



MIRJAMI MÄNTYMAA

Early Mother-Infant Interaction

Determinants and Predictivity



ACADEMIC DISSERTATION

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ACADEMIC DISSERTATION

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To those I love

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ORIGINAL COMMUNICATIONS

List of original communications

This review is based on original communications referred to in the text by their Roman numerals I-IV.

- I Mäntymaa M, Puura K, Luoma I, Salmelin R, Davis H, Tsiantis J et al. (2003): Infant-mother interaction as a predictor of child's chronic health problems. *Child Care Health Dev* 29:181-191.
- II Mäntymaa M, Puura K, Luoma I, Salmelin RK, Tamminen T (2004): Early mother-infant interaction, parental mental health and symptoms of behavioral and emotional problems in toddlers. *Inf Behav Dev* 27: 134-149.
- III Mäntymaa M, Puura K, Luoma I, Salmelin RK, Tamminen T. Mother's early perception of her infant's difficult temperament, parenting stress and early mother-infant interaction. *Nord J Psychiatry*. In press.
- IV Mäntymaa M, Tamminen T, Puura K, Luoma I, Koivisto A-M, Salmelin RK. Early mother-infant interaction: associations with the close relationships and mental health of the mother. *J Reprod Inf Psychol*. In press.

Abbreviations

EEPP	European Early Promotion Project
CBCL	Child Behavior Checklist
CI	confidence interval
GRS	Global Rating Scale for Mother-Infant Interaction
ICQ	Infant Characteristics Questionnaire
OR	odds ratio
PSI	Parenting Stress Index
SCID	Structured Clinical Interview for DSM-IV
SES	Socio-economic status

Abstract

In this dissertation the association of the quality of early mother-infant interaction with the child's physical health during the subsequent two years (n=120, Study I) and with the child's behavioural and emotional symptoms at two years (n=50, Study II) was examined. Maternal psychopathology (Studies II and IV) as well as the mother's close relationships (n=131, Study IV) were investigated as possible determinants of the mother's behaviour in early mother-infant interaction with her infant. The association between the quality of early mother-infant interaction and mother's perception of her child's temperament was investigated (n=124, Study III). Also, the role of the infant in early mother-infant interaction was addressed (Studies I-III), and aspects of the dyad were considered. Studies I and II were longitudinal and Studies III and IV cross-sectional.

The participants were from the Finnish subsample of a more extensive European early intervention study (the European Early Promotion Project, EEPP). The mothers were interviewed when the infants were 4-10 weeks of age, and as a part of the interview, the mothers' mental health was assessed using a structured diagnostic psychiatric interview (Structured Clinical Interview for DSM-IV, SCID). The mothers completed questionnaires on parenting stress (Parenting Stress Index, PSI) and their infant's temperament (Infant Characteristics Questionnaire, ICQ). Mother-infant interaction was videotaped when the infants were 8-11 weeks of age, and analysed using Global Rating Scale for Mother-Infant Interaction (GRS). After two years a follow-up interview was conducted and the mothers completed a questionnaire on their child's behaviour (Child Behavior Checklist, CBCL).

Certain deviant features in early mother-infant interaction were associated with the child's poorer outcome. Infant's poor interactive behaviour (i.e. avoidance and a lack of active communication and positive vocalisations) predicted the child's chronic or recurrent health problems during the subsequent two years. Mother's hostility and/or intrusiveness was a significant predictor of high externalising symptom scores and high total problem scores of the child at two years assessed by CBCL. Surprisingly, mother's mental health problems were not related to maternal behaviour in interaction with her two-month-old infant whereas the mother's childhood relationship with her own mother was an important determinant of her behaviour. Also, among mothers with mental health problems poor/disengaged marital relationship was associated with the mother's

poorer interactive behaviour. Infant's poor interactive behaviour and mother's intrusiveness in early mother-infant interaction increased the infant's risk of being perceived as difficult. The role of the infant as an active partner of the dyad was already important when the infant was two months old.

The results of this study imply that an important determinant of infant outcome may be the *mutual adaptation capacity* of the dyad - the extent to which the dyad, the infant and the mother, can adjust to achieve a balance between the two of them, but also in relation to complex systems of other relationships in the family, and in relation to other internal or external states. The deviant features that have been shown to relate to the infant's less than optimal outcome may be seen as indicators of the overloaded mutual adaptation capacity of the dyad.

Better and more accurate observational methods are still needed in order to be able to assess the infant's behaviour, and the functioning of the dyad in more detail. In the future, when assessing infants and early mother-infant interaction we need to combine these two aspects: a detailed observation and a systemic view of the dyad.

Tiivistelmä

Tässä tutkimuksessa selvitettiin äidin ja vauvan varhaisen vuorovaikutuksen laadun yhteyttä lapsen fyysiseen terveyteen kahden ensimmäisen vuoden aikana (n=120, osatyö I) sekä lapsen käyttäytymiseen ja emotionaalisiin oireisiin kahden vuoden iässä (n=50, osatyö II). Äidin mielenterveysongelmia (osatyöt II ja IV) ja hänen läheisiä ihmissuhteitaan (n=131, osatyö IV) tutkittiin tekijöinä, jotka voivat vaikuttaa äidin käyttäytymiseen varhaisessa vuorovaikutuksessa vauvansa kanssa. Äidin ja vauvan varhaisen vuorovaikutuksen laadun yhteyttä äidin käsitykseen vauvansa temperamentista selvitettiin osatyössä III (n=124). Vauvan osuutta varhaisessa vuorovaikutuksessa arvioitiin osatyöissä I-III, ja samalla pohdittiin myös erilaisia näkökohtia äiti-vauva -parin toiminnassa. Osatyöt I ja II olivat pitkittäistutkimuksia ja osatyöt III ja IV poikkileikkaustutkimuksia.

Tutkimukseen osallistujat kuuluivat laajemman eurooppalaisen interventiotutkimuksen (European Early Promotion Project, EEPP) suomalaiseen aineistoon. Äitejä haastateltiin, kun vauvat olivat 4-10 viikon ikäisiä, ja haastattelun osana äitien mielenterveyttä arvioitiin käyttämällä strukturoitua diagnostista haastattelua (Structured Clinical Interview for DSM-IV, SCID). Äidit täyttivät vanhemmuuden stressiä (Parenting Stress Index, PSI) ja lapsensa temperamenttia (Infant Characteristics Questionnaire, ICQ) kartoittavat lomakkeet. Äidin ja vauvan vuorovaikutusta arvioitiin videoimalla seurusteluhetki vauvan ollessa 8-11 viikon ikäinen. Vuorovaikutus analysoitiin Global Rating Scale for Mother-Infant Interaction – menetelmällä (GRS). Seuranta-ajan jälkeen, kun lapset olivat kahden vuoden ikäisiä, äitejä haastateltiin uudelleen ja he täyttivät lomakkeen lapsensa käyttäytymisestä (Child Behavior Checklist, CBCL).

Äidin ja vauvan varhaisessa vuorovaikutuksessa oli piirteitä, jotka olivat yhteydessä lapsen huonompaan selviytymiseen. Vauvan vuorovaikutuskäyttäytymisen puutteet (välttely sekä aktiivisen kommunikaation ja positiivisen ääntelyn vähäisyys tai puuttuminen) ennustivat lapsen kroonisia tai toistuvia terveysongelmia kahden ensimmäisen vuoden aikana. Äidin vihamielisyys ja/tai tunkeilevuus varhaisessa vuorovaikutuksessa ennusti merkitsevästi kahden vuoden ikäisen lapsen käyttäytymisessä eksternalisoivia oireita ja korkeita kokonaisoirepisteitä CBCL-lomakkeella arvioituna. Äidin mielenterveysongelmat eivät olleet yhteydessä hänen käyttäytymiseensä

vuorovaikutuksessa kahden kuukauden ikäisen vauvan kanssa kun taas äidin lapsuudenaikainen suhde hänen omaan äitiinsä oli tärkeä äidin käyttäytymisen määrittäjä. Äideillä, joilla oli mielenterveysongelmia, huono/etäinen suhde puolisoon oli yhteydessä äidin vuorovaikutuskäyttäytymisen puutteisiin. Vauvan vuorovaikutuskäyttäytymisen puutteet ja äidin tunkeilevuus lisäsivät vauvan riskiä tulla arvioituksi temperamentiltaan vaikeaksi. Vauvalla oli tärkeä merkitys vuorovaikutuksen aktiivisena osapuolena jo kahden kuukauden iässä.

Tutkimuksen tulokset viittaavat siihen, että tärkeä vauvan selviytymisen määrittäjä saattaa olla *äiti-vauva- parin yhteinen sopeutumiskyky* eli kyky sopeutua ja saavuttaa tasapaino paitsi keskenään, myös suhteessa perheen muihin ihmissuhteisiin ja laajempaan ihmissuhdeverkostoon, ja suhteessa muihin sisäisiin ja ulkoisiin tekijöihin. Vauvan selviytymisen pulmiin yhteydessä olevia poikkeavan vuorovaikutuksen piirteitä voidaan pitää merkkeinä äiti-vauva –parin yhteisen sopeutumiskyvyn riittämättömyydestä.

Tarvitsemme edelleen parempia ja tarkempia observaatiomenetelmiä, jotta voisimme havainnoida vauvan käyttäytymistä ja äiti-vauva -parin toimintaa yksityiskohtaisemmin. Vauvojen ja varhaisen vuorovaikutuksen arvioimisessa tulee yhdistää vauvan ja äiti-vauva –parin tarkka havainnointi sekä äiti-vauva -parin toiminnan systeminen ymmärtäminen.

Introduction

Infant development is a product of continuous, dynamic transactions between the biological organisation, the genotype, the organisation of the individual, the phenotype, and the organisation of the experience, the environment (Sameroff and Fiese 2000). During the very first months of the infant's life infant-caregiver interaction is the most powerful source for organising the infant's experience. Developmental risks or vulnerabilities as well as strengths may arise from the infant's genetic or biological characteristics, or from the psychosocial context. Good infant-caregiver interactions may moderate the impact of biological and psychosocial risks on child development. On the other hand, should the risks adversely affect the quality of infant-caregiver interaction, the influence of the risks may be presumed to be more pronounced than in cases where the infant-caregiver interaction remains good despite the risks, difficulties and adversities. Through interactions with the caregiver the infant encounters the world around him/her, and if the relationship between the infant and the caregiver fails to be appropriately established, the development of the child is compromised, no matter what the reason for the failure is (Tronick and Weinberg 1997).

Thus, infant development is embedded in the infant-caregiver relationship evolving from repeated interactions between them. Assessing parent-child interaction would seem to offer an opportunity to recognise children at risk for maladaptive development as early as possible. An important question is how early it is possible to identify children at risk. Is deviance in mother-infant interaction related to the infant's less than optimal development even when the infant is two months old? Also, given that infant development is rapid and involves many changes, and that parent-infant interaction also undergoes these changes, more knowledge is needed to understand what kind of deviations in early mother-infant interaction are stable enough and, thus, may relate to and possibly predict the child's problematic development. Furthermore, determinants of maternal behaviour other than maternal psychopathology have not been sufficiently studied and not even the effects of the mother's mental health problems on her behaviour in early mother-infant interactions are indisputable.

Review of the literature

Early mother-infant interaction

How early is early mother-infant interaction?

The first three years of a child's life form a period of rapid and complex developmental changes (Zeanah et al. 1997a). This period is often regarded as a time when the cornerstones for later development are laid. Major developmental shifts occur during the first three years (Crockenberg and Leerkes, 2000). These biobehavioural shifts are characterised by qualitative reorganisation of functioning and acquisition of qualitatively new skills in biological, motor coordination, perceptual, cognitive, emotional, communicative and social domains (Zeanah et al. 1997a, Trevarthen and Aitken, 2001).

These first three years are often referred to with expressions such as early development and early years. However, as there are so many rapid developmental changes, there are also qualitatively very different phases during these years. Parent-infant interaction also undergoes these changes (Emde, 1998).

In this dissertation early mother-infant interaction refers to mother-infant interaction before and around the first biobehavioural shift at 2-3 months. This developmental shift is typified by the onset and flourishing of social smile and is often regarded as an awakening of sociability (Emde, 1998).

Mother's behaviour in early mother-infant interaction

Transition to motherhood

Becoming a mother is one of the major transitions in a woman's life. The preparation for the birth of the baby and for the new role as a mother starts during the pregnancy (Leifer 1977, Cohen and Slade 2000). For example, to come to see herself as a mother, a pregnant woman invariably returns to her memories and experiences in her childhood with her own mother, evaluates them

and ponders how she will do things differently or similarly with her child; she must also find her position as a mother like her mother, and not only as a child of her mother (Cohen and Slade 2000). In addition, at representational level, the building of the mother-infant relationship starts during the pregnancy (Brazelton and Cramer 1991). The psychological changes and reorganisation occurring during the pregnancy are important for a successful adjustment to the new challenging life situation after the infant is born (Leifer 1977, Cohen and Slade 2000, Salmela-Aro et al. 2001) and are likely also to be important for the quality of early mother-infant interaction. Siddiqui and colleagues (2000) reported that a mother's childhood memories of her upbringing were associated with the quality of her prenatal attachment towards her unborn baby and, in another study, they showed that mother's prenatal attachment towards the fetus was associated with the quality of early mother-infant interaction (Siddiqui and Hägglöf 2000).

With the birth of a baby, the psychological processes in the mother's mind and concrete changes in everyday life merge. Further changes and reorganisation both on the psychological level and in daily life continue to occur. The family relationships change. The dyadic relationship between the parents must be reorganised into a triadic relationship that includes the newborn (von Klitzing et al. 1999). In families with older siblings the family relationships must also be reorganised to welcome the new member. A lack of social support and violated or very high expectations concerning parenting and postnatal relationships in the family may be associated with a more difficult adjustment to motherhood (Kalmuss et al. 1992, Priel and Besser 2002, Porter and Hsu 2003). Furthermore, mother's psychiatric problems during the pregnancy may hamper successful transition to motherhood. Porter and Hsu (2003) reported that among first-time mothers depression and anxiety during the pregnancy correlated with negative perceptions of maternal efficacy one month postnatally, in other words, mothers who had experienced anxiety and depression during the pregnancy felt less competent in their role as a nurturing mother.

Transition to motherhood notably involves reorganisations regarding the mother's close relationships, past and present. This is a challenge that, when successfully resolved, may be hypothesised to prepare the mother to be more sensitive, warmer and more able to adjust her behaviour to the needs of the infant. However, we lack studies examining early mother-infant interaction and mother's close relationships during the transition to motherhood.

Mother's interactive behaviour: sensitivity

Sensitivity is a feature of maternal behaviour in mother-infant interaction widely accepted as crucial to good mothering. A mother's sensitivity in mother-infant interactions refers to the mother's awareness of the infant's signals, the accuracy

of her interpretation of the signals, and the appropriateness and promptness of her response (Ainsworth et al. 1978). Winnicott (1965) coined the term “good-enough mother” which describes a mother who is sensitive but not too sensitive, allowing the infant signal his/her needs and then appropriately adapting her behaviour to the needs of the infant. Different mother-infant interaction assessment methods, although based on the original formulation of sensitivity by Ainsworth (1978), propose different definitions for the behaviours that should be noted and coded under maternal sensitivity. For example, in the Emotional Availability Scales (Biringen and Robinson 1991) emotional qualities of interaction have been emphasised, such as genuine and congruent affect that is predominantly positive. On the other hand, using the PCERA (the Parent–Child Early Relational Assessment Scale; Clark 1985), enjoyment, connectedness, mirroring, and structuring and mediating the environment have been defined as behavioural qualities denoting maternal sensitivity, in addition to those from Ainsworth’s formulation (Kivijärvi et al. 2001).

Some researchers have pointed out that Ainsworth’s description of sensitive mothers as being capable of seeing things from the child’s point of view has been much ignored (Meins et al. 2001, Oppenheim and Koren-Karie, 2002) and they have emphasised that it is not merely the mother’s prompt but *appropriate* response to the infant’s signals that is crucial to sensitivity. Meins and her colleagues (2001) have named this mother’s ability to understand her infant’s mind and mental state mother’s *mind-mindedness*, Oppenheim and Koren-Karie (2002) mother’s *insightfulness*. *Reflective function* or *mentalising* (Fonagy 1998) are also expressions describing this ability.

The abundance of studies on maternal sensitivity on the one hand and the diversity in the definition of sensitivity on the other suggest that sensitivity is a central aspect in a mother’s behaviour with her infant. In research, however, the concept of sensitivity is difficult specifically because of its diverseness and a lack of consensus on its definition. The broad nature of the definition of sensitivity may also imply that sensitivity should be regarded as a higher order construct, superior to other behavioural features and consisting of inferior constructs such as intrusiveness or affective behaviour. For example, in the study by Kivijärvi et al. (2001) the seven variables in maternal behaviour they included in maternal sensitivity were shown to have a high internal consistency, implying that they measured aspects of the same phenomenon, and yet their definition included affective behaviour as well as structuring and responsiveness.

Mother’s intrusiveness and remoteness

Another important feature of a mother’s behaviour has usually been identified, although under varying titles. A mother’s ability to structure (Biringen and Robinson 1991) or to cooperate (Ainsworth et al. 1978) describes the mother’s

capability to adjust her behaviour, interventions and initiations to the baby's state, mood and current interests, and her ability to organise or structure the baby's experience. A mother whose behaviour disrupts or interferes with the infant's ongoing activity or whose behaviour is guided by her own interests, rather than the infant's signals and initiative, is overstructuring, interfering, or *intrusive*. At the other end is a mother who often is unresponsive, not available to her infant to provide enough support or structuring and who may even physically be distant. These mothers are understructuring, withdrawn, or *remote*.

These extreme ends of mothers' cooperativeness have constantly been identified in studies on postnatal depression as two predominant patterns of interaction of depressed mothers. Some depressed mothers are intrusive and hostile, handling their infants roughly and being overstimulating towards them while others are unresponsive, withdrawn or remote, and flat in their affective displays (Field et al. 1990, Jones et al. 1997, Tronick and Weinberg 1997). Depression in mothers has been shown to be accompanied by changes in EEG-activity and biochemical markers such as norepinephrine, and these changes are different between mothers with intrusive and mothers with withdrawn behaviour (Field et al. 2003).

Mother's affective behaviour

One of the major functional components of a mother's behaviour is its affective quality (Cohn and Tronick 1989). Affects are manifest in the mother's tone of voice, facial and body movements, and timing and rhythm of the expressions (Trevarthen and Aitken 2001). In mother-infant interaction assessment methods the affective behaviour of mothers is sometimes assessed separately and sometimes under sensitivity or cooperativeness, either by definition or implicitly originating from the interpretation of the constructs. Anyhow, emotional qualities in maternal behaviour are recognised as essential.

Mother's good quality affective behaviour is usually characterised with expressions such as warmth and positivity (e.g. Cohn and Tronick 1989, Biringen 2000). Also, the contingency and authenticity of the emotions expressed have been regarded as important features (Cohn and Tronick 1989, Biringen and Robinson 1991).

Two predominant patterns of disrupted affective behaviour described are hostility and flat affect. Mother's hostility is often described together with mother's intrusiveness (Jones et al. 1997, Tronick and Weinberg 1997). Hostility may be displayed in a mother's rough way of handling the infant, her harsh tone of voice and her angry or hostile way of speaking to the infant or about the infant (Biringen 2000, Tronick and Weinberg 1997, Cohn and Tronick 1989). Flat

affect is often accompanied by mother's unresponsiveness and inability to read the infant's signals (Jones et al. 1997).

Infant's behaviour in early mother-infant interaction

Developmental stage of the infant at 2-3 months

Infants are born with preadapted, biologically driven capacities and an urge to participate in human interactions (Emde 1983, Trevarthen and Aitken 2001). They possess organised capacities for initiating, maintaining and terminating interactions with others and, for example, are capable of participating in eye-to-eye contact immediately after birth (Emde 1983). Implicit memory is present and operating from birth (Siegel 2001a). It is a form of memory that enables recall of behavioural, perceptual, emotional and possibly somatosensory experiences, but these memories cannot be remembered consciously, i.e. when recalls of implicit memory are retrieved they do not carry with them an internal sensation that something is being recalled (Siegel 2001a). Newborns are able to distinguish their mothers' face from the face of a female stranger shortly after birth (Field et al. 1984, Sai 2005). Field and colleagues (1984) demonstrated that neonates whose mean age was 45 hours but who only had approximately four hours' experience of being with their mothers showed an initial preference for their mother's face, i.e. they looked significantly longer at their mother's face than at the face of a stranger. Infants about one month old can visually recognise the pacifier of which they previously have only tactual experience (Meltzoff and Borton 1979). In spite of these perceptual and sensory abilities the experience of a young infant is holistic and undifferentiated and he/she is most likely to attend to amodal information, i.e. the infant detects attributes that are common to various sensory modalities and can be perceived by more than one sense such as shape, tempo or rhythm, and intensity (Meltzoff and Borton 1979, Stern 1985). Cross-modal or intermodal fluency allows "translation" of perceptual experiences across different modalities (Stern 1985, Kaye and Bower 1994, Zeanah et al. 1997a, Sai 2005). Cross-modality may also play an important role in explaining the findings of the aforementioned study by Field and colleagues (1984). Sai (2005) replicated this finding with infants whose mean age was 6 hours but demonstrated that only infants who had heard their mother's voice when being with her after the birth could recognise their mother's face by only looking at the mother.

Postural head control, increased and sustained looking toward the mother's face, smiling and positive vocalisations emerge at 2-3 months of age (van Wulfften Palthe and Hopkins 1993). Infants' interest in face-to-face interactions reaches its peak at this time (Lavelli and Fogel 2002). The biobehavioural shift is an outcome of developmental achievements in different domains, and

reorganisation and integration of these achievements to more complex and qualitatively distinct skills and behavioural functioning (Zeanah et al. 1997a, Emde 1998), and neurodevelopmental alterations underlie the changes observed at the biobehavioral shift (Siegel 2001b).

An infant at 2-3 months of age, with his/ her enhanced interest and ability to engage adults in synchronous and reciprocal social interactions, is suddenly a much more appealing, responsive and enjoyable partner (Zeanah et al. 1997a). From the perspective of understanding the early development of mother-child relationships and the early development of the infant, investigating mother-infant interaction at this particular time point seems essential.

Infant's interactive behaviour: Attentiveness and withdrawal

Right from birth, infants are motivated to interact with the caregiver and actively seek social stimulation during the periods of alertness (Trevvarthen and Aitken 2001), and curiosity is one of the driving forces or domains of motivation (Zeanah et al. 1989). As shown in a longitudinal study by Lavelli and Fogel on infants from 1 week to 14 weeks of age in face-to-face interaction with their mothers, even newborns can show active engagement in interactions, although the greatest proportion of newborns' face-to-face communication is simple gazing (Lavelli and Fogel 2002). With increased perceptual abilities and increased abilities in motor coordination and communication (van Wulfften Palthe and Hopkins 1993, Trevvarthen and Aitken 2001) infants can focus their attention better and for longer periods of time. At two months of age attentiveness and active engagement of the infant also include prespeech movements, i.e. active tonguing movements or wide open shaping of the mouth, and gestures of limbs, all directed towards the caregiver (Murray et al. 1996a, Trevvarthen and Aitken 2001).

Closing the eyes, turning the head and looking away are means for regulating the flow of interaction for the infant, and thus also means for regulating the emotions (Tronick 1989, Cohn and Tronick 1989). By these gestures the infant can signal the caregiver that he/she has had enough stimulation and needs to rest for a while. A sensitive caregiver notices the infant's signals and lowers the level of stimulation. An intrusive caregiver, on the other hand, either does not notice these signals or misinterprets them as if they would indicate the infant's disinterest in or dislike of the caregiver. This may cause the caregiver to persist in eliciting the infant's attention and overstimulating the infant which may, in turn, further increase the infant's withdrawal.

Thus, to a certain degree, avoidance or withdrawal is a normal feature of infant behaviour in mother-infant interactions. However, increased or sustained withdrawal reaction in infants can be observed in unsatisfying parent-infant

interactions, for example between a depressed mother and her infant (Field 1984), and in many chronic and acute conditions such as autism, chronic or severe pain, non-organic failure to thrive or post traumatic stress disorder (Guedeney 1997). Although depression in infants is still a controversial issue, many researchers and clinicians claim severe or sustained withdrawal to be a symptom of infant depression (Herzog and Rathbun 1982, Guedeney 1997, Guedeney 2004).

Infant's fussiness, irritability and temperamental factors

Infants' genetic, biological and constitutional characteristics are likely to have an impact on infants' behaviour in early mother-infant interaction. For example, Murray and colleagues showed that infants' hypo- or hyper aroused motor behaviour and irritability were correlated to the infants' poorer interactive behaviour at two months (Murray et al. 1996c). Irritable and hard-to-soothe infants are often perceived as difficult by their parents (Bates et al. 1979) and interaction between irritable infants and their mothers has been shown to differ from the beginning from interaction between non-irritable infants and their mothers (van den Boom and Hoeksma 1994).

Aspects of the dyad in early mother-infant interaction

Since the unique characteristics and the ways of acting of both the mother and the baby mould the nature of the mother-infant interaction, both the mother and the infant contribute to the quality of the dyadic interaction. Traditionally, more attention has been paid to the mother's role, but there is evidence suggesting that infants also have an important role in maintaining or improving the quality of the interaction, for example by eliciting better responses from the mother (Kivijärvi et al. 2001). Also, compared to most infants of the same age, some infants are probably easier and more advanced partners to interact with because of their better organised motor and behavioural characteristics (Field et al. 2003).

Features such as mutuality, reciprocity, engagement and affective sharing are often proposed as important aspects of good mother-infant interaction (e.g. Murray and Trevarthen 1985, Biringen and Robinson 1991). To operationalise the assessment of mother-infant interaction, maternal behaviour and infant behaviour are usually assessed separately. However, the behaviour of one partner should always be judged in relation to the behaviour of the other. For example, a mother's sensitivity can be estimated only by observing the mother's behaviour in the context of the child's behaviour. Also, if only the behaviour of one partner is observed without considering the behaviour in the context of the dyad, important aspects may be overlooked: smiles may be seen, but without observing

the behaviour of the other partner and the dyad mistiming or non-reciprocity are missed.

Factors relating to the quality of early mother-infant interaction

Maternal psychopathology

The effect of maternal psychopathology on the quality of mother-infant interaction has been a focus of intense research in recent decades. Parental psychopathology has been recognised as a risk factor for adverse infant developmental outcome (e.g. Zeanah et al. 1997a) and mother-infant interaction has been studied as one of the potential mediators of the influence of parental psychiatric illness (Murray and Cooper 1997, Goodman and Gotlib 1999).

Depression, and postnatal depression in particular, is the psychiatric disorder most studied in relation to the quality of mother-infant interaction. Depression is associated with negative cognitions, behaviours and affect (Goodman and Gotlib 1999) and has been found to influence many facets of mother-infant interaction. Compared to non-depressed mothers, depressed mothers are less sensitive in engagement with their infants (e.g. Murray et al. 1996a, Cooper et al. 1999), show less positive and more negative facial expressions (Field 1984, Cohn et al. 1990), vocalise less frequently, gaze at their infants and touch them less (Field 1984). Two predominant patterns of interaction of depressed mothers have been identified: an unresponsive, withdrawn style with flat affect and an intrusive, hostile style (Jones et al. 1997, Tronick and Weinberg 1997). However, some depressed mothers are not solely withdrawn or intrusive but show variation in the way they interact (Field et al. 1990), and some are good interaction partners (Field et al. 2003).

Infants of depressed mothers differ moreover from infants of non-depressed mothers in their interactive behaviour. They have been found to show gaze avoidance, vocalise less and be less positive (Field 1984, Cohn et al. 1990, Cooper et al. 1999) and their “depressed” style of interacting is not specific to the interactions with their depressed mothers but in time will be apparent even when interacting with a non-depressed adult (Field 1992). As a dyad, depressed mothers and their infants spend more time matched in negative behavioural states and less in positive states (e.g. play) compared to non-depressed mothers and their infants (Field et al. 1990). Furthermore, infants of depressed mothers have been reported to be more responsive to their mothers’ negative behaviour,

in contrast to infants of non-depressed mothers who tend to be more responsive to their mothers' positive behaviour (Field et al. 1990).

Disrupted mother-infant interactions have been reported in other psychiatric disorders. Crandell and colleagues (2003) examined mothers with a *borderline personality disorder* interacting with their two-month-old infants. They reported that, compared to controls, mothers with borderline personality disorder were more insensitive and intrusive and that during a challenging situation of emotional conflict and difficulty (the "still-face" procedure, Tronick et al. 1978) the infants of impaired mothers became less positive in affect and showed more dazed looks. The dyadic interaction was also less satisfying and less engaged in dyads with an impaired mother (Crandell et al. 2003). Warren and colleagues (2003) examined mothers with *panic disorder* and found them to be less sensitive in interaction with their 4-month-old infants than control mothers during normal daily routines. Pajulo and colleagues (2001a) reported that *substance-abusing mothers* tended to have more problematic areas in their interactive behaviour compared to control mothers from a low-risk community sample. Mother's *anxiety* may also have a disruptive effect on the quality of mother-infant interaction (Muzik et al. 2004) Mothers with *schizophrenia* have been found to interact with their infants even more poorly, even when compared to mothers with affective disorders, assessed among an in-patient sample (Riordan et al. 1999). The disturbances found in mother-infant interaction in dyads with a schizophrenic mother were found to be more pervasive during the hospital stay compared to dyads with mothers having unipolar depression or bipolar disorder (Hipwell and Kumar 1996).

Thus, maternal psychopathology seems to have an impairing effect on the mother's capability for good mother-infant interaction, regardless of the diagnosis, and the infants of affected mothers have also been reported to exhibit abnormal interactive behaviours. However, studies concerning early mother-infant interaction are rare and their findings controversial. For example, in studies on postnatal depression and mother-infant interaction with 2-3-month-old infants, the most distinct findings are from samples from lower socio-economic class and living in adverse conditions (e.g. Field 1984, Field et al. 1990, Cooper et al. 1999) while differences in the quality of mother-infant interaction of depressed mothers from upper/middle class families have been more difficult to demonstrate. Campbell and colleagues (1995) reported that among married, middle-class women there were no differences in mother-infant interaction between depressed and non-depressed mothers when the infant was two months old. Regarding other disorders, small samples and samples recruited at psychiatric hospitals (e.g. Hipwell and Kumar 1996, Riordan et al. 1999, Crandell et al. 2003) have hampered the interpretation of the results and restricted the generalisation of the findings to involve normal or non-clinical population. Therefore, more research on the association between maternal

psychopathology and early mother-infant interaction in community samples is clearly needed.

Mother's close relationships

The three most important relationships of a mother may well be claimed to be her relationships with her child, her spouse and her mother (or parents). It would be quite reasonable to assume that these relationships may influence one another, and the quality of early mother-infant interaction. Regarding attachment patterns, antisocial behaviour and child abuse, there is evidence suggesting that the behavioural patterns of relationships are transmitted from one generation to the next (Benoit and Parker 1994, Pears and Capaldi 2001, Smith and Farrington 2004). However, the mechanisms involved in the intergenerational transmission are inadequately understood. Parenting behaviours (Smith and Farrington 2004), cognitive schemas of relationships, and modelling (Putallaz et al. 1998) have been investigated as mediators of relationship patterns. The possibility that a mother's experiences of relationships may affect her behaviour in early mother-infant interaction and thereby transmit the behavioural patterns to the next generation has not been examined, although there are some suggestions of the contribution of mother's close relationships on the quality of mother-infant interaction. In the existing literature the entwining of mother's close relationships has been studied mainly from two perspectives, attachment and social support.

Continuity of attachment across relationships

Although the attachment theory presented by John Bowlby (1969) originally described attachment as an important bond between parent and infant, the development of attachment and developmental changes in attachment behaviours occur beyond infancy into adolescence and to adult-adult relationships such as the marital relationship (Ainsworth 1989, Waters and Cummings 2000). Despite the developmental changes there is evidence for the relative stability and continuity of attachment across development (Waters et al. 2000), across generations (Benoit and Parker 1994), and across relationships (Waters and Cummings 2000). For example, security and insecurity are attributes that can be used to describe all attachment relationships (Main et al. 1985, Ainsworth 1989, Waters and Cummings 2000) and secure base behaviour can be identified in all attachment relationships although its manifestation changes from infancy to adolescence and adulthood (Waters and Cummings 2000). In secure attachment relationships there is trust in the partner's help and support, a desire to maintain closeness to the partner, pleasure and joy upon reunion, and distress whenever inexplicable separation occurs (Ainsworth 1989). In insecure attachment relationships alternative strategies are adopted to deal with insecurity and protect

the self, resulting in avoidant (dismissive) and resistant (preoccupied) attachment styles (Main 1990, Fonagy 2001). Attachment experiences have been claimed to be organised as internal working models of relationships, i.e. mental representations of relationships and of self in relationships (Bowlby 1969, Main et al. 1985, Thompson 2000). An individual, on the basis of his/her earlier experiences in relationships and the mental representations evolving, knows what can be expected from others, how needs are expressed and how they are responded to. Mental representations may even affect an individual's behaviour so that he/she acts in a manner that evokes responses congruent with his/her internal representations of relationships (Sroufe 1995).

There is evidence that attachment experiences earlier in life, in the parent-child relationship, have an impact on the quality of the marital relationship (Morrison et al. 1997, Waters and Cummings 2000). Morrison and colleagues found that securely attached young adults described their intimate relationships as more positive and less conflictual than adults with insecure attachment representation. Also, attachment experiences may influence the selection of the partner: an individual is more likely to be attracted by someone who matches his/her representation of close relationships. Van IJzendoorn and Bakermans-Kranenburg (1996) showed in their meta-analysis that women and men with secure (autonomous) attachment representation tend to marry each other more often while autonomous men and preoccupied women tend to marry each other less often than would be expected by chance. On the other hand, the quality of the marital relationship may influence the quality of the mother's attachment to her infant. Zeanah and colleagues (1999) reported that partner violence was related to disorganised mother-child attachment.

There are several studies demonstrating the transmission of the attachment from parents to the child. The quality of infant's attachment organisation at 12 months can be predicted during pregnancy by the mother's representation of attachment towards her primary attachment figures (Fonagy et al. 1991) and also by mother's representation of her unborn child (Benoit et al. 1997). Despite this evidence, the ways attachment patterns are transmitted are inadequately understood. Parent's sensitivity in parent-child interactions has been regarded as one of the major mediators of attachment patterns (Ainsworth et al. 1978). However, in his meta-analysis of 22 studies van IJzendoorn (1995) discovered that the greatest influence of parental attachment on infant's attachment classification was explained by mechanisms other than sensitive responsiveness. Mother's attachment experiences may affect the mother's caregiving behaviour. For example, mothers preoccupied with their own experiences may be overprotective, inconsistent and unpredictable or have a role reversal with their child (i.e. the mother seeks comfort, protection and reassurance from her child rather than the opposite) (Maysless 1998), or traumatic experiences in the mother's childhood may result in hostile or emotionally withdrawn caregiving behaviour (Lyons-Ruth and Block 1996).

Thus, attachment research implies that a mother's attachment experiences may have an impact on the quality of her behaviour in early mother-infant interaction, although this assumption has been empirically tested in only few studies. Siddiqui and Hägglöf (2000) showed that mother's prenatal attachment to her unborn baby predicted the quality of early mother-infant interaction and according to Pajulo and colleagues, in substance-addicted mothers the change towards negativity in the content of mental representations of close relationships from late pregnancy to six months postpartum was associated with more problems in mother-infant interaction (Pajulo et al. 2001b).

Social support

Social support – i.e. emotional support, concrete or instrumental assistance, and social expectations of what is and is not appropriate behaviour – is posited to reduce or eliminate the negative effects of psychosocial stress on parenting (Belsky 1984). According to Belsky's (1984) model of the determinants of parenting, the social context of stress and support is one of the three major contributors to parental functioning, together with a parent's personality and psychological well-being, and infant characteristics. The marital relationship is often claimed to be the most important resource of social support but the family of origin or other relatives and friends are also important supporters (Belsky 1984, Gelfand et al. 1992, Cooper et al. 1999)

Regarding the mother-infant relationship, the beneficial effects of social support have been reported in many studies. For example, Pauli-Pott and colleagues (2003) found that a high degree of marital emotional support was positively correlated with high maternal reactivity/sensitivity in interaction with 4-month-old infants. In a longitudinal study of Feldman and her colleagues (1997), an increase in fathers' involvement from 3 to 9 months was related to a reduction in maternal intrusiveness in face-to-face interaction and to an increase in infants' involvement in exploratory play. They also reported that fathers' involvement at 3 months was significantly correlated with mothers' sensitivity and infants' involvement at 9 months. Among mothers living in adverse conditions, the presence of the partner in the home and the level of practical support from the partner were related to maternal sensitivity in face-to-face interaction with two-month-old infants (Cooper et al. 1999).

The adverse effects of low social support on mother-infant interaction may also be mediated partly by other factors associated with low social support and with known disruptive influence on mother-infant interaction. For example, low social support has been reported to be associated with depression in the mother (Gelfand et al. 1992, Cooper et al. 1999). Low social support and difficult infant temperament increase parenting stress (Östberg and Hagekull 2000), and they all

may affect the quality of mother-infant interaction. In well-functioning families with more social support mothers perceive their children to be less difficult and emotional neglect of the child is less likely to occur (Harrington et al. 1998).

Infant factors

Infant's biological or constitutional characteristics are likely to affect his/her interactive abilities and also influence the behaviour of the caregiver. Chronic conditions such as autism, developmental delays or sensory impairments debilitate the infant's capacity for age-appropriate behaviour in interaction with the caregiver. Prematurity also affects the infant's interactive capacities (Minde 2000). Severe medical conditions such as these are often accompanied by other factors that may challenge early mother-infant interaction, for example hospitalisation and separation from the parents (Minde 2000). Also, temporary conditions such as infectious diseases or pain, or tiredness, fatigue and hunger affect the infant's interactive behaviour, for example by temporarily lowering the infant's attentiveness (Guedeney 1997). Yet, even with healthy, full-term and normally developing infants there are variations in the infants' behaviour in parent-infant interactions. These variations may be due to temperamental differences.

Temperament

Temperamental characteristics are evident right from birth, an issue familiar to all parents. There are several conceptualisations of infant temperament, for example those by Thomas and Chess, Rothbart and Derryberry, Goldsmith and Campos, and Fox (see Fox 1998, for a review). All conceptualisations share the view that infants have biologically based predispositions to react to environmental events, novelty and stress in a unique way which leads to the development of relatively stable patterns of individual characteristics and interpersonal behaviour. According to Fox (1998) infants differ in the threshold at which they will respond to novelty or mild stress. In addition, infants differ in their tendency to express particular affects with a certain intensity, and finally, in the manner in which they modulate their responses. All these indices are part of temperament. Although temperament seems to be biologically determined, the further development of modulating the responses and emotional regulation depends on the actions of the caregiver and significant others, and also on the social expectations in the cultural context of the appropriate emotional displays in certain circumstances (Cole et al. 1994, Fox 1998).

One of the repeatedly raised questions regarding the infant's temperament is the way temperament has been assessed. Laboratory assessments, where infant

temperament is examined by observing infant behaviour, for example infant's reactions to standard stimuli, have usually been regarded as more objective methods of assessment. The use of questionnaires completed by parents has often been criticised because questionnaires do not assess the "true" or "objective" characteristics of the child but merely the parents' *perceptions* of the child's temperament. Parental perceptions, on the other hand, may be susceptible to many biases originating from, for example, psychiatric disorders and emotional distress of the parent (Najman et al. 2001, Foreman and Henshaw 2002, Pesonen et al. 2004), parenting stress (Gelfand et al. 1992, Östberg and Hagekull 2000) and the quality of mother's close relationships (Feldman et al. 1997, Harrington et al. 1998, Priel and Besser 2002, Pesonen et al. 2003). However, parental perceptions of infant temperament, reflected in parental reports, are by no means merely a product of parents' characteristics, mental state or degree of distress. Parental reports on infant temperament reflect both the actual characteristics of the child and parent-related factors (Bates et al. 1979, Mebert 1991, Wolk et al. 1992) and may be seen as a reflection of the parent-infant dyad as a whole (Foreman and Henshaw 2002). Moreover, characteristics of the child and parental perceptions influence one another (Bates et al. 1979, Pauli-Pott et al. 2003). Some researchers have suggested that parents act in a way that elicits from their infants the behaviour that meets their expectations (Mebert 1991), and evidence implying that parents shape the developing infant's temperament characteristics according to their perceptions have also been reported (Pauli-Pott et al. 2003). In addition, how the parents perceive their infant's temperament is of great importance. Although there are some contradictory findings on the stability and predictability of infant temperament measured during the first year, it is parent-reported (i.e. parent-perceived) difficult temperament of the infant, even when assessed during the first year, that has shown moderate stability over time, possibly predicting later behavioural problems (Lee and Bates 1985, Pettit and Bates 1989, Guerin and Gottfried 1994, Feldman et al. 1997, Keenan et al. 1998, Teerikangas et al. 1998, Luoma et al. 2004).

It is quite obvious that the infant's biologically determined temperamental factors should have an influence on the infant's behaviour (Murray et al. 1996c). There is also evidence suggesting that the infant's temperament influences the behaviour of the dyad (van den Boom and Hoeksma 1994). However, it is not likely that all irritable infants should be perceived as difficult by their mothers. Thus, the question remains as to how a mother's early perception of her infant's temperament develops. The quality of early mother-infant interaction could be assumed to contribute to the mother's perception of her infant's temperament since it is the context where the mother gets to know her infant, and the infant the mother. Only few studies have examined the relation of infant's temperament reported by the mother and the quality of early mother-infant interaction during the first months of the infant's life. Some studies suggest that infants perceived as more difficult receive less responsive mothering (Milliones 1978, Campbell

1979, Schuler et al. 1995). On the other hand, Zeanah and colleagues (1986) suggested that mother-reported difficult temperament was related to the infant's less responsive behaviour. Pauli-Pott et al. (2000), with a sample of 101 4-month-old babies, reported an association between low maternal reactivity/sensitivity and parent-reported infant's negative emotionality, but only when the mothers were also depressed. Most of these studies were conducted with small samples and with infants older than three months. Therefore, more research is needed to clarify the relation between infant's (perceived) temperament and early mother-infant interaction in the very first months of the infant's life.

Early mother-infant interaction and its effects on the child and child development

Developmental psychopathology studies the unfolding of clinical dysfunction over time in the context of maturational and developmental processes, in order to identify the mechanisms by which various biological and psychosocial factors influence development, and to identify individuals who are beginning to deviate from normal developmental trajectories (Kadzin 1989, Zeanah et al. 1997a, Zeanah et al. 1997b, Luoma 2004). In the transactional model the development of a child is seen as a product of continuous, dynamic interactions between the biological organisation, the genotype, the organisation of the individual, the phenotype, and the organisation of the experience, the environment (Sameroff and Fiese 2000). Thus, the developmental outcome of an individual is neither a function of the individual's characteristics nor the environment and experiential context alone, but of their transactions.

There are many known risk factors in the social context associated with the child's adverse developmental outcome. These include factors such as poor marital quality, parental psychopathology, low socio-economic status, poverty and family violence (Zeanah et al. 1997a). Also, infant's biological characteristics may carry a risk for the development. For example prematurity, severe medical illness, genetic predisposition, and difficult or inhibited temperament may be seen as risk factors (Zeanah et al. 1997a). However, as studies on risk and protective factors suggest, the transmission of risk is neither specific nor linear: a specific risk factor may be associated with several different outcomes and not all children exposed to the risk may show any deviation or disturbance at all but prove resilient (Zeanah et al. 1997a, Luoma 2004). Also, the accumulation and the number of risks seem to be more predictive of adverse outcome than any single risk factor alone, or any specific combination of risks (Zeanah et al. 1997a, Zeanah et al. 1997b, Sameroff and Fiese 2000).

During the very first months of the infant's life the infant-caregiver interaction is the most powerful source for organising the infant's experience.

Should the risks of the psychosocial environment or the biological constitution of the child affect the quality of infant-caregiver interaction, the influence of the risks on the development of the infant may be presumed to be more prominent than in cases where the infant-caregiver interaction remains good despite the risks, difficulties and adversities. There is evidence that good mother-infant interaction may moderate the impact of biological and psychosocial risks on child development (Laucht et al. 2001, Laucht et al. 2002). Through interactions with the caregiver the infant encounters the world around him/her, and if the relationship between the infant and the caregiver fails to be appropriately established, the development of the child is compromised, no matter what the reason for the failure is – acute or chronic illness of the child, parental psychopathology, mother's preoccupation with her worries because of life adversities and poverty, or poor parenting, to name a few examples (Tronick and Weinberg 1997).

Research in the last ten years has also shown the importance of early relationships, and, thus, early infant-caregiver interactions, on the functional development of the maturing brain (Mäntymaa et al. 2003). The structural development of the brain occurs during pregnancy but the functional development - the development of new synapses, grouping of neurons, and integrating groups of neurons into more complex functional units - is dependent on the experiences the child encounters; the functional development of the brain is activity dependent or use-dependent (Perry et al. 1995, Nelson and Bosquet 2000, Schore 2001a, Schore 2001b, Siegel 2001b). For example, synapses are first produced in excess, the peak in the formation occurring postnatally, and later spare synapses, those that have not been used, are pruned (Nelson and Bosquet 2000). This selective pruning is also directed by early emotional experiences in the infant-caregiver interaction (Perry et al. 1995, Schore 2001a, Siegel 2001b). The interdependence of interaction and brain development helps us to understand why early experiences may have such long-term consequences.

Studies on the association of mother-infant interaction and subsequent infant outcome have focused on the relation of mother-infant interaction to attachment, cognitive development, and to a lesser extent, to the socio-emotional development of the child. The possible associations with the child's physical health have been largely ignored.

Evolving of the attachment relationship

The quality of mother-infant interaction is associated with the child's attachment organisation. According to attachment theory (Bowlby 1969), attachment, a specific emotional bond between an infant and the caregiver, develops through infancy and reaches the phase of preferred attachment during the second half of the first year, after which the attachment patterns can be

assessed. Attachment patterns were originally classified into three main categories, 1) secure, 2) insecure avoidant, and 3) insecure ambivalent (resistant) (Ainsworth et al. 1978, Hautamäki 2001, Sinkkonen 2004). Later, a fourth category, a disorganised pattern was described (Main and Solomon 1990). The attachment patterns are assessed during brief episodes of separation from and reunion with the parent (The Strange Situation Procedure; Ainsworth et al. 1978), and classifications are based on the child's response and behaviour during the episodes. Secure infants show signs of missing the parent on separation, seek proximity on reunion and then return to play, insecure avoidant infants ignore the parent's leaving the room and avoid the parent upon reunion, and insecure ambivalent infants are highly distressed upon separation, cannot be settled by the parent and upon reunion they may seek proximity and display anger in quick succession (Ainsworth et al. 1978). Infants with disorganised attachment show sequentially or simultaneously displays of contradictory behaviour patterns, such as proximity seeking followed immediately by avoidance or freezing (Main and Solomon 1990).

In her seminal work on attachment assessment and classifications, Ainsworth noted that mothers who had earlier received high scores on sensitivity scales were more likely to have children classified as secure (Ainsworth et al. 1978). Mothers of secure infants have also been shown to be more involved with their infants, more responsive to their infants' signals, more positive and less negative in their affective expression and more appropriate in their responsiveness and their pacing of interaction, as compared to mothers of insecurely attached infants (Ainsworth et al. 1978, Isabella 1993). Mother's rejection, displayed, for example, as resentment and anger, and insensitivity are related to insecure avoidant attachment (Isabella 1993, Crittenden 1995). Mothers of insecure ambivalent (resistant) infants have been found to be unpredictable, unavailable, insensitive, and to show the least amount of reciprocal interaction and involvement with their infants (Isabella 1993, Cassidy and Berlin 1994, Crittenden 1995). In addition, Crittenden (1995) has argued that infants learn from the infant-caregiver interaction what kind of information is important in relationships: Infants classified as insecure avoidant have learned mostly to rely on causal or cognitive information and ignore affective information, while insecure ambivalent infants have learned to rely on affective information and ignore cognitive information. Secure infants integrate both affective and cognitive information in a good balance. Infant's disorganised attachment classification has been found to be associated with severely distorted patterns of infant-caregiver and family interaction such as child abuse (Cicchetti and Toth 1995) and family violence (Zeanah et al. 1999), but also with the parent's frightened, frightening or dissociated behaviour following the parent's unresolved loss or trauma (Main and Hesse 1990, Schuengel et al. 1996).

Infant's attachment organisation at 12-18 months has frequently been used as an outcome measure when infants and toddlers have been examined and, for

example, the influence of maternal psychopathology on child development or associations with the quality of mother-infant interaction have been investigated (e.g. Murray 1992, Teti et al. 1995, Braungart-Rieker et al. 2001). The assessment of attachment is important in order to understand the evolving of relationships and how experiences in early relationships affect attachment organisation. However, the attachment classification is quite a rough measure, dividing children into four (secure, avoidant, ambivalent and disorganised) or even down to two (secure versus insecure) categories. Efforts to define more accurate measures of attachment have not proven to be very successful. The Attachment Q Sort developed by Waters and Deane (1985), assesses the security of attachment as a continuous construct and rates infant behaviour in interaction with the parent. However, its validity has not been very high, especially when used as a self-report (completed by the parent) (van IJzendoorn et al. 2004). Furthermore, from the perspective of developmental psychopathology, in order to identify individuals on a pathway toward deviant or disturbed development as early as possible, and from the viewpoint of the clinical application of the results, the use of attachment organisation as an outcome measure is puzzling. Insecure attachment is not equivalent to disorder or disturbance in the child. Both insecure avoidant and insecure ambivalent attachments can be considered to be normal variants, and not necessarily associated with later psychopathology (Zeanah 1996, Boris and Zeanah 1999, Sinkkonen 2001). There is some evidence that disorganised attachment may be related to subsequent behavioural problems and hostile aggressive behaviour, although it may not be considered a disorder by itself (Zeanah et al. 1997b). In addition, even more distorted attachment patterns have been described suggesting that there are also disorders of attachment that should be regarded as psychopathological conditions in infants (Zeanah 1996, Zeanah et al. 1997b, Zeanah and Boris 2000).

Cognitive development of the child

The influence of the quality of early mother-infant interaction on the cognitive development of the child has mostly been studied in connection with postnatal depression. In addition, indirect evidence for the importance of mother-infant interaction on cognitive development of the child has been gained from early intervention studies that have shown that interventions aimed at supporting the mother-infant relationship, mother's sensitivity and mother's adjustment to her infant have proved to be the most effective in enhancing the cognitive development of the child, or in promoting behavioural features associated with cognitive abilities, such as exploration (Barrera et al. 1986, Achenbach et al. 1990, van den Boom 1994).

Postnatal depression in the mother has repeatedly been found to be related to impaired cognitive performance in the child, and boys seem to be particularly vulnerable to the effects of depression (Field 1992, Murray and Cooper 1997,

Hay et al. 2001). Insensitivity and unresponsiveness of the mother, lack of contingency in interaction and high levels of distress on the part of both the mother and the infant are all features associated with postnatal depression and may interfere with the child's intellectual development (Murray and Cooper 1997, Hay et al. 2001, Stanley et al. 2004). However, these deviant features may be present even when mothers are not depressed. Murray and colleagues (1996a) reported that mothers without depression but experiencing social or personal adversities (such as poor health, difficulties in close relationships, financial distress etc.) showed patterns of interaction similar to those of depressed mothers. They also showed that it was the deviancies in the quality of mother-infant interaction that were related to impairment in the child's cognitive performance, not the presence or absence of depression, or adversities. Also, Stanley and his colleagues (2004) reported that among infants of depressed and non-depressed, relatively low-risk mothers, mother's positive contingent responsiveness when the infant was two months of age, and not the presence or absence of depression, was related to infant's better performance on an instrumental learning task one month later. Furthermore, differences in the patterns of interaction among depressed women have been reported (Field et al. 1990, Jones et al. 1997, Tronick and Weinberg 1997, Field et al. 2003), resulting in differential effects on the child. Jones and colleagues (1997) showed that the infants of mothers who had been found to be depressed and show withdrawn behaviour at three months performed more poorly, i.e. they had lower scores on the Bayley Mental Scale (Bayley 1969) at 12 months of age compared to infants whose mothers were depressed and intrusive.

Murray and colleagues (1996a) reported that mother's sensitivity and non-remoteness, and infant's engagement and non-fretfulness in mother-infant interaction when the infant was two months of age were associated with better performance on the Bayley Mental Scale (Bayley 1969) at 18 months. Together these features in interaction explained 29 % of the variance in the child's Bayley Mental Scale scores, with especially mother's sensitivity and non-remoteness and infant's engagement as significant predictors in the model. Esser and colleagues (1993), with a sample of 362 first-borns with varying degrees of biological and psychosocial risks, showed that the quality of early mother-infant interaction, assessed at 3 months, was predictive of the child's cognitive performance at 2 and 4½ years. Lack of variability, contingency and responsivity in the maternal behaviour likewise low levels of stimulation as well as infant's lack of attentiveness, responsivity and engagement regarding the mother and fretfulness were predictive of poorer infant performance in cognitive tests at two years.

Behavioural and emotional development of the child

Although the importance of parent-child relationships on child development has been well documented, the effect of the quality of early mother-infant interaction on socio-emotional development of the child has gained more attention in the last ten years. Certain features of the mother-infant relationship have been shown to be associated with the socio-emotional development of the child. The mother's affective behaviour seems to be especially important. Given that emotions are powerful intra- and interpersonal regulators of behaviour (Cole et al. 1994, Siegel 2001b), maternal emotions are potentially important regulators of infants' and toddlers' socio-emotional development. For example, Denham (1989) showed among 2-3-year-olds that maternal anger was correlated with lower social competence in the child. In a study on three-month-olds, maternal affect mirroring, defined as attention maintenance, warm sensitivity and social responsiveness, was related to infants' prosocial behaviours, defined as infants' positive behaviour and increased attention towards the mother, and social expectancies for affective sharing (Legerstee and Varghese 2001). Also, parental psychopathology, which is often accompanied by disturbances in the parent-infant relationship and in the affective behaviour and emotional regulation of the parent (Cole et al. 1994), has been shown to be associated with problems in the child's socio-emotional development (Laucht et al. 1994, Murray et al. 1999). Furthermore, attachment studies have shown that there are differences in socio-emotional behaviour between children with different attachment organisation (Sroufe 1995, Murray et al. 1999), thus implying that as the quality of early mother-infant interaction is associated with the infant's attachment to the mother, early mother-infant interaction may also be associated with the child's behavioural and emotional development.

Only few studies have examined the quality of early mother-infant interaction as a predictor or antecedent of emotional/ behavioural problems in early childhood. In a study conducted by Carter and colleagues (2001) high emotional availability in the mother-child relationship when the infants were four months old was associated with fewer externalising symptoms and among girls also with fewer internalising symptoms at 30 months. Several papers have been published on a German longitudinal study on the development of first-born infants with varying degrees of biological and psychosocial risks. They assessed the quality of mother-infant interaction when the infants were 3 months of age (e.g. Esser et al. 1993). Socio-emotional problems of children at 2 and 4½ years were reported to be better predicted by the quality of early mother-infant interaction than by temperamental characteristics of the infant (Esser et al. 1993). When examining children who were stably socially withdrawn, several parameters of early mother-infant interaction were found to be related to social withdrawal: infant's gazing at the mother and positive vocalisation at three months decreased and maternal motor responsiveness increased the child's risk for social withdrawal (Gerhold et al. 2002). Laucht and his colleagues (2001) reported that maternal

responsiveness in early mother-infant interaction moderated the effects of psychosocial risks and family adversities on externalising and total problems and also influenced the consequences of low birth-weight on hyperkinetic and internalising problems.

Our understanding of socio-emotional problems and disturbances during infancy and early childhood and the ability to recognise them has increased in the last twenty years. Longitudinal studies also show that there is a remarkable continuity in childhood behavioural/ emotional problems and psychopathology, starting from infancy and toddlerhood (Lavigne et al. 1998, Keenan et al. 1998, Hofstra et al. 2000, Laucht et al. 2001). Limited data is available on the prevalence of socio-emotional problems among young children. Briggs-Gowan and colleagues (2001) reported in a community sample that the percentage of two-year-olds with possible behavioural/ emotional disturbances, i.e. scoring over subclinical or clinical range on CBCL/ 2-3 questionnaires (Achenbach 1992), was 6.7% for internalising, 9.3% for externalising and 6.0% for total problems, and 11.8% of the children scored over the subclinical range on at least one subscale. Among Finnish 3-year-olds, 8-10% of children have been reported to have one or more deviant syndrome scale in CBCL/2-3 (Uljas et al. 1999, Sourander 2001). Thus, a substantial proportion of toddlers experience problems in socio-emotional domain, and in spite of the progress made in recognising emotional/ behavioural problems and disorders in young children, we still need more knowledge of how to identify these children as early as possible, even before they develop severe symptoms. Assessing parent-child interactions would seem to give us an opportunity for early identification. However, there are many changes in mother-infant interaction in the course of development (de Weerth and van Geert 2001, Lavelli and Fogel 2002). Research previously reviewed here suggests that affective behaviour (for example hostility, anger and flat affect) and intrusiveness or withdrawal on the part of the mother, and attentiveness or avoidance on the part of the infant may have more stability in mother-infant interaction and thus more enduring effects on the child. However, more research and more evidence are needed to disentangle those features in early mother-infant interaction that may be related to later socio-emotional problems in the child and identify the children and families in need of early intervention.

Physical health of the child

The quality of early mother-infant interaction in relation to the subsequent physical health of the child has not previously been studied. There are, however, at least two streams of research that, taken together, may imply an association between mother-infant interaction and child's health. First, physical health and personal relationships have been found to be related. Attachment style has been

shown to be associated with health outcomes and a variety of health-related behaviours like symptom reporting, health care utilisation and restriction of normal activities (Feeney 2000, Ciechanowski et al. 2002). These studies, however, apply mainly to adults, adolescents and school-aged children. Secondly, in psychosomatic research, psychological stress has been shown to be associated with physical diseases like infections and asthma in adults and school-aged children (Turner Cobb and Steptoe 1996, Turner Cobb and Steptoe 1998, Wright et al. 1998, Sandberg et al. 2000). Also, early-onset asthma and difficulties in early parenting have been found to be related (Mrazek et al. 1999).

With infants, quality of relationships and psychological stress go closely hand in hand. For infants and toddlers the extent to which situations are perceived as stressful is heavily dependent on and connected to the interaction and the relationship with the caregiver. The caregiver alleviates the infant's distress by comforting, soothing and by responding sensitively to the infant's needs (Cole et al. 1994, Fox 1998). Secure attachment, evolved from sensitive, responsive and emotionally attuned infant-caregiver interactions, has been shown to decrease the physiological consequences of stress (Gunnar et al. 1996). Unsatisfying infant-caregiver interactions and impaired relationship between infant and caregiver, on the other hand, may lead to poorly developed stress regulation capacity in the infant, affect the reactivity of the child's hypothalamic-pituitary-adrenal axis and increase a child's vulnerability to stressful conditions and experiences (Gunnar 1998, Schore 2001b).

Day care centres may be assumed to be places where children's stress-coping capacities are tested. The younger the child, the larger the group of children and the more poorly developed stress regulation capacity in the child, the more likely the situation is to be experienced as stressful by the child. Daytime cortisol elevation has been demonstrated in children attending day care centres and particularly among younger children and those with more immature social skills (Dettling et al. 1999). Infections have been shown to be more common among children attending day care centres compared to children receiving family day care or home care (Wald et al. 1991, Louhiala et al. 1995). Although this is usually explained by easier transmission of microbes in large groups of children and by the immature immune system of young children, the possibility of an effect of psychological stress experienced by some toddlers in large groups of children should not be discounted.

All this evidence from previous studies suggests that early mother-infant interaction and the subsequent physical health may be related but empirical studies are few, or non-existent.

Aims of the study

The aims of the study were:

1) To examine whether early mother-infant interaction predicts the well-being of the child at two years of age (I, II).

More specifically,

1a) To examine whether the quality of early mother-infant interaction impacts on the subsequent physical health of the child at two years and during the preceding two-year follow-up (I).

1b) To examine whether the quality of early mother-infant interaction impacts on behavioural/ emotional symptoms of the child at two years (II).

2) To investigate factors associated with the quality of early mother-infant interaction (II, IV).

More specifically,

2a) To investigate the association of mother's close relationships with her behaviour in early mother-infant interaction (IV).

2b) To investigate the association of mother's mental health with her behaviour in early mother-infant interaction (II, IV).

3) To investigate the association between early mother-infant interaction and mother's perception of her infant's temperament (III).

4) To investigate the role of the infant in early mother-infant interaction (I-III).

Material and methods

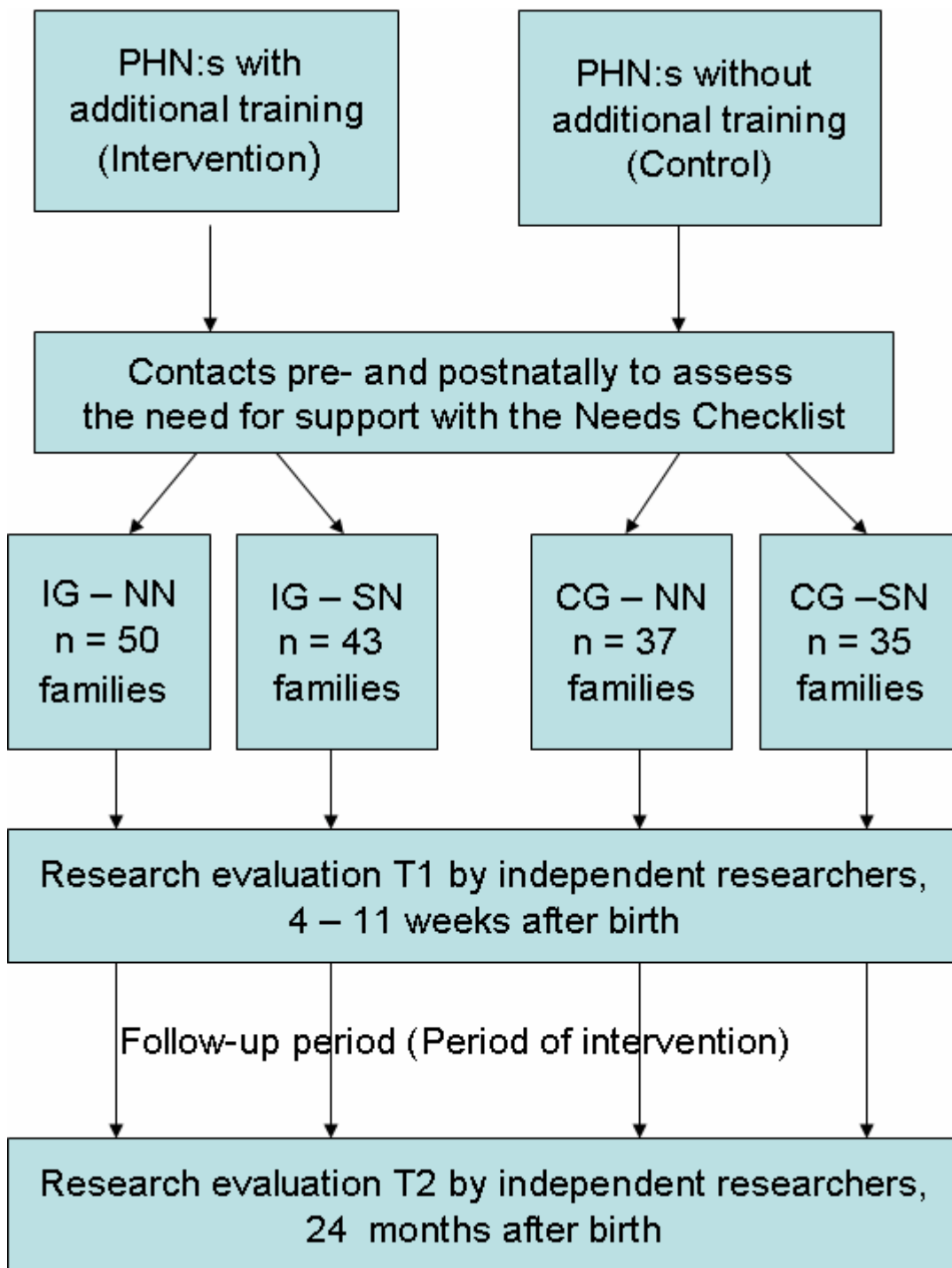
Study design

Study design of the European Early Promotion Project

The European Early Promotion Project (EEPP) is an early intervention study designed for primary health care services for infants and families. The EEPP is a collaboration of five European countries: Cyprus, the Federal Republic of Yugoslavia, Finland, Greece and the United Kingdom.

Expectant mothers within the normal population were invited by public health nurses working at well-baby clinics to participate in the study. The nurses contacted the mothers six weeks prior to delivery and four weeks postpartum and assessed the families' need for support with the help of a checklist devised to determine the risk of the children developing psychosocial problems (Davis et al. 2000, Puura et al. 2005; Appendix I). After recruiting a family with a need for support, the nurses invited the next non-risk family attending the well-baby clinic to participate. Thus, although the sample was drawn from the normal population, it was enriched with families having stressors and psychosocial problems of various sorts. Families with severe risks, such as psychotic illness of a parent, mother's treatment in a psychiatric hospital after the birth of the infant, or a history of child protection concerns were, however, excluded from the study and only full-term and healthy infants were included. Written informed consent was obtained from the participants.

Half of the nurses had received additional training in identifying families with psychosocial risks for the child's development, in supporting these families and in promoting mother-infant interaction (Layiou-Lignos et al. 2005). Moreover, during the period of the intervention (the follow-up period) they were regularly supervised by child mental health professionals. Families invited by these nurses to participate in the study formed the intervention group (n = 93 families in Finland). The rest of the public health nurses worked in a conventional way and the families they invited to participate in the study formed the control group (n = 72 families in Finland). There were families in need of support and families with no need for support in both groups (Figure 1).



PHN = public health nurse

IG = Intervention group

CG = Control group

NN = No need for support

SN = Some need for support

Figure 1. Study design and flow chart of the EEPP, Finnish subsample

To evaluate the effectiveness of the intervention, independent researchers assessed the families at the beginning of the intervention (T1), when the infants were 4 - 11 weeks of age by interviewing the mother, assessing videotaped mother-infant interaction and by means of questionnaires. After the follow-up (T2), when the children were two years old, this procedure was repeated (Figure 1).

In Finland the study was conducted in Tampere and the ethics committee of the social and welfare services of the City of Tampere approved the study.

Studies I – IV

Studies I – IV analysed the Finnish subsample of the EEPP. The measures used were from the EEPP study protocol except CBCL, which was collected only in Finland at T2.

Study I, a longitudinal study, consisted of 120 mother-infant dyads in the Finnish subsample who had been interviewed at 4-10 weeks of the infant's age, videotaped when the infant was 8-11 weeks old and who participated at the follow-up interview. Also, the health of the child during the two-year follow-up was an inclusion/ exclusion criterion. Those with serious health problems such as meningitis or sepsis were excluded. Other children were categorised into those who had chronic or recurrent health problems and those who had not.

For the purposes of this study the intervention and control groups were merged into one after analysing for possible differences and possible effects of the intervention on the outcome of this study (child's physical health). At the initial assessment there were no differences between the intervention and the control group regarding any dimensions of mother-infant interaction or the background factors (gender or birth order of the child, SES of the family, structure of the family, mother's age and infant's age at videotaping). At follow-up the intervention and the control group did not differ regarding the child's physical health, and in regression analysis group status (intervention/ control or no need/ some need) did not predict the outcome, and therefore, combining of the groups was regarded as feasible.

Study II was also a longitudinal study, and to avoid confounding effects of the intervention on interpreting the findings, the sample of Study II was formed only from the control group receiving no intervention. There were 50 control-group mother-child pairs for whom the complete data (interview and mother-infant interaction assessment at T1 and interview and mother-reported CBCL at T2) were available.

Study III analysed 124 mother-infant dyads for whom data from the T1 interview and mother-infant interaction assessment were available and who had completed questionnaires on infant temperament and parenting stress.

Study IV analysed 131 mother-infant dyads. The mothers included in this study had been interviewed at T1, assessed in mother-infant interaction and were either married or cohabiting.

A summary of the sample characteristics is presented in Table 1.

Procedure

T1 assessment: Interview

The T1 assessment was carried out by two child psychiatrists, each of whom assessed half of the participants. The initial interview was addressed to the mother and was conducted during a home visit when the infant was 4-10 weeks of age.

T1 assessment: Mother-infant interaction assessment and questionnaires

At the end of the interview a time for the videotaping to assess mother-infant interaction was scheduled to fit in the time period when the infant was 8-11 weeks old. Thus, although the interval between the interview and the videotaping varied, in all cases the interview preceded the videotaping.

The videotaped mother-infant interaction was analysed blind to any information on the mother-infant dyad or the family. The video recording took place either at home or in a laboratory when the infant was alert and not hungry. The decision as to where the video recording should take place was made by the researchers and was dependent on practical considerations such as time constraints.

At the end of the interview the mothers were also given questionnaires (ICQ and PSI) to complete. The mothers returned the questionnaires either by bringing them with them to the mother-infant interaction assessment, or by post.

Table 1. Summary of the sample characteristics and measures in Studies I-IV

	Study I	Study II	Study III	Study IV
Study setting	Longitudinal	Longitudinal	Cross-sectional (T1)	Cross-sectional (T1)
Measures				
- independent	GRS (T1) SCID (T2) (mother & father) day care (T2)	GRS (T1) SCID (T1,T2) (mother & father) day care (T2)	GRS SCID (mother) PSI	SCID (mother) mother's childhood relationship with her mother and marital relationship
- outcome	demographic factors Child's health during the follow-up (T2)	demographic factors CBCL/2-3 (T2)	demographic factors ICQ (fussy/difficult subscale)	GRS (maternal dimensions)
Sample size	120	50	124	131
Gender of children (%)				
- boys	48	46	53	50
- girls	52	54	47	50
Birth-order of children (%)				
- first	52	50	52	47
- other	48	50	48	53
SES of the family (%) ^a				
-upper/ middle	67	68	72	69
-lower	33	30	28	31
Structure of the family (T1) (%)				
-mother married/cohabiting	91	94	91	100
-mother single	9	6	9	-

Table 1. Continued

	Study I	Study II	Study III	Study IV
Structure of the family (T2)(%)				
-mother married/cohabiting	88	88	-	-
- mother single	13	12	-	-
Family's need for support assessed by PHN (%)				
- No need	53	58	55	60
- Some need	48	42	45	41

^a Upper/middle includes professionals, managerial, technical and non-manual skilled occupations.

T1 = initial assessment, infant 4-11 weeks

T2 = follow-up assessment, child 2 years

PHN = Public health nurse

GRS = Global Rating Scale for Mother-Infant Interaction (Murray et al. 1996a)

SCID = Structured Clinical Interview for DSM-IV (Spitzer et al. 1989)

T2 assessment: Interview and questionnaires

When the child was two years old the mothers were interviewed again during a home visit. After the interview the mothers were given questionnaires (CBCL) to complete and later return by post.

Measures

Interview

The interview at T1 and T2 was semi-structured, specifically designed for the EEPP (Puura et al. 2002) and based on established, validated methods (e.g. Brown and Rutter 1966; Quinton et al. 1976; Rutter and Brown 1966). It elicited information, for example, on the infant's characteristics, the parents' marital relationship, family functioning, the health of the parents and the child, the

mother's childhood experiences and her relationships to her parents, and demographic information.

At the follow-up when the children were two years old the interview was repeated but modified for the age of the child.

Health problems of the child (I)

As a part of the follow-up interview, the physical health of the child during the past two years was elicited as well as the number and the reasons for the child's visits to GPs or medical specialists. If the mother reported no or only few occasions of minor illness (like common cold, isolated ear infections) the child was considered to have no chronic health problems (NHP group). If the mother reported chronic or recurrent illnesses like recurring infections or severe allergy or asthma causing major restrictions to the child's diet or environment, or other long term problems requiring regular medication, rehabilitation and/or visits to a doctor, the child was considered to have chronic health problems (CHP group). Children reported to have had a serious, possibly life-threatening illness requiring hospitalisation (like meningitis or sepsis) but with no chronic or long-term problems were excluded from the study.

Mother's close relationships (IV)

Mother's childhood relationship with her mother as well as the quality of mother's marital relationship was elicited in the interview. No differentiation was made between those couples who were married and those who were unmarried and cohabiting but the terms "marital relationship" and "marriage" were used to refer to both conditions.

Mother's childhood relationship with her mother was assessed in the semi-structured interview through several questions regarding warmth, positive interaction and physical caring in their relationship (IV, Appendix). A sumscore was formed from these ratings and categorised at the 25th and 75th percentiles to define a positive, neutral or negative childhood relationship with the mother. The quality of the marital relationship was examined through several questions regarding the marriage. First, the quality of the marriage was assessed on a six-point scale from good (1) to very poor (6). If a rating of 2 or more was given the marriage was also judged to have either discordant or disengaged features. However, marriages rated with 2 were regarded as good ("good average"), and only marriages rated with 3-6 were regarded as poor discordant or poor disengaged (Quinton et al. 1976; IV, Appendix). Finally, three categories were defined: 1) good, 2) poor, discordant, and 3) poor, disengaged.

In order to examine whether a mother's childhood relationship with her mother and her marital relationship had a combined influence on maternal behaviour, a joint relationship variable was formed. On the basis of previous findings on the associations with the quality of maternal behaviour, indicating the most negative effect on maternal behaviour when the mother had a negative relationship with her mother or when the marital relationship was poor/disengaged, the joint variable was categorised as 0 = positive or neutral childhood relationship with the mother and a good marriage or a poor/discordant marriage (n = 84), 1 = either negative childhood relationship or poor/disengaged marriage (n = 36) and 2 = both negative childhood relationship with the mother and poor/disengaged marriage (n = 11).

Mental health problems (I-IV)

As a part of the interview, selected parts of a diagnostic psychiatric interview, the *Structured Clinical Interview for DSM-IV* (SCID, Spitzer et al. 1989) were addressed to the mothers to assess their present psychiatric status and retrospectively their mental health during and before the pregnancy, and in the follow-up interview, during the follow-up period. The mental health of the fathers was also assessed indirectly, by interviewing the mothers. Those with a psychiatric diagnosis together with some degree of social impairment were judged to have psychiatric problems.

Other

The interview also provided information on antisocial features of the parents and violence in their marital relationship (II), social factors (II) and day care (I and II). More detailed descriptions of these measures are given in the related communications.

Questionnaires

The Parenting Stress Index (PSI)

The short form of PSI (Abidin 1990) was used to assess the parenting stress of the mother (III). For each of its 36 statements mothers are asked to choose on a Likert scale (from 1= I fully agree to 5 = I fully disagree) the option that best describes their state of mind. Mothers' answers are scored from 1 (least distressed answer) to 5 (most distressed answer). The sum score of all 36 items

describes total stress. This total stress scale is formed from three subscales: parental distress (12 items), parent-child dysfunctional interaction (12 items) and difficult child (12 items).

The Infant Characteristics Questionnaire (ICQ)

The ICQ (Bates et al. 1979) was used to assess infant's temperament (III). At T1 the questionnaire was modified from the version for 6-month-olds by excluding one item enquiring the infant's response to solid food as irrelevant for 4-10-week-old infants. Normally, the ICQ contains 24 items and mothers are asked to rate infant behaviour on a 7-point scale from 1 (more optimal) to 7 (less optimal). Four dimensions of temperament are formed from the ICQ: a) fussy/difficult scale assessing infant's fussiness, irritability and soothability, b) unadaptable scale assessing the infant's reactions to new events, people, and things, c) dull scale containing items on the infant's social responsiveness and activity level and d) unpredictable scale to rate how easy or difficult it is to predict the infant's needs, for example hunger and wet nappy. The ICQ, and especially the fussy/ difficult dimension, has been found to have a good test-retest reliability and adequate validity as assessed against interview-based assessment and home observations of infant temperament and questionnaire-ratings by the other parent (Bates et al. 1979). The fussy/ difficult dimension was therefore chosen for use in the analyses (III). The possible range for the sum score of the six items of the fussy/ difficult scale is from 6 (not fussy /difficult) to 42 (very fussy/ difficult). The ICQ was used both as a continuous and as a categorised variable. When categorised, the 85th percentile of the distribution for fussy/difficult scores was used as a cut-off point, equaling approximately one standard deviation above the mean, which has previously been used as a cut-off point (Campbell 1979).

The Child Behavior Checklist/2-3 (CBCL)

The socio-emotional and behavioural problems of the children were evaluated at T2 by the Child Behavior Checklist/2-3 (Achenbach 1992), given to the mothers to complete (II). The CBCL/2-3 consists of 99 items describing the child's behavioural and emotional problems, and an additional item where parents can report other concerns they may have about child. Parents are requested to rate 2 if the item is very true or often true of their child, 1 if the item is sometimes or somewhat true, and 0 if the item is not true of their child at the time of the report or within the previous two months. The CBCL/2-3 is designed to identify syndromes of problems that tend to co-occur. The validity and reliability of the method have been found to be high (Achenbach 1992). Although CBCL/2-3 has

been widely used in Finland, in clinical work as well as in research, it has not been validated among Finnish children. Sourander (2001), however, found in his study with 374 three-year-olds that the mean total problem score was fairly similar to mean scores in studies examining population-based samples of Dutch, US and Canadian pre-schoolers.

The two broadband syndromes (internalising, including anxious/ depressed and withdrawn scales, and externalising, including aggressive and destructive scales), and total problem scores were analysed. As suggested by Achenbach (1992), raw scores were used to better portray differences in this non-clinical sample. Normalised T-scores converted from the raw scores were used only for descriptive purposes.

Observational assessment of early mother-infant interaction

The Global Rating Scale for Mother-Infant Interaction (Murray et al. 1996a) was used to analyse mother-infant interaction (I – IV). This method has shown a predictive validity to later performance (Murray et al. 1996a, Murray et al. 1996b) and a good discriminant validity in assessing the quality of mother-infant interaction among a number of clinical groups such as those with depression (vs. non-depressed), schizophrenia vs. affective disorders, social adversity (vs. no social adversity) and low-risk vs. high-risk groups (Murray et al. 1996a, Riordan et al. 1999, Gunning et al. 2002). It has also proved to be valid cross-culturally; it has been used in studies, for example, in South Africa, Venezuela, Japan and many European countries (Cooper et al. 1999, Gunning et al. 2002). The Winnicott Research Unit trained the researchers of the EEPP in the use of the Global Rating Scale. To ensure that the results are comparable with other studies using this instrument, the inter-rater reliability was evaluated between the trainer and the trainees and the required reliability (at least 90 % of the scores were within one point of the original score and at least 45% exactly the same) was achieved.

In the Global Rating Scale procedure a mother and her infant interact face-to-face for five minutes without using toys. The video recording captures the full-face image of the infant, the infant's upper limbs and trunk, and, through a mirror placed adjacent to the infant, also the mother's full-face reflection. Twenty five items are scored on a five-point scale from 1 (poor) to 5 (good), and clustered to form dimensions, including three maternal dimensions to describe the mother's behaviour, two infant dimensions to describe the infant's behaviour and a dimension of dyadic interaction to describe how mother and baby and their actions fit together (Table 2). These dimensions were used both as continuous ratings and as categorised variables where poor behaviour was distinguished by the cut-off point separating the poorest 15% in the whole EEPP Finnish subsample.

For the purposes of Study II new variables were formed of maternal items to identify maternal hostility, flat affect and insensitivity. Hostility included three items (warm-hostile, accepting-rejecting and non-demanding-demanding), flat affect three items (happy-sad, non-flaccid – flaccid and absorbed in infant – self-absorbed) and insensitivity two items (responsive-unresponsive and sensitive-insensitive).

Table 2. Dimensions of mother-infant interaction from the Global Rating Scale of Mother-Infant Interaction (Murray et al. 1996a)

Maternal scales

Mother's interactive behaviour¹

warm, positive - cold, hostile
 accepting - rejecting
 responsive - unresponsive
 nondemanding - demanding
 sensitive - insensitive

Mother's intrusiveness or remoteness²

non-intrusive behaviour - intrusive behaviour
 non-intrusive speech - intrusive speech
 non-remote - remote
 non-silent - silent

Mother's affective behaviour¹

happy - sad
 non-flaccid - flaccid
 absorbed in infant – self-absorbed
 relaxed - tense

Infant scales

Infant's interactive behaviour¹

attentive to mother - avoidant
 active communication - no active communication
 positive vocalisations - no positive vocalisations

Infant's inertness or fretfulness²

engaged with environment – self-absorbed
 lively - inert
 attentive - avoidant
 happy - distressed
 non-fretful - fretful

Interaction scale

Dyadic mother-infant interaction¹

smooth, easy - difficult
 fun - serious
 mutually satisfying - unsatisfying
 much engagement - no engagement
 excited engagement - quiet engagement

¹ The mean score of the items is calculated ; range from 1 (poor) to 5 (good).

² The difference between intrusiveness (mean score of the first two items) and remoteness (mean score of the last two items) or inertness (mean score of the first three items) and fretfulness (mean score of the last two items) is calculated and then divided by two; range from -2 (intrusive or inert) to +2 (remote or fretful); 0 describes the optimal state.

Statistical methods

All statistical analyses were accomplished with SPSS for Windows version 9.0 statistical software. First, bivariate analyses were conducted, either with cross-tabulations with Fisher exact test, or comparing continuous variables between categorised groups with Mann-Whitney U-test or Kruskal-Wallis analysis of variance (Studies I, II, IV), or Student's t-test (III). Correlations between continuous variables were also investigated in Studies I and III. Finally, multiple regression models were analysed in all studies using binary logistic regression, and in Study III also using linear regression. The results of the logistic regression analyses were reported as odds ratios (OR) and their 95% confidence intervals (CI), the results of the linear regression were reported as the proportion of the variance each significant model explained and by standardised β s indicating the direction and magnitude of the influence of each variable in the final model. Two-tailed P-values < 0.05 were considered as statistically significant. In Study I values < 0.15 and in Study IV values < 0.10 were reported.

In Study I, the associations between the child's health (no chronic health problems versus chronic or recurrent health problems) and other categorical variables were investigated by cross-tabulations. The mother-infant interaction variables were also dichotomised. To analyse the interdependence of the mother-infant interaction variables, they were also used as continuous variables, and analysed by the Mann-Whitney Test and the Spearman Rank Correlation. A two-phase logistic regression analysis was carried out in order to ascertain the combined effects of variables on chronic or recurrent health problems.

In Study II, CBCL raw scores were used as continuous variables and, because of somewhat skewed distributions, they were described as medians and quartiles. Their differences between categories of other variables were tested with Mann-Whitney or Kruskal-Wallis test, as appropriate. Mother-infant interaction variables were categorised to define deviant and non-deviant behaviour. Logistic regression analyses were used to examine the simultaneous effects of variables on high CBCL problem scores.

In Study III, two different approaches were selected. First, the difficultness scale of the temperament measure was used as a continuous variable and analysed using parametric tests: Student's t-test for bivariate analyses and linear regression for multivariate modelling. Secondly, infants were categorised into difficult and non-difficult and factors increasing the infant's risk of being perceived as difficult were examined by logistic regression.

In Study IV, nonparametric tests were chosen for continuous variables due to small sample sizes and somewhat skewed distribution in mother-infant interaction variables. Mother's close relationships were categorised into three

groups and the quality of maternal behaviour in mother-infant interaction between these groups was compared by the Kruskal-Wallis analysis of variance. Post-hoc pairwise comparisons were performed using the Mann-Whitney U-test with Bonferroni corrections due to multiple analyses. To evaluate the effect of maternal psychopathology on the association of maternal behaviour and close relationships, analyses were performed separately for healthy mothers and for mothers with psychiatric problems. To investigate predictive factors of poor maternal behaviour, binary logistic regression was used.

Summary of the results

Early mother-infant interaction as a predictor of the child's well-being at two years of age (I, II)

Early mother-infant interaction and the physical health of the child

Out of 120 mother-child pairs analysed in Study I, 24 (20%) were reported by their mothers to have recurrent or chronic health problems and 96 (80%) had no chronic health problems during the two-year follow-up. Thirteen children suffered from recurrent infections, three from allergy or asthma and six from both recurrent infections and allergy/ asthma. One of the other two judged to have chronic health problems had Erb's paresis and the other developmental delay.

In bivariate analyses poor dyadic mother-infant interaction at two months was significantly associated with the child's chronic health problems (CHP) during the subsequent two years, with 33% of the CHP group children having poor dyadic mother-infant interaction, compared to 14 % of children with no chronic health problems (NHP) ($p = 0.034$). In addition, 42% of the CHP group infants had shown poor interactive behaviour at two months, compared to 22% of the infants in NHP group ($p = 0.067$).

Because chronic health problems of the children were also significantly associated with day care centre attendance, with 63% of the CHP group children attending day care centres compared to 30% of the NHP group children ($p = 0.005$), the association of poor dyadic mother-infant interaction with the child's health was examined separately for those attending day care centres ($n = 44$). Forty percent (6/15) of the CHP group children at day care centres had had poor dyadic mother-infant interaction, compared to 10% (3/29) of children with no chronic health problems attending day care centres ($p = 0.044$). The quality of mother-infant interaction was not related to the choice of the day care system by any dimensions of mother-infant interaction.

After adjusting for other factors suggested by cross-tabulations (psychiatric problems of the mother, or of the father, day care centre attendance, number of day care places, infant's physical health at T1) in logistic regression, infant's poor interactive behaviour remained as a significant predictor of the child's

chronic health problems, increasing the child’s risk for chronic health problems over three-fold (OR 3.4, 95% CI 1.1-10.3). Infant’s health problems at the initial interview at T1 and day care attendance were also significant predictors of the child’s chronic health problems. Psychiatric problems of the mother had some, though non-significant effect. Dyadic mother-infant interaction was, however, removed from the model (Table 3).

Table 3. Impact of risk factors on child recurrent or chronic health problems (T2¹), as derived by logistic regression, expressed in odds ratios (OR) and their confidence intervals (95% CI)

Risk factors ²	OR	95% CI
Infant’s health problems at T1 ¹		
no problems	1.0	
problems	6.6	1.2 - 35.8
Day care centre attendance		
no	1.0	
yes	4.7	1.7 - 13.3
Infant’s interactive behaviour		
good	1.0	
poor	3.4	1.1 - 10.3
Psychiatric problems of the mother		
no	1.0	
yes	2.4	0.9 - 6.5

¹ Time of assessment:

T1= initial assessment, at 4 – 10 weeks of age

T2 = follow-up assessment, at two years of age

² The variables in the final regression model were derived from the results of cross-tabulations and previous logistic regression analyses. Dyadic mother-infant interaction was added to the model as a risk factor but did not remain in the model as a predictor of chronic or recurrent health problems.

Early mother-infant interaction and behavioural and emotional symptoms in the child

The medians with lower and upper quartiles for the CBCL raw scores were for the fifty control-group children in Study II as follows: 3.5 (2.0, 6.0) for internalising, 11.5 (6.0, 16.0) for externalising and 27.0 (19.5, 37.3) for total problem scores. In order to examine the predictors of a child's high problem scores in logistic regression, the raw scores were categorised by 75th percentile. According to this cutpoint, 10 children scored high on the internalising scale, 11 on the externalising scale and 12 on the total problem scale. When the definition by Achenbach (1992) was used, none had internalising symptoms (T scores over 67), one child had externalising borderline symptoms (T scores 67-70) and this child was also within a clinical range of the total problem scores with a T score of 72. Two other children had total problem T scores within the borderline range (60-63).

The association of behavioural and emotional symptoms of the child at two years of age with deviant features in early mother-infant interaction such as intrusiveness, hostility, remoteness, flat affect and insensitivity of the mother and avoidant behaviour of the infant were examined. Mother's hostility was significantly related to higher internalising scores, and her intrusiveness was almost significantly related to higher total problem scores (II, Table 2). Hostility and/or intrusiveness together were significantly related to higher internalising and total problem scores (II, Table 2). There were no differences in CBCL raw scores between mothers with non-deviant and deviant features in early mother-infant interaction regarding mother's insensitivity, remoteness, flat affect or the combination of remoteness and/or flat affect, or between avoidant and non-avoidant infants (II, Table 2).

When adjusted for other factors possibly predicting high (over the 75th percentile) internalising, externalising and total problem scores (psychiatric problems of the father, or of the mother, and day care started at or before the first birthday, suggested by cross-tabulations and/or separate logistic regression models), mother's hostility and/or intrusiveness was a significant predictor of high externalising symptoms and of high total problem scores (Table 4).

Table 4. Impact of risk factors on high (scores over 75th percentile) internalising, externalising and total problem scores (T2), as derived by logistic regression and expressed in odds ratios and their 95% confidence intervals in parentheses.

	Internalising symptoms OR (95%CI)	Externalising symptoms OR (95% CI)	Total problems OR (95% CI)
Mother's psychiatric problems before pregnancy ^a	---	11.8(1.4-101.8)	---
Father's psychiatric problems at any time point	15.5(2.7-87.7)	9.4 (1.1-79.3)	18.4 (1.9-173.0)
Hostility and/or intrusiveness of the mother in mother-infant interaction		10.3 (1.1-95.5)	11.8 (1.5-91.3)
Day care started before or on first birthday ^b	---	7.2(1.0-52.8)	11.8(1.5-91.3)

^a This variable was not included in the final regression model for high internalising or total problem scores.

^b This variable was not included in the final regression model for high internalising problem scores.

T2 = follow-up assessment, when the child was two years old

Factors associated with maternal behaviour in early mother-infant interaction (II, IV)

Mother's close relationships and maternal behaviour

Mother's childhood relationship with her mother was associated with mother's interactive and affective behaviour but not with the mother's intrusiveness or remoteness (IV). The interactive behaviour of mothers with a negative childhood relationship with their mothers was significantly poorer

compared to that of mothers describing the childhood relationship with their mother as positive. The influence of a mother's relationship with her mother on the affective behaviour of the mothers was even more noteworthy. Both mothers who described their childhood relationship with their mother as neutral and mothers reporting a negative relationship were significantly poorer in their affective behaviour, compared to mothers reporting a positive childhood relationship with their mother (Table 5).

Table 5. The quality of maternal interactive and affective behaviour in early mother-infant interaction by mother's childhood relationship with her mother among all mothers, mothers with psychiatric problems and mentally healthy mothers. Higher scores indicate better maternal behaviour. Medians with lower and upper quartiles are reported.

	Mother's childhood relationship with her mother			p ^a
	Positive	Neutral	Negative	
All mothers	(n = 41)	(n = 53)	(n = 37)	
Interactive behaviour	4.0 (3.6, 4.2) ^A	3.6 (3.0, 4.2)	3.4 (3.0, 4.0) ^{A**}	0.011
Affective behaviour	4.5 (4.0, 4.7) ^{BC}	4.0 (3.5, 4.3) ^{B**}	3.7 (3.5, 4.3) ^{C**}	<0.001
Mothers with psychiatric problems	(n = 7)	(n = 7)	(n = 9)	p ^a
Interactive behaviour	4.0 (3.6, 4.6)	3.2 (2.8, 4.0)	3.6 (3.4, 4.0)	N.S.
Affective behaviour	4.7 (4.5, 5.0)	4.0 (3.6, 4.5)	4.0 (3.3, 4.6)	0.068
Mentally healthy mothers	(n = 34)	(n = 45)	(n = 28)	p ^a
Interactive behaviour	4.0 (3.6, 4.2) ^D	3.6 (3.0, 4.3)	3.4 (3.0, 4.0) ^{D*}	0.039
Affective behaviour	4.5 (3.9, 4.7) ^{EF}	4.0 (3.5, 4.3) ^{E*}	3.7 (3.5, 4.2) ^{F*}	0.004

^aThe significance is for the Kruskal Wallis Test comparing all three groups.

The same superscript (A-F) indicates the groups between which there are significant differences in post hoc comparisons.

Significances in pairwise comparisons with Bonferroni corrections:

* p < 0.05, ** p < 0.01

N.S. = non-significant

The quality of the marital relationship was related to the mother's interactive behaviour but not to intrusiveness/ remoteness or affective behaviour (IV, Table 3). Mothers with a poor/disengaged marital relationship were significantly poorer in their interactive behaviour than mothers with a good marital relationship.

Mother's close relationships had a joint effect on the mother's interactive behaviour (IV). Mothers were divided into three groups according to the quality of their close relationships: 1) Mothers with positive or neutral childhood relationship with their mothers together with a good or poor/discordant marital relationship, $n = 84$; 2) Mothers with either negative childhood relationship with their mother or a poor/disengaged marital relationship, $n = 36$; and 3) Mothers with both negative childhood relationship with their mother and poor/disengaged marriage, $n = 11$. Regarding the mother's interactive behaviour there were significant differences among the three groups, $Md\ 3.9$, ($Q_1\ 3.3$, $Q_3\ 4.2$), 3.4 (3.0 , 4.0) and 3.4 (2.6 , 3.8) respectively, $p = 0.010$. In post hoc comparisons significant differences emerged between the first and the second groups. The affective behaviour of the mothers did not differ significantly between the groups.

Mother's mental health and maternal behaviour

In Study IV 23 mothers (18%) and in Study II 6 mothers (12%) had had psychiatric problems perinatally, i.e. during the pregnancy or postnatally 4-10 weeks after delivery. There were no significant differences in the quality of the maternal behaviour (mother's interactive behaviour, intrusiveness/remoteness or affective behaviour) in early mother-infant interaction between mothers with mental health problems and healthy mothers (IV). Nor were perinatal psychiatric problems related to deviant features in maternal behaviour such as intrusiveness, hostility, remoteness, flat affect or insensitivity (II).

However, mother's intrusiveness and/or hostility in early mother-infant interaction were significantly associated with the *subsequent* mental health of the mother: of the intrusive and/or hostile mothers none (0/12) had mental health problems during the two-year follow-up, compared to 16 (16/38, 43%) of the non-intrusive and non-hostile mothers ($p = 0.005$) (II).

Combined effect of mother's close relationships and psychopathology on maternal behaviour

The association between mother's childhood relationship with her mother and the quality of maternal behaviour was not explained by mental health problems

of the mother (IV). When analyses were conducted separately for mothers with psychiatric problems and healthy mothers, the pattern of association in both groups was similar to that of all mothers, but significant differences in maternal behaviour were found only among healthy mothers (Table 5).

Mental health problems of the mother seemed to aggravate the effect of a poor marital relationship on the mother's interactive behaviour, as the association was significant and more obvious among mothers with psychiatric problems. Among healthy mothers the quality of the marital relationship and the maternal behaviour in the mother-infant interaction were not related (IV, Table 3).

To investigate factors increasing a mother's risk of poor interactive behaviour with her two-month-old infant, a binary logistic regression was carried out with the joint relationship variable and the mother's perinatal mental health as predictors (IV). The mother's risk of poor interactive behaviour with her child was increased almost three-fold if she either had a negative childhood relationship with her mother or a poor/disengaged marital relationship (OR 2.7, 95% CI 1.0 - 6.9, $p = 0.042$) and over five-fold, if her childhood relationship with her mother was negative and her marital relationship was disengaged (OR 5.3, 95% CI 1.3 – 21.0, $p = 0.017$). The mother's perinatal mental health problems were not statistically significantly predictive of poor maternal interactive behaviour, although this variable remained in the model as a non-significant factor (OR 0.3, 95% CI 0.1 – 1.3, N.S.).

Early mother-infant interaction and mother's perception of her child's difficult temperament (III)

In the study sample, the mean score on the ICQ difficult temperament scale was 18.8 (SD 5.5). None of the dimensions of early mother-infant interaction significantly contributed to the mother's perception of her infant's temperament as more or less difficult, when the dimensions were used as continuous variables. A model including parental distress and mother's mental health explained 24% of the variance in infant difficultness (III, Table 3).

When the infants were categorised as difficult and not difficult, the 85th percentile of the difficultness score distribution was used as a cutpoint. Logistic regression was carried out in order to identify factors increasing the infant's risk of being perceived as difficult. Mother's intrusiveness and infant's poor interactive behaviour (i.e. avoidance, lack of active communication and positive vocalisation) increased the infant's risk of being perceived as difficult, the mother's intrusiveness over 7-fold and the infant's poor interactive behaviour

over 3-fold. Also, parental distress was a significant predictor of mother's perception of her infant as difficult (Table 6).

Table 6. Factors increasing infant's risk of being perceived as difficult. Parental distress, mother's mental health, mother's intrusiveness and infant's interactive behaviour were introduced into the regression analysis conducted with backward stepwise method. Results are expressed in odds ratios and their 95% confidence intervals for the variables left in the model in the final stage.

	OR	95%CI	p
Parental distress			
non-distressed (n = 103)	1.0		
distressed (n = 21)	10.3	2.7 - 38.9	0.001
Mother's intrusiveness			
non-intrusive (n = 101)	1.0		
intrusive (n = 23)	7.6	2.1 - 27.6	0.002
Infant's interactive behavior			
good (n = 94)	1.0		
poor (n = 30)	3.7	1.0 - 13.3	0.042

Role of the infant in early mother-infant interaction (I-III)

Factors relating to infant behaviour

In Study III, correlations between infant and maternal dimensions in early mother-infant interaction were examined. Infant's interactive behaviour was only weakly, though significantly, correlated with mother's interactive and affective behaviour (Table 7). However, in Study I, when the infants were categorised into those who were poor and those who were good in their interactive behaviour, significant associations between infants' and mothers' behaviour were found: The interactive behaviour of mothers of infants interacting poorly was significantly poorer compared to that of mothers of infants with good interactive behaviour (median 3.2, quartile range 3.0 - 3.8 vs. 4.0, 3.4 - 4.3, $p < 0.001$). The same applied to mothers' affective behaviour (3.7, 3.5 - 4.0 vs. 4.2, 3.6 - 4.6, $p = 0.004$) (I).

Infant dimensions were moderately and significantly positively correlated (Table 7), indicating that more inert infants were poorer in their interactive behaviour. Infant's physical health at T1 was related neither to infant's interactive behaviour nor to infant's inertness/ fretfulness in early mother-infant interaction (I). The perinatal mental health problems of the mother were not associated with infant's poor interactive behaviour (II).

Table 7. Correlations between maternal (M) and infant (I) behaviour in early mother-infant interaction (n = 124)

	2	3	4	5
1. Interactive behaviour (M)	0.07	0.66**	0.28**	0.07
2. Intrusiveness/ remoteness (M)		-0.36**	-0.06	-0.11
3. Affective behaviour (M)			0.30**	0.17
4. Interactive behaviour (I)				0.46**
5. Inertness/ fretfulness (I)				

* $p \leq 0.05$, ** $p \leq 0.01$

Infant's poor interactive behaviour and aspects of the dyad

Infant's poor interactive behaviour was found to be a predictor of the child's chronic health problems during the subsequent two years (I) and to increase the infant's risk of being perceived as difficult (III). In Study II, examining 50 mother-child pairs, infant's poor interactive behaviour was not associated with the child's CBCL scores.

The dimension of dyadic mother-infant interaction was significantly related to chronic health problems of the child (I). When adjusted for other factors in logistic regression, poor dyadic mother-infant interaction was no longer a predictor of the child's health. However, infant's poor interactive behaviour was

(Table 3, page 53). There were also significant correlations between interaction dimensions. Dyadic mother-infant interaction was significantly correlated with infants' interactive behaviour ($r = 0.79$, $p = 0.01$), mother's interactive behaviour ($r = 0.51$, $p = 0.01$) and mother's affective behaviour ($r = 0.54$, $p = 0.01$) (I).

Summary of associations of early mother-infant interaction

Some features of early mother-infant interaction were predictive of infant's well-being at two years of age and were concurrently associated with infant temperament. Mother's close relationships could be regarded as determinants of maternal behaviour in early mother-infant interaction. In this study mother's mental health problems were not related to maternal behaviour in early mother-infant interaction. The main findings are presented in Figure 2.

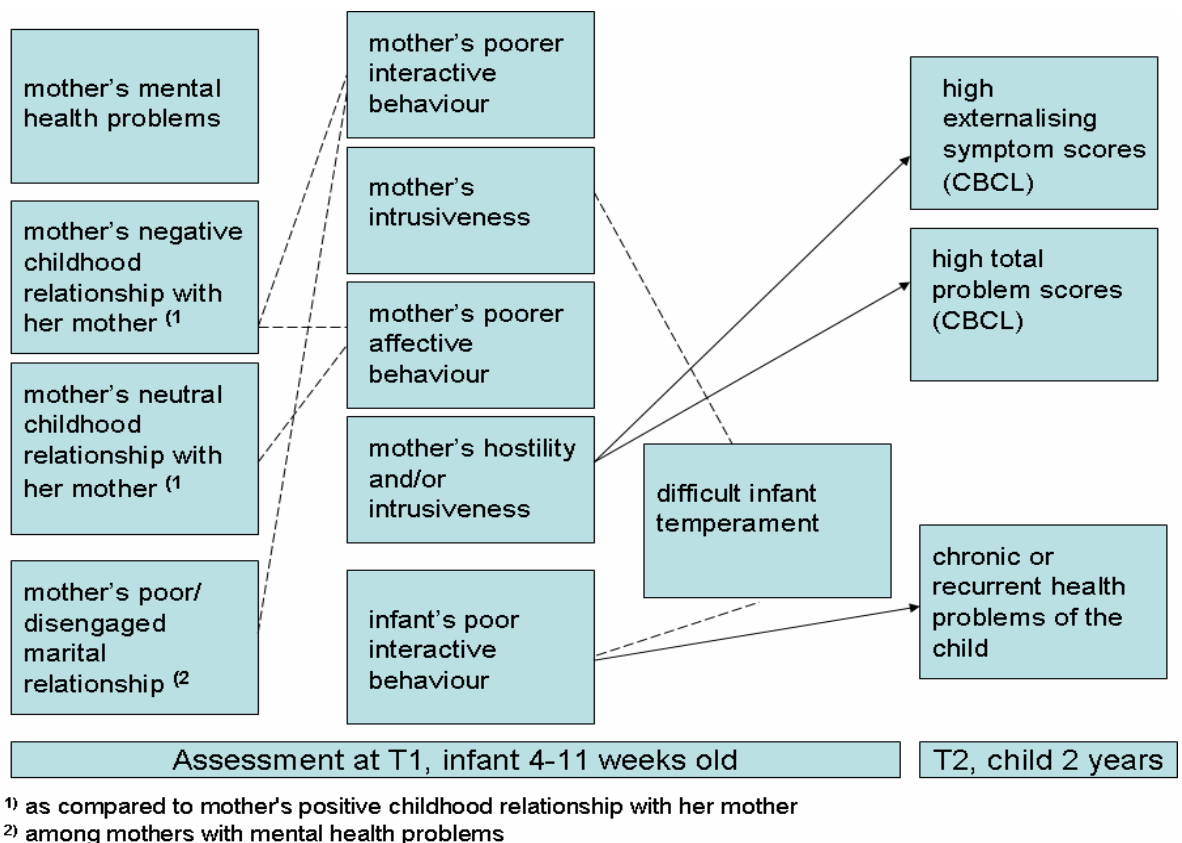


Figure 2. Main findings of associations of early mother-infant interaction. Dotted lines (- - -) represent associations and arrows (→) predictivity.

Discussion

Strengths and limitations

When interpreting the findings of the present study the limitations as well as the strengths of the study must be borne in mind. These aspects are discussed first generally, regarding the study design, sample and methods.

Study design

The study design was defined and the methods were chosen for the purposes of the more extensive EEPP intervention study. The aims of the intervention study guided the selection of methods and governed the assessment points. If the research questions of this study have guided the design of the study, the choice of the methods, sampling and the assessment points may well have been somewhat different. For example, mother-infant interaction could have been assessed at several time-points (e.g. 2, 12 and 24 months) using a method which is appropriate for different age-groups and the child outcome could have been assessed by reference to medical records to examine child's health problems, or by clinical assessment of the child to assess emotional/behavioural symptoms, in addition to parents' reports. Moreover, intervention-control design would not have been adopted. However, even if the research questions are not at the very core of the aims of the wider study, it is ethically and economically highly advisable to take advantage of all information and data the study offers, because a large group of participants was involved, examined thoroughly and followed up for a considerable period of time.

Dividing the groups into intervention and control groups is naturally essential in order to examine the effects of the intervention. However, in the present study, which investigates concurrent and subsequent associations of early mother-infant interaction and not the effect of the intervention, intervention-control group combination is a complicating factor. In the longitudinal studies (I and II) an attempt was made to avoid the confounding effects of the intervention by two different strategies: In Study I careful analyses were conducted to assess the possible differences between the two groups and the possible effects of the intervention on the outcome of the study (i.e. child's physical health). Since no differences between the intervention and the control group were found regarding

any dimensions of mother-infant interaction or the background factors (gender or birth-order of the child, SES of the family, structure of the family, mother's age and infant's age at videotaping) and since at follow-up the intervention and the control group did not differ regarding the child's physical health, and the group status (intervention/ control or no need/ some need) did not predict the outcome, the groups were combined. In Study II, on the other hand, only the control group mother-infant dyads were assessed, resulting in a smaller sample. In Studies III and IV, which were cross-sectional and analysed data from T1 assessment at the beginning of the intervention, the intervention and control groups were merged and examined as one after the possible differences between the groups had been carefully assessed and no differences found.

In cross-sectional studies it must be remembered that the question of the direction of the effect and the causality cannot be addressed. Although the cause-effect relationships may be theoretically interesting and require further research, in clinical work, and also in child psychiatric research, it is seldom that true linear, cause-effect associations can be verified, and often the association of the phenomena, and not the causal relationship, is essential. It is also often true that the influences are bi-directional because child development is a product of transactions between nature and nurture.

Sample

The participants of the present study were Finnish mothers and their infants. The fathers of the infants with a few exceptions were also Finnish. The participating families were doing quite well socio-economically. Thus, the results may not be generalised to more disadvantaged and culturally more diverse populations. Although from the viewpoint of generalisability the homogeneity and upper/middle-class status may be seen as limitations, from the perspective of understanding the influence of mother-infant interaction they may also be seen as strengths of this study. Although approximately half of the participants had psychosocial problems of various sorts, the families with the most severe risks and adverse conditions had been excluded from the study. This may emphasise the findings as true (findings of the associations of the quality of early mother-infant interaction and child developmental outcome, or the findings of factors associated with the quality of early mother-infant interaction), not confounded by associated adversities. Adverse conditions such as poverty, low level of education, antisocial background and single motherhood are usually regarded as risk factors for a child's development (e.g. Zeanah et al. 1997). However, in developed countries with good social welfare services, these adversities cannot solely explain the fact that in epidemiological studies about 15-20% of school-aged children are defined as disturbed or in need of psychological or psychiatric help (Almqvist et al. 1999, Puura et al. 1999, Costello et al. 2003). By focusing on a sample with less severe psycho-social risks it is possible to find other

important risks, operating perhaps more on the relationship level and not in the social context.

The sample size must also be considered as a limitation and the findings therefore as tentative. Due to sample selection, the number of cases varied between 50 and 131. With small samples and infrequent phenomena the effect of chance increases. However, it is more likely that a true association fails to emerge as statistically significant. Thus, the unexpected findings of an absence of association may have been due to a small sample and, especially when the sample was further divided into various categories, to a small number of cases in each category. On the other hand, when compared to other studies assessing the quality of mother-infant interaction by observational methods (e.g. Field 1984, Campbell et al. 1995, Schuler et al. 1995, Murray et al. 1996a, Feldman et al. 1997, Pajulo et al. 2001, Crandell et al. 2003, Field et al. 2003), the samples in Studies I, III and IV, including 120-131 videotaped and thoroughly analysed mother-infant interactions with two-month-old babies, may be considered as large and even the sample of 50 mother-infant dyads in Study II as moderate.

Methods

One of the strengths of this study is the use of a variety of assessment methods: interviews, observations and self-reports. For example, mothers' mental health was assessed in a diagnostic psychiatric interview which allowed many kinds of psychiatric disturbances to be examined. The questionnaires in the study have been extensively used in child psychiatric research and their validity and reliability have been well established. The Global Rating Scale used to investigate the quality of early mother-infant interaction was developed specifically to assess infants at two months of age interacting face-to-face with their mothers (Murray et al. 1996a).

However, even though the strengths of the methods are undeniable, there are also some limitations. Child outcome at two years, behavioural and emotional symptoms and the child's health during the first two years were based on the mother's reports on the child's problems. Parents' view of their child's behaviour and problems is important and an essential part of a clinical assessment of the child. However, one should be aware of the limitations and possible problems inherent in the use of parent reports, and also of the factors that influence parents' evaluation and perceptions of their child. These aspects will be further discussed later in the chapter.

It should be remembered that the choice of the methods, also the choice of the observational assessment method, inevitably affects the results. Assessing mother-infant interaction as early as at two months, around the first biobehavioural shift, is difficult and even methods designed for this age group,

such as the Global Rating Scale, may not be sensitive enough to capture all the important aspects of interaction.

Early mother-infant interaction as a predictor of child's well-being

There are certain deviant features to be found in early mother-infant interaction that seem to be associated with the child's less than optimal outcome at two years of age and during the preceding two-year-follow-up. Infant's poor interactive behaviour at two months of age (i.e. avoidance of the mother and lack of active communication and positive vocalisations) was predictive of the child's chronic or recurrent health problems during the subsequent two years (I). Mother's hostility and/ or intrusiveness increased the child's risk for emotional/behavioural problems by increasing the risk for high externalising and total problem scores at two years, assessed by the CBCL/2-3 (II).

Regarding the association of early mother-infant interaction and child's physical health (I) we lack studies earlier assessing this particular association. However, the study by Mrazek and his colleagues (1999) shows parallel findings when they conclude that parenting difficulties as early as three weeks after the birth of the infant predicted the onset of asthma by 3 years of age in children considered to be at a genetically elevated risk for the development of asthma. No observation of mother-infant interaction was included in their study but parenting difficulties were assessed in a semi-structured interview dealing, for example, with parents' psychiatric history, emotional availability, behavioural regulation strategies, and knowledge about and commitment to infant care. In Study I, the infant's risk for chronic or recurrent health problems was also increased by health problems at the initial interview, suggesting that some young children may be biologically more susceptible to recurrent infections, allergy or asthma. Also, day care centre attendance predicted chronic or recurrent health problems, which has also been shown in other studies (Wald et al. 1991, Louhiala et al. 1995). However, the results emphasise that it is probably not merely the number of microbes and the immature immune system of young children that explain the recurrent infections in day care. Even among children attending day care centres the quality of early mother-infant interaction and chronic or recurrent health problems of the child were significantly related.

In Study II three children (6.0%) could be regarded as problematic, i.e. they had symptoms exceeding the subclinical threshold on the total problem scale (T score over 60). This finding is in accordance with the prevalence estimations given by Briggs-Gowan and her colleagues (2001) for two-year-olds in a

community sample. Regarding the finding of mother's hostility and/or intrusiveness predicting the child's high externalising and total problem scores, the findings of Esser and colleagues (1993) are congruent. They reported that mother's rejection and neglect were major features of poor mother-infant interaction predicting socio-emotional problems of toddlers and preschool-aged children. Also, the study by Carter et al. (2001) showed an inverse correlation between emotional availability at 4 months and the child's externalising symptoms at 30 months (i.e. the lower the emotional availability, the higher the externalising symptom scores). The Emotional Availability Scales also assess intrusiveness and hostility of the mother and avoidant behaviour of the infant (Biringen 2000). In this method a greater degree of intrusiveness or hostility, or the infant's more avoidant behaviour results in lower emotional availability. In the study by Carter and her colleagues a composite score was used to describe emotional availability in the dyad, i.e. all the dimensions of the Emotional Availability Scales had been summed up.

One of the intriguing issues in the development of a child is the question of stability and change. The development of an infant and young child is rapid and biobehavioural shifts imply changes and discontinuities in the development (e.g. Zeanah et al. 1997). Also, the parent-infant interaction changes enormously, and variability and change are normal and important features of healthy infant-caregiver interaction, both within a dyad and between dyads (Lavelli and Fogel 2002, de Weerth and van Geert 2002). Thus, good infant-caregiver interaction encompasses a wide range of behaviours, both on the part of the caregiver and of the infant. On the other hand, there must be continuity of some features throughout an individual's development and major transitions, likewise sufficient stability and predictability in patterns of interaction are required for normal development (Emde 1983, de Weerth and van Geert 2002). Subjective, affective experiences have been hypothesised to account for continuity in the development of an individual (Emde 1983, Fonagy 2001). The results of Studies I and II also imply that those observable features in early mother-infant interaction that are related to affective behaviour or reflect affective experiences might be stable enough to be predictive of subsequent outcome in the child. Two-month-old infants are very sensitive to the emotional tone of the interaction and the timing of the mother's expressions (Murray and Trevarthen 1985, Trevarthen and Aitken 2001, Stormark and Braarud 2004). Thus, infants are aware of the mother's hostile affective display manifest in her tone of voice, facial and body movements, timing and rhythm of the expressions (Trevarthen and Aitken 2001). Intrusiveness of the mother, interfering in the child's activities and showing poor timing, may be interpreted by the infant as an unsympathetic and negative action, no matter how playful or loving the mother might be. On the other hand, infant's avoidant behaviour may be seen as a reflection of the infant's distress (Guedeney and Fermanian 2001).

Emotional regulation

One of the perspectives from which the relationship of early mother-infant interaction and infant's subsequent physical health and behavioural/emotional symptoms can be addressed and understood is the child's emotional regulation and stress coping capacities and their development. Emotions are fundamentally integrating and interconnecting by nature, and means of sharing between a mother and a child (Siegel 2001b, Trevarthen and Aitken 2001). The ability to express emotions and regulate them in a socially appropriate manner is part of a healthy development (Cole et al. 1994). Temperamental differences imply biological differences in the threshold to response, in the variability of the response and in the manner the responses are modulated (Fox 1998). However, the further development of the responses and their modulation, and thus, individual variations in experiencing stress and ability for emotional regulation are developed through the infant-caregiver relationship (Cole et al. 1994, Sroufe 1995, Gunnar 1998).

From the beginning both the baby and the mother contribute to the regulation of the infant's emotional state (Tronick 1989, Cole et al. 1994, Sroufe 1995). Looking away, self-stimulation and self-comforting are the baby's means of regulating emotions (Tronick 1989, Cohn and Tronick 1989). However, an infant's emotional regulation capacities are limited, immature and poorly coordinated and he/ she is incapable of accomplishing the task of emotional regulation alone without the help of the caregiver (Tronick 1989). Affective communication between the infant and the caregiver, sharing of affects, and the caregiver's empathic understanding of the infant's affective state may be seen as prerequisites in the process of emotional regulation (Stern 1985, Tronick 1989, Trevarthen and Aitken 2001). After understanding the infant's needs, the caregiver may respond in many ways, for example she/ he may relieve the infant's distress by soothing and comforting, or by nurturing, caring or providing the infant with whatever is appropriate regarding the infant's needs, whether physiological or psychological (Tronick 1989, Cole et al. 1994, Fox 1998). Emotional regulation does not include only a reduction of negative emotions but also sharing, amplification and intensification of the experience of positive affective states (Schore 2001a). The experience of sharing emotional states, and especially the experience of interactional repair, i.e. a shift from a mismatched, non-shared state to a matched, shared state (Tronick 1989, Biringen et al. 1997) has been hypothesised to be highly rewarding for the infant, expanding the infant's experiences to more organised, coherent and complex states (Tronick et al. 1998, Siegel 2001b), thereby fostering healthy psychological development.

If the caregiver cannot provide as much empathic help as the infant needs to successfully regulate his/her emotions, the infant is likely to show signs of distress like crying or gaze aversion (Tronick 1989, Weinberg and Tronick 1996). In Study I, infant's avoidant behaviour in early mother-infant interaction

increased the child's risk for chronic or recurrent illnesses in the next two years. Infant's avoidance may be an indicator of distress experienced by the infant (Guedeney and Fermanian 2001) and it may also reveal a discrepancy between the infant's capacity for emotional regulation and the mother's ability to help. In Study I mother's poor interactive or affective behaviour was not related to illnesses in the child but was significantly poorer in the group of children with poor interactive behaviour. Thus, maternal behaviour may have affected infant's interactive behaviour, which was, in turn, related to the health of the child. One may hypothesise that if the infant is often exposed to distress without adequate support in managing it, this may constitute ongoing psychological stress for the infant. Psychological stress has been found to relate to immune function (Cacioppo 1994), and thus infants with unsatisfactory infant-caregiver interactions may be more susceptible to certain chronic or recurrent health problems. Also, early stressful experiences may disrupt the highly labile stress response system of a young infant, make the infant more vulnerable to stressful conditions and inhibit the developing stress regulation capacity in the infant (Gunnar 1998, Schore 2001b). Sensitive responsiveness and affectively attuned care seem to be very important in buffering neuroendocrine stress reactions (Gunnar et al. 1996, Gunnar 1998).

Children's emotional and behavioural problems may also be seen as difficulties in their emotional regulation capacity. Emotions may be appropriately regulated, under-regulated and over-regulated (Cole et al. 1994). If the emotions are over-regulated in relation to the demands of the social context the child may be expected to show internalising symptoms and if the emotions are under-regulated externalising symptoms are more likely to be present. In Study II, mother's hostility and/or intrusiveness increased the child's risk for externalising symptoms and total problems. Intrusiveness of the mother may immediately result in the infant's avoidance in mother-infant interaction. Eventually, if avoidance is not successful in limiting the mother's intrusiveness, the children may easily become angry and frustrated (Tronick and Weinberg 1997). Mother's hostility may be related to avoidant attachment in the child (Isabella 1993, Crittenden 1995). Although avoidant attachment is not a psychopathological condition in itself, Burgess et al. (2003) have shown that particularly in children with uninhibited temperament avoidant attachment tends to be related to subsequent externalising problems. Throughout the development a child internalises and learns the repeated dyadic patterns of emotional regulation and will eventually be more capable of regulating emotions independently (Cole et al. 1994, Sroufe 1995, Fox 1998, Cole et al. 2004). The unfolding of attachment relationship and attachment behavioural patterns may be viewed as means for regulating the emotions and as expressions of the internalised dyadic patterns of emotional regulation (Main 1990, Sroufe 1995). Also, the regulatory means expand from concrete actions to the use of more symbolic ways of regulation (Fox 1998). Thus, a move to a level of representation described in attachment research (Main et al. 1985) can also be

seen in the development of emotional regulation. However, one may hypothesise that if the child internalises maladaptive emotional regulation models, the development of his/her own capacity to regulate more independently will not be optimal (Cole et al. 1994, Sroufe 1995, Gunnar 1998).

Difficulties in emotional regulation may also be evident in day care centres where children with a history of constantly unsatisfying care-giving interactions especially may be assumed to experience stress in large groups of children. The results of Study I support this view. Infants attending day care centres were more likely to have chronic or recurrent illnesses. However, those with perturbations in early mother-infant interaction were particularly affected. Day time cortisol elevation has been demonstrated in children attending day care centres and particularly among younger children and those with more immature social skills (Dettling et al. 1999, Watamura et al. 2003). On the other hand, secure attachment may decrease the physiological consequences of stress (Gunnar et al. 1996). In large groups there is less time and attention from carers for an individual child. Children with positive experiences in emotional regulation, and secure attachment are more likely to be capable of regulating their emotions and coping with the stress. If the stressful situation exceeds their capacity for regulating, they will be more likely to signal clearly to the carers that they need help. Children with poorly developed emotional regulation capacities will need more help from carers to regulate their emotions and these children may be less adept at seeking help or may seek it in awkward and unsuccessful ways. In Study II, infants who had started day care early (≤ 12 months of age) were at increased risk for high externalising and total problem scores, regardless of the type of day care, possibly reflecting their still inadequately developed capacity for emotional regulation. The younger the child, the more dependent he/she may be presumed to be on the emotional regulation provided by dyadic infant-caregiver interaction. Thus, the younger the child, the more vulnerable he/she may be assumed to be to stressful experiences faced in day care, and to being separated from the parent, and the more likely the development of self-regulation capacity is to be sub-optimal.

Mother's perceptions of her child's problems

Child outcome, child's health problems and behavioural/ emotional symptoms at two years were examined indirectly by parental reports. This may raise some concerns as to whether the children defined as chronically ill or having emotional or behavioural symptoms were truly having problems or whether they were only *perceived* to be chronically ill or problematic by their mothers. No objective assessments of the children's physical health or psychiatric symptoms were available.

Parents' perceptions of their child are of great importance, regardless of whether, objectively evaluated, they are correct or not. Perceptions guide parental actions in daily care-giving activities (e.g. when to feed the child and when to put him/her to bed) and in decisions concerning the child (e.g. whether or not to seek medical or psychological help for the child). From the child's point of view, the mother's perceptions form the reality in which the child lives. For example, if the mother perceives her child to be ill even if he/ she is not, or vice versa, the child may be exposed to unnecessary medical examinations and treatments, or the child may be hindered from receiving the medical help needed.

Although parents' perceptions concerning their child may be susceptible to many biases, as has already earlier been noted (page 29), it is not likely that parental perceptions would be independent of the child's characteristics or symptoms, at least when it comes to non-psychotic parents, as is the case in the present study. In the clinical examination of children, parents are very important sources of information on the child's health, symptoms and problems, as well as their competencies. The parents know their child best. They have a longer experience of their child than any one else and an opportunity to observe their child's behaviour in a variety of situations. Even judgements of clinicians may be biased, for example, by the experience they have, the sort of patients they usually see and their special interests. In addition, the symptoms of the child may be context- or relationship-specific (Achenbach et al. 1987). Thus there is no "objective" or "independent" way to judge infants' and toddlers' behavioural/ emotional symptoms.

Moreover, in psychosomatic research studies with objectively verified episodes of illness (e.g. Turner Cobb and Steptoe 1996, Turner Cobb and Steptoe 1998, Sandberg et al. 2000) have not invalidated the findings from earlier studies based on self-reports or parent-reports suggesting that psychosocial factors are associated with physical illnesses; in fact, recent studies have shown the importance of psychosocial factors not only in the exacerbation of an existing disease but also in its pathogenesis (Wright et al. 1998, Mrazek et al. 1999).

The CBCL is currently the most widely used assessment method for behavioural/emotional problems in children. Given this sample, the assessment of children and classification with the help of ICD-10, DSM-IV or DC: 0-3 would presumably not have provided any extra information, since most of them would not have been given any (Axis I) diagnosis. The CBCL enables continuous rating of children and divides normal children into those with more and those with fewer symptoms. In addition, continuity from parent-reported early temperamental difficulties and behavioural/ emotional problems assessed by CBCL to later DSM-III diagnosed disorders has been reported (Keenan et al. 1998), suggesting that mothers' reports on emotional/ behavioural symptoms of the children may be considered useful measures of the children's problems.

Early mother-infant interaction and mother's perception of the infant's temperament

Early mother-infant interaction provides the context in which the mother has her first experiences of her infant, and the infant the mother. Therefore, in an effort to better understand the origins and development of mothers' perception of their infants, and infants' temperament in particular, the quality of early mother-infant interaction was also considered as a possible contributor (III). However, none of the mother-infant interaction variables when used as continuous variables contributed to the mother's perception of her infant as more or less difficult.

When the infants were categorised into difficult and non-difficult, mother's intrusiveness and infant's poor interactive behaviour (i.e. avoidance and lack of active communication and positive vocalisations) both independently increased significantly the infant's risk of being perceived as difficult. The association of poor maternal behaviour in mother-infant interaction and infant difficultness has also been shown in the studies by Campbell (1979), Milliones (1978) and Schuler et al. (1995) although Campbell and Milliones examined mother's responsiveness and Schuler and colleagues mother's overall positive behaviour. This cross-sectional study allows no causal conclusions to be drawn. The direction of the effect could be either way: intrusive maternal behaviour could contribute to the perception of the infant as difficult or difficult infant temperament could elicit intrusive behaviour from the mother. Also, avoidant, non-communicative infants may be perceived as difficult, or infant's poor interactive behaviour may be a reflection of difficult infant characteristics, irritability and hypo- or hyper aroused motor behaviour as shown in the study by Murray and colleagues (1996c). Infant irritability has been found to affect the quality of early mother-infant interaction from the beginning (van den Boom and Hoeksma 1994). Although mother's intrusiveness and infant's poor interactive behaviour independently increased the infant's risk of being perceived as difficult, these factors may well go hand in hand: mother's intrusiveness may elicit infant's avoidance which, in turn, may increase mother's intrusiveness (Tronick and Weinberg 1997).

The finding that the quality of mother-infant interaction was related to infant's perceived difficult temperament only when both the temperament and mother-infant interaction variables were categorised causes one to reflect more on the nature of early mother-infant interaction and its dyadic aspects. These issues will be further discussed later in this chapter.

Determinants of maternal behaviour in early mother-infant interaction

Given the remarkable amount of research demonstrating the deleterious effects of maternal psychopathology, especially depression, on the mother-child relationship, the most surprising finding of this dissertation was that mothers' mental health problems were not associated with mothers' behaviour in early mother-infant interaction. There were no significant differences in the quality of maternal behaviour between healthy mothers and mothers with perinatal psychiatric problems (II, IV).

There are several possible explanations for the finding. First, mothers with the most severe mental health problems – mothers with psychotic disorders and those requiring treatment in a psychiatric hospital after the birth of the baby – were excluded from the study. The difficulties faced in assessing early mother-infant interaction have already earlier been mentioned. Thus, it is possible that mental health problems of the mother do influence her behaviour in early mother-infant interaction but the effects may be so subtle that the existing observation methods, even those that are specifically designed to examine the quality of mother-infant interaction when the infant is two months old, are not able to capture them. Also, while there were not so many mothers with mental health problems postnatally at the time of the initial interview, in order to increase the statistical power, an attempt was made to increase the number of affected mothers by focusing on perinatal mental health problems, i.e. the groups of mothers with mental health problems during the pregnancy and those having problems after the delivery were combined. It is possible that some mothers defined as having mental health problems had recovered by the time of the mother-infant interaction assessment and their behaviour was no longer affected. Also, the group of mothers with mental health problems was not homogenous regarding the disorder; they suffered from a variety of disorders.

On the other hand, it may well be that less severe maternal psychopathology does not affect maternal behaviour when the infant is two months old, at least among upper/middle-class mothers with less severe psychosocial problems. Studies on postnatal depression have found marked disturbances in mother-infant interaction in disadvantaged populations (Cohn and Tronick 1989, Field et al. 1990, Cooper et al. 1999) and differences in the quality of early mother-infant interaction have been more difficult to show in upper/middle class samples. Findings similar to those in Studies II and IV were reported by Campbell and colleagues (1995) who found no significant differences in the quality of mother-infant interaction between depressed, married, middle-class mothers and their non-depressed counterparts when the infants were two months old. The question of the duration of mother's mental health problems may also be central. Thus, it is possible that only later, if mental health problems persist, will the effect of

maternal psychopathology on maternal behaviour become evident. This was also the finding of the aforementioned study by Campbell and colleagues, who showed that only if the mother's depression lasted for six months was impaired capacity in interaction seen.

Besides the influence of maternal psychopathology, other determinants of maternal behaviour in early mother-infant interaction have received relatively little attention. However, according to the findings in Study IV, it is possible that during the first months of the infant's life the mother's close relationships are more important determinants of maternal behaviour than maternal psychopathology in a non-clinical, upper/middle class sample. The mother's childhood relationship with her own mother seems to be especially powerful. Mothers describing their childhood relationship with their mother, warmth in their relationship, positive interaction and physical caring, more positively were more sensitive, responsive, warm, accepting and non-demanding in the interaction with their two-month old infants. They were also happier, more contingently involved with their babies (non-flaccid and absorbed in the infant), and relaxed. The findings may be viewed as being in accordance with attachment studies in which the parent's sensitive responsiveness, emotional interaction and affect attunement have been regarded as important factors in the transmission of attachment (Ainsworth et al. 1978, van IJzendoorn 1995). The association between mother's childhood relationship with her mother and her behaviour in early mother-infant interaction was not explained by the mother's mental health problems. The findings were similar both among healthy mothers and mothers with mental health problems, although the differences were significant only among healthy mothers, probably due to the small number of cases in the group of impaired mothers.

Empirical studies regarding mother's early experiences as a determinant of her behaviour in interaction with her infant are surprisingly rare. In attachment theory the concept of working models of relationships (Bowlby 1969, Thompson 2000) implies that experiences in early relationships are carried forward to other relationships and thus, implicitly, possibly also to the adult's relationship with his/her infant. However, although the continuity of attachment patterns across generations has been shown (Benoit and Parker 1994, van IJzendoorn et al. 1995), studies examining whether maternal behaviour in early mother-infant interaction is determined by mothers' attachment experiences and attachment organisation are rare. Ward and Carlson (1995) showed among adolescent mothers that those who were autonomous in their attachment organisation were significantly more sensitive with their infants aged 3 and 9 months. Some studies conducted with older children also propose that mother's attachment pattern may be associated with her parenting behaviour (Crowell and Feldman 1988, Adam et al. 2004). From animal studies we have evidence suggesting that the way an animal mother cares for the young is influenced by the way the mother has been cared for in its childhood (Suomi 1997, Fleming et al. 1999) and there are also

some human studies implying parallel findings. Pelchat et al. (2003) with a sample of 116 mothers and 84 fathers studied the effects of the quality of parenting parents recalled receiving as children on parents' sensitivity, and they reported that fathers' sensitivity in interaction with their 18-month-old children was predicted by the quality of parenting in the fathers' childhood whereas no effect of recalled received parenting was found on mothers' sensitivity. Siddiqui and his colleagues (2000), however, reported from a sample of 161 mothers that a mother's childhood memories of her upbringing were associated with the quality of her prenatal attachment towards her unborn baby and that mothers who had experienced more emotional warmth from their own mothers were better at establishing an affectionate relationship with their fetus. In another study Siddiqui and Hägglöf (2000) showed that prenatal attachment was associated with the quality of early mother-infant interaction.

The quality of the marital relationship was also related to maternal behaviour in mother-infant interaction (IV). Support from the partner may be seen as a buffer against difficulties in early mother-infant interaction. Among mothers with mental health problems a good marriage was related to better maternal behaviour in early mother-infant interaction, as compared to mothers with a poor/disengaged marriage. It seems that despite a poor marriage, healthy mothers may interact with their babies in a positive way and only with two concurrent stressful situations (a poor/disengaged marriage and mental health problems) was the interactive behaviour of mothers impaired. There are also other studies showing that not a single risk factor but an accumulation of unfavourable conditions or risk factors may have negative effects on the interactive behaviour of the parent (Pauli-Pott et al. 2000, Mertensacker et al. 2004). This may also be seen in the finding that mother's close relationships had a cumulative effect on mother's behaviour. Mothers who had both a negative childhood relationship with their own mothers and a poor/disengaged marriage had the greatest risk for poor interactive behaviour but even with one problematic relationship the risk for poorer behaviour was significantly increased. That a disengaged marital relationship in particular was associated with poorer maternal behaviour may be explained by the assessment procedure: maternal behaviour was assessed in a situation where the mother and the infant were placed face-to-face and the mother was asked to interact with her infant as she normally would. For mothers familiar with disengaged relationships, face-to-face interaction with their infants is perhaps something they are not very used to and it may be difficult for them to engage their infants in a positive manner.

One may argue that mothers feeling more competent and interacting in a positive way with their infants might describe their other close relationships as more positive. Theoretically, it is quite likely that positive experiences in one relationship can shape internal representations of other close relationships, and the influence is most probably bidirectional (Bowlby 1969, Stern 1989, Zeanah et al. 1997). The causal relationship cannot be determined on the basis of this

study. However, although the cause-effect relationship between a mother's close relationships and her behaviour in the mother-infant interaction is theoretically interesting and further research on this issue is clearly needed, in clinical work the association of these phenomena, and not the causal relationship, is essential. The association implies that exploring the quality of a mother's close relationships and the way she describes them may reveal important aspects of the way she interacts with her child.

Role of the infant in early mother-infant interaction, and aspects of the dyad

From the beginning the infant is an active participant, seeking for human interaction and possessing capacities for initiating, maintaining and terminating interactions (Emde 1983). Although this has been acknowledged for some time, the role of the infant in mother-infant interaction has been much ignored. One of the reasons for this has been a lack of appropriate observational methods for infants under three or even under six months old. However, to a great extent it reflects a common attitude that, when it comes to young infants, mother-infant interaction means that the mother is interacting with the infant, and not vice versa. It is much easier to see that the mother's behaviour affects the quality of the mother-infant interaction than to note that the infant's behaviour also contributes to it. However, there are some recent studies showing the importance of the infant in creating, eliciting and improving the quality of mother-infant interaction (Kivijärvi et al. 2001, Field et al. 2003).

The important role the infant has also becomes evident in Studies I and II. In Study I, infant's poor interactive behaviour in early mother-infant interaction proved to be a feature in interaction that predicted the child's subsequent chronic or recurrent health problems. However, in bivariate analyses it was poor *dyadic* interaction that was significantly related to the child's health and infant's poor interactive behaviour was only approaching significance. Infant's poor interactive behaviour became a significant predictor after adjusting for other factors – infant's initial health at T1, day care, dyadic interaction and mother's mental health. When the explanations for this finding were further studied, significant associations between mothers' and infants' behaviours were found. Infant's interactive behaviour was significantly correlated with dyadic interaction and was even a more important determinant of the dyadic interaction than mother's interactive or affective behaviour. However, mother's behaviour influenced infant behaviour: the interactive and affective behaviour of mothers of poorly interacting infants was significantly poorer compared to the mothers of infants with good interactive behaviour. Yet mother's interactive or affective behaviour were not related to the child's health. It seems that infant's interactive behaviour is an indicator of the distress experienced by the infant. Thus, if the

mother's behaviour, however poor, does not result in infant's avoidant, non-communicative behaviour, the dyadic interaction may remain good. If the mother's behaviour, even when not categorised as poor, is too poor for her infant, it may result in the infant's poor interactive behaviour and poor dyadic mother-infant interaction.

The infant's important role may also be reflected in the finding that mothers' mental health problems were not related to the quality of mother-infant interaction when the infants were two months old. Some infants, due to their biological constitution, are able to a certain extent to improve the quality of the mother-infant interaction and maternal behaviour by their own actions and even elicit better responses from the mother. This is shown in the study by Field and colleagues (2003), who reported that in studies on postnatal depression a repeated finding has been a group of mothers who in spite of depression were judged as being "good interaction partners". When these mothers and their infants were examined, it was found that, although the mothers were in many respects (including biochemical and neurophysiological changes) similar to depressed intrusive or depressed withdrawn mothers, the infants had already shown more organised behaviour as neonates, right after the birth. The researchers concluded that the more organised behaviour of the newborns may have contributed to the better interaction ratings of their depressed mothers. Also, Kivijärvi and colleagues (2001) reported a positive and significant correlation between infant's smile at 3 months and mother's sensitivity at 6 months: thus, infants who smiled more were more likely to have a more sensitive mother three months later. However, it may be assumed that keeping up the quality of interaction for an extended period of time is too demanding a task for an infant and in the course of time, unless the mother recovers, the effect of maternal psychopathology on maternal and infant behaviour will become evident.

Biological considerations: biological principles guiding the early mother-infant interaction

Many researchers have emphasised that there are biological principles common to all living systems that direct infant and parent behaviour (Emde 1983, Tronick 1989). These are fundamental in order for a human infant - and the human species - to survive. At birth, a newborn is ready to participate in and keen to seek human interaction. A human infant has biologically, inherently determined patterns of behaviour that attract the caregiver's attention and elicit from the caregiver behaviour that provides the infant with the regulation of the physiological state, the comfort and the nurture that is needed for the baby's survival and development (Emde 1983, Trevarthen and Aitken 2001). Parents are also sensitised to their infant's needs and signals, and show a variety of intuitive parenting behaviour that goes beyond awareness. Right from birth on infants

monitor experiences according to what is pleasurable and unpleasurable, and this affective monitoring guides behaviour – first mostly the caregiver’s behaviour but later also the infant’s own behaviour (Emde 1983). Self-regulation is also one of these biological principles. At the level of physiology, self-regulation is built into cardiorespiratory or metabolic systems, for example, but self-regulation is also evident and vital at behavioural level (Emde 1983, Calkins and Fox 2002). Infant’s self-regulatory processes are directed by affective monitoring (Emde 1983). However, in human infants self-regulation is to a great extent dyadic in nature: hunger, cold or heat cannot be successfully regulated by the infant’s actions alone: the caregivers actions are vital (Tronick 1989), and emotional regulation and stress coping are also fundamentally dyadic.

In Study III, the features of early mother-infant interaction (mother’s intrusiveness and infant’s poor interactive behaviour) in multivariate modelling were significantly associated with difficult temperament only when the variables were categorised. Categorisation of infant’s interactive behaviour also revealed significant differences in Study I: mothers of infants interacting poorly were significantly poorer in their interactive and affective behaviour when compared to mothers of infants with good interactive behaviour. However, when maternal and infant dimensions were treated as continuous variables, significant but only moderate or weak correlations between infant and maternal dimension were found (I, III). This may lead to the speculation that the biological principles do not only apply to infant and parent behaviour but also to the early parent-infant interaction of the dyad, and Winnicott’s (1965) idea of a good-enough mother is supported by the results. Further evidence is still needed, but the results of this dissertation together with theoretical considerations could imply that there may be a threshold for a minimum standard requirement for the quality of the system of mother-infant interaction. Once this threshold is exceeded, positive infant developmental outcome and healthy development are possible, largely regardless of the quality of mother-infant interaction, and the improvement of the quality of mother-infant interaction does not necessarily result in ever better child outcome.

Dyad as a system striving for homeostasis: Mutual adaptation capacity

The quality of early mother-infant interaction has usually been assessed in order to identify *infants* at risk for maladjustment. However, theoretical considerations would suggest that infant-caregiver interaction, in its bidirectionality and reciprocity, also affects the well-being of the caregiver. There is some evidence supporting this hypothesis. Laucht and his colleagues (1994) reported that infant behaviour problems at three months were associated with psychiatric disorder in the mother when the infant was 24 months. Murray and her colleagues (1996c) found that characteristics of a newborn such as irritability and hypo- or hyperaroused motor behaviour predicted mother’s postnatal depression at two

months. They also reported a correlation between these characteristics and infant behaviour in mother-infant interaction at two months. In Study II an interesting finding was that, while mothers' perinatal mental health problems were not associated with deviant features in early mother-infant interaction, deviant features in early mother-infant interaction, namely mothers' hostility and/or intrusiveness, were related to the subsequent mental health of the mothers. Surprisingly, hostility and/or intrusiveness were not related to mental health *problems* but mothers who were hostile and/or intrusive in early mother-infant interaction stayed well and did not experience any psychiatric disorders at all in the next two years.

From the very beginning interaction between an infant and the caregiver is bidirectional, a reciprocal, coregulatory process of negotiating towards positive engagement, repairing unmatched affective states and obtaining homeostasis in the physiological, behavioural and emotional states of the infant, the caregiver and the dyadic relationship (Tronick and Weinberg 1997, Tronick et al. 1998, Trevarthen and Aitken 2001, de Weerth and van Geert 2002). To a certain extent, both the infant and the mother may adjust their behaviour to achieve homeostasis, although it is clear that due to the enormously wider array of behaviours, and greater adaptability and flexibility to adjust the behaviours in relation to the demands of the social context, the caregiver carries the main responsibility for re-establishing and maintaining homeostasis.

In Study II mothers seemed to adjust their behaviour to protect the child from the harmful effects of their hostility by taking distance from the child: hostile mothers, when compared to non-hostile mothers, were significantly more likely to be remote. This combination was not related to higher problem scores of the child. On the other hand, mothers seemed to act in a way that protected their own mental health, while none of the hostile and/ or intrusive mothers suffered from mental health problems during the next two years and the difference from non-hostile/ non-intrusive mothers was significant. Besides the dyadic system of the mother and the infant, homeostasis or balance must be achieved in relation to complex systems of other relationships in the family and in relation to other internal or external states. Thus, a mother's seemingly poor behaviour with her infant may, in fact, serve a meaningful purpose. In clinical work this is familiar: irrational behaviour becomes rational after understanding the experiences and representations behind the behaviour.

The results of this thesis suggest that in order to better understand early mother-infant interaction and its effects on the infant, the parent and the dyad, it is important to assess the early mother-infant interaction from the viewpoint of adjustment of the dyad. *Mutual adaptation capacity* of the dyad is a construct not previously presented in the literature. However, it is a logical continuation and a corollary to the construct of dyadic emotional regulation, the mutual regulation model presented by Tronick and colleagues (Tronick 1989, Tronick et al. 1998).

The mutual adaptation capacity of the dyad seems to be an important determinant of infant outcome. It means that only behaviour poor enough to exceed the capacity of the dyadic system to adjust may be associated with poor infant outcome. The deviant features that have been shown to relate to the infant's less than optimal outcome may be seen as indicators of the exceeded adjustment capacity of the dyad.

Conclusions

There are several conclusions to be drawn from the study:

1) There are certain deviant features to be found in early mother-infant interaction which are associated with and predict the child's physical health and behavioural and emotional symptoms at two years of age and during the preceding two-year-follow-up.

1a) Hostility and intrusiveness on the part of the mother and poor interactive behaviour including avoidance and lack of active communication and positive vocalisations on the part of the infant are characteristics of early mother-infant interaction which should be carefully noted.

2) Mother's close relationships in a non-clinical, upper/middle class sample with less severe psychosocial problems may be more important determinants of maternal behaviour than maternal psychopathology when the infant is two months old.

2a) Mother's childhood relationship with her mother is associated with her behaviour in interaction with her two-month-old infant, independently of the mother's mental health problems.

2b) Mother's mental health problems are not necessarily related to the quality of early mother-infant interaction when the infant is two months old.

2c) Poor/disengaged marital relationship is associated with impaired maternal interactive behaviour among mothers with mental health problems.

3) Problems in early mother-infant interaction, especially mother's intrusiveness and infant's avoidant, non-communicative style of interacting, may cause the mother to perceive her infant's temperament as difficult.

4) The role of the infant as an active partner of the dyad is important already when the infant is two months old.

4a) Better observational methods are still needed in order to be able to assess the infant's behaviour and role, and the function of the dyadic system in more detail.

5) Despite the deviances in early mother-infant interaction that relate to the child's less than optimal outcome, the more important determinant of infant outcome is the *mutual adaptation capacity* of the dyad. Only behaviour poor enough to exceed the capacity of the dyadic system to adjust may be associated with poor infant outcome. The deviant features that have been shown to relate to the infant's less than optimal outcome may be seen as indicators of the exceeded adjustment capacity of the dyad.

Implications for clinical practice and future research

Infant's poor interactive behaviour – avoidance and lack of active communication and positive vocalisations – as well as mother's hostility and/or intrusiveness are features in early mother-infant interaction that are important to notice. They seem to relate to and predict recurrent and chronic health problems in the child or may be the first signs of subsequent problematic development leading to possible behavioural problems in the child. They are also associated with maternal perception of her child's temperament as difficult. Child's parent-perceived difficult temperament, on the other hand, has shown moderate stability over time, possibly predicting later behavioural problems in the child (Luoma et al. 2004).

Not all chronic or recurrent health problems can be explained by difficulties in early mother-infant interaction. However, it is important to note that some children with chronic or recurrent health problems may have relationship difficulties, even beyond the early mother-infant interaction, with which they will need help.

Interventions to improve the mother-infant relationship should be tailored individually for each mother-child pair considering the interaction style of the dyad (Jones et al. 1997, Hart et al. 1999). Theoretically it could be assumed that if, for example, a hostile but remote mother is encouraged and supported to be more actively involved with her baby, it may increase the mother's intrusiveness and result in more harmful effects on the infant. If the infant is avoidant, infant-centred methods where the parent is encouraged to wait for the infant to initiate or to signal his/her willingness to interact and then respond would seem to be beneficial. It is important to understand the rationality behind poor and seemingly irrational behaviour to be able to intervene in an effective and helpful way.

Mother's close relationships are associated with her behaviour in interaction with her two-month-old infant. The childhood relationship with one's mother influences a mother's behaviour independently of mental health problems, whereas the influence of the marital relationship is aggravated by concurrent psychopathology. Examining the quality of a mother's close relationships may

be useful in a variety of services for infants and families and may reveal important aspects of the mother's way of interacting with her infant.

In Finland well-baby clinics, attended by virtually all children, are in a key position to identify difficulties in early mother-infant interaction and deviations in child's socio-emotional development as early as possible. Moreover, the vast majority of public health nurses in well-baby clinics have been trained to support families and the parent-child relationship. We must ensure that this important work is acknowledged and allocated adequate resources for its accomplishment.

This dissertation focused on mothers and infants. However, in Study II father's mental health problems were found to predict high internalising, externalising and total problem scores. More attention in future research should be paid to fathers, children and the father-child relationship.

In future research, the importance of the infant as an active and effective partner of the dyad from early on should be acknowledged and further studied. In order to accomplish this, better observational methods more suitable for the assessment of infants are needed. One of the difficulties still to be overcome in order to recognise deviant development as early as possible by assessing the quality of parent-infant interaction is the variability and change in the behaviour of the infant, the parent, and the dyad throughout the development. Subjective emotional experiences have been hypothesised to account for the continuity in the development of an individual, and methods assessing behaviour reflecting the individual's subjective emotional experience would seem to be beneficial.

Also, the mutual adaptation capacity of the dyad seems to be an important determinant of the infant development, and methods assessing the dyad's capacity to adjust are needed. Infant's avoidant and withdrawn behaviour may be seen as one of the indicators of the subjective experience of the infant or as an indicator of the exceeded mutual adaptation capacity of the dyad. Guedeney (2004) developed a method to assess sustained withdrawal reaction in infants and a study using this method has been conducted at the University of Tampere in collaboration with Tampere University Hospital and the City of Tampere, and the results will be reported in the near future.

In the future, in assessing mother-infant dyads, the perspective needs to be widened to involve the context the dyad is living in. Just as the assessment of the infant's behaviour or the mother's behaviour alone is not enough but the aspects of the dyad need to be considered, we also need to assess the dyad as a part of a complex system of relationships in the family, and consider the dyad in the context of other internal and external states, thereby achieving a systemic view on the dyad.

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References

- Abidin R (1990): Parenting stress index. University of Virginia, Charlottesville, VA: Paediatric Psychology Press
- Achenbach TM (1992): Manual for the Child Behavior Checklist/2-3 and 1992 profile. Burlington, VT: University of Vermont Department of Psychiatry
- Achenbach TM, McConaughy SH, Howell CT (1987): Child/adolescent behavioural and emotional problems: implications of cross-informant correlations for situational specificity. *Psychol Bull* 101: 213-232.
- Achenbach TM, Phares V, Howell CT, Rauh VA, Nurcombe B (1990): Seven-year outcome of the Vermont Intervention Program for low-birthweight infants. *Child Dev* 61:1672-1681.
- Adam EK, Gunnar MR, Tanaka A (2004): Adult attachment, parent emotion, and observed parenting behavior: mediator and moderator models. *Child Dev* 75: 110-122.
- Ainsworth MDS (1989): Attachments beyond infancy. *Am Psychol* 44: 709-716.
- Ainsworth M, Blehar M, Waters E, Wall S (1978): Patterns of attachment. A psychological study of the Strange Situation. Lawrence Erlbaum Associates Publishers, Hillsdale, New Jersey.
- Almqvist F, Kumpulainen K, Ikäheimo K, Linna S-L, Henttonen I, Huikko E, Tuompo-Johansson E, Aronen E, Puura K, Piha J, Tamminen T, Räsänen E, Moilanen I (1999): Behavioural and emotional symptoms in 8-9-year-old children. *Eur Child Adolesc Psychiatry* 8: Suppl.4, IV/7-IV/16.
- Barrera ME, Rosenbaum PL, Cunningham CE (1986): Early home intervention with low-birthweight infants and their parents. *Child Dev* 57: 20-33.
- Bates JE, Freeland CA, Lounsbury ML (1979): Measurement of infant difficulty. *Child Dev* 50: 794-803.
- Bayley N (1969): Bayley Scales of Infant Development. Psychological corporation, New York.
- Belsky J (1984): The determinants of parenting: a process model. *Child Dev* 55: 83-96.
- Benoit D, Parker KCH (1994): Stability and transmission of attachment across three generations. *Child Dev* 65: 1444-1456.

- Benoit D, Parker KCH, Zeanah CH (1997): Mothers' representations of their infants assessed prenatally: Stability and association with infants' attachment classification. *J Child Psychol Psychiatry*: 38, 307-313.
- Biringen Z (2000): Emotional availability: conceptualization and research findings. *Am J Orthopsychiatry* 70: 104-114.
- Biringen Z, Emde RN, Pipp-Siegel S (1997): Dyssynchrony, conflict, and resolution: positive contributions to infant development. *Am J Orthopsychiatry* 67: 4-19.
- Biringen Z, Robinson JA (1991): Emotional availability in mother-child interaction: a reconceptualization for research. *Am J Orthopsychiatry*, 61: 258-271.
- Braungart-Rieker JM, Garwood MM, Powers BP, Wang X (2001): Parental sensitivity, infant affect and affect regulation: predictors of later attachment. *Child Dev* 72: 252-270.
- Brazelton TB, Cramer BG (1991): *The earliest relationship. Parents, infants and the drama of early attachment.* Karnac Books, London.
- Briggs-Gowan MJ, Carter AS, Moye Skuban E, McCue Horwitz S (2001): Prevalence of social-emotional and behavioural problems in a community sample of 1- and 2-year-old children. *J Am Acad Child Adolesc Psychiatry* 40: 811-819.
- Brown E, Rutter M (1966): The measurement of family activities and relationships: a methodological study. *Human Relations* 19: 241-263.
- Boris NW, Zeanah CH (1999): Disturbances and disorders of attachment in infancy: an overview. *Inf Mental Hlth J* 20:1-9.
- Bowlby J (1969): *Attachment and loss: Vol. 1, Attachment.* Basic Books, New York.
- Burgess KB, Marshall PJ, Rubin KH, Fox NA (2003). Infant attachment and temperament as predictors of subsequent externalizing problems and cardiac physiology. *J Child Psychol Psychiatry* 44: 819-831.
- Cacioppo JT (1994): Social neuroscience: autonomic, neuroendocrine, and immune response to stress. *Psychophysiology* 31: 113-128.
- Calkins SD, Fox NA (2002): Self-regulatory processes in early personality development: a multilevel approach to the study of childhood social withdrawal and aggression. *Dev Psychopathol* 14: 477-498.
- Campbell SB (1979): Mother-infant interaction as a function of maternal ratings of temperament. *Child Psychiatry Hum Dev* 10: 67-76.
- Campbell SB, Cohn JF, Meyers T (1995): Depression in first-time mothers: mother-infant interaction and depression chronicity. *Dev Psychol* 31: 349-357.
- Carter AS, Garrity-Rokous FE, Chazan-Cohen R, Little C, Briggs-Gowan MJ (2001): Maternal depression and comorbidity: predicting early parenting, attachment security, and toddler social-emotional problems and competencies. *J Am Acad Child Adolesc Psychiatry* 40: 18-26.

- Cassidy J, Berlin LJ (1994): The insecure/ ambivalent pattern of attachment: Theory and research. *Child Dev* 65: 971 - 991.
- Cicchetti D, Toth SL (1995): A developmental psychopathology perspective on child abuse and neglect. *J Am Acad Child Adolesc Psychiatry* 34: 541-565.
- Ciechanowski PS, Walker EA, Katon WJ, Russo JE (2002): Attachment theory: a model for health care utilization and somatization. *Psychosom Med* 64: 660-667.
- Clark R (1985): The Parent-Child Early Relational Assessment . Instrument and Manual. University of Wisconsin Medical School, Department of Psychiatry, Madison, WI.
- Cohen LJ, Slade A (2000): The psychology and psychopathology of pregnancy: reorganization and transformation. In: *Handbook of infant mental health*, pp. 20-36. Ed. CH Zeanah, 2nd edition, The Guilford Press, New York.
- Cohn JF, Campbell SB, Matias R, Hopkins J (1990): Face-to-face interactions of postpartum depressed and nondepressed mother-infant pairs at 2 months. *Dev Psychol* 26: 15-23.
- Cohn JF, Tronick E (1989): Specificity of infants' response to mothers' affective behaviour. *J Am Acad Child Adolesc Psychiatry* 28:242-248.
- Cole PM, Martin SE, Dennis TA (2004): Emotion regulation as a scientific construct: methodological challenges and directions for child development research. *Child Dev* 75: 317-333.
- Cole PM, Michel MK, O'Donnell Teti L (1994): The development of emotion regulation and dysregulation: a clinical perspective. *Monogr Soc Res Child Dev* 59: 73-100.
- Cooper PJ, Tomlinson M, Swartz L, Woolgar M, Murray L, Molteno C (1999): Post-partum depression and the mother-infant relationship in a South African peri-urban settlement. *Br J Psychiatry* 175: 554-558.
- Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A (2003): Prevalence and development of psychiatric disorders in childhood and adolescence. *Arch Gen Psychiatry* 60: 837-844.
- Crandell LE, Patrick MPH, Hobson RP (2003): "Still-face" interactions between mothers with borderline personality disorder and their 2-month-old infants. *Br J Psychiatry* 183: 239-247.
- Crittenden PM (1995): Attachment and risk for psychopathology: the early years. *J Dev Behav Pediatr* 16: S12-S16.
- Crockenberg S, Leerkes E (2000): Infant social and emotional development in family context. In: *Handbook of infant mental health*, pp.60-90. Ed. CH Zeanah, 2nd edition, The Guilford Press, New York.
- Crowell JA, Feldman SS (1988): Mothers' internal models of relationships and children's behavioral and developmental status: a study of mother-child interaction. *Child Dev* 59: 1273-1285.

- Davis H, Cox A, Day C, Roberts R, Loxton R, Ispanovic-Radojkovic V, Tsiantis J, Layiou-Lignos E, Puura K, Tamminen T, Turunen M-M, Paradisiotou A, Hadjipanayi Y, Pandeli P (Eds) (2000) Primary health care worker training manual. Institute of Mental Health, Belgrade.
- Denham SA (1989): Maternal affect and toddlers' social-emotional competence. *Am J Orthopsychiatry* 59:368-376.
- Detting AC, Gunnar MR, Donzella (1999): Cortisol levels of young children in full-day childcare centers: relations with age and temperament. *Psychoneuroendocrinology* 24: 519-536.
- de Weerth C, van Geert P (2002): Changing patterns of infant behavior and mother-infant interaction: intra- and interindividual variability. *Inf Behav Dev* 24: 347-371.
- Emde RN (1983): The prerepresentational self and its affective core. *Psychoanal Study Child* 38:165-192.
- Emde RN (1998): Early emotional development: new modes of thinking for research and intervention. *Pediatrics* 102: 1236-1243.
- Esser G, Dinter R, Jörg M, Rose F, Villalba P, Laucht M, Schmidt MH (1993): Bedeutung und Determinanten der frühen Mutter-Kind-Beziehung. *Zeitschrift für Psychosomatische Medizin* 39: 246-264.
- Feeney JA (2000): Implications of attachment style for patterns of health and illness. *Child Care Health Dev* 26: 277-288.
- Feldman R, Greenbaum CW, Mayes LC, Erlich SH (1997): Change in mother-infant interactive behavior: relations to change in the mother, the infant, and the social context. *Inf Behav Dev* 20: 151-163.
- Field T (1984): Early interactions between infants and their postpartum depressed mothers. *Inf Behav Dev* 7: 517-522.
- Field T (1992): Infants of depressed mothers. *Dev Psychopathol* 4:49-66.
- Field T, Cohen D, Garcia R, Greenberg R (1984): Mother-stranger face discrimination by their newborn. *Inf Behav Dev* 7: 19-25.
- Field T, Diego M, Hernandez-Reif M, Schanberg S, Kuhn C (2003): Depressed mothers who are "good interaction" partners versus those who are withdrawn or intrusive. *Inf Behav Dev* 26: 238-252.
- Field T, Healy B, Goldstein S, Guthertz M (1990): Behavior-state matching and synchrony in mother-infant interactions of nondepressed versus depressed dyads. *Dev Psychol* 26: 7-14.
- Fleming AS, O'Day DH, Kraemer GW (1999): Neurobiology of mother-infant interactions: experience and central nervous system plasticity across development and generations. *Neurosci Biobehav Rev* 23: 673-685.
- Fonagy P (1998): Prevention, the appropriate target of infant psychotherapy. *Inf Mental Hlth J* 19: 124-150.
- Fonagy P (2001): The human genome and the representational world: the role of early mother-infant interaction in creating an interpersonal

- interpretive mechanism. *Bull Menninger Clin* 65:427-448.
- Fonagy P, Steele H, Steele M (1991): Maternal representations of attachment during pregnancy predict the organization of infant-mother attachment at one year of age. *Child Dev* 62: 891 - 905.
- Foreman DM, Henshaw C (2002): Objectivity and subjectivity in postnatally depressed mothers' perceptions of their infants. *Child Psychiatry Hum Dev* 32: 263-275.
- Fox NA (1998): Temperament and regulation of emotion in the first years of life. *Pediatrics* 102: 1230-1235.
- Gelfand DM, Teti DM, Fox CE (1992): Sources of parenting stress for depressed and nondepressed mothers of infants. *J Clin Child Psychol* 21: 262-272.
- Gerhold M, Laucht M, Texdorf C, Schmidt MH, Esser G (2002): Early mother-infant interaction as a precursor to childhood social withdrawal. *Child Psychiatry Hum Dev* 32:277-293.
- Goodman SH, Gotlib IH (1999): Risk for psychopathology in the children of depressed mothers: a developmental model for understanding mechanisms of transmission. *Psychol Rev* 106: 458-490.
- Guedeney A (1997): From early withdrawal reaction to infant depression: a baby alone does exist. *Inf Mental Hlth J* 8: 339-349.
- Guedeney A (2004): Early withdrawal and depression in infancy. A plenary presentation held in WAIMH (World Association for Infant Mental Health) 9th world congress in Melbourne, Australia, January 2004.
- Guedeney A, Fermanian J (2001): A validity and reliability study of assessment and screening for sustained withdrawal reaction in infancy: the alarm distress baby scale. *Inf Mental Hlth J* 22: 559-575.
- Guerin D, Gottfried AW (1994): Temperamental consequences of infant difficultness. *Inf Behav Dev* 17: 413-421.
- Gunnar MR (1998): Quality of early care and buffering of neuroendocrine stress reactions: Potential effects on the developing human brain. *Prev Med* 27: 208-211.
- Gunnar MR, Brodersen L, Nachmias M, Buss K, Rigatuso J (1996): Stress reactivity and attachment security. *Dev Psychobiol* 29: 191-204.
- Gunning M, Murray L, Lawson C (2002): Global Rating Scheme. A paper presented at the 8th Congress of the World Association for Infant Mental Health, Amsterdam.
- Harrington D, Black MM, Starr RH, Dubowitz H (1998): Child neglect: relation to child temperament and family context. *Am J Orthopsychiatry* 68: 108-116.
- Hart S, Field T, Jones N, Yando R (1999): Intrusive and withdrawn behaviours of mothers interacting with their infants and boyfriends. *J Child Psychol Psychiatry* 40: 239 - 245.

- Hautamäki A (2001): Kiintymyssuhdeteoria – teoria yksilön kiin(nit)tymisestä tärkeisiin toisiin ihmisiin, kiintymyssuhteen katkoksista ja merkityksestä ihmiselle. In: Varhaiset ihmissuhteet ja niiden häiriintyminen, pp. 13-66. Eds. J Sinkkonen, M Kalland, WSOY, Helsinki.
- Hay DF, Pawlby S, Sharp D, Asten P, Mills A, Kumar R (2001): Intellectual problems shown by 11-year-old children whose mothers had postnatal depression. *J Child Psychol Psychiatry* 42: 871-889.
- Herzog DB, Rathbun JM (1982): Childhood depression: developmental considerations. *Am J Dis Childhood* 136: 115-120.
- Hipwell AE, Kumar R (1996): Maternal psychopathology and prediction of outcome based on mother-infant interaction ratings (BMIS). *Br J Psychiatry* 169: 655-661.
- Hofstra MB, Van der Ende J, Verhulst FC (2000): Continuity and change of psychopathology from childhood into adulthood: a 14-year follow-up study. *J Am Acad Child Adolesc Psychiatry* 39: 850-858.
- Isabella RA (1993): Origins of attachment: maternal interactive behavior across the first year. *Child Dev* 64: 605-621.
- Jones N, Field T, Fox NA, Davalos M, Malphurs J, Carraway K et al. (1997). Infants of intrusive and withdrawn mothers. *Inf Behav Dev* 20: 175-186.
- Kadzin AE (1989): Developmental psychopathology. Current research, issues, and directions. *Am Psychol* 44: 180-187.
- Kalmuss D, Davidson A, Cushman L (1992): Parenting expectations, experiences, and adjustment to parenthood: a test of the violated expectations framework. *J Marriage Fam* 54: 516-526.
- Kaye KL, Bower TGR (1994): Learning and intermodal transfer of information in newborns. *Psychol Sci* 5: 286-288.
- Keenan K, Shaw D, Delliquadri E, Giovannelli J, Walsh B (1998): Evidence for the continuity of early problem behaviors: Application of a developmental model. *J Abn Child Psychol* 26:441-454.
- Kivijärvi M, Voeten MJM, Niemelä P, Räihä H, Lertola K, Piha J (2001): Maternal sensitivity behavior and infant behavior in early interaction. *Inf Mental Hlth J* 22: 627-640.
- Laucht M, Esser G, Schmidt MH (1994): Parental mental disorder and early child development. *Eur Child Adolesc Psychiatry* 3: 125-137.
- Laucht M, Esser G, Schmidt MH (2001): Differential development of infants at risk for psychopathology: the moderating role of early maternal responsivity. *Dev Med Child Neurol* 43:292-300.
- Laucht M, Esser G, Schmidt MH (2002): Heterogeneous development of children of postnatally depressed mothers. *Zeitschrift für Klinische Psychologie und Psychotherapie* 31: 127-134.
- Lavelli M, Fogel A (2002): Developmental changes in mother-infant face-to-face communication: birth to 3 months. *Dev Psychol* 38: 288-305.

- Lavigne JV, Arend R, Rosenbaum D, Binns HJ, Kaufer Christoffel K, Gibbons RD (1998): Psychiatric disorders with the onset in the preschool years: I. Stability of diagnoses. *J Am Acad Child Adolesc Psychiatry* 37: 1246-1254.
- Layioun-Lignos E, Tsiantis J, Davis H, Rudic N, Puura K, Paradisiotou A, Ispanovic-Radojkovic V, Roberts R, Hadjipanayi Y, Radojkovic D, Mäntymaa M, Tamminen T (2005) Training for primary health care practitioners. *Int J Mental Health Prom* 7:41-53.
- Lee CL, Bates JE (1985): Mother-child interaction at age two years and perceived child temperament. *Child Dev* 56: 1314-1325.
- Legerstee M, Varghese J (2001): The role of maternal affect mirroring on social expectancies in three-month-old infants. *Child Dev* 72:1301-1313.
- Leifer M (1977): Psychological changes accompanying pregnancy and motherhood. *Gen Psychol Monogr* 95: 55-96.
- Louhiala PJ, Jaakkola N, Ruotsalainen R, Jaakkola JJ (1995): Form of day care and respiratory infections among Finnish children. *Am J Public Health* 85: 1109-1112.
- Luoma I (2004): From pregnancy to middle childhood. What predicts a child's socio-emotional well-being? Academic dissertation. *Acta Universitatis Tamperensis* 1002. Tampereen yliopistopaino Oy Juvenes Print, Tampere.
- Luoma I, Kaukonen P, Mäntymaa M, Puura K, Salmelin R, Tamminen T (2004): A longitudinal study of maternal depressive symptoms, negative expectations and perceptions of child problems. *Child Psychiatry Hum Dev* 35: 37-52.
- Lyons-Ruth K, Block D (1996): The disturbed caregiving system: relations among childhood trauma, maternal caregiving, and infant affect and attachment. *Inf Mental Hlth J* 17: 257 - 275.
- Main M. (1990): Cross-cultural studies of attachment organization: Recent studies, changing methodologies, and the concept of conditional strategies. *Hum Dev* 33: 48 - 61.
- Main M, Hesse E (1990): Parent's unresolved traumatic experiences are related to infant disorganized attachment status: is frightened and/or frightening parental behavior the linking mechanism. In: *Attachment in the preschool years*, pp. 161 – 182. Eds. MT Greenberg, D Cicchetti, EM Cummings. The University of Chicago Press, Chicago.
- Main M, Solomon J (1990): Procedures for identifying infants as disorganized/disoriented during the Ainsworth Strange Situation. In: *Attachment in the preschool years*, pp. 121-160. Eds. MT Greenberg, D Cicchetti, EM Cummings. The University of Chicago Press, Chicago.
- Main M, Kaplan N, Cassidy J (1985): Security in infancy, childhood, and adulthood: a move to the level of representation. In: *Growing*

- points of attachment theory and research, pp. 66 – 104. Eds. I Bretherton, E Waters, *Monogr Soc Res Child Dev*, Vol 50, nr. 1-2, Ser nr 209.
- Mäntymaa M, Luoma I, Puura K, Tamminen T (2003): Tunteet, varhainen vuorovaikutus ja aivojen toiminnallinen kehitys. *Duodecim* 119: 459-465 (in Finnish).
- Maysless O (1998): Maternal caregiving strategy - a distinction between the ambivalent and the disorganized profile. *Inf Mental Hlth J* 19: 20 - 33.
- Mebert CJ (1991): Dimensions of subjectivity in parents' ratings of infant temperament. *Child Dev* 62: 352 - 361.
- Meins E, Fernyhough C, Fradley E, Tuckey M (2001): Rethinking maternal sensitivity: mothers' comments on infants' mental processes predict security of attachment at 12 months. *J Child Psychol Psychiatry* 42: 637-648.
- Meltzoff AN, Borton RW (1979): Intermodal matching by human neonates. *Nature* 282: 403-404.
- Mertesacker B, Bade U, Haverkock A, Pauli-Pott U (2004): Predicting maternal reactivity/sensitivity: the role of infant emotionality, maternal depressiveness/anxiety, and social support. *Inf Mental Hlth J* 25: 47-61.
- Milliones J (1978): Relationship between perceived child temperament and maternal behaviors. *Child Dev* 49: 1255-1257.
- Minde K (2000): Prematurity and serious medical conditions in infancy: implications for development, behavior, and intervention. In: *Handbook of infant mental health*, pp.176-194. Ed. CH Zeanah, 2nd edition, The Guilford Press, New York.
- Morrison TL, Goodlin-Jones BL, Urquiza AJ (1997): Attachment and the representation of intimate relationships in adulthood. *J Psychol* 131: 57- 71.
- Mrazek DA, Klinnert M, Mrazek PJ, Bower A, McCormick D, Rubin B, Ikle D, Kastner W; Larsen G, Harbeck R, Jones J (1999): Prediction of early-onset asthma in genetically at-risk children. *Pediatr Pulmonol* 27: 85-94.
- Murray L (1992): The impact of postnatal depression on infant development. *J Child Psychol Psychiatry* 33: 543-561.
- Murray L, Cooper P (1997): Effects of postnatal depression on infant development. *Arch Dis Child* 77: 99-101.
- Murray L, Fiori-Cowley A, Hooper R, Cooper P (1996a): The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcome. *Child Dev* 67: 2512-2526.
- Murray L, Hipwell A, Hooper R, Stein A, Cooper P (1996b): The cognitive development of 5-year-old children of postnatally depressed mothers. *J Child Psychol Psychiatry* 37: 927 - 935.

- Murray L, Sinclair D, Cooper P, Ducournau P, Turner P (1999): The socioemotional development of 5-year-old children of postnatally depressed mothers. *J Child Psychol Psychiatry* 40: 1259-1271.
- Murray L, Stanley C, Hooper R, King F, Fiori-Cowley A (1996c): The role of infant factors in postnatal depression and mother-infant interactions. *Dev Med Child Neurol* 38: 109-119.
- Murray L, Trevarthen C (1985): Emotional regulation of interaction between two-month-olds and their mothers. In: *Social perception in infancy*, pp. 177-198. Eds T Field and NA Fox, Ablex Publishing Corporation, New Jersey.
- Muzik M, MacKenzie M, Rosenblum KL, McDonough S, Sameroff A, Liberzon I (2004): Links between maternal anxiety, mother-infant interaction and child stress regulation. *Biol Psychiatry* 55:17S
- Najman JM, Williams GM, Nikles J, Spence S, Bor W, O'Callaghan MJ, Le Brocque R, Andersen MJ, Shuttlewood GJ (2001): Bias influencing maternal reports of child behavior and emotional state. *Soc Psychiatry Psychiatr Epidemiol* 36: 186-194.
- Nelson CA, Bosquet M (2000): Neurobiology of fetal and infant development: implications for infant mental health. In: *Handbook of infant mental health*, pp. 37-59. Ed. CH Zeanah, 2nd edition, The Guilford Press, New York.
- Oppenheim D, Koren-Karie N (2002): Mothers' insightfulness regarding their children's internal worlds: the capacity underlying secure child-mother relationships. *Inf Mental Hlth J* 23: 593-605.
- Östberg M, Hagekull B (2000): A structural modeling approach to the understanding of parenting stress. *J Clin Child Psychol* 29: 615-625.
- Pajulo M, Savonlahti E, Sourander A, Ahlqvist S, Helenius H, Piha J (2001a): An early report on mother-baby interactive capacity of substance abusing mothers. *J Subst Abuse Treat* 20: 143-151.
- Pajulo M, Savonlahti E, Sourander A, Piha J, Helenius H (2001b): Prenatal maternal representations: Mothers at psychosocial risk. *Inf Mental Hlth J* 22: 529 – 544.
- Pauli-Pott U, Mertesacker B, Bade U, Bauer C, Beckmann D (2000): Contexts of relations of infant negative emotionality to caregiver's reactivity /sensitivity. *Inf Behav Dev* 23: 23-39.
- Pauli-Pott U, Mertesacker B, Bade U, Haverkock A, Beckmann D (2003): Parental perceptions and infant temperament development. *Inf Behav Dev* 26: 27-48.
- Pears KC, Capaldi DM (2001): Intergenerational transmission of abuse: a two-generational prospective study of an at-risk sample. *Child Abuse Negl* 25: 1439-1461.
- Pelchat D, Bisson J, Bois C, Saucier JF (2003): The effects of early relational antecedents and other factors on the parental sensitivity of mothers and fathers. *Inf Child Dev* 12: 27-51.

- Perry BD, Pollard RA, Blakeley TL, Baker WL, Vigilante D (1995): Childhood trauma, the neurobiology of adaptation, and “use-dependent” development of the brain: How “states” become “traits”. *Inf Mental Hlth J* 16: 271-289.
- Pesonen A-K, Räikkönen K, Keltikangas-Järvinen L, Strandberg T, Järvenpää A-L (2003): Parental perception of infant temperament: Does parents’ joint attachment matter? *Inf Behav Dev* 26:167-182.
- Pesonen A-K, Räikkönen K, Strandberg T, Keltikangas-Järvinen L, Järvenpää A-L (2004): Insecure adult attachment style and depressive symptoms: Implications for parental perceptions of infant temperament. *Inf Mental Hlth J* 25: 99-116.
- Pettit GS, Bates JE (1989): Family interaction patterns and children’s behavior problems from infancy to 4 years. *Dev Psychol* 25: 413-420.
- Porter CL, Hsu H-C (2003): First-time mothers’ perceptions of efficacy during the transition to motherhood: links to infant temperament. *J Fam Psychol* 17: 54-64.
- Priel B, Besser A (2002): Perceptions of early relationships during the transition to motherhood: the mediating role of social support. *Inf Mental Hlth J* 23: 343-360.
- Putallaz M, Costanzo PR, Grimes CL, Sherman DM (1998): Intergenerational continuities and their influences on children’s social development. *Soc Dev* 7: 389-427.
- Puura K, Almqvist F, Tamminen T, Piha J, Räsänen E, Kumpulainen K, Moilanen I, Koivisto AM (1999): Psychiatric disturbances among prepubertal children in Southern Finland. *Soc Psychiatry Psychiatr Epidemiol* 33: 310-318.
- Puura K, Davis H, Cox A, Tsiantis J, Tamminen T, Ispanovic-Radojkovic V, Paradisiotou A, Mäntymaa M, Roberts R, Dragonas T, Layiou-Lignos E, Dusoir T, Rudic N, Tenjovic L, Vizacou S (2005) The European Early Promotion Project: Description of the service and evaluation study. *Int J Mental Hlth Prom* 7: 17- 31.
- Puura K, Davis H, Papadopoulou K, Tsiantis J, Ispanovic-Radojkovic V, Rudic N, Tamminen T, Turunen M-M, Dragonas T, Paradisiotou A, Vizakou S, Roberts R, Cox A, Day C (2002): The European Early Promotion Project: A new primary health care service to promote children’s mental health. *Inf Mental Hlth J* 23: 606-624.
- Quinton D, Rutter M, Rowlands O (1976): An evaluation of an interview assessment of marriage. *Psychol Med* 6: 577 - 586.
- Riordan D, Appleby L, Faragher B (1999): Mother-infant interaction in post-partum women with schizophrenia and affective disorders. *Psychol Med* 29: 991-995.

- Rutter M, Brown E (1966): The reliability and validity measures of family life and relationships in families containing a psychiatric patient. *Soc Psychiatry* 1: 38 -53.
- Sai FZ (2005): The role of the mother's voice in developing mother's face preference: evidence for intermodal perception at birth. *Inf Child Dev* 14:29-50.
- Sameroff AJ, Fiese BH (2000): Models of development and developmental risk. In: *Handbook of infant mental health*, pp. 3-19. Ed. CH Zeanah, 2nd edition, The Guilford Press, New York.
- Salmela-Aro K, Nurmi J-E, Saisto T, Halmesmäki E (2001): Goal reconstruction and depressive symptoms during the transition to motherhood: evidence from two cross-lagged longitudinal studies. *J Pers Soc Psychol* 81: 1144-1159.
- Sandberg S, Paton JY, Ahola S, McCann DC, McGuinness D, Hillary CR, Oja H (2000): The role of acute and chronic stress in asthma attacks in children. *Lancet* 356: 982-987.
- Schore AN (2001a): Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Inf Mental Hlth J* 22: 7-66.
- Schore AN (2001b): The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Inf Mental Hlth J* 22: 201-269.
- Schuengel C, Bakermans-Kranenburg MJ, van IJzendoorn MH (1999): Frightening maternal behaviour linking unresolved loss and disorganized infant attachment. *J Consult Clin Psychol* 67: 54-63.
- Schuler ME, Black MM, Starr RH (1995): Determinants of mother-infant interaction: effects of prenatal drug exposure, social support, and infant temperament. *J Clin Child Psychol* 24: 397-405.
- Siddiqui A, Hägglöf B (2000): Does maternal prenatal attachment predict postnatal mother-infant interaction? *Early Hum Dev* 59: 13 - 25.
- Siddiqui A, Hägglöf B, Eisemann M (2000): Own memories of upbringing as a determinant of prenatal attachment in expectant women. *J Reprod Inf Psychol*, 18: 67-74.
- Siegel DJ (2001 a): Memory: an overview, with emphasis on developmental, interpersonal, and neurobiological aspects. *J Am Acad Child Adolesc Psychiatry* 40: 997-1011.
- Siegel DJ (2001 b): Toward an interpersonal neurobiology of the developing mind: attachment relationships, "mindsight", and neural integration. *Inf Mental Hlth J* 22:67-94.
- Smith CA, Farrington DP (2004): Continuities in antisocial behaviour and parenting across three generations. *J Child Psychol Psychiatry* 45: 230-247.
- Sinkkonen J (2001): Kiintymyssuhteen häiriöiden yhteydet psykopatologiaan. In: *Varhaiset ihmissuhteet ja niiden*

- häiriintyminen, pp. 146-173. Eds J Sinkkonen, M Kalland, WSOY, Helsinki.
- Sinkkonen J (2004): Kiintymyssuhdeteoria - tutkimuslöydöksistä käytännön sovelluksiin. *Duodecim* 120: 1866-1873 (In Finnish).
- Sourander A (2001): Emotional and behavioural problems in a sample of Finnish three-year-olds. *Eur Child Adolesc Psychiatry* 10: 98-104.
- Spitzer RL, Williams JB, Gibbon M, First MB (1989): Instruction manual for the structured clinical interview for DSM-III-R. New York State Psychiatric Institute, Biometrics Research Department.
- Sroufe LA (1995): Emotional development. The organization of emotional life in the early years. Cambridge: Cambridge University Press.
- Stanley C, Murray L, Stein A (2004): The effect of postnatal depression on mother-infant interaction, infant response to the Still-face perturbation, and performance on an Instrumental Learning task. *Dev Psychopathol* 16:1-18.
- Stern DN (1985): The interpersonal world of the infant. Basic Books, New York.
- Stern DN (1989): The representation of relational patterns: developmental considerations. In: *Relationship disturbances in early childhood*, pp. 52 – 69. Eds. AJ Sameroff, RN Emde. Basic Books Inc., New York.
- Stormark KM, Braarud HC (2004): Infants' sensitivity to social contingency: a "double video" study of face-to-face communication between 2- and 4-month-olds and their mothers. *Inf Behav Dev* 27: 195-203.
- Suomi SJ (1997): Early determinants of behaviour: evidence from primate studies. *Br Med Bull* 53:170-184.
- Teerikangas OM, Aronen ET, Martin RP, Huttunen MO (1998): Effects of infant temperament and early intervention on the psychiatric symptoms of adolescents. *J Am Acad Child Adolesc Psychiatry* 37: 1070-1076.
- Teti DM, Gelfand DM, Messinger DS, Isabella R (1995): Maternal depression and the quality of early attachment: an examination of infants, preschoolers, and their mothers. *Dev Psychol* 31: 364-376.
- Thompson RA (2000): The legacy of early attachments. *Child Dev* 71: 145-152.
- Trevarthen C, Aitken KJ (2001): Infant intersubjectivity: research, theory and clinical application. *J Child Psychol Psychiatry* 42: 3-48.
- Tronick EZ (1989): Emotions and emotional communication in infants. *Am Psychol* 44: 112-119.
- Tronick EZ, Als H, Adamson L, Wise S, Brazelton TB (1978): The infant's response to entrapment between contradictory messages in face-to-face interaction. *J Am Acad Child Adolesc Psychiatry* 17: 1-13.
- Tronick EZ, Bruschweiler-Stern N, Harrison AM, Lyons-Ruth K, Morgan AC, Nahum JP, Sander L, Stern DN (1998): Dyadically expanded

- states of consciousness and the process of therapeutic change. *Inf Mental Hlth J* 19: 290-299.
- Tronick EZ, Weinberg, MK (1997): Depressed mothers and infants: Failure to form dyadic states of consciousness. In: *Postpartum depression and child development*, pp. 54-81. Eds. L Murray, P Cooper. The Guilford Press, New York.
- Turner Cobb JM, Steptoe A (1996): Psychosocial stress and susceptibility to upper respiratory tract illness in an adult population sample. *Psychosom Med* 58: 404-412.
- Turner Cobb JM, Steptoe A (1998): Psychosocial influences on upper respiratory infectious illness in children. *J Psychosom Res* 45: 319-330.
- Uljas H, Rautava P, Helenius H, Sillanpää M (1999): Behaviour of Finnish 3-year-old children. I: Effects of sociodemographic factors, mother's health, and pregnancy outcome. *Dev Med Child Neurol* 41: 412-419.
- van den Boom DC (1994): The influence of temperament and mothering on attachment and exploration: an experimental manipulation of sensitive responsiveness among lower-class mothers with irritable infants. *Child Dev* 65: 1457-1477.
- van den Boom DC, Hoeksma JB (1994): The effect of infant irritability on mother-infant interaction: A growth-curve analysis. *Dev Psychol* 30: 581-590.
- van IJzendoorn MH (1995): Adult attachment representations, parental responsiveness, and infant attachment: a meta-analysis on the predictive validity of the adult attachment interview. *Psychol Bull* 117: 387 - 403.
- van IJzendoorn MH, Bakermans-Kranenburg MJ (1996): Attachment representations in mothers, fathers, adolescents, and clinical groups: a meta-analytic search for normative data. *J Consult Clin Psychol* 64:8-21.
- van IJzendoorn MH, Juffer F, Duyvesteyn MGC (1995): Breaking the intergenerational cycle of insecure attachment: a review of the effects of attachment-based interventions on maternal sensitivity and infant security. *J Child Psychol Psychiatry* 36: 225 - 248.
- van IJzendoorn MH, Vereijken CMJL, Bakermans-Kranenburg MJ, Riksen-Walraven JM (2004): Assessing attachment security with the Attachment Q Sort: meta-analytic evidence for the validity of the observer AQS. *Child Dev* 75: 1188-1213.
- van Wulfften Palthe T, Hopkins B (1993): A longitudinal study of neural maturation and early mother-infant interaction: a research note. *J Child Psychol Psychiatry* 34: 1031-1041.
- von Klitzing K, Simoni H , Bürgin D (1999): Child development and early triadic relationships. *Int J Psychoanal* 80: 71-89.

- Wald ER, Guerra N, Byers C (1991): Frequency and severity of infections in day care: three-year follow-up. *J Pediatr* 118: 509-514.
- Ward MJ, Carlson EA (1995): Associations among adult attachment representations, maternal sensitivity, and infant-mother attachment in a sample of adolescent mothers. *Child Dev* 66: 69-79.
- Warren SL, Gunnar MR, Kagan J, Anders TF, Simmens SJ, Ronen M, Wease S, Aron E, Dahl RE, Sroufe LA (2003): Maternal panic disorder: infant temperament, *neurophysiology*, and parenting behaviours, *J Am Acad Child Adolesc Psychiatry* 42: 814-825.
- Watamura SE, Donzella B, Alwin J, Gunnar MR (2003): Morning-to-afternoon increases in cortisol concentrations for infants and toddlers at child care: age differences and behavioral correlates. *Child Dev* 74: 1006-1020.
- Waters E, Cummings EM (2000): A secure base from which to explore close relationships. *Child Dev* 71: 164 - 172.
- Waters E, Deane K (1985): Defining and assessing individual differences in attachment relationships: Q-methodology and the organization of behaviour in infancy and early childhood. In: *Growing points of attachment theory and research*, pp. 41-65. Eds. I Bretherton, E Waters, *Monogr Soc Res Child Dev*, Vol 50, nr. 1-2, Ser nr 209.
- Waters E, Weinfield NS, Hamilton CE (2000): The stability of attachment security from infancy to adolescence and early adulthood: general discussion. *Child Dev* 71: 703 - 706.
- Weinberg MK, Tronick EZ (1996): Infant affective reactions to the resumption of maternal interaction after the still-face. *Child Dev* 67: 905-914.
- Winnicott DW (1965): *The maturational processes and the facilitating environment. Studies in the theory of emotional development*. 14th printing, 1996, International Universities Press, Inc. Madison, Connecticut
- Wolk S, Zeanah CH, Coll C-T G, Carr S (1992): Factors affecting parents' perceptions of temperament in early infancy. *Am J Orthopsychiatry* 62: 71-81.
- Wright RJ, Rodriguez M, Cohen S (1998): Review of psychosocial stress and asthma: an integrated biopsychosocial approach. *Thorax* 53: 1066-1074.
- Zeanah CH (1996): Beyond insecurity: a reconceptualization of attachment disorders in infancy. *J Consult Clin Psychol* 64: 42-52.
- Zeanah CH, Anders TF, Seifer R, Stern DN (1989): Implications of research on infant development for psychodynamic theory and practice. *J Am Acad Child Adolesc Psychiatry* 28: 657-668.
- Zeanah CH, Boris NW (2000): Disturbances and disorders of attachment in early childhood. In: *Handbook of infant mental health*, pp. 353-368. Ed. CH Zeanah, 2nd edition, The Guilford Press, New York.

- Zeanah CH, Boris NW, Larrieu JA (1997a): Infant development and developmental risk: a review of the past 10 years. *J Am Acad Child Adolesc Psychiatry* 36: 165-178.
- Zeanah CH, Boris NW, Scheeringa MS (1997b): Psychopathology in infancy. *J Child Psychol Psychiatry* 38: 81-99.
- Zeanah CH, Boris NW, Scott Heller S, Hinshaw-Fuselier S, Larrieu JA, Lewis M, Palomino R, Rovaris M, Valliere J (1997c): Relationship assessment in infant mental health. *Inf Mental Hlth J* 18: 182-197.
- Zeanah CH, Danis B, Hirshberg L, Benoit D, Miller D, Scott Heller S (1999): Disorganized attachment associated with partner violence: a research note. *Inf Mental Hlth J* 20: 77-86.
- Zeanah CH, Keener MA, Anders TF (1986): Developing perceptions of temperament and their relation to mother and infant behavior. *J Child Psychol Psychiatry* 27: 499-512.

Appendices

1. Covering letter for parents
2. Informed consent
3. Need checklist for primary health nurses
4. Parenting Stress Index (PSI), short form
5. Infants Characteristics Questionnaire (ICQ)
6. Child Behaviour Checklist (CBCL)/2-3

Original communications

Infant–mother interaction as a predictor of child’s chronic health problems

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Abstract

Background Psychological stress is associated with physical illnesses like asthma or infections. For an infant, situations perceived as stressful are highly dependent on the relationship with the caregiver. Constantly poor mother–infant interaction increases the child’s vulnerability to stressful conditions and experiences. The aim of the study was to investigate the impact of the quality of early mother–infant interaction on the subsequent physical health of the child. Poor mother–infant interaction was hypothesized to be associated with chronic or recurrent health problems in the child. **Participants** Fifty-seven mother–infant dyads from families at risk of psychosocial problems and 63 from non-risk families, altogether 120 dyads, participated in the study. Families were drawn from normal population, from well-baby clinics in the city of Tampere, Finland. Infants were full-term and healthy, families with severe risks like psychotic illnesses of the parents or a history of child protection concerns were excluded from the study.

Methods After the initial interview with the mother, the mother–infant interaction was videotaped when the infants were 8–11 weeks of age and the interaction was assessed using the Global Rating Scale for Mother–Infant Interaction (Murray et al. 1996a). After the 2-year follow-up mothers were interviewed again and the health problems of the child were elicited.

Results Poor dyadic mother–infant interaction and infant’s poor interactive behaviour assessed at two months were separately associated with the physical health of the child during the two-year follow-up. After adjusting for other factors in the logistic regression analysis infant’s poor interactive behaviour remained as a significant predictor of chronic or recurrent health problems in the child. Infant’s health problems at the time of the initial interview and day care centre attendance were also significant predictors.

Conclusions The results suggest that interactional issues between a mother and her infant are related to the child’s subsequent physical health. Children with recurrent or chronic health problems may have relationship difficulties with which they need help. Also, early avoidant behaviour of the

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infant should be regarded as an indicator of the infant's distress with possibly adverse outcomes in the child's physical health, among other consequences.

Keywords

mother–infant interaction, physical health, emotional regulation, psychological stress

Introduction

Children develop and grow in the care-giving context. At the beginning their survival is totally dependent on another person, who feeds, protects and nurtures them. There is an increasing amount of scientific evidence emphasizing the importance of the quality of early infant–caregiver interaction and the quality of attachment to child development (Crittenden 1995; Teti *et al.* 1995; Murray *et al.* 2001). Unsatisfactory mother–infant interactions have long-term consequences for the child, affecting the child's cognitive and socio-emotional development (Murray & Cooper 1997; Carter *et al.* 2001; Hay *et al.* 2001; Luoma *et al.* 2001). However, recent findings from neuro-psycho-biological studies show that early interaction also has effects on the growth and organization of the maturing brain, affecting both physiological and psychological development (Gunnar 1998; Schore 2001a). In addition, physical health and personal relationships have been found to be related; attachment style has been shown to be associated with health outcomes and a variety of health-related behaviours like symptom reporting, health care utilization and restriction of normal activities (Feeney 2000; Ciechanowski *et al.* 2002). These studies apply mainly to adults, adolescents and school-aged children. Research concerning infants and toddlers and the impact of early mother–infant interaction on the physical health of the child is, however, scarce.

Psychological stress has been shown to be associated with physical diseases like infections and asthma in adults (e.g. Turner *et al.* 1996; Wright *et al.* 1998) and also in school-aged children (Turner *et al.* 1998; Sandberg *et al.* 2000). There is evidence from preschool children showing that infections are more common in those attending

day care centres compared with children receiving family day care or home care (Wald *et al.* 1991; Louhiala *et al.* 1995). This is usually explained by easier transmission of microbes in large groups of children and by the immature immune system of small children. However, the possibility that psychological stress experienced by some toddlers in large groups of children might have an effect should not be discounted.

For children, and small children particularly, the extent to which situations are perceived as stressful is highly dependent on and connected to the interaction and the relationship with the caregiver. The caregiver alleviates the infant's distress by comforting, soothing (Cole *et al.* 1994) and by responding sensitively to the infant's needs (Tronick 1989). This emotional regulation is to a great extent dependent on the actions of the caregiver, although from birth on it is a dyadic task and the infant also has some capacity to regulate his/her emotional state (Tronick 1989; Sroufe 1995). If the caregiver cannot provide as much empathic help as the infant needs to successfully regulate his/her emotions, the infant is likely to show signs of distress like crying or gaze aversion (Tronick 1989; Weinberg & Tronick 1996). If there is often or constantly a gap between the infant's needs and the caregiver's ability to help the infant in emotional regulation, it can be considered as ongoing psychological stress for the infant.

Unsatisfying infant–caregiver interactions may also lead to poorly developed stress regulation capacity in the infant (Schore 2001b). It may affect the reactivity of the child's hypothalamic–pituitary–adrenal axis and increase a child's vulnerability to stressful conditions and experiences (Gunnar 1998). Satisfying infant–caregiver interactions build up a secure attachment relationship (Braungart-Rieker *et al.* 2001) which may decrease

the physiological consequences of stress (Gunnar *et al.* 1996). Throughout development a child internalizes and learns the practised dyadic patterns of emotional regulation and his/her stress-coping capacity gradually increases (Cole *et al.* 1994; Sroufe 1995). Theoretically, one may hypothesize, that if the child internalizes maladaptive emotional regulation models, his/her own capacity to regulate does not develop in an optimal way and the capability for using help from others through interaction is also limited (Cole *et al.* 1994; Sroufe 1995).

Based on the existing literature it was hypothesized that poor mother–infant interaction would be associated with chronic or recurrent health problems in the child. The aim of this study was to investigate whether the quality of early mother–infant interaction 8–11 weeks after birth had an impact on the subsequent physical health of the child during a 2-year follow-up.

Materials and methods

This study analyses the Finnish subsample of a more extensive longitudinal early intervention study, the European Early Promotion Project (EEPP). The EEPP is a collaboration of five European countries (Cyprus, the Federal Republic of Yugoslavia, Finland, Greece and the United Kingdom) and is described in detail elsewhere (Puura *et al.* 2002). The participants were invited to the study during pregnancy by public health nurses working at well – baby clinics. A group of these nurses had received special training in identifying families with psychosocial risks for the child’s development as well as in supporting these families and mother–infant interaction (‘trained nurses’), and mothers invited to participate in the study by these nurses formed the intervention group. The rest of the public health nurses worked in a traditional way (‘non-trained nurses’) and mothers invited to the study by them formed the control group (see Fig. 1).

The nurses contacted mothers six weeks prior to the delivery and four weeks postpartum and assessed the need status of the families with the help of a checklist devised to determine the risk of the children developing psychosocial problems (Davis

et al. 2000). They recruited both families with a need for support and families with no need for support for the EEPP study; after recruiting a family with a need for support, they invited the next non-risk family attending the well-baby clinic to participate in the study. Thus, although the sample was drawn from the normal population, it was enriched with risk-families. However, families with severe risks of psychosocial problems, like a psychotic illness of a parent, mother’s treatment in a psychiatric hospital after the birth of the infant, or a history of child protection concerns, were excluded from the study and only infants that were full-term and healthy were included. Written informed consent was obtained from the participants.

Initial assessment (T1): interview and mother–infant interaction

Mothers were interviewed when the infants were 4–10 weeks of age. The interview was semistructured and designed for the EEPP (Puura *et al.* 2002) to elicit information on the characteristics of the infant and the family, infant’s and parents’ health, psychosocial stressors and family functioning. Mother–infant interactions were videotaped when the infants were 8–11 weeks of age. The video recording took place either at home or in a laboratory when the infant was alert and not hungry. The interaction was assessed using the Global Rating Scale for Mother–Infant Interactions (Murray *et al.* 1996a). This method has shown a predictive validity for subsequent performance (Murray *et al.* 1996a, b) and a good discriminant validity for a number of clinical groups such as depression and schizophrenia, social adversity and low-risk/high-risk groups (Murray *et al.* 1996a; Riordan *et al.* 1999; Gunning *et al.* 2002). In this procedure a mother and her infant interact face-to-face for five minutes without using toys. The video recording captures the full-face image of the infant, the infant’s upper limbs and trunk, and through a mirror placed adjacent to the infant, also the mother’s full-face reflection. Six dimensions, each consisting of 3–5 items, are scored: three maternal dimensions to describe the mother’s behaviour, two infant dimensions to describe the infant’s behaviour and an interaction dimension to describe how the

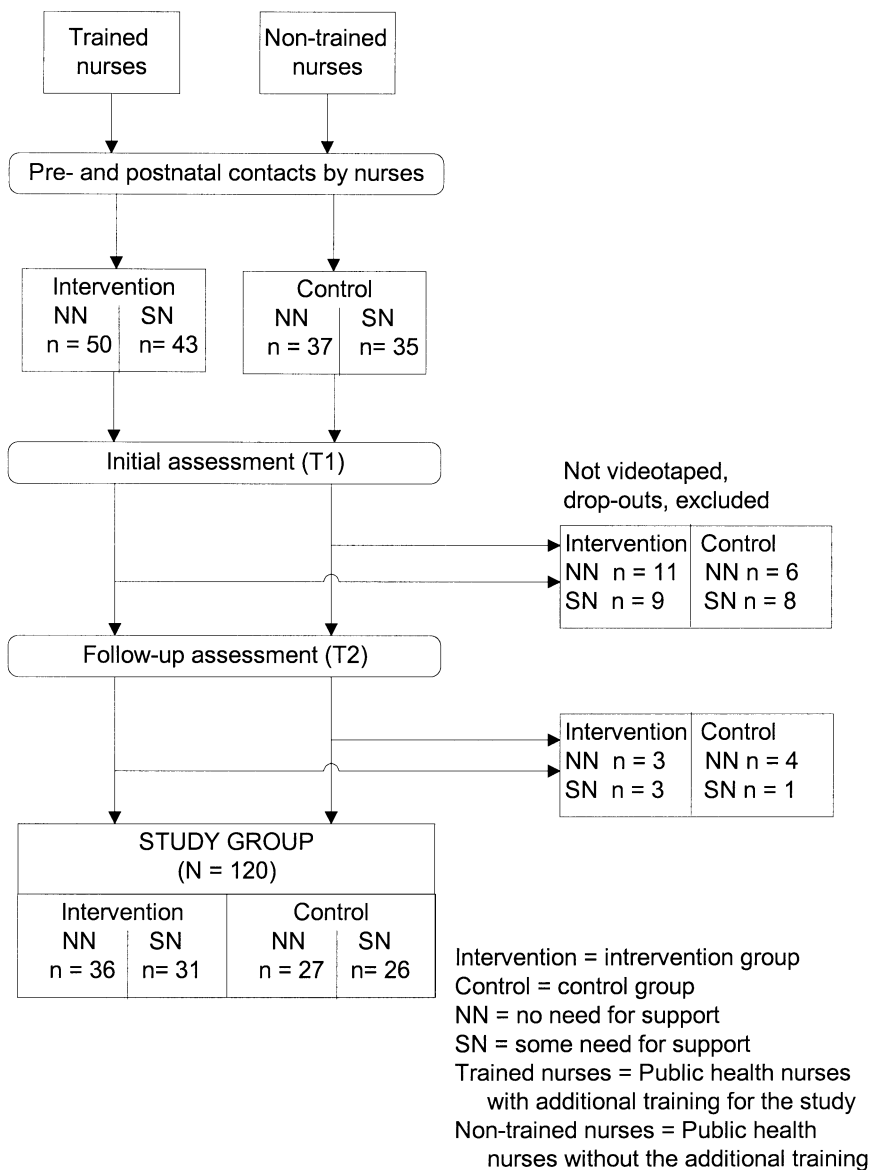


Fig. 1. The flow chart of the study

mother and the baby and their actions fit together (Table 1). Each item is scored on a five-point-scale from 1 (poor) to 5 (good). The lowest 15% of the mean scores on each dimension (the lowest and the highest 15% for mother's intrusiveness or remoteness and infant's inertness or fretfulness) is regarded as representing poor interaction; good interaction refers to the remaining portion.

In this study two-thirds (80/120) of the video recordings were made in the laboratory and one-third (40/120) at home. The decision as to where

the video recording should take place was made by the researchers and was dependent on practical reasons like time limitations. There was no association between the place where the dyads had been observed and the health of the children during follow-up. Those videotaped at home and those in the laboratory did not differ regarding mother's intrusiveness or remoteness, mother's affective behaviour, infant's interactive behaviour or dyadic mother-infant interaction. However, a greater proportion of infants observed in the laboratory

Table 1. Dimensions of mother–infant interaction. The subscales of Global Rating Scale of Mother–Infant Interaction (Murray *et al.* 1996a)

<i>Maternal scales</i>	
Mother's interactive behaviour*	warm, positive – cold, hostile accepting – rejecting responsive – unresponsive non-demanding – demanding sensitive – insensitive
Mother's intrusiveness or remoteness†	non-intrusive behaviour – intrusive behaviour non-intrusive speech – intrusive speech non remote – remote non-silent – silent
Mother's affective behaviour*	happy – sad non-flaccid – flaccid absorbed in infant – self absorbed relaxed – tense
<i>Infant scales</i>	
Infant's interactive behaviour*	attentive to mother – avoidant active communication – no active communication positive vocalizations – no positive vocalizations
Infant's inertness or fretfulness†	engaged with environment – self absorbed lively – inert attentive – avoidant happy – distressed non-fretful – fretful
<i>Interaction scale</i>	
Dyadic mother–infant interaction*	smooth, easy – difficult fun – serious mutually satisfying – unsatisfying much engagement – no engagement excited engagement – quiet engagement

*The mean score of the items is calculated; range from 1 (poor) to 5 (good).

†The difference between intrusiveness (mean score of the first two items) and remoteness (mean score of the last two items) or inertness (mean score of the first three items) and fretfulness mean score of the last two items) is calculated and then divided by two; range from –2 (intrusive or inert) to +2 (remote or fretful); 0 describes the optimal state.

scored poorly on the fretful/inert dimension, compared to infants observed at home (40% vs. 18%, respectively, $P = 0.014$) and the proportion of mothers with poor interactive behaviour was somewhat greater in the group observed in the laboratory (24% vs. 10%, $P = 0.087$).

The researchers, two child psychiatrists, were blind to the group-division of the mothers (intervention/control or some need/no need for sup-

port) and the one interviewing the mother and assessing the health of the child and parental psychopathology had no information on the mother–infant interaction analysis, and vice versa. The Winnicott Research Unit had trained the researchers in the use of the Global Rating Scale with an interrater reliability as follows: at least 90% of the scores within one point of the original score and at least 45% exactly the same.

Follow-up assessment (T2): interview

When the child was two years old the initial interview was repeated but modified for the age of the child (Puura *et al.* 2002). As a part of this interview the physical health of the child during the past two years and the number and the reasons of the child's visits to GPs or specialists were elicited. If the mother reported none or only a few occasions of minor illness (like common cold, isolated ear infections) the child was considered to have no health problems (NHP group). If the mother reported chronic or recurrent illnesses like recurring infections or severe allergy or asthma causing major restrictions to the child's diet or environment, or other long-term problems requiring regular medication, rehabilitation and/or visits to a doctor, the child was considered to have chronic health problems (CHP group). If the mother reported a serious, possibly life-threatening illness requiring hospitalization (like meningitis or sepsis) but with no chronic or long-term problems the child was considered to have serious health problems. Thus, the group division was based on the mother's report on and perception of the child's health. The children with serious health problems were excluded from this study, because on the basis of the literature it was not expected that poor mother–infant interaction would be associated with serious health problems of this sort.

Because parental psychopathology may influence the quality of mother–child interaction and parenting (Murray *et al.* 1996a; Carter *et al.* 2001), psychiatric problems of the parents were assessed through the Structured Clinical Interview for DSM-III-R (Spitzer *et al.* 1989) addressed to the mother. The severity of the psychiatric state was

also evaluated on a five-point scale from 0 to 4; 0 standing for no psychiatric disorder, 1 for psychiatric disorder with no social impairment and 2, 3 and 4 for psychiatric disorder producing increasingly severe impairment in social relationships, activities, work and household duties. In this study disorders with some degree of social impairment (2–4) were judged to be psychiatric problems.

Sample

Of the original sample of 165 mother–infant dyads 120 were analysed in this study (Fig. 1). At the initial assessment there were no differences between the intervention and the control group regarding any dimensions of mother–infant interaction or the background factors (see variables in Table 2). At follow-up the intervention and the control group did not differ regarding the child's health, and in regression analysis intervention or being in some need – group did not predict the health of the child. Therefore, in all further analyses the intervention and the control groups were assessed as one. The characteristics of the study sample are shown in Table 2. The excluded group of children with serious health problems did not differ significantly from the healthy children regarding the quality of mother–infant interaction. Neither did those who dropped out or were excluded differ significantly from the study sample on the variables presented in Table 2.

Statistical methods

Categorical variables were dichotomized because of the relatively small number of cases. Their associations with the dichotomized mother–infant dimensions were investigated by cross-tabulation with Fisher's Exact Test. To analyse the interdependence of the dimensions of mother–infant interaction, they were also used as continuous variables, and analysed by the Mann–Whitney Test and the Spearman Rank Correlation. A two-phase logistic regression analysis was carried out in order to ascertain the combined effects of variables on chronic or recurrent health problems. *P*-values <0.05 were considered statistically significant; values >0.15 are reported not significant (NS). The

Table 2. Characteristics of the sample (*n* = 120)

	%	Mean	SD
Gender of the child			
Boy	48		
Girl	52		
Birth order of the child			
First	52		
Other	48		
Socio-economic status of the family* (T1)†			
Upper or middle class	67		
Lower class and students	33		
Structure of the family (T1)			
Both parents together	91		
Lone mothers	9		
Structure of the family (T2)†			
Intact or reconstituted families	88		
Lone mothers	13		
Mother's age (years) (T1)		29.1	5.2
Infant's age (days) (videotaping)		63.8	6.4

*Socio-economic status of the family is determined by the occupation of the main breadwinner or by the occupation of the mother for lone mothers' families. Upper and middle class are classifications I, II and III non-manual (Government Statistics Service 1991).

†T1 = first phase of the study; T2 = follow-up phase of the study

statistical analyses were carried out using SPSS version 9.0.

Results

The majority of the children (*n* = 96) had no health problems (NHP group) and one-fifth (*n* = 24) were reported by their mothers to have recurrent or chronic health problems (CHP group). Most of them (*n* = 22) suffered from recurring infections, asthma and/or allergy, or both (Table 3).

Children in the CHP group had visited GPs and specialists significantly more often than healthy children during the two-year follow-up; 83% of them had visited a doctor over 10 times, compared to 8% of the NHP group (*P* < 0.001). They were more likely already to have had problems by the time the initial interview took place. They had also attended day care centres significantly more often than healthy children and were more likely to have had two or more day care places (see Table 4).

Neither the socio-economic status of the family nor the physical health of the parents were related to chronic or recurrent health problems of the child. However, psychiatric problems in the mother

were significantly more common in the CHP group and there was also a similar trend for mental health problems in the father (see Table 4).

A significantly larger proportion of the CHP group had had poor dyadic mother–infant interaction compared to the NHP group ($P = 0.034$) (Table 4). This association remained significant even when the children attending day care centres ($n = 44$) were analysed separately; 40% (6/15) of the CHP group at day care centres had had poor dyadic mother–infant interaction, compared to

10% (3/29) of healthy children attending day care centres ($P = 0.044$). The quality of mother–infant interaction and the choice of day care system were not related.

Infant’s poor interactive behaviour was associated with subsequent health problems in the child (Table 4). Infant’s poor interactive behaviour was not related to infant’s health problems at the initial assessment (T1), nor was infant’s initial health related to any other dimension of mother–infant interaction. When assessing other explanations for infant’s poor interactive behaviour, significant associations between mothers’ and infants’ behaviours were found. The interactive behaviour of mothers of infants interacting poorly was significantly poorer compared to the mothers of infants with good interactive behaviour (median 3.2, quartile range 3.0–3.8 vs. 4.0, 3.4–4.3, $P < 0.001$). The same applied to the affective behaviour of mothers (3.7, 3.5–4.0 vs. 4.2, 3.6–4.6, $P = 0.004$). There were also significant correlations between interaction dimensions. Mother’s interactive and affective behaviour were correlated with infant’s interactive behaviour ($r = 0.31$ and 0.34 , respectively, $P = 0.01$). Dyadic mother–infant interaction was significantly correlated with infants’ interactive

Table 3. Health problems of the CHP-group

Problem	Number of children suffering
Recurrent infections Ear infections, upper respiratory infections, Urinary infections	13
Allergy and/or asthma	3
Recurrent infections and allergy/asthma	6
Other Erb’s paresis, developmental delay	2

Children with recurrent infections or allergy/asthma may also have other chronic problems like epilepsy or reflux; the ‘other’ group is for children with chronic problems but no infections or allergy/asthma.

Table 4. Frequency of potential risk factors among children with no health problems (NHP) and children with recurrent and chronic health problems (CHP)

Risk factor	NHP ($n = 96$) %	CHP ($n = 24$) %	P^*
Infant’s health problems at T1†	4	17	0.05
Day care centre attendance ≥ 2 day care places	30 25	63 50	0.005 0.024
Socio-economic status of the family Lower class	32	35	NS
Mothers with health problems Physical Psychiatric	10 26	17 50	NS 0.028
Fathers with health problems‡ Physical Psychiatric	22 13	30 30	NS 0.083
Dimensions of mother–infant interaction Poor interactive behaviour (mother) Intrusiveness or remoteness (mother) Poor affective behaviour (mother) Poor interactive behaviour (infant) Inertness or fretfulness (infant) Poor dyadic mother–infant interaction	19 37 18 22 30 14	21 42 13 42 42 33	NS NS NS 0.067 NS 0.034

*Fisher’s exact test, two-tailed

†T1 = initial assessment at 4–10 weeks of age

‡ $n = 108$ (88 NHP/20 CHP) due to missing data

behaviour ($r = 0.79, P = 0.01$), mother's interactive behaviour ($r = 0.51, P = 0.01$) and mother's affective behaviour ($r = 0.54, P = 0.01$).

To analyse the combined effects of risk factors on chronic or recurrent health problems, and estimate their predictiveness, backward stepwise logistic regression analysis was performed. To keep the number of variables in each regression model acceptable compared to the number of cases, the analysis was performed in two phases. In the first phase two separate logistic regression models were calculated. The independent variables of the first one were all mother–infant interaction dimensions. The independent variables of the second model were all the other explanatory variables suggested by cross-tabulations (psychiatric problems of the mother, or of the father, day care centre attendance, number of day care places and infant's health at T1). In the second phase those variables that were predictive in the first phase were included. Infant's interactive behaviour was included as well, as cross-tabulations suggested an association with the child's health and because in the first phase it was the last variable removed from the model. The final regression model thus included dyadic mother–infant interaction, infant's interactive behaviour, psychiatric state of the mother, day care centre attendance and infant's health problems at T1, all dichotomized, as explanatory variables; results of the analysis are shown in Table 5. Infant's poor interactive behaviour increased the risk of chronic or recurrent illnesses over threefold. Infant's health problems at T1 and day care centre attendance were also predictive. Psychiatric problems of the mother had some, though non-significant effect. Dyadic mother–infant interaction was, however, removed from the model.

Discussion

Poor interaction between a mother and her infant assessed as early as two months was associated with chronic or recurrent health problems in the child during a two-year follow-up, as was hypothesized. There are, however, some methodological issues and limitations that should be borne in mind. The sample of 120 videotaped and thoroughly analysed

Table 5. Impact of risk factors on child recurrent or chronic health problems, as derived by logistic regression, expressed in odds ratios (OR) and their confidence intervals (95% CI)

Risk factors*	OR	95% CI
Infant's health problems at T1†		
No problems	1.0	
Problems	6.6	1.2–35.8
Day care centre attendance		
No	1.0	
Yes	4.7	1.7–13.3
Infant's interactive behaviour		
Good	1.0	
Poor	3.4	1.1–10.3
Psychiatric problems of the mother		
No	1.0	
Yes	2.4	0.9–6.5

*The variables in the final regression model were derived from the results of cross-tabulations and previous logistic regression analyses. Dyadic mother–infant interaction was added to the model as a risk factor but did not remain in the model as a predictor of chronic or recurrent health problems. †T1 = initial assessment, at 4–10 weeks of age

mother–infant interactions with two-month-old babies is exceptionally large. Nevertheless, the sample size is a limitation of the study and the results may only be tentative.

One of the concerns is whether the children defined as chronically ill were truly having chronic health problems or whether they were only perceived as chronically ill by their mothers. No objective assessment of the children's health or independent measure of the number of visits to a doctor was available. However, the importance of the mother's perceptions of her child should not be underrated. For doctors seeing child patients, the parents are very important sources of information on the child's health, sometimes the only sources available, and the parents are often regarded to be the best ones to know their child. Also, from the child's point of view, the mother's perceptions form the reality the child lives in. If the mother perceives her child to be ill even if he/she is not, or vice versa, the child may be exposed to unnecessary medical examinations and treatments, or the child may be hindered from receiving medical help needed. Furthermore, in psychosomatic research studies with objectively verified episodes of illness (e.g. Turner Cobb & Steptoe 1996, 1998; Sandberg *et al.* 2000) have not invalidated the findings from earlier studies based on self-reports or parent-

reports suggesting that psychosocial factors are associated with physical illnesses; in fact, recent studies have shown the importance of psychosocial factors not only in exacerbation of an existing disease but also in the pathogenesis of it (Wright *et al.* 1998).

In spite of the limitations the results of the present study suggest that interactional issues between a mother and her infant are related to the child's subsequent physical health. This relationship can be explained from bio-psychosocial and developmental viewpoints through the child's emotional regulation and stress coping capacities. Both individual variations in experiencing stress and emotional regulation capacities are developed through the infant-caregiver relationship (Cole *et al.* 1994; Sroufe 1995; Gunnar 1998). From the beginning both the baby and the mother contribute to the regulation of the infant's emotional state (Cole *et al.* 1994; Sroufe 1995). In the present study the quality of dyadic mother–infant interaction, considered alone, was significantly related to the health of the child. Further analyses gave support to the importance of both partners and their fitting together in interaction. Mother's poor interactive or affective behaviour were not related to illnesses in the child but they were significantly poorer in the group of children with poor interactive behaviour. Thus, maternal behaviour may have affected infant's interactive behaviour, which was, in turn, related to the health of the child.

In multivariate modelling infant's poor interactive behaviour remained in the model as a significant predictor of child's health problems but poor dyadic mother–infant interaction was removed from the model. This may be explained by the strong correlation between infant's interactive behaviour and dyadic interaction. It reflects the important role the infant has in mother–infant interaction. To a certain extent, the infant can improve the quality of mother–infant interaction by his/her own actions and even elicit better responses from the mother (Weinberg & Tronick 1996; Kivijärvi *et al.* 2001). If the mother's behaviour, however poor, does not result in the infant's avoidant, non-communicative behaviour, the dyadic interaction may remain good. If the mother's behaviour, even when not categorized as

poor, is too poor for her infant, it may result in the infant's poor interactive behaviour and poor dyadic mother–infant interaction.

The finding that children attending day care centres suffered more chronic or recurrent health problems has also been shown in other studies (Wald *et al.* 1991; Louhiala *et al.* 1995). The results of the present study emphasize that it is probably not merely the number of microbes and the immature immune system of small children that explain the recurrent infections in day care. Even among children at day care centres chronic or recurrent health problems and poor dyadic mother–infant interaction were significantly related. One can hypothesize that especially children who have a history of constantly unsatisfying care–giving interactions experience stress in large groups of children at day care centres. Daytime cortisol elevation has been demonstrated in children attending day care centres and particularly among younger children and those with more immature social skills (Detting *et al.* 1999). In large groups there is less time and attention from carers for an individual child. Children with poorly developed emotional regulation capacities will need more help from carers to regulate their emotions. On the other hand, these children may be poorer at seeking help or may seek it in awkward and unsuccessful ways.

Psychiatric problems in the mother were associated with chronic or recurrent illnesses in the child. Mother's psychopathology may affect her parenting abilities and the mother–child interaction (Murray *et al.* 1996a; Carter *et al.* 2001) thereby impairing her ability to help the emotional regulation and the stress coping capacities of her child. In poor living conditions the lower quality of care a depressed mother can provide has also been hypothesized to increase the child's risk of physical illnesses (Rahman *et al.* 2002). In the present study the families were mainly from the upper and middle classes and this may explain the finding that the socio-economic status of the family was not related to the child's health problems. In addition, the results may apply only with upper and middle class families. On the other hand, many other studies (e.g. Cohn & Tronick 1989; Field *et al.* 1990) have found marked disturbances in mother–infant interaction only with disadvantaged populations. The present

study shows that there are also significant and meaningful differences in the quality of mother–infant interaction in more affluent families.

It is an open question whether children experiencing chronic or recurrent illnesses were biologically more susceptible to somatic problems. The physical health of the parents was not related to the health of the child. Infants who had had health problems already by the initial interview were more likely to suffer from chronic or recurrent health problems during the follow-up. The infant's initial health, however, was not related to any dimensions of mother–infant interaction at 2 months. Both the infant's poor health initially and infant's poor interactive behaviour were predictors of the child's subsequent health, and the association of the quality of mother–infant interaction and the child's later health cannot be totally explained by infant's poor health impairing the quality of mother–infant interaction.

The results of this study may guide GPs and paediatricians to observe that children with recurrent or chronic health problems may have relationship difficulties with which they need help. Also, early avoidant behaviour of the infant should be regarded as a warning signal or indicator of the infant's distress (Guedeny & Fermanian 2001), with possibly adverse outcomes in the child's physical health, among other consequences.

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References

- Braungart-Rieker, J.M., Garwood, M.M., Powers, B.P. & Wang, X. (2001) Parental sensitivity, infant affect and affect regulation: predictors of later attachment. *Child Development*, *72*, 252–270.
- Carter, A. S., Garrity-Rokous, E., Chazan-Cohen, R., Little, C. & Briggs-Gowan, M. (2001) Maternal depression and comorbidity: predicting early parenting, attachment security, and toddler social-emotional problems and competencies. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 18–26.
- Ciechanowski, P.S., Walker, E. A., Katon, W.J. & Russo, J.E. (2002) Attachment theory: a model for health care utilization and somatization. *Psychosomatic Medicine*, *64*, 660–667.
- Cohn, J.F. & Tronick, E. (1989) Specificity of infants' response to mothers' affective behavior. *Journal of the American Academy of Child and Adolescent Psychiatry*, *28*, 242–248.
- Cole, P.M., Michel, M.K. & O'Donnell Teti, L. (1994) The development of emotion regulation and dysregulation: a clinical perspective. *Monographs of the Society for Research in Child Development*, *59*, 73–100.
- Crittenden, P.M. (1995) Attachment and risk for psychopathology: the early years. *Journal of Developmental and Behavioral Pediatrics*, *16*, S12–S16.
- Davis, H., Cox, A., Day, C., Roberts, R., Loxton, R., Ispanovic-Radojkovic, V. et al., (eds). (2000) *Primary Health Care Worker Training Manual*. Institute of Mental Health, Belgrade.
- Dettling, A.C., Gunnar, M.R. & Donzella, B. (1999) Cortisol levels of young children in full-day childcare centers: relations with age and temperament. *Psychoneuroendocrinology*, *24*, 519–536.
- Feeney, J.A. (2000) Implications of attachment style for patterns of health and illness. *Child: Care, Health and Development*, *26*, 277–288.
- Field, T.M., Healy, B., Goldstein, S. & Guthertz, M. (1990) Behavior-state matching and synchrony in mother–infant interactions in nondepressed versus depressed dyads. *Developmental Psychology*, *26*, 7–14.
- Guedeny, A. & Fermanian, J. (2001) A validity and reliability study of assessment and screening for sustained withdrawal reaction in infancy: the alarm distress baby scale. *Infant Mental Health Journal*, *22*, 559–575.
- Gunnar, M.R. (1998) Quality of early care and buffering of neuroendocrine stress reactions: Potential effects on the developing human brain. *Preventive Medicine*, *27*, 208–211.

- Gunnar, M.R., Brodersen, L., Nachmias, M., Buss, K. & Rigatuso, J. (1996) Stress reactivity and attachment security. *Developmental Psychobiology*, **29**, 191–204.
- Gunning, M., Murray, L. & Lawson, C. (2002) *Global Rating Scheme*. A Paper Presented in the 8th Congress of World Association for Infant Mental Health, Amsterdam.
- Hay, D.F., Pawlby, S., Sharp, D., Asten, P., Mills, A. & Kumar, R. (2001) Intellectual problems shown by 11-year-old children whose mothers had postnatal depression. *Journal of Child Psychology and Psychiatry*, **42**, 871–889.
- Kivijärvi, M., Voeten, M.J.M., Niemelä, P., Räihä, H., Lertola, K. & Piha, J. (2001) Maternal sensitivity behavior and infant behavior in early interaction. *Infant Mental Health Journal*, **22**, 627–640.
- Louhiala, P.J., Jaakkola, N., Ruotsalainen, R. & Jaakkola, J.J. (1995) Form of day care and respiratory infections among Finnish children. *American Journal of Public Health*, **85**, 1109–1112.
- Luoma, I., Tamminen, T., Kaukonen, P., Laippala, P., Puura, K., Salmelin, R. & Almqvist, F. (2001) Longitudinal study of maternal depressive symptoms and child well-being. *Journal of the American Academy of Child and Adolescent Psychiatry*, **40**, 1367–1374.
- Murray, L. & Cooper, P.J. (1997) Effects of postnatal depression on infant development. *Archives of Diseases in Childhood*, **77**, 99–101.
- Murray, L., Fiori-Cowley, A., Hooper, R. & Cooper, P. (1996a) The impact of postnatal depression and associated adversity on early mother–infant interactions and later infant outcome. *Child Development*, **67**, 2512–2526.
- Murray, L., Hipwell, A., Hooper, R., Stein, A. & Cooper, P. (1996b) The cognitive development of 5-year-old children of postnatally depressed mothers. *Journal of Child Psychology and Psychiatry*, **37**, 927–935.
- Murray, L., Woolgar, M., Cooper, P. & Hipwell, A. (2001) Cognitive vulnerability to depression in 5-year-old children of depressed mothers. *Journal of Child Psychology and Psychiatry*, **42**, 891–899.
- Puura, K., Davis, H., Papadopoulou, K., Tsiantis, J., Ispanovic-Radojkovic, V., Rudic, N. *et al.* (2002) The European Early Promotion Project: a new primary health care service to promote children's mental health. *Infant Mental Health Journal*, **23**, 606–624.
- Rahman, A., Harrington, R. & Bunn, J. (2002) Can maternal depression increase infant risk of illness and growth impairment in developing countries? *Child: Care, Health and Development*, **28**, 51–56.
- Riordan, D., Appleby, L. & Faragher, B. (1999) Mother–infant interaction in post-partum women with schizophrenia and affective disorders. *Psychological Medicine*, **29**, 991–995.
- Sandberg, S., Paton, J.Y., Ahola, S., McCann, D.C., McGuinness, D., Hillary, C.R. & Oja, H. (2000) The role of acute and chronic stress in asthma attacks in children. *Lancet*, **356**, 982–987.
- Schore, A.N. (2001a) Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, **22**, 7–66.
- Schore, A.N. (2001b) The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, **22**, 201–269.
- Spitzer, R.L., Williams, J.B., Gibbon, M. & First, M.B. (1989) *Instruction Manual for the Structured Clinical Interview for DSM-III-R* New York State Psychiatric Institute, Biometrics Research Department.
- Sroufe, A.L. (1995) *Emotional Development. The Organization of Emotional Life in the Early Years*. Cambridge University Press, Cambridge.
- Teti, D.M., Gelfand, D.M., Messinger, D.S. & Isabella, R. (1995) Maternal depression and the quality of early attachment: an examination of infants, preschoolers, and their mothers. *Developmental Psychology*, **31**, 364–376.
- Tronick, E.Z. (1989) Emotions and emotional communication in infants. *American Psychology*, **44**, 112–119.
- Turner Cobb, J.M. & Steptoe, A. (1996) Psychosocial stress and susceptibility to upper respiratory tract illness in an adult population sample. *Psychosomatic Medicine*, **58**, 404–412.
- Turner Cobb, J.M. & Steptoe, A. (1998) Psychosocial influences on upper respiratory infectious illness in children. *Journal of Psychosomatic Research*, **45**, 319–330.
- Wald, E.R., Guerra, N. & Byers, C. (1991) Frequency and severity of infections in day care: three-year follow-up. *Journal of Pediatrics*, **118**, 509–514.
- Weinberg, M.K. & Tronick, E.Z. (1996) Infant affective reactions to the resumption of maternal interactions after the still-face. *Child Development*, **67**, 905–914.
- Wright, R.J., Rodriguez, M. & Cohen, S. (1998) Review of psychosocial stress and asthma: an integrated biopsychosocial approach. *Thorax*, **53**, 1066–1074.



Early mother–infant interaction, parental mental health and symptoms of behavioral and emotional problems in toddlers

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Abstract

This study examined the associations of deviant features in early mother–infant interaction and parental psychopathology with symptoms of behavioral/emotional problems in the child 2 years later. Fifty mother–infant dyads were assessed in the study; mother–infant interaction was videotaped at infant’s 8–11 weeks of age, parental psychopathology was assessed by a structured diagnostic interview. At 2 years the symptoms of behavioral/emotional problems were investigated by CBCL questionnaires. The results suggest that the mother’s hostility and/or intrusiveness in early mother–infant interaction and parental psychopathology are related to and predict behavioral/emotional symptoms in the child but their influence varies. Father’s psychiatric problems predicted high internalizing, externalizing and total problem scores and mother’s psychiatric problems before the pregnancy predicted high externalizing scores in the child at 2 years. Mother’s hostility and/or intrusiveness in early mother–infant interaction predicted high externalizing and total problem scores.

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Keywords: Mother–infant interaction; Parental psychopathology; Behavioral problems; Emotional problems

1. Introduction

Infant–caregiver interaction is of crucial importance to child development. Interaction with the caregivers builds up the social context through which the child encounters the world around him/her (Tronick & Weinberg, 1997). If the relationship between the infant and the caregiver fails to be appropriately

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established, the development of the child is compromised, no matter what the reason for the failure is (Tronick & Weinberg, 1997). Studies have shown that the quality of mother–infant interaction is associated with the quality of attachment (e.g. Braungart-Rieker, Garwood, Powers, & Wang, 2001; Crittenden, 1995; Isabella, 1993), cognitive development (Murray, Fiori-Cowley, Hooper, & Cooper, 1996a), socio-emotional development (Gerhold, Laucht, Texdorf, & Schmidt, 2002; Kochanska, Forman, & Coy, 1999) and physical health (Mäntymaa et al., 2003). There is evidence for the importance of the quality of mother–infant interaction in moderating the impact of biological and psychosocial risks on child development (Laucht, Esser, & Schmidt, 2001). The growth and organization of the maturing brain are also affected by infant–caregiver interactions and the attachment relationship between them (e.g. Schore, 2001), further stressing the significance of early experiences in shaping the future development of the child. The interdependence of interaction and brain development helps us to understand why early experiences may have such long-term effects.

Assessing the quality of infant–caregiver interaction would seem an ideal way to identify as early as possible those on the pathway of later problematic outcome. However, variability and change are normal and important features of healthy infant–caregiver interaction, both within a dyad and between dyads (de Weerth & van Geert, 2002; Lavelli & Fogel, 2002). In the first months of an infant’s life the infant develops rapidly, and the interaction with the caregiver also changes enormously (Lavelli & Fogel, 2002). Thus, good infant–caregiver interaction encompasses a wide range of behaviors, both on the part of the caregiver and the infant. On the other hand, sufficient stability and predictability in patterns of interaction are also required for normal development. Further studies are needed to identify the early maladaptive patterns of interaction that are possibly stable enough to increase the likelihood of less than optimal outcome for the child and that should be noted early on.

The consequences of parental psychopathology for infant development have been the focus of intense research in recent years. Postnatal depression especially has been studied in relation to poor infant outcome. The harmful effects of postnatal depression may be mediated by several routes, one of which is the quality of mother–infant interaction (Murray & Cooper, 1997). Two predominant patterns of interaction of depressed mothers have been identified. Some depressed mothers are unresponsive, withdrawn and flat in their affective displays, others are intrusive and hostile, handling their infants roughly and being overstimulating towards them (Jones et al., 1997; Tronick & Weinberg, 1997). Also, infants of depressed mothers differ from infants of healthy mothers in their interactive behavior; they have been found to show gaze avoidance, vocalize less and be less positive (Cohn, Campbell, Matias, & Hopkins, 1990; Field, 1984). Whether these deviant features suggested by depression studies may be present in mother–infant interaction otherwise than together with depression, and harmful as such, is less known.

Most of the studies on parental psychopathology concerning infants and their development investigate the effects of maternal psychopathology. However, the effects of the mental health problems of fathers on infant development should not be ignored. In one of the few studies assessing the association between psychiatric disorder in father and infant development during the first 2 years (Laucht, Esser, & Schmidt, 1994), paternal psychopathology was reported to be related to poorer cognitive development but not to behavioral problems of the child at 2 years. The effects of psychopathology in mothers versus fathers on child development may vary according to the child’s age, timing and severity of the disorder and parental role (e.g. primary caregiver or not; how much involved in the child care) (Connell & Goodman, 2002).

The aim of the study was to investigate the associations of the quality of early mother–infant interaction, parental psychopathology and behavioral/emotional symptoms of the child in a longitudinal setting. It was expected that: (1) deviant features in early mother–infant interaction such as intrusiveness, remoteness,

hostility, flat affect or insensitivity of the mother and avoidant behavior of the infant assessed at 8–11 weeks of age would be associated with higher problem scores in the child's CBCL at 2 years; (2) mental health problems of both the mother and the father would be related to higher problem scores in the CBCL at 2 years of age; and (3) both deviant features of mother–infant interaction and parental psychopathology would independently predict the highest quartile of internalizing, externalizing and total problem scores in the CBCL at 2 years. Because maternal psychopathology may impact on the quality of mother–infant interaction (e.g. Field, 1984; Murray & Cooper, 1997), the association of mother's psychiatric problems and deviant features in mother–infant interaction was investigated. Also, factors of the social environment such as single-parenthood, poor living environment and low socio-economic status (Boyle & Lipman, 2002; Sourander, 2001) may increase the risk for emotional and behavioral problems in the child, and these common risks were controlled for. In addition, day care may be an important contributor in a child's socio-emotional development. The form of day care, the intensity of day care and the age of children when day care started were examined in relation to the CBCL scores at 2 years.

2. Method

2.1. Participants

The sample for this study was drawn from the Finnish sub-sample of a more extensive longitudinal early intervention study, the European Early Promotion Project (EEPP). The EEPP, a collaboration of five European countries (Cyprus, the Federal Republic of Yugoslavia, Finland, Greece and the United Kingdom), has been described in detail elsewhere (Puura et al., 2002) and only a short description of the project is given here. The intervention study extended from late pregnancy till the child's second birthday. Expectant mothers within the normal population were invited by public health nurses working at well-baby clinics to participate in the study. The nurses were instructed to recruit both families that in their judgement were in some need for extra support and families with no need for support. After recruiting a family with some need for support the nurses invited the next non-risk family attending the well-baby clinic to participate. Thus, about half of the participating families were judged by the nurses to have some sort of psychosocial risks for child development. However, families with severe risks for psychosocial problems, such as psychotic illness of a parent, a history of child protection concerns or mother's treatment in a psychiatric hospital after the birth of the infant were excluded from the study and only full-term and healthy infants were included. Written informed consent was obtained from the participants.

Half of the nurses had received special training in identifying families with psychosocial risks for the child's development, in supporting these families and in promoting mother–infant interaction. Mothers invited to participate in the study by these nurses formed the intervention group. The rest of the public health nurses worked in a traditional way and mothers invited to the study by them formed the control group. There were risk- and non-risk families in both groups.

Because of our interest in detecting early signs of later problematic outcome, the study sample is formed of the control group receiving no intervention to avoid confounding effects of the intervention on interpreting the findings. Out of 72 control-group mother–infant dyads 61 were observed and videotaped in mother–infant interaction. Seven mothers refused to be videotaped and for four dyads no videotaping time was scheduled because of the summer vacation. Three of the videotaped dyads could not be reached or did not want to continue, and 58 mothers were seen in the follow-up interview. Despite two reminders,

Table 1
 Characteristics of the sample ($n = 50$)

	%	Mean	S.D.
Gender of the child			
Boy	46		
Girl	54		
Socio-economic status of the family			
Upper and middle class	68		
Lower class	30		
Birth order of the infant			
First	50		
Other	50		
Structure of the family at T1			
Mother married or cohabiting	94		
Mother single	6		
Structure of the family at T2			
Mother married or cohabiting	88		
Mother single	12		
Need status			
No need	58		
Some need	42		
Mother's age (years), T1		29.3	4.8
Infant's age (days) at videotaping		62.1	4.5

five mothers did not return CBCL questionnaires and three were incomplete. Thus, the sample of this study consists of 50 mother–child pairs (23 boys, 27 girls). According to the judgement of the public health nurses, 29 (58%) participants had no need and 21 (42%) some need for extra support. The characteristics of the study group are presented in Table 1. Those belonging to the control group but not being analyzed in the present study did not differ significantly from the study sample by mother's age, socio-economic status of the family, family structure, infant's gender or infant's age at videotaping. Nor were there differences in the mental health of the parents or the quality of mother–infant interaction. In the drop-out group, however, there was a somewhat greater proportion of first-born babies (79% versus 50%, $P = 0.054$) and families judged by the nurses to be in some need for support (64% versus 42%, $P = 0.126$) than in the study group.

2.2. Procedure

Independent researchers assessed the families at the beginning of the intervention when the infants were 4–10 weeks of age (T1) and at the follow-up when the children were 2 years old (T2). The first assessment was carried out in two stages by two child psychiatrists, each of whom assessed half of the participants. The initial interview was addressed to the mother and was conducted during a home visit when the infant was 4–10 weeks of age. At the end of the interview a time for the videotaping was scheduled to fit in the time period of 8–11 weeks of infant's age. Thus, the interval between the interview and the videotaping varied; in all cases the interview preceded the videotaping. The videorecording was

made by the researcher who had interviewed the mother, and the videotaped mother–infant interaction was later analyzed by the other researcher blind to any information on the mother–infant dyad or the family. The video recording took place either at home (18 dyads) or in a laboratory (32 dyads) when the infant was alert and not hungry. The decision as to where the video recording should take place was made by the researchers and was dependent on practical reasons like time limitations. Those observed at home did not differ from those assessed in the laboratory regarding hostility, flat affect, intrusiveness or avoidant behavior of the infant. In the laboratory there were slightly but non-significantly greater proportions of insensitive (25% versus 6%, $P = 0.130$) and remote (31% versus 11%, $P = 0.170$) mothers.

When the child was 2 years old the initial interview was repeated but modified for the age of the child (Puura et al., 2002). After the interview the mothers were given CBCL questionnaires to fill in and later return by mail.

2.3. Measures

2.3.1. The EEPP interview

The interview is semistructured, specifically designed for the EEPP (Puura et al., 2002) and based on established methods (e.g. Brown & Rutter, 1966; Quinton, Rutter, & Rowlands, 1976; Rutter & Brown, 1966). It elicits information on the infant's characteristics, mother's childhood experiences and early relationships to her parents, parents' marital relationship, family functioning, health of the parents and the child, and demographic information. As a part of the interview selected parts of a diagnostic psychiatric interview, the Structured Clinical Interview for DSM-III-R (SCID; Spitzer, Williams, Gibbon, & First, 1989) are addressed to the mother to assess the present psychiatric status of the parents and retrospectively their mental health during and before the pregnancy, and in the follow-up interview, during the follow-up period. In this study those with a psychiatric diagnosis and some degree of social impairment were judged to have psychiatric problems. Anti-social features of the parents and violence in their marital relationship were investigated through the EEPP interview at follow-up. Parents were judged to have anti-social features if during the follow-up period they had had convictions (a non-trivial conviction or two or more trivial convictions; a conviction was trivial if it was due to offences such as illegal parking or cycling without lights), if they had been on probation or in prison or if they had had problems with aggression or obvious difficulties with relationships with non-family members. The marital relationship was violent if there had occasionally or frequently been episodes of physical violence between the partners.

2.3.2. The Global Rating Scale for mother–infant interaction

The *Global Rating Scale for mother–infant interaction* (Murray et al., 1996a) was used to analyze mother–infant interaction. This method has shown a predictive validity to later performance (Murray et al., 1996a; Murray, Hipwell, Hooper, Stein, & Cooper, 1996b) and a good discriminant validity for a number of clinical groups such as those with depression, schizophrenia, social adversity and low-risk/high-risk groups (Gunning, Murray, & Lawson, 2002; Murray et al., 1996a; Riordan, Appleby, & Faragher, 1999). It has also proved to be valid cross-culturally; it has been used in studies, for example, in South Africa, Venezuela, Japan and many European countries (Cooper et al., 1999; Gunning et al., 2002). The Winnicott Research Unit had trained the researchers in the use of the Global Rating Scale. To ensure that the results are comparable with other studies using this instrument, the inter-rater reliability was evaluated between the trainer and the trainees and the required reliability (at least 90% of the scores were within one point of the original score and at least 45% exactly the same) was achieved.

In the Global Rating Scale procedure a mother and her infant interact face-to-face for 5 min without using toys. The video recording captures the full-face image of the infant, the infant's upper limbs and trunk, and through a mirror placed adjacent to the infant, also the mother's full-face reflection. Thirteen items of mother's behavior, seven items of infant's behavior and five items of dyadic behavior are scored on a 5-point scale from 1 (poor) to 5 (good), and clustered to form dimensions. In the present study, two dimensions (mother's intrusiveness or remoteness, and infant's interactive behavior to describe infant's avoidance) were used as such and in both dimensions poor behavior was distinguished by the cut-off point separating the poorest 15% in the whole EEPP Finnish subsample, also used in our previous report (Mäntymaa et al., 2003). For *mother's intrusiveness or remoteness* the difference between intrusive behavior (mean score of the two items describing intrusive behavior and intrusive speech) and remote behavior (mean score of the two items describing remote and silent behavior) is calculated and then divided by two, with a possible range from -2 (intrusive) to $+2$ (remote) and 0 representing a balanced state. A mother was judged to be *intrusive*, if she scored ≤ -0.70 (the lowest 15%), and *remote* if she scored ≥ 0.50 (the highest 15%). Infants were judged to be *avoidant* if the mean score of three infant items (attentive-avoidant, active communication—no active communication and positive vocalizations—no positive vocalization) was ≤ 2.0 (the lowest 15%).

To capture other deviant features in maternal behavior (hostility, flat affect and insensitivity), new variables were formed. Mother's behavior was judged *hostile* if the sum score of three items describing hostile behavior (warm–hostile, accepting–rejecting and non-demanding–demanding) was < 9.0 . A mother was judged to display *flat affect* if the sum score of three items describing flat affect (happy–sad, non-flaccid–flaccid and absorbed in infant–self-absorbed) was < 11.0 . *Insensitive* mothers were distinguished by the sum score of the two items describing mother's sensitivity (responsive–unresponsive and sensitive–insensitive) being < 7.0 . The cut-off point for each of these variables was defined by the 25th percentile of the distribution in the study sample.

2.3.3. *The Child Behavior Checklist/2–3 (CBCL)*

The social–emotional and behavioral problems of the children were evaluated by the Child Behavior Checklist/2–3 (CBCL; Achenbach, 1992), given to the mothers to complete. CBCL/2–3 consists of 99 items describing child's behavioral and emotional problems, and an additional item where parents can report other symptoms they may be concerned about in their child. Parents are requested to rate 2 if the item is very true or often true of their child, 1 if the item is sometimes or somewhat true, and 0 if the item is not true of their child at the time of the report or within the previous 2 months. The CBCL/2–3 is designed to identify syndromes of problems that tend to occur together. The validity and reliability of the method has been found to be high (Achenbach, 1992). In the present study we analyze the two broad-band syndromes (internalizing including anxious/depressed and withdrawn scales, and externalizing including aggressive and destructive scales), and total problem scores (Achenbach, 1992) and use raw scores to better grasp differences in this non-clinical sample. Normalized *T*-scores converted from the raw scores are used only for descriptive purposes.

2.3.4. *The assessment of social factors*

To control for risks of social environment, socio-economic status (SES) of the family, structure of the family and the quality of the living environment were assessed by the interview at T1. The socio-economic status of the family was determined by the occupation of the main breadwinner of the family or by the occupation of the mother for single mothers' families. Upper and middle classes include professionals,

managerial, technical and non-manual skilled occupations. In regression analyses SES was collapsed into two categories (others versus lower class), and two-parent families were evaluated versus single mothers' families. The living environment was judged to be poor if the sum score of items describing the quality of environment (pleasantness of house, pleasantness of immediate environment, physical state of the accommodation, housing problems, environmental problems, mother's opinion of housing and environment, accessibility of play space) was 6 or more, i.e. over the 75th percentile of the distribution of the sum scores.

2.3.5. *Day care*

The EEPP interview at the follow-up provided information on the children's day care attendance. The form of day care (no day care, family day care or day care center), the intensity of day care (full-time versus part-time) and the age the child had started day care were examined. Day care was considered part-time if the child attended it only on 1–3 days a week or if the day care was only for part of the day, not exceeding 4 h. Because the first year is very important in the formation of attachment (e.g. Crittenden, 1995; Isabella, 1993) the children were divided into those who started day care before or at their first birthday and those who started later (or not at all).

2.4. *Statistical methods*

Frequencies of categorized variables are reported as counts and percentages. The significance of their associations was tested with Fisher's exact test, thus allowing the comparison of even small groups. Because of skewed distributions continuous variables are described as medians and quartiles, and their differences between categories of other variables were tested with Mann–Whitney or Kruskal–Wallis test, as appropriate. Logistic regression analyses were used to examine the simultaneous effects of variables. All analyses were accomplished with SPSS version 9.0.

3. Results

3.1. *CBCL scores of the sample*

Medians of raw scores with lower and upper quartiles were 3.5 (2.0, 6.0) for internalizing, 11.5 (6.0, 16.0) for externalizing and 27.0 (19.5, 37.3) for total problem scores. For logistic regression the raw scores were categorized by 75th percentile and according to this definition 10 children had internalizing and 11 externalizing symptoms, while 12 were symptomatic on the total problem scale. According to the definition given by Achenbach (1992), none had internalizing symptoms (*T* scores over 67), one child had externalizing borderline symptoms (*T* scores 67–70), and two children had total problem *T* scores within the borderline range (60–63). One child was within the clinical range of total problem scores, with a *T* score of 72.

3.2. *Deviant features in interaction and CBCL problem scores*

Mother's hostility was significantly related to higher internalizing problem scores, and hostility and/or intrusiveness together to higher internalizing and total problem scores (see Table 2). Remoteness, flat

Table 2

Comparison of CBCL internalizing, externalizing and total problem raw scores at 2 years of child's age between groups of mothers with non-deviant (ND) and deviant (e.g. hostile, intrusive; D) features in interaction with an 8–11-week-old infant

Interactional feature	Internalizing symptoms		Externalizing symptoms		Total problem scores	
	ND	D	ND	D	ND	D
Intrusiveness ($n = 43$ ND/7 D)	3.0 (2.0, 6.0)	6.0 (3.0, 7.0)	10.0 (6.0, 14.0)	17.0 (10.0, 18.0)	25.0 (18.0, 30.0)	39.0 (30.0, 42.0)*
Hostility ($n = 43/7$)	3.0 (2.0, 6.0)	6.0 (5.0, 7.0)***	10.0 (6.0, 14.0)	16.0 (6.0, 18.0)	27.0 (18.0, 37.0)	33.0 (23.0, 39.0)
Intrusiveness and/or hostility ($n = 38/12$)	3.0 (2.0, 5.0)	6.0 (5.0, 7.0)***	10.0 (6.0, 14.0)	16.0 (9.3, 18.0)	25.0 (16.8, 30.0)	36.0 (23.8, 41.5)**
Remoteness ($n = 38/12$)	3.5 (2.0, 6.0)	3.5 (2.3, 6.8)	12.0 (6.0, 16.3)	10.0 (5.0, 15.5)	27.5 (20.0, 38.0)	25.5 (18.0, 35.0)
Flat affect ($n = 39/11$)	3.0 (2.0, 6.0)	4.0 (2.0, 6.0)	11.0 (6.0, 17.0)	12.0 (5.0, 14.0)	27.0 (20.0, 38.0)	23.0 (18.0, 29.0)
Remoteness and/or flat affect ($n = 32/18$)	4.0 (2.0, 6.0)	3.5 (2.0, 6.0)	11.5 (6.0, 17.8)	11.0 (5.0, 14.0)	29.0 (20.0, 38.8)	24.5 (18.0, 29.0)
Insensitivity ($n = 41/9$)	3.0 (2.0, 6.0)	5.0 (2.0, 5.5)	11.0 (6.0, 16.5)	12.0 (5.5, 15.0)	27.0 (19.0, 37.5)	24.0 (14.5, 34.5)
Avoidant behavior of the infant ($n = 35/15$)	3.0 (2.0, 6.0)	5.0 (3.0, 6.0)	10.0 (6.0, 16.0)	12.0 (6.0, 17.0)	27.0 (20.0, 38.0)	26.0 (18.0, 37.0)

Medians with lower and upper quartiles (in parentheses) are reported.

* $P = 0.056$.

** $P = 0.033$.

*** $P = 0.014$.

Table 3

Frequency of psychiatric diagnoses in mothers and fathers in their lifetime before the pregnancy (BP), perinatally (P; during the pregnancy or afterwards by 4–10 weeks of infant's age), and during the follow-up (F)

	Diagnoses of mothers			Diagnoses of fathers ^a		
	BP	P	F	BP	P	F
Panic disorder	1	–	1	–	–	–
Social phobia	3	1	2	–	–	–
Specific phobia	1	–	–	–	–	–
Obsessive–compulsive disorder	1	1	1	–	–	–
Generalized anxiety disorder	2	2	7	–	–	4
Minor depressive episode	6	2	5	1	–	–
Major depressive episode	5	1	4	–	–	3
Alcohol abuse	2	–	1	2	2	5
Drug dependence/abuse	–	–	–	–	–	–
Post-traumatic stress disorder	2	–	2	–	–	2
Somatiform disorders	–	–	2	–	–	–
Eating disorders (anorexia nervosa or bulimia nervosa)	2	–	–	–	–	–
Number of mothers/fathers with more than one diagnosis ^b	7	1	6	–	–	5

^a According to the interview of the mother.

^b This may indicate either true co-morbidity or separate episodes of illness.

affect or insensitivity of the mother or avoidant behavior of the infant were not associated with the child's higher problem scores at 2 years.

The combination of hostility and intrusiveness was not, however, a very common feature. Out of seven hostile mothers only two (29%) were also intrusive. Instead, hostile mothers, as compared to non-hostile mothers, were significantly more likely to be remote (57% versus 19%, respectively, $P = 0.048$). There were no differences in the problem scores between children of non-hostile/non-remote and hostile and/or remote mothers.

3.3. Parental mental health problems and CBCL problem scores

Psychiatric problems had troubled 19 (38%) mothers during their lifetime before the pregnancy, 6 (12%) mothers perinatally, i.e. during the pregnancy or afterwards by the time of the initial interview, and 16 (32%) mothers during the follow-up period. Frequencies of the diagnoses are reported in Table 3. There were no statistically significant differences between continuous CBCL problem scores of the children of mothers with or without psychiatric problems at any time points.

Three (6%) fathers had had mental health problems during their lifetime before the pregnancy, 2 (4%) perinatally and 8 (16%) during the follow-up period, according to the interview with the mothers. Frequencies of the diagnoses are reported in Table 3. Because the number of fathers with psychiatric problems was limited, the mental health problems of the fathers were collapsed into two categories (no psychiatric problems or problems at any time point), resulting in 9 problematic and 35 non-problematic fathers; for six fathers the information was missing. Psychiatric problems in fathers were significantly related to higher internalizing, externalizing and total problem scores of the children (see Table 4).

Table 4

Comparison of CBCL internalizing, externalizing and total problem raw scores at 2 years of child's age between groups of fathers with and without psychiatric problems

	NPP	PP	<i>P</i> ^a
Internalizing scores	3.0 (2.0, 6.0)	7.0 (3.0, 13.0)	0.017
Externalizing scores	9.0 (6.0, 16.0)	14.0 (11.0, 26.0)	0.027
Total problem scores	25.0 (18.0, 33.0)	42.0 (24.0, 59.0)	0.024

Medians with lower and upper quartiles in parentheses are reported. NPP: no psychiatric problems; PP: psychiatric problems.

^a Significance of Mann–Whitney test.

Nine fathers and one mother had anti-social features. Five couples had occasional or frequent episodes of physical violence. The children of families with anti-social features in either parent and/or physical violence between parents did not differ in their CBCL scores from the children of families with no parental anti-social features and no partner violence.

Mothers' mental health problems before the pregnancy or perinatally were not related to deviant features in mother–infant interaction. Mother's intrusiveness and/or hostility in mother–infant interaction were significantly associated with the mother's mental health during the follow-up period. Of intrusive and/or hostile mothers none had mental health problems subsequently, compared to 16 (43%) of non-intrusive and non-hostile mothers ($P = 0.005$).

3.4. Day care and CBCL problem scores

There were no differences in children's internalizing, externalizing or total problem scores between different forms of day care (no day care, family day care and day care center) or between full-time versus part-time day care. Children who had started day care before or at their first birthday scored significantly higher in internalizing and total problem scores compared to those who had started later or who received maternal care (internalizing scores: 6.0 (3.0, 8.8) versus 3.0 (2.0, 5.3), respectively, $P = 0.044$; total problem scores: 34.0 (24.3, 46.0) versus 25.5 (12.5, 30.8), $P = 0.028$). They also scored somewhat higher in externalizing symptoms although the difference was not significant (13.5 (9.3, 18.0) versus 10.0 (5.8, 14.5), $P = 0.090$).

3.5. Predictors of child's high problem scores in CBCL

To evaluate the simultaneous predictiveness of parental psychiatric problems and deviant features in interaction on high problems scores, logistic backward stepwise regression models were analyzed. The cut-point for internalizing, externalizing and total problem scores acting as dependent variables was the upper quartile. The possible effects of the day care (whether it had started before/at the first birthday or later) and socio-environmental risks were also controlled for. The explanatory variables of the final regression models were chosen on the basis of previous analyses and separate logistic regression analyses when needed.

Of the interaction factors the combined hostility and/or intrusiveness variable was chosen because it seemed to be the factor most likely to be associated with child's higher problem scores. To decide which of the time points of mother's psychiatric problems should be included in the final regression model, separate

Table 5

Impact of risk factors on high (scores over 75th percentile) internalizing, externalizing and total problem scores, as derived by logistic regression and expressed in odds ratios (or) and their 95% confidence intervals (CI) in parentheses

	Internalizing symptoms OR (95% CI)	Externalizing symptoms OR (95% CI)	Total problems OR (95% CI)
Mother's psychiatric problems ^a before pregnancy	–	11.8 (1.4–101.8)	–
Father's psychiatric problems at any time point	15.5 (2.7–87.7)	9.4 (1.1–79.3)	18.4 (1.9–173.0)
Hostility and/or intrusiveness of the mother in mother–infant interactions	–	10.3(1.1–95.5)	11.8 (1.5–91.3)
Day care started before or at the first birthday ^b	–	7.2 (1.0–52.8)	11.8 (1.5–91.3)

^a This variable was not included in the final regression model for high internalizing or total problem scores.

^b This variable was not included in the final regression model for high internalizing problem scores.

logistic regression models on upper quartile of internalizing, externalizing and total problem scores were carried out, with mother's mental health problems before pregnancy, perinatally and during the follow up as explanatory variables. Mother's mental health problems at any of the assessed time points did not predict the upper quartile of internalizing symptoms or total problem scores and mother's psychiatric problems were not included in the final regression model of these variables at all. The upper quartile of externalizing symptoms was predicted by mother's mental health problems before the pregnancy and it was chosen to be included to the final model. None of the socio-environmental risk factors assessed were predictive in separate regression analyses and they were not included in the final regression models. No gender differences were observed. Day care started at 12 months or earlier, assessed separately, was predictive of high total problem scores and was also left in the regression model of high externalizing symptoms, although not as a significant predictor. Thus, day care was included in the final regression models on high externalizing and total problems.

The final regression model on internalizing problems included psychiatric problems of the father and intrusiveness and/or hostility of the mother in early mother–infant interaction. Father's psychiatric problems predicted internalizing symptoms (see Table 5). Intrusiveness and/or hostility of the mother was not predictive.

The final regression model on externalizing symptoms included father's psychiatric problems, mother's psychiatric problems before pregnancy, intrusiveness and/or hostility of the mother and day care started before or at 12 months of age as explanatory variables. All these factors increased the risk of externalizing symptoms, although day care started early was not a significant predictor. Mother's intrusiveness and/or hostility increased the risk of externalizing problems over 10-fold (see Table 5).

The final regression model on total problem scores included intrusiveness and/or hostility of the mother, psychiatric problems of the father and day care started early. They were all significant predictors of higher total problem scores (see Table 5).

4. Discussion

The results of this study suggest that some features of mother–infant interaction as early as at 2 months of infant's age may be associated with later emotional and behavioral symptoms in the child. When

interpreting the findings the limitations of the study should be borne in mind. The study design has been defined and the methods have been chosen for the purposes of the more extensive intervention study. Such studies comprehend a large group of participants examined thoroughly and followed up for a considerable period of time. Therefore, from the ethical perspective it is highly advisable to take advantage of all information and data the study offers, even if the research questions are not at the very core of the aims of the wider study. This study examined the relation of deviant features in early mother–infant interaction at 2 months and child behavioral outcome at 2 years. It could be argued that more measurements in between would have been important to see whether other factors later on in the development could have had an impact on the outcome. However, at the follow-up interview information regarding other factors that might have had an effect during the 2-year-time, such as mental health and anti-social features of the parents and day care were investigated. Child outcome, behavioral and emotional symptoms at 2 years were examined indirectly by parent-reports. CBCL is currently the most widely used assessment method for behavioral/emotional problems of children. Given this sample, the assessment of children and classification with the help of ICD, DSM or DC: 0–3 would presumably not have provided any extra information since most of them would not have been given any (Axis I) diagnosis. CBCL enables continuous rating of children and divides normal children to those with more and those with fewer symptoms.

Because of the small sample size the results can be only tentative. With small samples and infrequent phenomena the effect of chance increases. However, it is more likely that a true association fails to emerge as significant. Thus, unexpected findings of lack of association such as in this study the finding that psychiatric problems of the mother were not related to higher problem scores of the child should not be taken to indicate that there truly is no association, i.e. that maternal psychopathology is not a risk to child development. In addition, to have an adequate number of cases in both deviant and non-deviant groups the poorest 25% was chosen to represent deviant features (mother's hostility, flat affect and insensitivity) resulting in fairly high cut-off points in this sample. Also, the participants were from culturally homogeneous backgrounds and socio-economically doing quite well, and the results may not be generalizable to more disadvantaged and culturally more diverse populations. Although approximately half of the participants had some need for extra support, i.e. they had stressors and psychosocial problems of various sorts, the families with most severe risks and adverse conditions had been excluded from the study. This may emphasize the findings of the associations of the quality of early mother–infant interaction and child behavioral/emotional outcome as true associations, not findings confounded by associated adversities.

In this sample 3 (6%) children could be regarded as problematic, i.e. they had symptoms exceeding the subclinical threshold on the total problem scale (T score over 60). Limited data are available concerning the prevalence estimations of emotional/behavioral problems for 2-year-olds. However, in a community sample Briggs-Gowan, Carter, Skuban, and McCue Horwitz (2001) reported a prevalence of 6.0% for 2-year-olds on the total problem scale when T score 60 was regarded as the cut-off point. Although the great majority of the children in our study were normal and did not have emotional/behavioral problems to such an extent that they exceeded the threshold for (sub)clinical caseness, our approach of investigating factors in relation to higher problem scores and predicting scores over 75th percentile seems well warranted. There is data from several longitudinal studies suggesting a remarkable continuity in childhood behavioral/emotional problems and psychopathology, starting from infancy and toddlerhood (Hofstra, Van der Ende, & Verhulst, 2000; Keenan, Shaw, Delliquadri, Giovannelli, & Walsh, 1998; Laucht et al., 2001; Lavigne et al., 1998). All this emphasizes the importance of early identification of problems, and antecedents of problems, and need for early intervention.

In this study hostility and intrusiveness were the features in early mother–infant interaction most likely to be associated with behavioral and emotional symptoms of the child. This finding is congruent with the study by Esser et al. (1993) who reported that mother's rejection and neglect was a major feature of poor mother–infant interaction predicting social–emotional problems of toddlers and preschool-aged children. Two-month-old infants are very sensitive to the emotional tone of the interaction and the timing of mother's expressions (Trevarthen & Aitken, 2001). Thus, infants are aware of the mother's hostile affective display, i.e. rejection, lack of warmth, and demanding behavior of the mother, manifested in the mother's tone of voice, facial and body movements, timing and rhythm of the expressions (Trevarthen & Aitken, 2001). Intrusiveness of the mother, interfering in child's activities and showing poor timing, may be appreciated by the infant as an unsympathetic and negative action, no matter how playful or loving the mother might be.

From the very beginning interaction between infant and caregiver is bidirectional, a reciprocal, coregulatory process of negotiating towards positive engagement, repairing unmatched affective states and obtaining homeostasis in physiological, behavioral and emotional states of the infant, the caregiver and the dyadic relationship (de Weerth & van Geert, 2002; Trevarthen & Aitken, 2001; Tronick & Weinberg, 1997). It is clear that due to the enormously wider array of behaviors, and greater adaptability and flexibility to adjust the behaviors in relation to the demands of the social context, the caregiver carries the main responsibility in re-establishing and maintaining the homeostasis. In the present study it seemed that mothers adjusted their behavior to protect the child from the harmful effects of their hostility: hostile mothers, as compared to non-hostile mothers, were significantly more likely to be remote. This combination was not related to higher problem scores of the child. On the other hand, some mothers seemed to act in a way that protected their own mental health. None of the hostile and/or intrusive mothers suffered from mental health problems during the subsequent 2 years and the difference from non-hostile/non-intrusive mothers was significant. This may indicate that for some mothers hostility and intrusiveness are coping mechanisms.

Other features of maternal behavior assessed in the present study were not related to higher behavioral or emotional symptoms of the child. This finding must not, however, be interpreted as suggesting that remoteness, flat affect or insensitivity of the mother do not mean a disruption in the mother–child relationship and a possibly harmful effect on the child. It may suggest that these features may not be very common in face-to-face interactions with 2-month-old babies in normal population, at least not in such severity as to increase the risk of infants for later problems. There is evidence suggesting that mother's withdrawn behavior is associated with more severe depression (Jones et al., 1997). If there had been more (severely) depressed mothers in our study sample, the association of remoteness, flat affect and behavioral/emotional problems of the child would possibly have been more likely to emerge. Also, the behavioral assessment method used in this study may have caused mothers who are normally remote and flat in their affective displays to be more actively engaged with their infant. Mothers were instructed to play with their infant as they normally would in a face-to-face situation. It is possible that the remoteness and flat affect of some mothers would have been better observed in longer and more naturalistic situations and settings (during feeding, bathing, etc.) in this non-clinical, upper/middle-class sample of mothers with less severe psychosocial problems.

Avoidant behavior of the infant did not distinguish those with subsequent higher problem scores. The age of the infants in our study may be of importance in interpreting this finding. Two-month-olds are very interested in face-to-face interactions (Trevarthen & Aitken, 2001). Lavelli and Fogel (2002) reported a peak in the duration of face-to-face communication at 8–11 weeks of infant's age and Murray et al. (1996a) found no significant differences in engagement between infants of non-depressed and depressed

mothers at 2 months. By 3 months infants have “learned” what is to be expected in the interaction with their mother and differences in attentiveness or avoidance emerge (Field, 1984). Gaze avoidance is a way for the infant to self-regulate emotions and, to a certain extent, may be an adaptive way for an infant to cope with the distress (Tronick & Weinberg, 1997). If unsatisfactory patterns of interaction between a mother and her infant recur, an originally adaptive gaze avoidance of the infant may turn into infant’s way of interacting with others, and a maladaptive sign (Guedeney & Fermanian, 2001).

Psychiatric problems of fathers, but not of mothers, were related to higher problem scores in CBCL. This finding should be interpreted with caution. The judgement as to whether a father had a psychiatric disorder or not was based on the interview with the mother and her description of the father’s symptoms. This indirect information may be biased in many ways. Generally, the frequency of psychiatric disorders may be underestimated (Laucht et al., 1994). Problems such as depression or anxiety especially may be under-reported. On the other hand, problems such as substance abuse may be more accurately reported in indirect assessment. Also, it is more likely that mothers are aware of and report problems of their spouses that are severe enough to cause obvious impairment. Thus, fathers judged to have psychiatric problems are probably more severely ill than mothers judged to have mental health problems. Despite the probability that the number of fathers with psychiatric disorder was underestimated, the association between fathers’ mental health problems and higher CBCL problem scores was significant and indicates the importance of the father and his well-being in infant development.

In logistic regression analyses both deviant features in early mother–infant interaction (namely, hostility and/or intrusiveness of the mother) and parental psychopathology predicted emotional/behavioral symptoms of the child at 2 years, as was expected, but their influence varied. Also, day-care attendance, if started before or at the first birthday, increased the risk for high total problem scores and high externalizing symptoms. The confidence intervals for the odds ratios were quite large, reflecting the small sample size. Still, many of the significant predictors had the lower scope clearly above 1.0, thus emphasizing the significance of the findings.

Hostility and/or intrusiveness increased the child’s risk for externalizing symptoms and total problems. Intrusiveness of the mother may immediately result in infant’s avoidance in mother–infant interaction. Eventually, if avoidance is not successful in limiting the mother’s intrusiveness, the children may become easily angered and frustrated (Tronick & Weinberg, 1997). Father’s psychiatric problems were predictive of child’s internalizing symptoms and total problems. The finding that mother’s psychiatric problems during her lifetime before the pregnancy predicted externalizing symptoms in the child may indicate that some children may be genetically vulnerable to behavioral/emotional problems. Children who attended day care already during the first year of their lives were at greater risk of high externalizing symptoms and particularly high total problem scores. This interesting finding needs to be returned to later, as in this study day care was only regarded and examined as a confounding factor.

5. Conclusions

Hostility and intrusiveness are features of mother–infant interaction that should be noted already early on. They may be the first signs of later problematic development leading to possible behavioral problems in the child. This is in line with Tremblay (2000, 2002) who has stated that to prevent behavior problems and aggression we have to turn to the early development of children, even beyond the preschool age back to infancy. Early intervention is needed, but the intervention should be tailored for each mother–child

dyad considering the interaction style of the mother (Hart, Field, Jones, & Yando, 1999; Jones et al., 1997). If a remote but hostile mother is supported to be more actively involved with her baby, it may increase the mother's intrusiveness and result in more harmful effects on the infant.

This study emphasizes the importance of fathers and their well-being for child development. Therefore, in health care services for infants and families more attention should be focused on possible mental health problems of fathers. Also, if mothers report the mental health problems of their spouses, it is quite likely that the problems are severe enough to cause impairment, and the family needs help.

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References

- Achenbach, T. M. (1992). *Manual for the Child Behavior Checklist/2–3 and 1992 profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Boyle, M. H., & Lipman, E. L. (2002). Do places matter? Socioeconomic disadvantage and behavioral problems of children in Canada. *Journal of Consulting and Clinical Psychology, 70*, 378–389.
- Braungart-Rieker, J. M., Garwood, M. M., Powers, B. P., & Wang, X. (2001). Parental sensitivity, infant affect and affect regulation: Predictors of later attachment. *Child Development, 72*, 252–270.
- Briggs-Gowan, M. J., Carter, A. S., Skuban, E., & McCue Horwitz, S. (2001). Prevalence of social-emotional and behavioral problems in a community sample of 1- and 2-year-old children. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*, 811–819.
- Brown, E., & Rutter, M. (1966). The measurement of family activities and relationships: A methodological study. *Human Relations, 19*, 241–263.
- Cohn, J. F., Campbell, S. B., Matias, R., & Hopkins, J. (1990). Face-to-face interactions of postpartum depressed and non-depressed mother–infant pairs at 2 months. *Developmental Psychology, 26*, 15–23.
- Connell, A. M., & Goodman, S. H. (2002). The association between psychopathology in fathers versus mothers and children's internalizing and externalizing behaviour problems: A meta-analysis. *Psychological Bulletin, 128*, 746–773.
- Cooper, P. J., Tomlinson, M., Swartz, L., Woolgar, M., Murray, L., & Molteno, C. (1999). Post-partum depression and the mother–infant relationship in a South African peri-urban settlements. *British Journal of Psychiatry, 175*, 554–558.
- Crittenden, P. M. (1995). Attachment and risk for psychopathology: The early years. *Developmental and Behavioral Pediatrics, 16*, S12–S16.
- de Weerth, C., & van Geert, P. (2002). Changing patterns of infant behavior and mother–infant interaction: Intra- and interindividual variability. *Infant Behavior & Development, 24*, 347–371.
- Esser, G., Dinter, R., Jörg, M., Rose, F., Villalba, P., Laucht, M., et al. (1993). Significance and determinants of early mother–child interaction. *Zeitschrift für Psychosomatische Medizin und Psychoanalyse, 39*, 246–264.
- Field, T. (1984). Early interactions between infants and their postpartum depressed mothers. *Infant Behavior and Development, 7*, 517–522.
- Gerhold, M., Laucht, M., Texdorf, C., & Schmidt, M. H. (2002). Early mother–infant interaction as a precursor to childhood social withdrawal. *Child Psychiatry & Human Development, 32*, 277–293.
- Guedeney, A., & Fermanian, J. (2001). A validity and reliability study of assessment and screening for sustained withdrawal reaction in infancy: The alarm distress baby scale. *Infant Mental Health Journal, 22*, 559–575.
- Gunning, M., Murray, L., & Lawson, C. (2002, July) Global Rating Scheme. A paper presented in the 8th congress of World Association for Infant Mental Health, Amsterdam.

- Hart, S., Field, T., Jones, N., & Yando, R. (1999). Intrusive and withdrawn behaviours of mothers interacting with their infants and boyfriends. *Journal of Child Psychology and Psychiatry*, *40*, 239–245.
- Hofstra, M. B., Van der Ende, J., & Verhulst, F. C. (2000). Continuity and change of psychopathology from childhood into adulthood: A 14-year follow-up study. *Journal of the American Academy of Child and Adolescent Psychiatry*, *39*, 850–858.
- Isabella, R. A. (1993). Origins of attachment: Maternal interactive behavior across the first year. *Child Development*, *64*, 605–621.
- Jones, N., Field, T., Fox, N. A., Davalos, M., Malphurs, J., Carraway, K., et al. (1997). Infants of intrusive and withdrawn mothers. *Infant Behavior and Development*, *20*, 175–186.
- Keenan, K., Shaw, D., Delliquadri, E., Giovannelli, J., & Walsh, B. (1998). Evidence for the continuity of early problem behaviors: Application of a developmental model. *Journal of Abnormal Child Psychology*, *26*, 441–454.
- Kochanska, G., Forman, D. R., & Coy, K. C. (1999). Implications of the mother–child relationship in infancy for socialization in the second year of life. *Infant Behavior and Development*, *22*, 249–265.
- Laucht, M., Esser, G., & Schmidt, M. S. (1994). Parental mental disorder and early child development. *European Child & Adolescent Psychiatry*, *3*, 125–137.
- Laucht, M., Esser, G., & Schmidt, M. H. (2001). Differential development of infants at risk for psychopathology: The moderating role of early maternal responsiveness. *Developmental Medicine and Child Neurology*, *43*, 292–300.
- Lavelli, M., & Fogel, A. (2002). Developmental changes in mother–infant face-to-face communication: Birth to 3 months. *Developmental Psychology*, *38*, 288–305.
- Lavigne, J. V., Arend, R., Rosenbaum, D., Binns, H. J., Kaufer Christoffel, K., & Gibbons, R. D. (1998). Psychiatric disorders with the onset in the preschool years: I. Stability of diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry*, *37*, 1246–1254.
- Mäntymaa, M., Puura, K., Luoma, I., Salmelin, R., Davis, H., Tsiantis, J., et al. (2003). Infant–mother interaction as a predictor of child’s chronic health problems. *Child: Care, Health and Development*, *29*, 181–191.
- Murray, L., & Cooper, P. (1997). Effects of postnatal depression in infant development. *Archives of Disease in Childhood*, *77*, 99–101.
- Murray, L., Fiori-Cowley, A., Hooper, R., & Cooper, P. (1996a). The impact of postnatal depression and associated adversity on early mother–infant interaction and later infant outcome. *Child Development*, *67*, 2512–2526.
- Murray, L., Hipwell, A., Hooper, R., Stein, A., & Cooper, P. (1996b). The cognitive development of 5-year-old children of postnatally depressed mothers. *Journal of Child Psychology and Psychiatry*, *37*, 927–935.
- Puura, K., Davis, H., Papadopoulou, K., Tsiantis, J., Ispanovic-Radojkovic, V., Rudic, N., et al. (2002). The European Early Promotion Project: A new primary health care service to promote children’s mental health. *Infant Mental Health Journal*, *23*, 606–624.
- Quinton, D., Rutter, M., & Rowlands, O. (1976). An evaluation of an interview assessment of marriage. *Psychological Medicine*, *6*, 577–586.
- Riordan, D., Appleby, L., & Faragher, B. (1999). Mother–infant interaction in post-partum women with schizophrenia and affective disorders. *Psychological Medicine*, *29*, 991–995.
- Rutter, M., & Brown, E. (1966). The reliability and validity measures of family life and relationships in families containing a psychiatric patient. *Social Psychiatry*, *1*, 38–53.
- Schore, A. N. (2001). Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, *22*, 7–66.
- Sourander, A. (2001). Emotional and behavioural problems in a sample of Finnish three-year-olds. *European Child & Adolescent Psychiatry*, *10*, 98–104.
- Spitzer, R. L., Williams, J. B., Gibbon, M., & First, M. B. (1989). *Instruction manual for the structured clinical interview for DSM-III-R*. New York State Psychiatric Institute, Biometrics Research Department.
- Tremblay, R. E. (2000). The development of aggressive behaviour during childhood: What have we learned in the past century? *International Journal of Behavioral Development*, *24*, 129–141.
- Tremblay, R. E. (2002, July). Development of physical aggression during infancy. A plenary presentation in the *8th congress of World Association for Infant Mental Health*, Amsterdam.
- Trevarthen, C., & Aitken, K. J. (2001). Infant intersubjectivity: Research, theory, and clinical applications. *Journal of Child Psychology and Psychiatry*, *42*, 3–48.
- Tronick, E. Z., & Weinberg, M. K. (1997). Depressed mothers and infants: Failure to form dyadic states of consciousness. In L. Murray & P. Cooper (Eds.), *Postpartum depression and child development* (pp. 54–81). New York: The Guilford Press.

Mother's early perception of her infant's difficult temperament, parenting stress and early mother-infant interaction

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Running head: Perception of infants' temperament

Mother's early perception of her infant's difficult temperament, parenting stress and early mother-infant interaction

Abstract

The current study investigated factors contributing to mother's early perception of her infant's difficult temperament. 124 mother-infant dyads participated in the study. Mother's perception of the infant's temperament was assessed with Infant Characteristic Questionnaire (ICQ). The influence of mother-infant interaction, mother's mental health and parenting stress were investigated. Mother-infant interaction was videotaped during a face-to-face interaction and analysed using the Global Rating Scale. Mother's mental health was assessed through a structured interview (Structured Clinical Interview for DSM-IV, SCID) and parenting stress was examined by a questionnaire (Parenting Stress Index). First, the difficultness scale of the ICQ was used as a continuous variable and factors contributing to mother's perception of her infant's temperament as more or less difficult were examined. Secondly, infants were categorised into difficult and non-difficult and factors increasing the infant's risk of being perceived as difficult were examined.

The model including mother's mental health and parental distress accounted for 24% of the variance in perceived infant difficultness, with parental distress in particular being an influential contributor. When infants categorised as difficult were examined, mother's intrusiveness and infant's poor interactive behaviour in early mother-infant interaction as well as parental distress significantly increased the infant's risk of being perceived as difficult.

Key words: temperament, perception, mother-infant interaction, parenting stress

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Introduction

Parents' perceptions of their child are of great importance, regardless of whether, objectively evaluated, they are correct or not. Perceptions guide parental actions in daily care-giving activities (e.g. when to feed the child and when to put him/her to bed) and in decisions concerning the child (e.g. whether to seek medical or psychological help for the child or not). Parents' perceptions of their child are reflected in parent-reports of child's behaviour or temperament. Parent reports include an objective component, referring to actual characteristics of the child and a subjective component, comprising parent-related factors (1-3). However, these are not independent: characteristics of the child and parental perceptions influence one another (1,4). Some researchers have suggested that parents act in a way that elicits from their infants behaviour that meets their expectations (2). Pauli-Pott and colleagues (4) reported that between 4, 8 and 12 months the caregiver's perceptions preceded the observed temperament characteristic and they concluded that this finding suggests that parents shape the developing infant temperament characteristics according to their perceptions. Foreman & Henshaw (5) showed that parent and child factors are not separable in parent reports and suggested that parent reports reflect the parent-child relationship and could be used as a way of assessing the parent-infant dyad as a whole. Seifer et al. (6) reported that the unique relationship between the mother and the child importantly affects the way the mother perceives her child's behaviour.

Parental perceptions of the child's temperament may have notable effects on the child. Child's parent-reported difficult temperament has been found to be associated with emotional neglect of the child (7) and more conflicts with the parent, leading to coercive

interaction style (8). Although there are some contradictory findings on the stability and predictability of infant temperament measured during the first year, parent-reported (i.e. parent perceived) difficult temperament of the infant in particular, even when assessed during the first year, has shown moderate stability over time (8-13), possibly predicting later behavioural problems. In a study by Keenan et al. (11), difficult temperament was considered as the earliest form of problem behaviour in infants, and they reported continuity from parent-reported difficult temperament at 18 and 24 months to later internalising DSM-III diagnosed disorders. In addition, Teerikangas et al. (13) showed that fussy/demanding temperament at six months of infant's age predicted psychiatric symptoms in adolescence.

How, then, does a mother's early perception of her infant's temperament develop? In studies addressing this question, parental pre- and postnatal characteristics on the one hand and laboratory assessed infant temperament on the other have been examined (1-3). However, mother-infant interaction is the context where the mother gets to know her infant and the infant the mother; it is where parental characteristics, prenatal expectations of the baby and baby's temperament (2,3) and the true baby, actual infant characteristics, meet. Mother's prenatal expectations and representations concerning her relationship with the infant may impact on the way she acts in early mother-infant interaction (14). Infant characteristics such as irritability and hypo- or hyper aroused motor behaviour may impact on the infant's interactive behaviour (15) and his/her ability to initiate, take part and regulate mother-infant interaction. Not many studies have examined the relation of infant's temperament reported by mother and the quality of early mother-infant interaction during the first months of the infant's life. Milliones (16) and Campbell (17) reported that infants

perceived as more difficult received less responsive mothering. Zeanah et al. (18) suggested that mother-reported difficult temperament was related to infant's less responsive behaviour. Pauli-Pott et al.(19), with a sample of 101 4-month-old babies, reported an association between low maternal reactivity/ sensitivity and parent-reported infant's negative emotionality, but only when mothers were also depressed. Schuler et al. (20) examined the relation of infant's (observed and perceived) irritability, social support and mother-infant interaction among low-income drug-using and drug-free mothers. In the drug-free group high perceived infant irritability and low levels of positive maternal behaviour were related. Most of these studies were conducted with small samples and with infants older than three months. Furthermore, there are also studies suggesting that difficult or irritable infants receive more optimal maternal care (21). Therefore, more research is needed to clarify the relation between early mother-infant interaction and infant's perceived temperament in the very first months of the infant's life.

Psychiatric disorders and emotional distress may negatively distort parental perception of the child (22). Depressed and emotionally impaired mothers perceive their children as more problematic than healthy mothers (5, 22-24). Furthermore, parenting stress has been found to be related to difficult infant temperament in several studies (e.g. 25, 26), also regarding young infants as shown in the study of Zelkowitz & Milet (27) who reported that fathers with more stress perceived their infants as more negative at 7-9 weeks of infant's age.

The aim of this study was to investigate factors contributing to mother's early perception of her infant's difficult temperament. From the clinical perspective it might be important to distinguish factors increasing the infant's risk of being perceived as extremely difficult.

Two approaches were therefore selected: First, factors contributing to mother's overall perception of her infant's temperament as more or less difficult were examined, and the difficultness scale was used as a continuous variable. Secondly, infants were categorised into difficult and non-difficult and factors increasing the infant's risk of being perceived as difficult were examined. The effect of mother-infant interaction, mother's mental health, and parenting stress were investigated. We anticipated that both maternal and infant behaviour in early mother-infant interaction would be associated with mother's perception of her infant's temperament and that poor maternal and infant behaviour would increase the infant's risk of being perceived as difficult. We also anticipated that increased parenting stress and mother's psychiatric problems would magnify mother's perception of her child's difficult temperament and increase the infant's risk of being perceived as difficult.

Method

Participants

This study analyses data of the Finnish sub-sample of the European Early Promotion Project (EEPP). EEPP is an extensive longitudinal early intervention study and a collaboration of five European countries (Cyprus, the Federal Republic of Yugoslavia, Finland, Greece and the United Kingdom). The project has been described in detail elsewhere (28, 29) and only a short description is given here. Expectant mothers within the normal population were invited by public health nurses working at well-baby clinics to participate in the study. The nurses contacted the mothers six weeks prior to the delivery and four weeks postpartum and assessed the families' need for support with the help of a checklist devised to determine the risk of the children developing psychosocial problems (30). After recruiting a family with a need for support, the nurses invited the next non-risk

family attending the well-baby clinic to participate. Thus, although the sample was drawn from the normal population, it was enriched with families having stressors and psychosocial problems of various sorts. Families with severe risks, such as psychotic illness of a parent, mother's treatment in a psychiatric hospital after the birth of the infant, or a history of child protection concerns were excluded from the study and only full-term and healthy infants were included. Written informed consent was obtained from the participants.

Half of the nurses had received special training in identifying families with psychosocial risks for the child's development, in supporting these families and in promoting mother-infant interaction. Mothers invited to participate in the study by these nurses formed the intervention group. The rest of the public health nurses worked in a traditional way and the mothers they invited to participate in the study formed the control group. There were families in need for support and families with no need for support in both groups. To evaluate the effectiveness of the intervention, independent researchers assessed the families at the beginning of the intervention, when the infants were 4 - 10 weeks of age, and after the follow-up when the children were two years old. The results of the intervention study will be reported elsewhere.

The current study

The current study analyses data from the initial assessment of the EEPP study, i.e. at the beginning of the intervention when the infants were 4 – 10 weeks old. At this time point there were no differences between the intervention and the control group regarding the background factors, mother's perception of her infant's temperament, the amount of

parenting stress or the quality of mother-infant interaction, and in the present study the groups were assessed as one.

Initially, 165 mothers participated in the study and were interviewed. Questionnaires were completed by 156 (Parenting Stress Index, PSI; 31) and 138 mothers (Infant Characteristics Questionnaire, ICQ; 1). Mother-infant interaction was assessed in 144 dyads. Fifteen mothers refused to be videotaped and for six mothers no video recording time was scheduled because of the summer vacation. The sample in the current study consisted of the 124 mother-infant dyads for whom complete data from these assessments was available. The characteristics of the study group are presented in Table 1. Those excluded ($n = 41$) did not differ significantly from the study sample by the variables presented in Table 1 or by mental health of the parents.

= Table 1 =

Procedure

The initial assessment was carried out in two stages by two child psychiatrists, each of whom randomly assessed half of the participants. The interview was addressed to the mother and was conducted during a home visit when the infant was 4-10 weeks of age. At the end of the interview mothers were given the questionnaires, and a time for the mother-infant interaction assessment (videotaping) was scheduled to fit in the time period of 8-11 weeks of infant's age. Thus, the interval between the interview and the videotaping varied; in all cases the interview preceded the videotaping. Mothers returned the questionnaires either by bringing the reports with them when they arrived for the mother-infant observation, or by mail. If necessary, two reminders were sent.

The video recording took place either in a laboratory (91 dyads, 73%) or at home (33 dyads, 27%) when the infant was alert and not hungry. The decision as to where the video recording should take place was made by the researchers and was dependent on practical reasons like time constraints. Those observed at home did not differ from those assessed in the laboratory in the interactive behaviour of the mother or the infant, mother's intrusiveness/ remoteness or infant's inertness/ fretfulness. However, mothers observed at home scored better on affective behaviour scale (mean 4.2, SD 0.6 at home vs. 3.8, SD 0.7 in the lab, $p = 0.009$). The videotaped mother-infant interaction was analysed blind to any information on the mother-infant dyad or the family.

Measures

Interview. The mothers were interviewed using a semi-structured interview, specifically designed for the EEPP (28, 29) and based on established methods (e.g. 32-34). It elicits information on the infant's characteristics, parents' marital relationship, family functioning, health of the parents and the child, mother's childhood experiences and her relationships to her parents, and demographic information. As a part of the interview selected parts of a diagnostic psychiatric interview, the Structured Clinical Interview for DSM-IV (SCID; 35) were addressed to the mother to assess her present psychiatric status and retrospectively her mental health during the pregnancy.

The Infant Characteristics Questionnaire (ICQ; 1) was used to assess infant's temperament. ICQ contains 24 items and mothers are asked to rate infant behaviour on a 7-point scale from 1 (more optimal) to 7 (less optimal). Four dimensions of temperament are

formed from the ICQ and in this study we used the 6-item fussy/difficult dimension assessing infant's fussiness, irritability and soothability. The fussy/ difficult dimension especially has proven to have good validity and reliability (Bates et al., 1979). The possible range for the sum score of these six items is from 6 (not fussy /difficult) to 42 (very fussy/ difficult). When infants were categorised into non-difficult and difficult the 85th percentile of the distribution in fussy/difficult scores was used as a cut-off point. This cut-off point was chosen to ensure a reasonable number of cases into both categories. Also, the chosen cut-off point equals approximately + 1 standard deviation, which was used as a cut-off point in the study by Campbell (17).

The Parenting Stress Index (PSI; 31). The short form of PSI was used to assess the parenting stress of the mother. For each of its 36 statements mothers were asked to choose on a Likert scale (from 1= I fully agree to 5 = I fully disagree) the option that best described their state of mind. Mothers' answers were scored from 1 (least distressed answer) to 5 (most distressed answer). The sum score of all 36 items described total stress. This total stress scale was formed from three subscales: parental distress (12 items), parent-child dysfunctional interaction (12 items) and difficult child (12 items). In the current study the parental distress subscale was used to reflect parenting stress. This subscale was chosen as it is more independent of child's difficult temperament and difficult parent-child interaction. For some analyses mothers were categorised into non-distressed and distressed groups at the 85th percentile of the distribution of the parental distress scores.

The Global Rating Scale for Mother-Infant Interaction (36) was used to analyse mother-infant interaction. This method has shown a predictive validity regarding later performance

(36, 37), and a good discriminant validity for a number of clinical groups such as those with depression, schizophrenia, social adversity and low-risk / high-risk groups (15, 38, 39). It has also proved to be valid cross-culturally; it has been used, for example, in studies in South Africa, Venezuela, Japan and many European countries (39, 40). The Winnicott Research Unit had trained the researchers in the use of the Global Rating Scale. To ensure that the results are comparable with other studies using this instrument, the inter-rater reliability was evaluated between the trainer and the trainees and the required reliability was achieved when at least 90% of the scores were within one point of the original score and at least 45% exactly the same.

In the Global Rating Scale procedure a mother and her infant interact face-to-face for five minutes without using toys. The video recording captures the full-face image of the infant, the infant's upper limbs and trunk, and through a mirror placed beside the infant, also the mother's full-face reflection. Thirteen items of mother's behaviour, seven items of infant's behaviour and five items of dyadic behaviour are scored on a five-point scale from 1 (poor) to 5 (good), and clustered to form dimensions. Maternal dimensions describe mother's overall *interactive behaviour* (i.e. her warmth, acceptance, responsiveness, non-demanding behaviour and sensitivity), *affective behaviour* (i.e. how happy, non-flaccid, absorbed in the infant vs. self-absorbed, and relaxed she is) and *intrusiveness/remoteness* (i.e. the balance between her intrusive behaviour and speech and her remote behaviour and silence). Infant dimensions describe *infant's interactive behaviour* (i.e. the attentiveness vs. avoidance of the infant, the amount of active communication and positive vocalisation) and *infant's inertness / fretfulness* (i.e. how attentive, engaged with environment vs. self-absorbed, lively vs. inert, happy vs. distressed/ miserable and how fretful the infant is).

In the present study, maternal and infant dimensions were used both as continuous ratings and as categorised variables. In each dimension poor and good behaviour were distinguished by cut-off points separating the poorest 15% in the whole EEPP Finnish subsample, also used in our previous report (41).

Results

In this sample, the mean score of ICQ difficult-scale of the infants was 18.8 (SD 5.5). There were no statistically significant differences in infant's difficult-scale scores between boys and girls or between firstborns and later borns. Nor did infant's difficultness differ by the socioeconomic status (SES) of the family. Mothers with a psychiatric disorder perinatally (i.e. during the pregnancy or afterwards by the time of the interview) perceived their infant as more difficult than healthy mothers (mean 21.2, SD 6.7 vs. 18.4, SD 5.2, $t = -2.2$, $p = 0.028$).

Infant difficultness was significantly correlated with parental distress (See Table 2). Infant mother-reported difficultness and parental distress were independent of observed maternal or infant behaviour. Infant's interactive behaviour was moderately correlated with mother's interactive and affective behaviour. Infant's interactive behaviour and inertness/ fretfulness were positively correlated, indicating that more inert infants were poorer in their interactive behaviour. Maternal interactive and affective behaviour were also correlated (See Table 2).

= Table 2 here =

Factors contributing to mother's overall perception of her infant's temperament as more or less difficult

In order to find the strongest predictors of mother's perception of her infant's temperament, a linear regression analysis was conducted. At first, the background factors (gender of the child, birth order, SES of the family) and the place of the video recording were entered into a separate linear regression model in order to examine their possible effects, and whether any of these variables should be entered into the final linear regression. None of these factors significantly contributed to infant's perceived temperament. Thus, the variables introduced into the final linear regression model in blocks with stepwise method were in the order of introduction: 1) all mother-infant interaction variables, 2) mother's mental health, and 3) mother's parental distress. None of the mother-infant interaction variables significantly contributed to the mother's perception of her infant's temperament. Increase in parental distress and mother's mental health problems were, however, associated with mother's perception of her infant as more difficult. Both of these variables significantly improved the model although the contribution of mother's mental health was weak, as shown by the β -coefficients of the final equation (Table 3). The final model including mother's mental health and parental distress accounted for 24% of the variance in infant difficulty (See Table 3).

Parental distress was an influential contributor. When the variables were introduced to the model in reverse order (parental distress, mother's mental health and mother-infant interaction variables) only parental distress was found to significantly improve the model.

Alone it explained 23% of the variance in infant difficultness. None of the other variables introduced to the model after parental distress significantly further improved the model.

= Table 3 here =

Difficult infants: associations with mother-infant interaction, parenting stress and mental health of the mother

To investigate factors related to infant's risk of being perceived as difficult (i.e. scoring over the 85th percentile of the difficultness score distribution) and their combined effect, a logistic regression analysis with backward stepwise method was conducted. To examine whether any of the background factors (gender of the child, birth-order, SES of the family and the place of the video assessment) should be entered in the final regression model, a separate logistic regression on infant difficultness with background factors as explanatory variables was carried out. None of these factors appeared to be significant predictors of infant difficultness. Another logistic regression analysis was performed to examine the predictors of infant difficultness among mother-infant interaction variables. Mother's intrusiveness and infant's poor interactive behaviour were the strongest predictors of infant difficultness. The initial step of the final regression model thus included mother's mental health, parental distress, mother's intrusiveness and infant's interactive behaviour as explanatory variables (See Table 4). Mother's intrusiveness and infant's poor interactive behaviour (i.e. avoidance, lack of active communication and positive vocalisation) increased the infant's risk of being perceived as difficult. Also, parental distress was a significant predictor of mother's perception of her infant as difficult (See Table 4).

Discussion

When using the fussy/ difficult scale as a continuous variable, the model including parental distress and mother's mental health explained 24% of the variance in infant difficultness. Mother's mental health contributed only weakly though statistically significantly to the mother's perception of her infant's temperament. Instead, parental distress was an influential contributor to the mother's perception of her infant's temperament. This finding is in accordance with earlier studies showing the association of parenting stress and child's difficult temperament (25, 26). The information on parenting stress and infant temperament were gathered at the same time and therefore the direction of the effect cannot be determined. However, it is obvious that infant difficultness and parenting stress may provoke a vicious circle where infant difficultness increases parenting stress which, in turn, amplifies the perception of the infant as difficult.

When infants were categorised into difficult and non-difficult, parental distress as well as certain aspects of the quality of mother-infant interaction were associated with mother's early perception of her infant as difficult. Mother's intrusiveness and infant's poor interactive behaviour (i.e. avoidance and lack of active communication and positive vocalisations) significantly increased the infant's risk of being perceived as difficult. These features of early mother-infant interaction were in multivariate modeling significantly associated with difficult temperament only when the variables were categorised. This is probably due to the nature of mother-infant interaction and the difficulties in measuring it. Mother-infant interaction is from the beginning a dyadic process, coregulatory and bi-

directional, aiming at obtaining homeostasis in physiological, behavioural and emotional states of the infant, the mother and the dyadic system (42, 43). However, to operationalise the assessment of mother-infant interaction, maternal behaviour and infant behaviour are assessed separately. To a certain extent, both the infant and the mother may adjust their behaviour to obtain the homeostasis. Thus, it is understandable that only behaviour poor enough to exceed the capacity of the dyadic system to adjust may be associated with poor outcome, in this case mother's perception of her infant as difficult. The association of poor maternal behaviour in mother-infant interaction and infant difficultness has also been shown in the studies by Campbell (17), Milliones (16) and Schuler et al. (20) although Campbell, and Milliones examined mother's responsiveness and Schuler et al. mother's overall positive behaviour. Van den Boom and Hoeksma (44) observed longitudinally 30 mother-infant dyads, each dyad twelve times during the infants' first six months. They reported that the overall behaviour of mothers of infants who had been objectively assessed to be irritable was less positive from the beginning. The investigators concluded that infant irritability seems to produce mother-infant interactive behaviour that is different from that created by non-irritable infants. Also, avoidant, non-communicative infants may be perceived as difficult, or infant's poor interactive behaviour may be a reflection of difficult infant characteristics, irritability and hypo- or hyper aroused motor behaviour as shown in the study by Murray and colleagues (15). Although in the present study mother's intrusiveness and infant's poor interactive behaviour independently increased the infant's risk of being perceived as difficult, these factors may well act hand in hand: mother's intrusiveness may elicit infant's avoidance which, in turn, may increase mother's intrusiveness (45).

Even though mothers with mental health problems perceived their infants as significantly more difficult than healthy mothers, in multivariate modeling the association was not clear. In linear regression, mother's mental health only weakly contributed to the mother's perception of her infant's temperament. In logistic regression examining factors predicting infant's risk of being perceived as difficult, mother's mental health was not a predictor. Many studies have shown the importance of mother's mental health on the mother's perception of her child (2, 5, 22, 23, 46). The weakness or lack of association in multivariate modeling in the current study may be due to the fact that parental distress and mental health problems such as depression are closely interwoven and are not easily distinguished, neither theoretically nor in practice, and many of the items in the parental distress subscale describe depressive symptoms (e.g. *I don't enjoy things as I used to; I am not as interested in other people as I used to be*).

The limitations of the study need to be discussed. In the present study no causal conclusions can be drawn, and only associations of different phenomena may be reported. It has to be noted that there is some overlap between the measures of parenting stress and infant difficultness. The total stress scale of PSI includes subscales of difficult child, parent-child dysfunctional interaction and parental distress. Therefore, in the present study, in order to minimise the overlap between the measures of parenting stress and infant difficultness, the parental distress subscale was used as a rating of parenting stress instead of the total stress scale. The participants in the present study were from culturally homogenous backgrounds and socio-economically doing quite well, and the results may not be generalized to more disadvantaged and culturally more diverse populations. Although approximately half of the participants had psychosocial problems of various sorts, the

families with most severe risks and adverse conditions had been excluded from the study. The sample size must also be considered as a limitation and the findings therefore as tentative, although the sample of 124 videotaped and thoroughly analysed mother-infant interactions with two-month-old babies is exceptionally large.

Conclusions

Alleviating parenting stress would be one of the most important issues to be considered when intervention strategies to reduce mother's negative perceptions of her infant are applied. On the basis of a parenting stress model proposed by Östberg & Hagekull (26), supporting and strengthening the social network of the families and offering concrete help in household duties and child-care would be beneficial for families with young children. Promoting mother-infant relationship would also seem to be of benefit. As shown in the study by Porter & Hsu (47), mothers feeling more competent with their infants may find them less difficult.

The present study suggests that deviant features in early mother-infant interaction such as mother's intrusiveness and infant's avoidant and non-communicative interaction style increase the infant's risk of being perceived as difficult. These features should be noticed and addressed as difficult temperament has been found to show stability over time and possibly relate to later behavioural problems (11, 13). Mother-infant interaction guidance and therapy should be individually tailored for each mother-child pair considering the interaction style of the dyad (48, 49). Infant-centered methods where mothers are

encouraged to wait for the infant to initiate or to signal his/her willingness to interact and then respond would seem to be beneficial.

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References

1. Bates JE, Freeland CA Lounsbury ML. Measurement of infant difficultness. *Child Dev* 1979;50:794-803.
2. Mebert CJ. Dimensions of subjectivity in parents' ratings of infant temperament. *Child Dev* 1991;62:352-61.
3. Wolk S, Zeanah CH, Coll C-TG, Carr S. Factors affecting parents' perceptions of temperament in early infancy. *Am J Orthopsychiatry* 1992;62:71-81.
4. Pauli-Pott U, Mertesacker B, Bade U, Haverkock A, Beckmann D. Parental perceptions and infant temperament development. *Inf Behav Dev* 2003;26:27-48.
5. Foreman DM, Henshaw C. Objectivity and subjectivity in postnatally depressed mothers' perceptions of their infants. *Child Psychiatry Hum Dev* 2002;32:263-75.
6. Seifer R, Sameroff A, Dickstein S, Schiller M, Hayden LC. Your own children are special: clues to sources of reporting bias in temperament assessments. *Inf Behav Dev* 2004;27:323-41.
7. Harrington D, Black MM, Starr RH, Dubowitz H. Child neglect: relation to child temperament and family context. *Am J Orthopsychiatry* 1998;68:108-16.
8. Lee CL, Bates JE. Mother-child interaction at age two years and perceived child temperament. *Child Dev* 1985;56:1314-25.
9. Feldman R, Greenbaum CW, Mayes LC, Erlich SH. Change in mother-infant interactive behavior: relations to change in the mother, the infant, and the social context. *Infant Behav Dev* 1997;20:151-63.

10. Guerin D, Gottfried AW. Temperamental consequences of infant difficultness. *Infant Behav Dev* 1994;17: 413-21.
11. Keenan K, Shaw D, Delliquadri E, Giovannelli J, Walsh B. Evidence for the continuity of early problems: Application of a developmental model. *J Abn Child Psychol* 1998;26:441-54.
12. Pettit GS, Bates JE. Family interaction patterns and children's behavior problems from infancy to 4 years. *Dev Psychol* 1989;25:413-20.
13. Teerikangas OM, Aronen ET, Martin RP, Huttunen MO. Effects of infant temperament and early intervention on the psychiatric symptoms of adolescents. *J Am Acad Child Adolesc Psychiatry* 1998;37:1070-76.
14. Siddiqui A, Hägglöf B. Does maternal prenatal attachment predict postnatal mother-infant interaction? *Early Hum Dev* 2000;59:13-25.
15. Murray L, Stanley C, Hooper R, King F, Fiori-Cowley A. The role of infant factors in postnatal depression and mother-infant interactions. *Dev Med Child Neurol* 1996;38:109-19.
16. Milliones J. Relationship between perceived child temperament and maternal behaviors. *Child Dev* 1978;49:1255-57.
17. Campbell SB. Mother-infant interaction as a function of maternal ratings of temperament. *Child Psychiatry Hum Dev* 1979;10:67-76.
18. Zeanah CH, Keener MA, Anders TF. Developing perceptions of temperament and their relation to mother and infant behavior. *J Child Psychol Psychiatry* 1986;27:499-512.

19. Pauli-Pott U, Mertesacker B, Bade U, Bauer C, Beckmann D. Contexts of relations of infant negative emotionality to caregiver's reactivity /sensitivity. *Infant Behav Dev* 2000;23:23-39.
20. Schuler ME, Black MM, Starr RH. (1995). Determinants of mother-infant interaction: effects of prenatal drug exposure, social support, and infant temperament. *J Clin Child Psychol* 1995;24:397-405.
21. Crockenberg SB. Are temperamental differences in babies associated with predictable differences in care giving? *New Dir Child Dev* 1986;31:53-73.
22. Najman JM, Williams GM, Nikles J, Spence S, Bor W, O'Callaghan MJ. et al. Bias influencing maternal reports of child behavior and emotional state. *Soc Psychiatry Psychiatr Epidemiol* 2001;36:186-94.
23. Luoma I, Koivisto A-M, Tamminen T. Fathers' and mothers' perception of their child and maternal depressive symptoms. *Nord J Psychiatry* 2004;58:205-11.
24. Pesonen A-K, Räikkönen K, Strandberg T, Keltikangas-Järvinen L, Järvenpää A-L. Insecure adult attachment style and depressive symptoms: Implications for parental perceptions of infant temperament. *Infant Ment Health J* 2004;25:99-116.
25. Gelfand DM, Teti DM, Fox CE. Sources of parenting stress for depressed and nondepressed mothers of infants. *J Clin Child Psychol* 1992;21:262-72.
26. Östberg M, Hagekull B. A structural modeling approach to the understanding of parenting stress. *J Clin Child Psychol* 2000;29:615-25.
27. Zelkowitz P, Milet TH . Stress and support as related to postpartum paternal mental health and perceptions of the infant. *Infant Ment Health J* 1997;18:424-35.

28. Puura K, Davis H, Papadopoulou K, Tsiantis J, Ispanovic-Radojkovic V, Rudic N et al. The European Early Promotion Project: A new primary health care service to promote children's mental health. *Infant Ment Health J* 2002;23:606-24.
29. Puura K, Davis H, Cox A, Tsiantis J, Tamminen T, Ispanovic-Radojkovic V et al. The European Early Promotion Project: Description of the Service and Evaluation Study. *Int J Ment Health Promotion* 2005;7:17-31.
30. Davis H, Cox A, Day C, Roberts R, Loxton R, Ispanovic-Radojkovic V et al. (Eds). Primary health care worker training manual. Belgrade: Institute of Mental Health; 2000.
31. Abidin R. Parenting stress index. University of Virginia, Charlottesville, VA: Paediatric Psychology Press; 1990.
32. Brown E, Rutter M (1966). The measurement of family activities and relationships: a methodological study. *Hum Relations* 1966;19:241-63.
33. Quinton D, Rutter M, Rowlands O. An evaluation of an interview assessment of marriage. *Psychol Med* 1976;6:577-86.
34. Rutter M, Brown E. The reliability and validity measures of family life and relationships in families containing a psychiatric patient. *Soc Psychiatry* 1966;1:38-53.
35. Spitzer RL, Williams JB, Gibbon M, First MB. Instruction manual for the structured clinical interview for DSM-III-R. New York State Psychiatric Institute, Biometrics Research Department; 1989.
36. Murray L, Fiori-Cowley A, Hooper R, Cooper P. The impact of postnatal depression and associated adversity on early mother-infant interactions and later infant outcome. *Child Dev* 1996;67:2512-26.

37. Murray L, Hipwell A, Hooper R, Stein A, Cooper P. The cognitive development of 5-year-old children of postnatally depressed mothers. *J Child Psychol Psychiatry* 1996;37:927-35.
38. Riordan D, Appleby L, Faragher B. Mother-infant interaction in post-partum women with schizophrenia and affective disorders. *Psychol Med* 1999;29:991-5.
39. Gunning M, Murray L, Lawson C. Global Rating Scheme. A paper presented at the 8th Congress of the World Association for Infant Mental Health, Amsterdam; 2002.
40. Cooper PJ, Tomlinson M, Swartz L, Woolgar M, Murray L, Molteno C. Post-partum depression and the mother-infant relationship in a South African peri-urban settlement. *Br J Psychiatry* 1999;175:554-8.
41. Mäntymaa M, Puura K, Luoma I, Salmelin R, Davis H, Tsiantis J et al. Infant-mother interaction as a predictor of child's chronic health problems. *Child Care Health Dev* 2003;29:181-91.
42. de Weerth C, van Geert P. Changing patterns of infant behavior and mother-infant interaction: Intra- and interindividual variability. *Infant Behav Dev* 2002;24:347-71.
43. Trevarthen C, Aitken KJ. Infant intersubjectivity: research, theory, and clinical applications. *J Child Psychol Psychiatry* 2001;42:3-48.
44. van den Boom DC, Hoeksma JB. The effect of infant irritability on mother-infant interaction: A growth-curve analysis. *Dev Psychol* 1994;30:581-90.
45. Tronick EZ, Weinberg MK. Depressed mothers and infants: Failure to form dyadic states of consciousness. In: Murray L, Cooper P, editors. *Postpartum depression and child development*. New York: The Guilford Press; 1997. p. 54-81.
46. Edhborg M, Seimyr L, Lundh W, Widström A-M. Fussy child – difficult parenthood? Comparisons between families with a “depressed” mother and non-

- depressed mother 2 months postpartum. *J Repr Infant Psychol* 2000;18:225-38.
47. Porter CL, Hsu H-C. First-time mothers' perceptions of efficacy during the transition to motherhood: links to infant temperament. *J Fam Psychol* 2003;17:54-64.
48. Hart S, Field T, Jones N, Yando R. Intrusive and withdrawn behaviours of mothers interacting with their infants and boyfriends. *J Child Psychol Psychiatry* 1999;40:239-45.
49. Jones N, Field T, Fox NA, Davalos M, Malphurs J, Carraway K et al. Infants of intrusive and withdrawn mothers. *Infant Behav Dev* 1997;20:175-86.

Table 1 Characteristics of the sample (n = 124)

	%	Mean	SD
Gender of the child			
boy	53		
girl	47		
Birth order of the child			
first-born	52		
later-born	48		
Socio-economic status of the family ¹			
upper/middle class	69		
lower class and students	31		
Structure of the family			
both parents together	91		
lone mothers	9		
Family's need for support assessed by public health nurses			
no need	55		
some need	45		
Mother's age (years)		29.2	5.1
Infant's age (days) (videotaping)	64.1	6.5	

¹ Socio-economic status of the family is determined by the occupation of the main breadwinner or by the occupation of the mother for lone mothers' families. Upper class is classification I including professionals and middle class classifications II and III non-manual including managerial, technical and non-manual skilled occupations (Government Statistics Service 1991).

Table 2 Correlations between infant difficulty, parenting stress and maternal (M) and infant (I) behaviour in early mother-infant interaction.

	2	3	4	5	6	7
1. Infant difficulty	0.48**	-0.17	-0.15	-0.06	-0.02	0.03
2. Parental distress		-0.11	-0.04	-0.14	-0.04	-0.04
3. Interactive behaviour (M)			0.07	0.66**	0.28**	0.07
4. Intrusiveness/ remoteness (M)				-0.36**	-0.06	-0.11
5. Affective behaviour (M)					0.30**	0.17
6. Interactive behaviour (I)						0.46**
7. Inertness/ fretfulness (I)						

* $p \leq 0.05$, ** $p \leq 0.01$

Table 3 Factors contributing significantly to mother's perception of infant's temperament as more or less difficult as derived from linear regression. The variables were introduced to the model as blocks with stepwise method in the following order: 1) all mother-infant interaction variables, 2) mother's mental health and 3) parental distress. Values are shown only for variables significantly improving the model.

Model	R ²	df	ΔF	p ^a	β
1. Interactive behaviour (M) ^b Intrusiveness/ remoteness (M) Affective behaviour (M) Interactive behaviour (I) Inertness/ Fretfulness (I)					
2. Mother's mental health	0.04	1, 122	5.0	0.028	0.20
3. Mother's mental health Parental distress	0.24	1,121	32.8	< 0.001	0.10 0.46

R² describes the proportion of variance in infant difficultness accounted for by the variables in the model at each step.

^aThe significance is for the change of F

^bM = Mother, I = Infant

Table 4 Factors increasing infant's risk of being perceived as difficult. Parental distress, mother's mental health, mother's intrusiveness and infant's interactive behaviour were introduced into the regression analysis conducted with backward stepwise method. Results are expressed in odds ratios (OR) and their 95% confidence intervals (95%CI) for the variables left in the model at the final stage.

		OR	95%CI	p
Parental distress	non-distressed	1.0		
	distressed	10.3	2.7, 38.9	0.001
Mother's intrusiveness	not intrusive	1.0		
	intrusive	7.6	2.1, 27.6	0.002
Infant's interactive behaviour	good	1.0		
	poor	3.7	1.0, 13.3	0.043