

Parental negative affect and postnatal depressive symptoms:

Associations with infant negative affect

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Associations between postnatal depression and infant temperament have been studied widely. Also, parental temperament and infant outcomes have been under consideration due to the genetic link between these two and because parental personality is related to higher risk for depression postnatally. However, very few previous studies with a focus on postnatal depression have controlled for parental temperament. This study included a subset of participants (N = 347) from the larger FinnBrain Birth Cohort Study. The aim was to investigate the associations between parental Negative Affectivity, postnatal depressive symptoms and parent-rated infant Negative Affectivity during the first year after birth. Specifically, we examined both maternal and paternal self-reported temperament, parent-reported postnatal depression at 3, 6 and 12 months and parental perceptions of infant temperament at 6 and 12 months of age separately. Results showed that including maternal Negative Affect to the linear regression model attenuated the association between postnatal depression and infant Negative Affect both at 6 and 12 months. However, in paternal models, paternal Negative Affect did not have as strong attenuating effect at 6 months, and at 12 months, both paternal depressive symptoms and paternal Negative Affect had a clear unique association with infant Negative Affect. The results raise questions about the overlap of Negative Affectivity temperament trait and postnatal depression, especially in mothers, and suggests that both should be considered when studying the influence of postnatal depression on ratings of child temperament. However, the findings also indicate that both parent temperament and depression may have unique association with infant temperament especially in paternal data. Clinical implications and future research are discussed.

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Key words: postnatal depression, infant temperament, negative affect, fathers

## **Preface**

Some things take more time than others, but they are always worth it.

I would like to thank the people who believed in this thesis and in me, even when I did not. I am grateful for the opportunity to get to work in the FinnBrain project. Thank you Ph.D. Saara Nolvi for all the guidance and help with the thesis, thank you Ph.D. Johanna Kaakinen for the help with the groundwork on the statistics. Thanks to my fellow student Sari Pusa for all the fun times in the basement with the mothers and the babies. Thanks to my friend Maria Ruohola who arranged the perfect conditions for restarting this process after almost two-year break. Thanks to my friend Ulla Lång for the help in the busy final stages of this project. For all the help with grammar, discipline and for huge emotional support I want to thank my dearest spouse Joonas Lehtinen.

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# 1. INTRODUCTION

Postnatal depression is prevalent in mothers, and it is known to influence infant temperament, especially by increasing its aspect of negative affectivity (Prenoveau et al., 2017). A less recognized fact is that fathers also suffer from postnatal depression (Paulson & Bazemore, 2010; Philpott & Corcoran, 2018) and that their depression also has an impact on the infant (Luoma et al., 2013).

Parental temperament is connected to infant temperament by both a biological and environmental route (Matthews, Deary, & Whiteman, 2003; Rothbart, 2011). The biological route consists of genes inherited and activated before and after birth, while the environmental route refers to parenting and conditions (cultural, economic, emotional etc.) wherein the infant is brought up (Buss & Plomin, 1986). Parental negative affectivity in particular has a negative impact on infant development and is consequently in the focus of many studies (Coplan, Reichel, & Rowan, 2009; Kornienko, 2016; Laxman et al., 2013; Macedo et al., 2011). Parental postnatal depression is a risk factor for the infant's poorer future mental health and behavior problems (Chess & Thomas, 1989). However, parental negative affectivity (or neuroticism, which is a personality trait predicted by negative affectivity) also has a connection to parental depression symptoms (Matthews et al., 2003), but few studies have examined the association between these phenomena and infant negative affectivity when the other one is controlled for. Especially there is a lack of research focusing on the influence of paternal postnatal depression and paternal negative affectivity on infant negative affectivity.

A better understanding of how parental depression and negative affectivity are related to infant negative affectivity would improve opportunities for health care professionals to help parents to give their infant a well-balanced start to their life and prevent future mental health and behavior problems of these children. This thesis aims to specify the associations between parental postpartum depressive symptoms, parental negative affectivity and infant negative affectivity by testing the hypothesis in a birth cohort research setting. Specifically, the interest is in how controlling for parental temperament influences the well-established relation between parental postnatal depression and infant negative affectivity.

## **1.1. Temperament in infancy and adulthood**

Temperament is characterized as individual differences in reactivity and self-regulation, which are constitutionally based and already exist in early infancy (Rothbart & Derryberry, 1981; Rothbart & Putnam, 2002; Rothbart & Rueda, 2005). Reactivity refers to how easily an individual gets excited, responds to a stimulus (with negative or positive response) or gets aroused, and self-regulation in turn refers to the neural and behavioral processes that modulate reactivity (Rothbart & Rueda, 2005). Temperament forms the biological basis on which personality is built during a child's development (Rothbart & Putnam, 2002). In addition to the genetic basis, maturation and experience also influence temperament development over time (Rothbart & Derryberry, 1981; Rothbart & Putnam, 2002; Rothbart & Rueda, 2005). A study conducted by Rothbart, Ahadi and Evans (2000) showed that temperament traits were moderately stable from infancy up to the age of seven, hence the temperament traits may have predictive value for later development at a very young age already.

Negative Affect is one of the main temperament dimensions of Rothbart's theory of infant temperament along with Extraversion/Surgency and Orienting Sensitivity (Gartstein & Rothbart, 2003; Rothbart & Putnam, 2002). The Negative Affect dimension measures the extent to which an individual experiences and expresses negative affectivity while including the subdimensions of distress to limitations, sadness, fear and falling reactivity (recovery from negative emotions). An infant with high Negative Affectivity is more sensitive to novel or stressful stimuli and feels the negative reactions more strongly than an infant low in Negative Affectivity (Crawford, Schrock, & Woodruff-Borden, 2011).

Moreover, the same dimensions have been found while constructing a model of adult temperament (Evans & Rothbart, 2007), though the adult temperament questionnaire additionally has a fourth dimension and age appropriate descriptions of traits. The dimensions are Extraversion/Surgency, Effortful Control, Orienting Sensitivity and Negative Affect. Adult Negative Affect dimension includes fear, sadness, discomfort and frustration (Evans & Rothbart, 2007; Rothbart et al., 2000). It predicts the personality trait of Neuroticism (Evans & Rothbart, 2007; Matthews et al., 2003).

The difference between infant and adult temperament traits is in how they manifest in behavior. They have the same biological basis, but adults have more control on how their

reactions impact their actions. Especially negative situations and emotions tend to have a strong effect on infants' behavior, but adults can regulate their emotions more efficiently. Thus, the underlying tendency remains the same, but adults and older children present far more efficient regulation of these tendencies in comparison to young children and infants. That is the reason why infant negative temperament traits can appear to be so overwhelming and have a big impact on their environment, including the interaction with the caregiver (Buss & Plomin, 1986; Rothbart & Derryberry, 1981).

Negative Affectivity is linked to brain systems operating largely at subcortical areas and controlling the punishment/avoidance system (Rothbart & Bates, 2006). Adult Negative Affectivity is related to Neuroticism which in turn predicts lower life satisfaction due to its tendency to negatively affect the ability to handle negative feelings and focus on the positive aspects in life (Matthews et al., 2003). It even has an impact on evoking more negative life events (Jeronimus, Riese, Sanderman, & Ormel, 2014), therefore increasing the risk of depression and other mood disorders as well as psychosomatic illnesses (Compas, Connor-Smith, & Jaser, 2004; Matthews et al., 2003).

Researchers have been trying to figure out the possible distinction between temperament and personality, and multiple ways to describe the relation exist. One theory regards temperament as a heritable subclass of personality traits and recognizes same underlying traits in temperament and personality (Buss & Plomin, 1986), whereas some views suggest temperament to be the main variable shaping personality (Shiner & Caspi, 2012), not just a subclass. In another theory, there is a straightforward hypothesis stating that temperament is biologically based while personality is a product of socialization and learning (Strelau, 1983). Some see temperamental differences specifically as a result of differences in the central nervous system (Matthews et al., 2003). All of these theories share the same idea of temperament being largely a genetic, inherited set of traits, and that those traits are moderately stable through life (Shiner et al., 2012).

As temperament remains rather similar from infancy to adulthood and is the core of adult personality (Shiner & Caspi, 2012), it is important to investigate which factors influence infant Negative Affectivity, which in turn predicts adulthood temperament and higher risk for depression, and may affect the parent's way to evaluate their infant.



### **1.1.1. Infant negative affect**

Already at the time of birth, children have a set of tendencies to react towards their environment that include emotion, activity and attention (Rothbart, 2011). These differences underlie the individual differences in the observed behavior. While one child is happily investigating their surroundings without their parents, another wants to stay safely in the lap of their parent. One child gets easily frustrated and starts crying when a toy is taken away, another one stays calm in the same situation. These reactions and the mechanisms that regulate them constitute the child's temperament (Rothbart & Rueda, 2005). In addition to Negative Affectivity, another overlapping concept is "difficult temperament" introduced by Thomas & Chess, characterized by infant negative mood, problems in adaptation and emotional regulation (Thomas & Chess, 1986; Alexander Thomas, Chess, Birch, Hertzog, & Korn, 1964). It is a term dividing infant temperament into three classes: "easy", "difficult" and "slow to warm up" (Thomas & Chess, 1986). An infant with a "difficult temperament" expresses or is evaluated to express high Negative Affectivity.

The continuity of temperament, especially Negative Affectivity, has been proven in many studies (Durbin & Hayden, 2007; Komsis et al., 2006; Rothbart et al., 2000; A. Thomas & Chess, 1986). Having high Negative Affectivity or a "difficult temperament" affects how the child is treated, taken care of and reacted to by their parents, and there is an association with negative parenting and child's negative emotionality (Micalizzi, Wang, & Saudino, 2017). Moreover, infants with higher Negative Affectivity are more susceptible to negative parenting and exhibit more externalizing and internalizing problems and lower social and cognitive competence after exposure to negative or insensitive parenting (Slagt, Semon, Deković, & van Aken, 2016).

Negative Affectivity and "difficult temperament" are also associated with a risk for problems in personality, poor socialization and behavior problems throughout development (Karreman, de Haas, van Tuijl, van Aken, & Deković, 2010; Sanson, Hemphill, Yagmurlu, & McClowry, 2011). More precisely, these infants will more probably suffer from symptoms of anxiety or depression, attention deficit hyperactivity disorder (ADHD), or autism spectrum disorders in their future than the infants with lower Negative Affectivity (De Pauw & Mervielde, 2010; Sayal, Heron, Maughan, Rowe, & Ramchandani, 2014). Thus, the investigation of the multiple determinants of Negative

Affectivity is important for understanding the development of temperament as well as the probable origins of pathological emotional development.

### **1.1.2. Associations between parental negative affectivity and infant negative affect**

In line with the current view that temperament is largely heritable, parent temperament is reportedly strongly associated with infant temperament (Baker, Cesa, Gatz, & Mellins, 1992; Buss & Plomin, 1986; Komsis et al., 2006; Macedo et al., 2011). Mechanisms mediating the association between parent and infant temperament include genetics (20-60% depending on the study), quality of parenting and parent-infant interaction (Baker et al., 1992; Crawford et al., 2011; Zentner & Bates, 2008). Genes affect temperament directly by giving the infant a set of physical and mental tendencies, but the individual genetic make-up also interacts with the social environment by regulating the infant's tendency to react to stress and sensitivity towards environmental features formed by the parents (Komsis et al., 2006; Reiss, Leve, & Neiderhiser, 2013). The genetic variation in Negative Affectivity is estimated to be higher than in some other temperament traits, 69% (Neiss, Stevenson, Legrand, Iacono, & Sedikides, 2009).

Several studies show that parental temperament is one of the key factors affecting parenting style (Kornienko, 2016), which may in turn influence infant negative responses. In general, Negative Affectivity and Neuroticism are related to less competent parenting in terms of responsiveness and warmth, and may be connected to power-asserted discipline (Lee Anna Clark, Kochanska, & Ready, 2000; Coplan et al., 2009). In a study by Kochanska et al. (2004) it was shown that parental Negative Affectivity predicted a less positive emotional atmosphere with the infant, less adaptive parenting and, due to the parent's own insecurity and mistrust, there is a higher risk of insecure attachment for the infant. Laxman et al. (2013) studied how parental Negative Affectivity was associated with co-parenting and found that fathers' Negative Affectivity was related to higher levels of undermining parenting style (negative behavior towards other parents parenting), while mothers' Negative Affectivity was not.

Infants are dependent on their caregivers in all their physiological and emotional needs, and the help of their parent is essential for them to regulate negative and positive emotions, which makes the parent–infant relationship very significant (Propper & Moore,

2006). Crawford et al. (2011) have discovered that infants with high Negative Affectivity and low self-regulation are more prone to have later internalizing symptoms especially when parental Negative Affectivity affects the family environment in a way that does not support the development of advanced coping mechanisms. Neurological growth is rapid during the first year of life, and the response an infant receives to their needs may have a long-term impact on their ability to regulate and modulate emotions and physiological reactivity (Propper & Moore, 2006).

In a study by Komsis et al. (2006) it was found that high parental Neuroticism and stress predicted higher infant Negative Affectivity, while other studies have also proved the correlation between parent Negative Affectivity and infant Negative Affectivity both in parental evaluations and actual outcomes (Kochanska et al., 2004; Propper & Moore, 2006). On the other hand, in many studies the association between parent and infant temperament has been discovered to be bidirectional: for instance, Lengua and Kovacs (2005) found that inconsistent discipline by parents increased infant Negative Affectivity, and infant irritability increased inconsistent parental discipline. In some studies, infant Negative Affectivity has been the main factor of moderation, like in the study of Casalin, Tang, Vliegen and Luyten (2014), where there was a positive correlation with stress generation and infant Negative Affectivity for parents with high dependency.

Crawford (2011) states that parents with high Negative Affectivity probably do not have enough emotional resources to assist an infant with high Negative Affectivity in coping with stressful situations, which makes this kind of parent-infant dyad so disadvantageous. However, the relations between parental temperament, parenting and infant temperament are not easily interpretable because of the reciprocal associations between these phenomena, emphasizing the need for longitudinal approaches. Further, most of the studies have focused on mothers, and very few have gathered information from the paternal perspective. In this study, fathers are considered parallel with mothers.

## **1.2. Postnatal depression**

Many mothers (50–80%) encounter “baby blues” after giving birth (O’Hara, 2011), and it is considered to be a rather normal phenomenon after labor, disappearing after a few days or at the latest after ten days (“Synnytyksen jälkeinen masennus - Lapset, nuoret ja

perheet - THL,” 2018). When symptoms of depression (dysphoria, mood lability, anxiety, crying, poor appetite, insomnia and irritability) last longer, the state is diagnosed as postnatal (or postpartum) depression (Kuosmanen, Vuorilehto, Kumpuniemi, & Melartin, 2010). Postnatal depression symptoms are at their highest during the first three months after labor and will usually start to fade away between the 4th and 11th month (“Synnytyksen jälkeinen masennus - Lapset, nuoret ja perheet - THL,” 2018). Postnatal depression is limited to the first year after giving birth, but the consequences to the mother, child and other family members may be long-lasting (Habel, Feeley, Hayton, Bell, & Zelkowitz, 2015).

According to international meta-analyses, 13% of mothers (O’Hara & Swain, 1996) and 10% of fathers (Paulson & Bazemore, 2010) suffer from postnatal depression. Studies show that in Finland, approximately 9–16% of mothers and 10% of fathers experience symptoms of postnatal depression (Kuosmanen et al., 2010). Some reviews offer even higher rates: Goodman (Goodman, 2004) states that paternal postnatal depression ranged between 1,2% and 25,5% in the community samples, while 25–50% of fathers with a partner with postnatal depression also had symptoms of postnatal depression (review of 20 studies from the years of 1980–2002). Studies also show that it occurs in as many as 19% of new mothers (Gavin et al., 2005), and that first-timers are at a higher risk to have postnatal depression (Shimizu, Nishiumi, Okumura, & Watanabe, 2015). Other high risk factors are previous mental health problems and tendency for depression symptoms. (“Synnytyksen jälkeinen masennus - Lapset, nuoret ja perheet - THL,” 2018). Habel, Feeley, Hayton, Bell & Zelkowitz (2015) found that mothers and fathers have mutual perceptions about the causes of postnatal depression, for example child health and temperament, maternal personality and parental past mental health history.

As mentioned previously, parental personality characteristics, including Neuroticism and its temperament core, Negative Affectivity, are associated with the risk of depression (L. A. Clark, Watson, & Mineka, 1994; Compas et al., 2004; Matthews et al., 2003; Watson & Clark, 1995). According to Clark, Watson and Mineka (1994) there are four ways to explain the relation: “(a) a *vulnerability model*, in which temperament places individuals at risk for experiencing depression; (b) a *pathoplasty model*, in which temperament shapes the course of a disorder, perhaps by influencing environments or interactions with others or determining the specific symptoms experienced; (c) a *scar model*, in which the

experience of a depressive episode changes personality; and (d) a *spectrum or continuity model*, in which depression simply represents the extreme endpoint of a trait” (Compas et al., 2004). Studies show that the personality and temperament of a person with depression are overall similar to a person with postnatal depression (Josefsson, Larsson, Sydsjö, & Nylander, 2007). The same association with Negative Affectivity and depression also applies to the postnatal depression (Ghaedrahmati, Kazemi, Kheirabadi, Ebrahimi, & Bahrami, 2017; Habel et al., 2015; Hakulinen-Viitanen & Solantaus, 2018).

Postnatal depression is a very prevalent health problem both for mothers and fathers (Luoma et al., 2013; Mayberry & Affonso, 1993; Ngai & Ngu, 2015; O’Hara & Swain, 1996; Sweeney & MacBeth, 2016). There are consistent findings suggesting that paternal postnatal depression influences infants mainly through marital variables, like couple conflict and lack of paternal support for the mother, especially when the mother is also suffering from postnatal depression (Gutierrez-Galve, Stein, Hanington, Heron, & Ramchandani, 2015; Luoma et al., 2013; Sweeney & MacBeth, 2016), while maternal postnatal depression is considered to affect the infant more directly, for example through lack of maternal positive affect expression and responsiveness, poor quality of parenting and difficulties to understand the communication of the infant (Campbell, Cohn, & Meyers, 1995; Mezulis, Hyde, & Abramson, 2006; Tamminen, 1990; Tronick, 1989).

In general, the harmful mechanisms of parental depression are quite similar to the influence of parental Negative Affectivity. Both of them may be linked to negative parenting, which increases the tendency of infant /child negative cognition, making the child more vulnerable to the influence of depression and to developing depressive symptoms themselves (Mezulis et al., 2006). Results of many studies also support the theory of parental depression decreasing parental responsiveness. That in turn decreases the infant’s ability to regulate Negative Affect and to concentrate, as well as increases the amount of irregular demands of the infant, which in turn increases maternal postnatal depression (Field, Healy, Goldstein, & Guthertz, 1990; Forbes, Cohn, Allen, & Lewinsohn, 2004; Moore & Calkins, 2004; Propper & Moore, 2006; Sugawara, Kitamura, Toda, & Shima, 1999).

It is known that the more persistent the parental depression is, the higher are the risks of problems in infant development (Cornish et al., 2005). Therefore, it is important to

investigate the associations between postnatal depression and infant outcomes concurrently controlling for the influence of parental temperament.

### **1.3. Associations between postnatal depression and infant negative affectivity**

The association between parental postnatal depression and infant Negative Affectivity has been detected in many studies (Bridgett et al., 2009; Feldman et al., 2009; Kingston, Tough, & Whitfield, 2012; Mayberry & Affonso, 1993). Parents with postnatal depression perceive their infants temperamentally more difficult 1–6 months after birth than parents with no symptoms of postnatal depression (Aalto, Kaltiala-Heino, Poutanen, & Huhtala, 2007; Britton, 2011; Edhborg, Seimyr, Lundh, & Widström, 2000; McGrath, Records, & Rice, 2008; McMahon, Barnett, Kowalenko, Tennant, & Don, 2001). The same effect was found in a longitudinal study by Gross, Conrad, Fogg and Wothke (1994), where mothers of 1- to 3-year-old toddlers rated the child's temperament and their own state of depression. To summarize, in a meta-analysis by Beck (17 studies; 1996) a statistically significant relationship was found between the postpartum depression and infant Negative Affect; correlation was moderate and effect size ranged from .31 to .36 depending on the weighing.

The relation between postnatal depression and infant Negative Affectivity is complicated, again emphasizing reciprocity between these two phenomena. Hopkins, Campbell and Marcus (1987) found in their early studies of postnatal depression that maternal perception of infant temperament and infant medical complications accounted for 17% of the variance in severity of depression. In a study by Cutrona and Troutman (1986) difficult infant temperament explained 30% of the variance in maternal postpartum depression. “A vicious circle” has been described as child Negative Affect, poor maternal self-trust and postnatal depression all correlating positively with each other (Gross et al., 1994). The causality of these variables is still very difficult to show. Of note, several studies have also described that prenatal depression plays a role beyond postnatal depression. For instance, in the study of Davis et al. (2004) there was an association between prenatal, but not postnatal, depression and infant Negative Affectivity, and in the study of Diego, Field and Hernandez-Reif (2005) the influence of prenatal depression was also higher than that of postnatal depression. Pre- and postnatal depression are

typically highly correlated, and in the present study, the focus is restricted on parental postnatal mood.

Postnatal depression may affect parental perception of the infant's temperament (Albertsson-Karlgren, Hagekull, Bohlin, & Nettelbladt, 1999), as might the relation to the infant as a parent (Seifer, Sameroff, Dickstein, Schiller, & Hayden, 2004) or the parental temperament (Vaughn, Taraldson, Crichton, & Egeland, 1981). On the other hand, parents are very familiar with their infants' reactions in everyday situations, and might be able to have a better perception of their infant's temperament (Gartstein & Rothbart, 2003). However, Pauli-Pott, Mertesacker and Beckmann (2004) found in their study that 4-month-old infants of depressed mothers were not more difficult than others when observed by an independent observer.

Many of the previous studies have focused only on maternal evaluation of the infant temperament, and as Mayberry and Affonso (1993) stated, it is also important to study paternal perception and other paternal variables possibly affecting the infant Negative Affect. By understanding the mechanisms of postnatal depression, it is possible to develop appropriate health care interventions. There is also a need for studies with a focus on postnatal depression that also consider the parental personality as a contributor to the ratings of infant Negative Affect. As temperament is a largely heritable trait, controlling for parental Negative Affect is a way to reveal the influence of parental postnatal depression, but this kind of studies are hard to come by. Although quite few studies have incorporated this approach, an a study by Austin, Hadzi-Pavlovic, Leader, Saint and Parker (2005) trait anxiety was found to have an independent influence on infant Negative Affect, when postnatal depression was controlled for, suggesting that both most likely have at least a degree of unique variance on infant Negative Affect.

## 2. RESEARCH QUESTIONS

The aim of this study was to examine to what extent the parental symptoms of postnatal depression during the first year of infant's life and parental self-reported negative affectivity have unique associations with parent-reported infant negative affectivity at 6 and 12 months of age when assessed simultaneously.

More specifically, the research questions were the following:

1. Are (a) maternal postnatal depressive symptoms and (b) maternal self-reported negative affectivity associated with infant Negative Affectivity at 6 and 12 months, when the other one is controlled for?
2. Are (a) paternal postnatal depressive symptoms and (b) paternal self-reported Negative Affectivity associated with infant Negative Affectivity at 6 and 12 months, when the other one is controlled for?

Based on the previous literature, we hypothesized that both maternal and paternal postnatal depressive symptoms and self-reported Negative Affectivity would be uniquely associated with reports of elevated infant Negative Affectivity at 6 and 12 months when the each other is controlled for.



### **3. METHODS**

#### **3.1. Participants**

The sample used in this study is a subsample of the FinnBrain Birth Cohort Study, gathered in South-Western Finland between December 2011 and April 2015, consisting of 3808 families. The families were recruited at the maternity clinics during their ultrasound visit at gestational week 12. Among all the families asked to take part in the study, 66% accepted to participate.

The sample of the present study is a subsample consisting of the families who filled in questionnaires on infant and maternal temperament 12 months postpartum. Furthermore, fathers in these families who had provided similar data were included in the study. The study sample was collected until this study started in January 2016. It consists of 347 infants and their parents (two twins in the sample). The descriptive statistics are shown in the Table 1. There were 155 (45%) girls and 192 (55%) boys in the sample. Most of the infants (94%) were born close to the expected time (at gestational weeks 37–42), while 20 infants were born preterm (at gestational weeks 29–36). The Ethics Committee of the Hospital District of South-Western Finland has approved the study protocol.

Table 1: Background statistics of the parents

	Mothers	Fathers	All
	n (%)		
Age in average (sd)	31.3 (4.2)	33.21 (5.1)	32.26 (4.7)
Relationship status			
Married or in a domestic relationship	320 (99)	308 (95)	628 (97)
In a relationship	12 (1)	17 (5)	19 (3)
Previous children			
No previous children	199 (59)	238 (69)	447 (65)
≥ 1 previous children	140 (41)	109 (31)	239 (35)
Education			
Basic education	3 (1)	9 (3)	12 (2)
Upper secondary education <sup>1</sup>	90 (27)	128 (38)	218 (33)
Higher education <sup>2</sup>	228 (67)	190 (57)	418 (62)
Postgraduate <sup>3</sup>	18 (5)	9 (3)	27 (4)
Monthly income (self-evaluated) <sup>4</sup>			
< 1500	122 (36)	62 (19)	184 (28)
1501–2500	180 (53)	175 (52)	477 (53)
2501–3500	35 (10)	85 (25)	120 (18)
>3501	2 (1)	12 (4)	14 (3)

<sup>1</sup>high school, vocational school, apprenticeship or other;

<sup>2</sup>bachelor's/master's degree in a university or in a uni. of applied sciences;

<sup>3</sup>postgraduate studies in a university; <sup>4</sup>Euros

### 3.2. Procedure

The parents answered questions concerning background information at the beginning of second trimester (gwk 14–16). Parental postnatal depressive symptoms were assessed

with the official Finnish translation of the Edinburgh Postnatal Depression Scale (Cox, Holden, & Sagovsky, 1987) three times after the infant was born: 3, 6 and 12 months postpartum. Parent temperament was measured with the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007) when the infant was 12 months old. Infant temperament was measured with the Infant Behavior Questionnaire Revised (IBQ; Gartstein & Rothbart, 2003) by both parents separately when the infants were 6 months old, and again at the infant age of 12 months.

### **3.3. Measurements**

#### **3.3.1. Background information**

Information gathered from both parents included age, education (on a scale of 1 to 10), monthly income (scale 1–9), relationship status (scale 1–6) and questions about previous children. Education was further divided into four categories (1= basic education, 2= upper secondary education, 3= higher education, 4= postgraduate studies), as was the monthly income (1= <1500, 2= 1501–2500, 3= 2501–3500, 4= >3501). Relationship status was categorized to two groups (1= in a marital or domestic relationship, 2= in a relationship). Based on the information about previous children, parents were categorized into two groups (1= no previous children, 2=  $\geq 1$  previous children).

Information concerning the infant (length of the pregnancy and infant gender) was gathered from the hospital records after the infant was born. Infants were classified into two groups based on the length of the gestation (1=not preterm (gwk 37–42), 2=preterm birth (gwk 29–36)). Infant gender, parental parity, parental education and parental age were used as covariates in the analyses. Other information was only used to describe the sample.

#### **3.3.2. Postnatal depressive symptoms**

The Edinburgh Postnatal Depression Scale (EPDS) was used to assess parental depressive symptoms. The EPDS is a widely used measure in the screening of depressive symptoms with good reliability and validity, and can be used for assessment in both mothers and

fathers (Cox et al., 1987; Matthey, Henshaw, Elliott, & Barnett, 2006). Parents respond to 10 items on a scale of 0 to 3 based on the previous 7 days at the time of response.

EPDS was used as a continuous variable in this study. However, a cut point was used to describe the amount of possible clinical depression among the parents. A cut point of 10 is recommended to be used to identify minor clinical depression with men and women (Cox et al., 1987; Hakulinen-Viitanen & Solantaus, 2018). A cut point of 13 is recommended to detect major clinical depression (Matthey et al., 2006). A cut point of 10 was used in this study to classify the subjects with clinical depressive symptoms. EPDS questions were formed into mean sum variables, and their internal consistency was assessed using Cronbach's alpha. In this study, the reliability of the questionnaire was high ( $\alpha = 0.82\text{--}0.83$ ) in mothers and varied from moderate to high ( $\alpha = 0.77\text{--}0.82$ ) in fathers.

### **3.3.3. Parental temperament**

The Finnish version of the Adult Temperament Questionnaire (ATQ) was used to assess parental temperament when the infant was 12 months old. The ATQ is a valid and reliable self-report questionnaire of adult temperament (Evans & Rothbart, 2007). The questionnaire includes 77 items (scored on a scale of 1–7), and consists of 4 broad dimensions (Negative Affect, Extraversion/Surgency, Effortful Control and Orienting Sensitivity) and 13 subscales. In this study, only Negative Affect was used. Negative Affect includes subscales from the subscales Fear (*negative affect related to anticipation of distress*), Sadness (*negative affect and lowered mood and energy related to exposure to suffering, disappointment, and object loss*), Discomfort (*negative affect related to sensory qualities of stimulation*) and Frustration (*negative affect related to interruption of ongoing tasks or goal blocking*) (Evans & Rothbart, 2007). Internal consistency was assessed using Cronbach's alpha. In this study, the reliability of the Negative Affect dimension of the ATQ questionnaire was low ( $\alpha = 0.58$  for mothers,  $\alpha = 0.64$  for fathers).

### 3.3.4. Infant temperament

The Finnish version of the Infant Behavior Questionnaire Revised (IBQ-R) was used to assess infant temperament at 6 and 12 months. The IBQ-R is a widely used, valid and reliable parent-report questionnaire measuring different dimensions of temperament (Gartstein & Rothbart, 2003; Rothbart, 1981). The revised version has 14 scales which form three broad dimensions, Surgency/Extraversion, Negative Affectivity and Orienting/Regulation (Gartstein & Rothbart, 2003). In this study the broad dimension Negative Affectivity was used, including items from the subscales of Distress to limitations, Sadness and Falling reactivity (recovery from negative emotions). In general, the subscale of fear is also included in calculating Negative Affect. However, in the present study, it was excluded because the consistency of the Negative Affectivity dimension was higher when Fear was assessed separately. This confirms the idea that fearful and irritable distress might have different neurobiological and developmental implications (Rothbart, 2011). Parents report infant behavior on a scale of one to seven based on how often their infant is involved in certain behaviors over the past week or past two weeks. The questions include, for example, “*When placed on their back, how often did the baby fuss or protest?*” (Distress to limitations), “*Did the baby seem sad when the caregiver was gone for an unusually long period of time?*” (Sadness) and “*When frustrated with something, how often did the baby calm down within 5 min?*” (Falling reactivity) (Gartstein & Rothbart, 2003). Parent-report is a frequently-used method in studying infants (Parade & Leerkes, 2008). The items in IBQ-R are constructed in a way that parents only report the frequency of their infant’s behavior in a specific context or situation and they don’t have to make comparative judgments or answer abstract or more global questions, which may help specific recall and limit social desirability in the answers (Gartstein & Rothbart, 2003).

Internal consistency was assessed using Cronbach’s alpha. In this study, the reliability of the Negative Affect dimension of the IBQ questionnaire was moderate ( $\alpha = 0.71$ – $0.76$  for mother-reported and  $\alpha = 0.73$ – $0.75$  for father-reported infant negative affect).

### **3.4. Statistical analyses**

Statistical analyses were made with IBM SPSS version 22 and 24. The normality of the outcome variables were tested with normality tests (Kolmogorov-Smirnov). The parent-reported infant Negative Affectivity was not normally distributed at any of the time points, so a basic 10-based logarithmic transformation was used to be able to conduct analyses with parametric assumptions (Tabachnick & Fidel, 2007).

The associations between parental depressive symptoms, parental temperament and infant temperament were analyzed with Spearman's rho correlations. The association between covariates and main dependent variables were examined using Spearman's rho correlations, independent t-tests and one-way variance analysis.

Finally, to examine the influence of parental temperament and postpartum depressive symptoms on parent reported infant Negative Affect simultaneously, a standard hierarchical linear regression (using the Enter method with 3 steps) was used. Every model was run separately for the mothers and fathers, and for infant temperament at 6 months and at 12 months postpartum. In each model, parental age, education, infant gender and number of previous children were controlled for in the first step of the model. Parental depressive symptoms (EPDS) at 3, 6 (for infant negative affect at 6 months) and at 3, 6 and 12 months (for infant negative affect at 12 months) were added to the second step of the model, and the effect of parental Negative Affect was examined in the third step of the model to draw the information on the unique effect of both predictors. Collinearity of the parental depressive symptoms at different time points was low ( $VIF \leq 2.8$ ), so it was possible to include all the time points to the model separately at the same time.

## 4. RESULTS

### 4.1. Descriptive statistics for parental postpartum depressive symptoms, parental temperament and infant temperament

Descriptive statistics of parental depressive symptoms are shown in Table 2. The sample had approximately the same number of parents with clinical postpartum depression as the source population (9-13% of mothers, 10% of fathers) according to studies (Kuosmanen et al., 2010). In the FinnBrain Birth Cohort Study of Karlsson et al. (2018) the mean of EPDS 3 months postpartum was a bit higher for mothers (4.4) and for fathers (3.4) than in this subsample. In this subsample there was an increasing trend in the quantity of depressive symptoms from the first time point (3 months) to the last time point (12 months).

Table 2: Parental depressive symptoms<sup>1</sup>

		Mean	SD	Min; Max	Cut point ≥10 (%)
EPDS 3 months postpartum	Mothers	4.22	3.80	0; 19	9.1
	Fathers	3.00	3.02	0; 17	3.6
EPDS 6 months postpartum	Mothers	4.34	3.91	0; 22	10.5
	Fathers	3.13	3.49	0; 20	4.7
EPDS 12 months postpartum	Mothers	4.97	3.89	0; 22	13.5
	Fathers	3.89	3.71	0; 18	10.4

<sup>1</sup>EPDS sum range is from 0 to 30

Descriptive statistics of parent and infant temperament are shown in Table 3. The mean of ATQ Negative Affect was higher in this sample than the mean of ATQ Negative Affect in the study of Evans and Rothbart (2007), in which it was 2.7 (women and men).

Mean of IBQ Negative Affect was 2.77 for 6–9 months and 3.04 for 9–12 months in a study of Gartstein and Rothbart (2003). In this sample the IBQ negative affect was higher in both groups.

Table 3: Parent and infant temperament<sup>1</sup>

		Mean	SD	Min; Max
ATQ Negative Affect	Mothers	4.00	0.65	2.07; 5.63
	Fathers	3.21	0.66	1.55; 5.01
IBQ 6 months	Mother report	3.12	0.75	1.35; 5.83
	Father report	3.16	0.70	1.25; 5.08
IBQ 12 months	Mother report	3.30	0.70	1.57; 5.46
	Father report	3.33	0.77	1.79; 5.38

<sup>1</sup>ATQ and IBQ range is from 1 to 7

#### **4.2. Associations between background variables and parent postpartum depressive symptoms, parent negative affect and infant negative affect**

There was no difference in depressive symptoms between the parents of girls and boys, parents from different education groups or between the parents with previous or no previous children.

In mother-reported data (Table 4), there was a statistically significant positive correlation between age and infant Negative Affect at 6 months. Among father-reported data (Table 5), there was a statistically significant positive correlation between age and paternal Negative Affect, indicating that older fathers self-reported more negative affectivity than younger fathers. For fathers, higher education predicted higher infant



Negative Affect at 6 months' age. If fathers had previous children, they evaluated their infant higher in Negative Affect at 12 months' age.

There was a positive correlation between mother and father reports of infant Negative Affect ( $r = .50, p < .001$ ). The finding suggests that, in this sample, mothers and fathers rated infant Negative Affectivity similarly. Spearman's rho correlations are shown in Table 4 (mothers) and Table 5 (fathers).

### **4.3. Associations between parental postpartum depressive symptoms, parental temperament and infant temperament**

There were statistically significant positive correlations between all the key variables (EPDS3, EDPS 6, EPDS 12, parental Negative Affect, NEG6 and NEG12) among both mother-rated and father-rated data. Parents with more depressive symptoms or higher self-reported Negative Affect evaluated their infants higher in Negative Affect.

Table 4: Spearman's rho correlations between covariates, maternal depressive symptoms (EPDS), maternal Negative Affect and mother reported infant Negative Affect (NEG)

	EPDS3	EPDS6	EPDS12	NegAff	NEG6	NEG12	Gender	Age	ED
EPDS 6 months	.68**								
EPDS 12 months	.56**	.66**							
Negative affect	.33**	.35**	.43**						
NEG 6 months	.20**	.25**	.27**	.30**					
NEG 12 months	.21**	.21**	.22**	.27**	.60**				
Infant gender	.03	-.03	-.01	.04	.02	.02			
Maternal age	.06	.08	.08	.07	.11*	.07	-.09		
Maternal education	.08	.07	.06	.05	.08	.10	.02	.34**	
Parity	.02	.10	.06	-.07	-.03	.06	-.15**	.23**	.01

\*p<.05

\*\*p<.01

Table 5: Spearman's rho correlations between covariates, paternal depressive symptoms (EPDS), paternal Negative Affect and

father reported infant Negative Affect (NEG)

	EPDS3	EPDS6	EPDS12	NegAff	NEG6	NEG12	Gender	Age	ED
EPDS 6 months	.65**								
EPDS 12 months	.63**	.67**							
Negative affect	.33**	.41**	.37**						
NEG 6 months	.16**	.22**	.20**	.21**					
NEG 12 months	.18**	.20**	.29**	.21**	.53**				
Infant gender	.02	.03	.08	.04	.02	-.06			
Paternal age	.08	.04	.05	.11*	.01	.05	-.11*		
Paternal education	-.06	-.06	-.03	.02	.12*	.08	-.05	.12	
Parity	.00	-.02	.03	-.06	.07	.14**	-.05	.17**	.02

\*p<.05

\*\*p<.01

#### 4.4. Standard hierarchical linear regression

##### 4.4.1. Linear regression models for mother-reported infant Negative Affect

The results of linear regression models for infant Negative Affect at 6 and 12 months are displayed in tables 6 and 7. Maternal age, education, infant gender and parity were not associated with mother-reported infant Negative Affect rated at 6 months postpartum or 12 months postpartum (Step 1).

Maternal depressive symptoms at 6 months were positively associated with infant Negative Affect at 6 months ( $R^2_{adj.} = .053$ ,  $\Delta R^2 = .048$ ,  $p < .001$ ). No association was found between maternal depressive symptoms at 3 months and infant Negative Affect at 6 months (Step2).

When maternal Negative Affect was added to the model (Step 3), the association between maternal depressive symptoms and infant Negative Affect attenuated. Maternal Negative Affect was also associated with 6-month infant Negative Affect and added the explanatory power of the model ( $R^2_{adj.} = .094$ ,  $\Delta R^2 = .043$ ,  $p < .001$ ).

In turn, after controlling for covariates, maternal depressive symptoms increased the explanatory power of the model predicting infant Negative Affect 12 months postpartum (Table 7) ( $R^2_{adj.} = .070$ ,  $\Delta R^2 = 0.075$ ,  $p < .001$ ). However, none of the individual depressive symptom points were statistically significantly associated with the outcome. When maternal Negative Affect was added to the model, it was a statistically significant predictor for infant Negative Affect, and the model again gained explanatory power ( $R^2_{adj.} = .110$ ,  $\Delta R^2 = .042$ ,  $p < .001$ ).

Table 6: The predictors of mother-reported infant Negative Affect 6 months postpartum: maternal depressive symptoms (EPDS 3 and 6 months) and maternal Negative Affect

	95,0% Confidence Interval for B			Stdz.		
	B	Lower Bound	Upper Bound	Beta	t	Sig.
Step 1	.372	.270	.475		7.155	<.001
Maternal age	.002	-.001	.005	.093	1.553	.121
Education	.017	-.006	.039	.086	1.465	.144
Infant gender	.003	-.020	.026	.014	.250	.803
Parity	-.012	-.036	.012	-.055	-.964	.336
Step 2	.359	.258	.459		7.025	<.001
Maternal age	.002	-.001	.005	.089	1.528	.128
Education	.014	-.008	.036	.071	1.238	.217
Infant gender	.003	-.020	.026	.015	.285	.776
Parity	-.015	-.039	.009	-.068	-1.232	.219
EPDS3	.002	-.002	.006	.063	.838	.403
EPDS6	.005	.001	.009	.172	2.274	.024
Step 3	.226	.107	.344		3.752	<.001
Maternal Age	.002	-.001	.005	.076	1.334	.183
Education	.014	-.007	.035	.072	1.282	.201
Infant gender	.002	-.021	.024	.008	.155	.877
Parity	-.011	-.034	.013	-.050	-.912	.362
EPDS3	.001	-.003	.005	.031	.421	.674
EPDS6	.003	-.001	.007	.115	1.524	.128
Maternal Negative Affect	.037	.019	.056	.224	3.957	<.001

Table 7: The predictors of mother-reported infant Negative Affect 12 months postpartum: maternal depressive symptoms (EPDS 3, 6 and 12 months) and maternal Negative Affect

	95,0% Confidence Interval for B			Stdz. Beta	t	Sig.
	B	Lower Bound	Upper Bound			
Step 1	.425	.327	.523		8.525	<.001
Education	.017	-.004	.039	.095	1.614	.108
Maternal age	<.001	-.002	.003	.019	.318	.751
Parity	.014	-.009	.038	.070	1.216	.225
Infant gender	.002	-.021	.024	.007	.132	.895
Step 2	.404	.308	.499		8.333	<.001
Education	.015	-.006	.035	.080	1.394	.164
Maternal age	<.001	-.002	.003	.016	.280	.780
Parity	.011	-.011	.034	.054	.976	.330
Infant gender	.002	-.020	.024	.010	.183	.855
EPDS3	.003	-.001	.007	.129	1.705	.089
EPDS6	.004	-.001	.008	.144	1.618	.107
EPDS12	.001	-.003	.005	.030	.392	.696
Step 3	.278	.166	.391		4.855	<.001
Education	.015	-.005	.035	.083	1.481	.140
Maternal age	<.001	-.003	.003	.003	.045	.964
Parity	.014	-.008	.036	.069	1.280	.202
Infant gender	.001	-.021	.022	.003	.059	.953
EPDS3	.003	-.001	.007	.110	1.481	.140
EPDS6	.004	-.001	.008	.136	1.563	.119
EPDS12	-.001	-.005	.003	-.053	-.669	.504
Maternal Negative Affect	.036	.018	.055	.229	3.888	<.001

#### 4.4.2. Linear regression models for father-reported infant Negative Affect

The linear regression models for father-infant dyads are presented in Tables 8 and 9. Paternal age, education, infant gender and parity were not associated with father-reported infant Negative Affect rated at 6 months postpartum (Step 1). Parity was significantly associated with father reported infant Negative Affect 12 months postpartum ( $\beta = 0.28$ ,  $p < .05$ )

When examining the predictors of infant Negative Affect at 6 months after controlling for the covariates (Step 2), EPDS at 6 months was a statistically significant predictor and the model gained more prediction value ( $R^2 \text{ adj.} = .031$ ,  $\Delta R^2 = .037$ ,  $p < .01$ ).

When paternal Negative Affect was added to the model (Step 3), the association between paternal depressive symptoms and infant Negative Affect attenuated. Paternal Negative Affect was a statistically significant predictor and the model again gained explanatory power ( $R^2 \text{ adj.} = .047$ ,  $\Delta R^2 = .019$ ,  $p < .05$ ).

For 12-month infant negative affect, EPDS at 12 months was a statistically significant predictor after controlling for covariates ( $R^2 \text{ adj.} = .096$ ,  $\Delta R^2 = 0.086$ ,  $p < .001$ ). Unlike in other time-points and for mothers, this association remained statistically significant, even after controlling for paternal Negative Affect (in Step 3). Paternal Negative Affect was also a statistically significant predictor and the model again gained more prediction value ( $R^2 \text{ adj.} = .115$ ,  $\Delta R^2 = .021$ ,  $p < .01$ ).

Table 8: The predictors of father-reported infant Negative Affect 6 months postpartum: paternal depressive symptoms (EPDS 3 and 6 months) and paternal Negative Affect

	95,0% Confidence Interval for B			Stdz. Beta	t	Sig.
	B	Lower Bound	Upper Bound			
Step 1	.441	.350	.532		9.545	<.001
Paternal Age	<.001	-.002	.002	-.006	-.107	.915
Infant gender	.004	-.018	.026	.022	.385	.700
Education	.017	-.002	.035	.100	1.760	.079
Parity	.009	-.015	.033	.042	.741	.459
Step 2	.429	.340	.519		9.424	<.001
Paternal Age	<.001	-.003	.002	-.021	-.358	.720
Infant gender	.002	-.019	.024	.012	.208	.835
Education	.019	<.001	.037	.112	1.994	.047
Parity	.010	-.014	.033	.046	.814	.416
EPDS3	.001	-.004	.006	.026	.359	.720
EPDS6	.005	.001	.009	.176	2.459	.014
Step 3	.373	.273	.472		7.379	<.001
Paternal Age	-.001	-.003	.002	-.034	-.589	.556
Infant gender	.001	-.020	.023	.006	.104	.917
Education	.019	<.001	.037	.111	1.992	.047
Parity	.011	-.012	.035	.053	.956	.340
EPDS3	.000	-.005	.005	.004	.061	.952
EPDS6	.004	<.001	.008	.131	1.780	.076
Paternal Negative Affect	.023	.005	.040	.151	2.501	.013



Table 9: The predictors of father reported infant Negative Affect 12 months postpartum: paternal depressive symptoms (EPDS 3, 6 and 12 months) and paternal Negative Affect

	95,0% Confidence Interval for B			Stdz. Beta	t	Sig.
	B	Lower Bound	Upper Bound			
Step 1	.492	.407	.578		11,270	<.001
Paternal Age	-.001	-.003	.002	-.030	-.518	.605
Infant gender	-.009	-.030	.012	-.048	-.854	.394
Education	.015	-.003	.032	.093	1.647	.101
Parity	.028	.005	.050	.137	2.432	.016
Step 2	.477	.395	.560		11.361	<.001
Paternal Age	-.001	-.003	.001	-.045	-.806	.421
Infant gender	-.015	-.035	.005	-.078	-1.444	.150
Education	.016	-.001	.033	.103	1.897	.059
Parity	.027	.005	.049	.132	2.442	.015
EPDS3	-.001	-.006	.004	-.031	-.422	.673
EPDS6	.001	-.003	.005	.027	.341	.733
EPDS12	.008	.004	.011	.296	3.789	<.001
Step 3	.420	.329	.512		9.029	<.001
Paternal Age	-.001	-.003	.001	-.059	-1.071	.285
Infant gender	-.016	-.036	.004	-.082	-1.541	.124
Education	.016	-.001	.033	.102	1.904	.058
Parity	.029	.007	.050	.141	2.628	.009
EPDS3	-.001	-.006	.003	-.045	-.616	.538
EPDS6	<.001	-.004	.004	-.009	-.114	.909
EPDS12	.007	.003	.011	.269	3.449	.001
Paternal Negative Affect	.023	.007	.040	.161	2.743	.006

## **5. DISCUSSION**

### **5.1. Findings of this study**

The aim of the current study was to investigate the associations between parental Negative Affect, postnatal depressive symptoms and infant Negative Affect during the first year after birth. Specifically, we examined both maternal and paternal temperament, postnatal depression and perceptions of infant temperament at 6 and 12 months of age separately, with an expectation that parental symptoms of postnatal depression and parental Negative Affect would have unique associations with infant temperament.

We found that both maternal and paternal postnatal depressive symptoms had positive correlations with infant Negative Affect, as did parental Negative Affect with infant Negative Affect. Parents with more depressive symptoms or higher self-reported Negative Affect evaluated their infants higher in Negative Affect. For mothers, including Negative Affect in the regression model attenuated the positive association between concurrent postnatal depressive symptoms and infant Negative Affect. For fathers, however, including Negative Affect slightly attenuated the effect of postpartum depressive symptoms on infant Negative Affect at 6 months, but had no influence on the association between depressive symptoms and infant Negative Affect at 12 months. Thus, both depressive symptoms and paternal Negative Affect were associated with higher ratings of father-rated Infant Negative Affect, whereas maternal Negative Affect largely accounted for the positive association between (concurrent) depressive symptoms and infant Negative Affect. Moreover, both parental depressive symptoms and parental Negative Affect were associated with infant Negative Affect when included in the same linear regression model.

### **5.2. Relation to previous studies**

In mothers, we found that depressive symptoms 6 months postpartum were associated with concurrent evaluation of the infant's Negative Affectivity. This finding is in line

with previous studies that have found the strong association between postnatal depression and infant Negative Affect in the first 6 months postpartum (Aalto et al., 2007; Britton, 2011; Edhborg et al., 2000; McGrath et al., 2008; McMahon et al., 2001). However, when maternal Negative Affect was considered, the effect of concurrent depressive symptoms attenuated. We assume that maternal postnatal depression and maternal Negative Affect are at some extent different sides of the same phenomenon that has association with maternal evaluation of infant Negative Affect, or that depression represents the extreme endpoint of the Negative Affect trait (Clark et al., 1994), which could possibly explain the strong effect that the inclusion of maternal Negative Affect had on the models.

Interestingly, at 12 months postpartum, the significant association between mothers' concurrent depressive symptoms and the evaluation of infant Negative Affect disappeared completely after including parental Negative Affect. This is probably due to the timing effect: parental temperament was assessed at 12 months, and the proximity of the assessment might have resulted in even stronger association. In the same model, the coefficients of maternal depressive symptoms at 3 and 6 months in predicting infant Negative Affect were still clearly positive, although not statistically significant. However, there are also alternative explanations to this observation. Possible reasons for the association being stronger for infant outcome at 6 months than at 12 months might have something to do with changed maternal hormone states and other differences in daily routines due to changes in lactation (most infants have started to eat solid food and mothers give up breastfeeding at 12 months postpartum), better sleep rhythmicity, staying at home or taking the infant to child care, or becoming more adapted to the infant temperament.

For fathers, both self-reported Negative Affectivity and depression symptoms had independent effects on the evaluation of infant Negative Affect. This phenomenon was especially at 12 months, when for mothers the associations were clearly attenuated. This might be linked to the fact that paternal postnatal depression is linked to infant outcomes with different mechanisms than maternal postnatal depression. For instance, paternal depression is more likely to have an impact on infant Negative Affect through marital

aspects (Gutierrez-Galve et al., 2015). Our findings on fathers also hint that paternal temperament and depressive symptoms might be less intertwined in terms of predicting infant emotionality and might present more objective ratings of paternal trait and state aspects of personality. However, it must be also considered that the rates for paternal depressive symptoms are lower than maternal depressive symptoms in the postnatal period (Paulson & Bazemore, 2010), causing less reporter bias to the ratings used in the present study.

In this study, mother and father reports of infant Negative Affectivity were statistically significantly correlated with each other. This positive correlation is in line with previous studies (Parade & Leerkes, 2008). There was no difference in depressive symptoms between the parents of girls and boys, parents from different education groups or between the parents with previous or no previous children, though there are previous findings that first time parents would be at higher risk for postnatal depression (Shimizu et al., 2015). Furthermore, there were associations between some background variables and parental ratings of infant Negative Affect. Maternal age correlated positively with maternal evaluation of infant Negative Affect at 6 months, indicating that older mothers evaluated their infants higher on Negative Affect. For fathers, higher education predicted higher infant Negative Affect at 6 months' age. If fathers had previous children, they evaluated their infant higher in Negative Affect at 12 months' age. In a study by Glynn et al. (2007) maternal age and parity were associated with infant Negative Affect, but maternal education was not. These observations are in line with the findings of Parade and Leerkes (2008) who found correlations between maternal age and education and maternal evaluation of infant temperament. The same study did not have findings considering paternal education or parity in relation to infant Negative Affect.

To summarize, as was hypothesized, parental postnatal depressive symptoms and infant Negative Affectivity were positively associated at a zero-order level. However, when the effect of parental Negative Affectivity was considered, unique association of parental postnatal depressive symptoms and infant Negative Affect remained significant only for fathers. For mothers, including self-rated Negative Affect attenuated the association

between postnatal depressive symptoms and infant Negative Affect. Mothers' and fathers' self-reported Negative Affectivity were associated with infant Negative Affectivity at 6 and 12 months postpartum.

### **5.3. Further discussion and implications for future research**

Results revealed that association between parental postnatal depressive symptoms and infant Negative Affectivity attenuated in all cases but paternal depressive symptoms 12 at months when parental Negative Affectivity was added to the model. The explanation for the attenuation might be in the features of depression and Negative Affectivity. It might be that depressive symptoms and Negative Affectivity overlap considerably, that they largely represent same features, and this goes in line with the continuity model by Clark et al. (1994) presented earlier. We must consider the fact that depression and negative temperament might not be separate phenomena, and that parental Negative Affectivity, depression and infant Negative Affectivity have a combined influence, all affecting each other. This study does not answer the question considering the mechanisms between the parental temperament and the perception of infant temperament, or the mechanisms between the infant temperament and the infant's perception of parental temperament or depression. It might be useful to study these associations with a longitudinal cross-lagged panel model that could reveal the reciprocity between the phenomena. We assume that a parent with higher Negative Affectivity or postnatal depressive symptoms reacts more strongly to the negative behavior of the infant, and an infant with higher Negative Affectivity is more sensitive to the negative behavior of the parent (Slagt et al., 2016). In this situation, the goodness of fit of the parent and infant is not the best possible and is likely to cause problems to the wellbeing of the infant and the parent.

Remarkably, associations for mothers and fathers were different across models. Paternal aspects have not got much attention in previous studies, so there is a paucity of information regarding the possible explanations to these differences. It is important to

consider that also paternal depression and self-reported temperament has an association with perceived infant temperament. We assume that the mechanisms of paternal Negative Affectivity that explain variation in infant behavior are relatively similar to maternal, because we know that temperament is transmitted through genetical and parenting-related pathways (Matthews et al., 2003; Rothbart, 2011). However, there is also evidence about differential mechanisms for paternal postnatal depression and child outcomes in comparison to maternal postpartum depression (Gutierrez-Galve et al., 2015; Luoma et al., 2013; Sweeney & MacBeth, 2016). Future research should seek to study the shared and differing relations of maternal and paternal depression and child outcomes further to generate knowledge that could be used in the clinical realm.

Implications can be made based on the information these results and earlier studies have brought. The vast majority of the population attends to maternity clinic checks and treatments multiple times after the birth of the child. The compatibility of the temperaments of parent and child and synchrony between the parent and infant, referred to as goodness of fit, is known to be poorer if both parent and/or infant are high on Negative Affectivity (McGrath et al., 2008). Negative Affectivity of parent or infant influences the parental perception and the infant is perceived to be more difficult and demanding than other infants (Coplan et al., 2009). As shown by these findings, parental Negative Affectivity is also considerably intertwined with parental ratings of their mood as well as their ratings of infant temperament, and this is especially pronounced for mothers. It might be relevant for parents to have some support by health care professionals to explore their own temperament and how it manifests in everyday life, especially in their perceptions of infant's temperament traits. If the parents have a better understanding about their own personality and temperamental tendencies, they might be able to more objectively assess everyday life situations and adjust their behavior to better respond to the infant's needs. Furthermore, depressed parents might need help in recognizing the positive characteristics of their infant, and positive reinforcement and guidance about the interaction and infant behavior could be provided (McGrath et al., 2008)

Families with an infant high on Negative Affectivity might benefit from specific support to prevent internalizing and externalizing problems later, and there is a dual risk if parents are also high in Negative Affectivity or suffer from postnatal depression. Infants with high Negative Affectivity need to be taught how to appropriately cope with their intense emotional reactions (Crawford et al., 2011), and sensitive and correctly responsive parenting is related to better infant outcomes (Propper & Moore, 2006).

#### **5.4. Strengths and limitations**

This study has many strengths. First, the consideration of paternal features is quite rare in previous studies. Compared to previous studies, this study considers postnatal environment from a wider perspective by including both parental temperament and parental postnatal depression when investigating the associations with infant Negative Affectivity. Both depressive symptoms and infant Negative Affectivity were assessed multiple times to have more reliable results.

There are also some limitations that should be considered when interpreting the results. Though these findings detected positive associations and correlations between the key variables, the causality of these features cannot be confirmed in this study. Consequently, the results can only be used as guidelines for future research. Secondly, although the inclusion of several time points in the models is a strength, different time points of parental depressive symptoms and infant negative affect share a considerable amount of variance. Consequently, regardless of the acceptable collinearity metrics, the models might have suffered from collinearity problems. For instance, in maternal models, the positive coefficients of early postpartum depressive symptoms persisted even though they did not reach statistical significance, which may indicate that including fewer time points might have revealed statistically significant unique variance for both maternal depressive symptoms and temperament.

Also, the use of self-reports only is a challenge, as so many different variables may affect the evaluation and the answering. The data of this study was gathered by questionnaires

filled out by mothers and fathers. The validity of parental perception has been a subject of previous studies, since there might be several variables influencing the parental answers, ranging from social desirability to subjective characteristics like knowledge, experience and psychopathology. In some studies the parental postnatal depression is assumed to influence the perception of infant temperament (Albertsson-Karlgren et al., 1999; Parade & Leerkes, 2008). Vaughnet et al. (1981) are implying that parental personality is reflected more in the evaluation than the real temperament of the infant. However, many studies show parental reports to have a good validity (Pauli-Pott et al., 2004), and Richters (1992) has even stated that the previous studies supporting the theory of depression causing distortion in parental perception do not meet the criteria of properly conducted studies. This current study did not include objective observation by a professional, but such data has already been collected in the FinnBrain Cohort Study (Nolvi et al., 2019), and provides a good opportunity to investigate the differences between the relations of parent-reported and observational child temperament and postnatal mood.

In this study, the reliability of the questionnaires ranged from low to high. However, the alphas for Adult Temperament Questionnaire were calculated based on subscales, which might have weakened the reliability in comparison to alphas based on the original items; this was chosen because many of the subjects had missing data on some original items, and the calculation of the alphas would have required multiple imputation procedures too lengthy for the scope of this thesis. Finally, unfortunately, it was not possible to consider parental temperament at more than one timepoint. Although temperament in adulthood is considered to be a stable phenomenon, two-time measurement might have provided more information on re-test reliability. Future research would do well to consider the associations on a longer time scale.



## **5.5. Conclusion**

The results of this study indicate that parental postnatal depressive symptoms and infant Negative Affectivity are positively associated, as is mothers' and fathers' self-reported Negative Affectivity with infant Negative Affectivity at 6 and 12 months postpartum. We must consider the fact that depression and negative temperament might not be separate phenomena, and that parental Negative Affectivity, depression and infant Negative Affectivity have a combined influence, all affecting each other. There were some differences between maternal and paternal associations. Future research should seek to study the shared and differing relations of maternal and paternal depression and child outcomes further to generate knowledge that could be used in the clinical realm.

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