnuson & Duncan, 2002) as well as maternal age and parity. A higher level of education has been shown to predict more positive maternal sensitivity (LeCuyer-Maus, 2000; Meins, et al., 2001). It is therefore vitally important that these demographics be incorporated in models testing relationships between specific factors e.g. depression and maternal sensitivity as they risk confounding the data.

Enhancing/disrupting maternal characteristics and experiences

Psychological

The pregnancy period, although it has major psychological (particularly related to identity) and biological implications for mothers has been relatively neglected in the search for precursors of maternal interactive behaviour. It has been postulated that the physiological events of pregnancy and delivery probably do not impact maternal sensitivity directly but can influence the mother's affective state and behavioral systems around the time of birth, and thus influence sensitive maternal interactions (Bernier, Jarry-Boileau, Tarabulsky, & Miljkovitch, 1996). For a mother to be responsive towards her infant from the moment of birth it would be of evolutionary advantage for precursors of maternal responsiveness to develop by the end of pregnancy rather than after the infant is born. In support of this women who report stronger prenatal infant attachment and infant mental representations during pregnancy (for example imagining what the infant looks like) show greater maternal sensitive responsiveness after birth (Shin, et al., 2006; Siddiqui & Hagglof, 2000). A woman's self identity as a mother has been shown to be positively associated with maternal sensitivity (Shin, et al., 2006) and therefore a potentially enhancing factor (although causation cannot be

inferred). Evidence also suggests that mothers' sensitive responsiveness depends on their insightfulness and their capacity to see things from the infant's point of view (Koren-Karie, et al., 2002). In contrast, insensitive mothers do not base their responses on the infant's perspective, but focus more on other factors such as their own states and wishes, general ideas about infants' needs, or other determinants unrelated to the infant's specific emotional needs.

Differences in maternal response to infant distress will in part be explained by differences in mothers' basic neuro-cognitive processing of infant emotion. Neuro-cognitive changes, including sensitivity towards emotional facial expressions and enhanced attentional engagement towards infant distress stimuli, have been shown to occur between early and late pregnancy in human mothers (Pearson, Lightman, & Evans, 2009; Pearson, et al., 2011) and are associated with mothers self reported relationships with their infants after birth. Studies have also begun to elucidate individual differences in maternal neural activations relevant to mothers abilities to connect with and respond appropriately to their infants (Musser, et al., 2012), however it would be incorrect to infer causation, experiences of responding to infants may elicit changes in the brain function. Emotional and cognitive availability is proposed to be an important component of the maternal sensitivity construct. A growing body of research explores the impact of psychological difficulties such as depression on a mother's capacity to respond to her infant in a sensitive responsive manner. Depression during pregnancy may disrupt the development of these neuro-cognitive precursors of maternal responsiveness, described above, through its association with dysfunctional reward and motivational neural networks that also underpin maternal responses. In a longitudinal study Pearson and colleagues (2012) found that depression during mid pregnancy was associated with reduced maternal responsiveness during mother-infant interactions after birth, independently of recent maternal depression (Pearson, et al., 2012). Another longitudinal study found that depressed

mothers are less engaged, show less eye contact and show more negating behaviour to signals of distress from their infant (Murray, et al., 1996). Leerkes and colleagues (2010) illustrated mothers' emotional (i.e., empathy, self-focused anxiety and anger) and cognitive responses (i.e., distress detection, infant-oriented emotion goals) to videos of crying infants predicted maternal sensitivity to distress independent of maternal depression.

Behavioural

The majority of empirical work determining the factors influencing the development of maternal sensitivity has neglected to consider the feeding method. The widespread physiological and psychological benefits of breastfeeding on infant development continue to be well documented (Ivarsson, Hernell, Stenlund, & Persson, 2002; Kramer, et al., 2008; Kramer, et al., 2001) (Ivarsson, et al., 2002 & Persson, 2002). Considering that beneficial effects of breastfeeding for the infant-mother relationship are often assumed, empirical research addressing the association of breastfeeding and maternal sensitivity is important. Jansen et al (2006) reviewed the scarce literature on the association between breastfeeding and mother-infant attachment quality and concluded that there is no convincing empirical evidence for such an association due to a lack of pertinent studies and to methodological limitations (Jansen, de Weerth, & Riksen-Walraven, 2008). This is perhaps surprising considering the seemingly strong theoretical argument for a positive relationship between breastfeeding and maternal sensitivity. For example, breastfeeding stimulates release of the hormone oxytocin, shown to be essential for maternal responsiveness in some mammals (Kendrick, 2000), and also implicated in the experience of maternal love (Bartels & Zeki, 2004) as well as maternal bonding (Levine, Zagoory-Sharon, Feldman, & Weller, 2007). Breastfeeding has been reported to foster the early post-partum maternal bond, via touch, response, and mutual gazing (Kuzela, Stifter, & Worobey, 1990; Lavelli & Poli, 1998) as well as more affectionate responses during feeding at 1 and 3 months postpartum in comparison

with bottle feeding mothers (Dunn, Davies, McCleary, Edwards, & Gaboury, 2006). Indeed, a randomised controlled trial observed that levels of skin to skin contact in the first 6 months were associated with enhanced maternal sensitivity (Bigelow, et al.2000). A handful of studies have demonstrated that longer breastfeeding duration and breastfeeding versus bottle feeding is associated with greater maternal sensitivity (Britton, Britton, & Gronwaldt, 2006; Kim, et al., 2011; Pearson, et al., 2011; Tharner, et al., 2012). It is however difficult to disentangle whether associations between breastfeeding and sensitive maternal responses are influenced by the act of breastfeeding or merely indicative of the pre-existing differences in the women who choose to breastfeed (such as those maternal characteristics associated with maternal sensitivity highlighted so far). Studies have shown that breastfeeding mothers tend to be older, more educated, of higher socioeconomic status, and of greater social support (Dennis, 2002) and these factors are also associated with sensitive parenting. This may suggest that women who are already more likely to be sensitive to their infant choose to breastfeed, for example, Britton and colleagues (2006) found that intention to breastfeed prior to the child's birth predicted maternal sensitivity (assessed using the sensitivity to cues subscale of the Nursing Child Assessment Satellite Training feeding scale) at 3 months postpartum. One might expect that Britton et al., (2006) would find both intentions to breastfeed and breastfeeding practice predict maternal sensitivity as measurements were obtained from the same women. To include women in the rarer categories, that is those who had no intention to breastfeed but who went on to breastfeed, larger sample sizes using longitudinal data are needed. Kim and co-workers (2011) showed that mothers who exclusively breastfed during the first 2 to 4 weeks tended to be more sensitive in interactions with their infants at 3 to 4 months than formula-feeding mothers. Breastfeeding mothers also showed a greater response to their own infant cry sounds in brain regions known to be associated with infant bonding from animal studies. This suggests that the act of

breastfeeding may indirectly enhance maternal sensitivity via changes at the neural level (Kim, et al., 2011).

A longitudinal study with a large population sample investigated whether the act of breastfeeding was associated with women's attentional bias towards infant distress which was measured both during pregnancy and postnatally (Pearson, et al., 2011). To investigate whether breastfeeding itself influences sensitivity towards infant distress rather than women's existing sensitivity to infant distress influencing their choice to breastfeed, it was important to control for women's response to infant distress before their infant was born. It was hypothesised that if breastfeeding leads to attentional bias towards infant distress no differences between women who went on to breast or formula feed will exist during pregnancy and such differences will emerge after birth once breastfeeding has commenced. Mothers who breastfed showed enhanced attentional bias to infant distress which was only present following the onset of breastfeeding. This indicates the potential of breastfeeding promoting maternal sensitivity through cognitive mechanisms.

The evidence reviewed above suggests that breastfeeding behaviour may not directly influence maternal sensitivity, however the limitations in defining and measuring maternal sensitivity, as discussed, suggests inferences should be made with caution. The few behavioural studies done on breastfeeding mothers provide some evidence for behavioural differences in mothers who breastfeed compared to those who bottle feed, however they have not empirically tested associations with maternal sensitivity.

Social

The transition to motherhood ushers in many life changes and adjustments as well as new patterns, responsibilities, and routines. There is growing evidence that maternal social support is positively associated with maternal sensitivity (Broom, 1994; Shin, et al., 2006). Goldstein and co-workers (1996) demonstrated the importance of examining maternal

characteristics and social support during both the prenatal and postpartum periods in order to fully understand the antecedents of individual differences in the quality of maternal behaviour. Women who had larger support networks prenatally and postpartum and were more sensitive in home observations, although critically, demographics such as level of education were not considered. It has also been observed that mothers who showed higher maternal sensitivity to infant distress (crying) report greater support from their best friends and husbands than did mothers who showed lower sensitivity scores (Shin, et al., 2006). Mertesacker and colleagues (2004) demonstrated that good social and emotional support functions as a protective factor that can buffer the difficulties in handling a baby high in negative emotionality. Mothers with sufficient social and emotional support were evidently able to use these resources to the infants' benefit whereas in cases where social support was lacking, in addition to the strains of the negative child, this compensatory mechanism fails and again is associated with a drastic decrease in maternal sensitivity (Mertesacker, Bade, Haverkock, & Pauli-Pott, 2004).

Conclusions

In conclusion, it seems that sensitivity, a mother's ability to perceive her infant's signals accurately by considering the infant's point of view and respond to them promptly, contingently and appropriately, is dependent on the interaction of predisposing maternal characteristics and subsequent factors pre and postnatally which act to enhance or disrupt the further development of maternal sensitivity. Growing evidence that a mother's perceived relationship history may be related to her current parenting style extend our current knowledge of the impact of relationship history on maternal sensitivity and responsiveness. Evidence that precursors for maternal responsiveness develop during pregnancy is therefore emerging with mother-foetus attachment representing a strong predictor. If maternal sensitivity is not fully established through the interaction of predisposing factors and changes

during pregnancy and childbirth it is likely that maternal sensitivity will continue to flourish following birth, through interactions with the infant and learning how to respond sensitively. There is also evidence that maternal sensitivity is vulnerable to disruption. For example, there may be a disruptive effect of prenatal depression on the development of important preparations for maternal responsiveness as well as a reported effect of concurrent maternal depression on the expression of maternal sensitive responsiveness.

This review highlights that across studies, sensitivity has been measured in myriad ways and has been examined in relation to a variety of child outcomes resulting in a broad range of effect sizes that have been viewed as disappointing by some. In view of this researchers agree that greater specificity in the definition and measurement of sensitivity taking into account the child outcomes of interest and the theoretical based mechanisms purported to underlie such associations is crucial to further our understanding (Grusec & Davidov, 2010). Maternal sensitivity is therefore clearly not a unitary construct, but rather, composed of specific sub-domains that should be differentiated to fully appreciate its basis. We therefore suggest that cumulative models involving the interplay between multiple determinants are likely to be more fruitful in explaining developmental phenomena than a narrow focus on one or a few factors. In light of the literature reviewed, we cautiously propose that maternal mental health, breastfeeding and social networks should form the focus of intervention efforts to boost maternal sensitivity and parenting capabilities. This may have substantial benefits for mothers in more disadvantaged communities who are likely not only to have lower levels of these factors, but whose parenting seems to be more strongly influenced by such factors both in the short and long term. Furthermore, such interventions for enhancing maternal sensitivity should be started during pregnancy and be directed at enhancing maternal– foetal attachment. It is important to keep in mind that the majority of empirical studies reviewed here do not permit the inference of cause-effect relations between

variables, due to limitations in study design and analysis. Although in recent years researchers have focussed their attention towards the influence of child attributes on maternal sensitivity, it appears that if the maternal psychosocial situation was satisfactory, mothers were able to adequately manage the challenges involved in caring for a difficult child. Some have proposed that mothers who are not experiencing depression are probably less occupied with problems centring on their own personality and wellbeing and are more emotionally stable (Crockenberg & Leerkes, 2003). The mother's sensitivity to her infant is the major characteristic that predicts securely attached infants. Diminished maternal sensitivity is associated with diminished attachment security, which may place the infant at a higher risk for developmental delays, behavioural problems, neglect, and abuse. Given its importance, further research on determining the multiple dimensions of maternal sensitivity and the origins of individual differences in maternal sensitivity is warranted.

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