

Maternal Anxiety During and After Pregnancy and Infant Temperament at Three Months of Age

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Abstract: None available.

Full Text: Headnote ABSTRACT: The purpose of the current study was to explore associations between maternal anxiety and infant temperament. Participants (n = 60 women) completed measures of state and trait anxiety during the third trimester of pregnancy and again three months postpartum, as well as an assessment of infant temperament. Maternal trait anxiety predicted infant distress to novelty and limitations, and difficulty soothing. Antenatal state anxiety predicted less infant positive affect and lower attention-span. Postnatal state anxiety was related to infant activity level and distress to limitations. Results are discussed in terms of conceptual mechanisms that may underlie the complex inter-associations between different types of maternal anxiety and infant temperament. KEY WORDS: maternal anxiety, infant temperament, pregnancy, postpartum mood. INTRODUCTION There is a long history of research linking maternal psychological stress during pregnancy to negative outcomes in infancy (e.g., Davids & Devaut, 1962; Davids, Holden, & Gray, 1963; Farber, Vaughn, & Egeland, 1981; Ottinger & Simmons, 1964; Stott, 1973). Results from animal studies indicate that offspring of mothers subjected to stressful conditions during pregnancy cope less well in stressful situations (Weinstock, 1997), are at risk for depression and heightened anxiety (Weinstock, 2000) and tend to be fearful in new situations (Worlein & Sackett, 1995). In a recent review of the literature, Huizink, Mulder, and Buitelaar (2004) reported that animals exposed to prenatal stress have increased emotionality as well as delays in learning and neuromotor development. However, as compared to extant animal literature, less is known about the effects of prenatal stress on human infants and children (Huizink et al., 2004). There is growing evidence to suggest a relation between maternal anxiety experienced during pregnancy and a range of child outcomes (Bhagwanani, Seagraves, Dierker, & Lax, 1997; Buitelaar, Huizink, Mulder, Robles de Medina, & Visser, 2003; O'Connor, Heron, Golding, Beveridge, & Glover, 2002; O'Connor, Heron, Golding, Glover, & the ALSPAC Study Team, 2003; Singer, Davillier, Bruening, Hawkins & Yamashita, 1996; Van den Bergh & Marcoen, in press). The focus of the current study was on the relation between maternal anxiety and infant temperament. More specifically, we sought to explore the differential and unique associations between different types of maternal anxiety [i.e., prenatal state anxiety (also referred to as antenatal state anxiety), postnatal state anxiety, postnatal trait anxiety] and child temperament at three months postpartum. Theoretical Links Between Maternal Anxiety and Child Temperament There are numerous and somewhat diverse theoretical and conceptual approaches to the study of child temperament (Wachs & Kohnstamm, 2001). Temperament can be broadly defined as the physical basis for the affective arousal, expression, and regulation components of personality (Goldsmith, Buss, Plomin, & Rothbart, 1987). Child temperament is considered to have a biological foundation, to be genetically influenced, and to be relatively stable over time (Buss & Plomin, 1984; Rothbart & Bates, 1998). Several different theoretical explanations have been posited to account for the relation between antenatal maternal anxiety and child temperament. To begin with, mothers who tend to be anxious, stressed, and easily distressed may tend to have offspring with similar tendencies (Whaley, Pinto, & Sigman, 1999). For example, Goldsmith, Lemery, Buss, and Campos (1999) reported genetic influences on stranger distress in infants. In terms of more severe anxiety, heritability estimates have been reported ranging from 19% to 30% for liability to the Generalized Anxiety Disorder (Kendler, Neale, Kessler, Heath & Eaves, 1992). Interestingly, the genetic link between parental and child anxiety disorders seems to be more pronounced for mothers than fathers (McClure, Brennan, Hammen, & Le Brocque, 2001). As such, the link between maternal anxiety and child temperament may simply be a reflection of the heritability of child temperament characteristics (Buss & Plomin, 1984). A second explanation

is that stress specifically experienced during pregnancy may alter hormones or other biochemical agents that in turn affect the neurochemistry of the offspring (e.g., Chrousos & Gold, 1992; Teixeira, Fisk, & Glover, 1999). For example, it has been suggested that there is some hormonal mediation reflected in the activity of the maternal hypothalamus-pituitary-adrenal (HPA) axis that affects the developing fetus (Huizink, Rubles de Medina, Mulder, Visser, & Buitelaar, 2002; O'Connor et al., 2002). As well, maternal anxiety during the later stages of pregnancy may increase uterine artery resistance, altering blood flow to the fetus and potentially influencing development (O'Connor et al., 2003; Teixeira et al., 1999). These may be considered contributions to the widely assumed biological substrates of child temperament (Rothbart & Bates, 1998). From a different perspective, it is possible that anxious women may simply perceive their children more negatively (McMahon, Ungerer, Beaupaire, Tennant, & Saunders, 1997). In support of this notion, results from several studies have indicated that mothers under stress are more likely to rate their child's temperament as being more difficult (e.g., Calkins, 2002; Esdaile & Greenwood, 1995). Infants may also respond to or 'match' their mother's negative behavior state (Field, Healy, Goldstein, & Guthertz, 1988). For instance, mothers who are anxious may have babies who are also anxious because the babies frequently witness this type of behavior in their mothers. Indeed, mothers may be teaching their babies negative emotional affect. Finally, the relation between maternal prenatal psychological affect and infant temperament may be mediated by mother-infant attachment. In this regard, mother's negative affect may influence the infant attachment relationship, which in turn impacts upon the infant's behavior (White, Wilson, Blander, & Persson, 1999). The question arises as to whether different forms of maternal anxiety might make unique contributions to child temperamental characteristics. Trait anxiety refers to dispositional and relatively stable individual differences in anxiety proneness - whereas state anxiety refers to anxiety in response to a specific situation, and is transitory in nature (Spielberger, Gorsuch, & Lushene, 1970). There is a well-established association between trait and state anxiety (Brouwers, van Baar, & Pop, 2001; Van den Bergh, 1990; Van den Bergh & Marcoen, in press). Thus, women who suffer from trait anxiety may be more prone to both antenatal and postnatal state anxiety (Scott-Heyes, 1982). However, to date, the differential relations between different types of anxiety (i.e., trait vs. state) as experienced at different times (i.e., pre- vs. postnatal) and later infant temperament remains under-explored.

Empirical Links Between Maternal Anxiety and Child Temperament

There is some empirical support linking maternal antenatal anxiety with later child temperamental characteristics. For example, Van den Bergh (1992) reported that maternal state anxiety during pregnancy was associated with fetal motor activity and behavioral state organization, and predicted infant difficult temperament at ten weeks of age. Huizink and colleagues (Buitelaar et al., 2003; Huizink et al., 2002) have also reported associations between maternal antenatal anxiety and infant difficultness (i.e., unadaptability, lack of attention regulation) at both three and eight months of age. There is also some indication that the relations between antenatal anxiety and infant temperament appear to hold even when controlling for postnatal anxiety (e.g., Huizink et al., 2002; Roy, Noyés, & Wisenbaker, 1999). Antenatal anxiety also seems to be related to child temperament beyond the contributions of trait anxiety. In a sample of over 7000 women, O'Connor et al. (2002) reported that prenatal anxiety predicted child hyperactivity, emotional problems, and conduct problems (constructs that appear to have a partial basis in child temperament) at four-years of age, even when controlling for postnatal trait anxiety. However, very little is known about the potential differential associations between state and trait anxiety, assessed both pre- and postnatally, and child temperament. Rizzardo, Magni, Cremonese, Rossi, and Consentino (1988) did report that prenatal state anxiety predicted birth/pregnancy complications whereas trait anxiety did not. As well, Symons (2001) reported that maternal postpartum state anxiety was related to maternal ratings of child fussiness and unadaptability at age 3 and 6 months, as well child separation anxiety at six months after birth. However, the majority of studies where researchers have explored the relation between maternal anxiety and child outcomes have failed to distinguish between different forms of maternal anxiety (e.g., Brouwers et al., 2001; O'Connor et al., 2002; O'Connor et al., 2003).

The Present Study

There is at least some preliminary evidence to suggest that different types of maternal anxiety

might be differentially related to child outcomes (e.g., Rizzardo et al., 1988; Symons, 2001). However, to date these associations remain under-explored. In the present study, we sought to further explore the unique and differential associations between maternal antenatal state anxiety (assessed in the third trimester of pregnancy), postnatal state anxiety, trait anxiety, and dimensions of infant temperament three months after birth. The decision to study maternal prenatal anxiety during the third trimester as opposed to the early trimesters was based on previous research that has found an association between maternal anxiety in the final trimester and child outcomes (e.g., Brouwers et al., 2001; O'Connor et al., 2002; O'Connor et al., 2003).

METHOD

Participants

The participants in this study were 60 women from a mid-sized city in southeastern Ontario, Canada. Mothers ranged in age from 23 to 41 years ($M^{\text{age}} = 31.85$ years, $SD = 4.46$). Mothers were recruited between 26 weeks and 38 weeks of pregnancy ($M = 34.1^{\text{weeks}}$, $SD = 3.97$). Approximately one-third of the participants were contacted through a local 'diaper service,' and the rest were recruited from prenatal classes. The sample was predominately Caucasian (96.7%), with 3.3% of mothers having only a high school education, 18.3% having completed a college degree, 45% with an undergraduate university degree, and 31.7% with a graduate degree. Approximately three months after the birth of their child ($M = 14.83^{\text{sub weeks}}$, $SD = 4.74$), 47 mothers agreed to continue their participation in the study. Results from t-tests indicated that mothers who discontinued participation did not differ from those who continued in terms of demographic variables or measures of antenatal anxiety.

Measures

Demographic Questionnaires.

Prenatal demographic/background information collected included maternal and paternal education levels, birth order of the child, pregnancy complications, as well as alcohol consumption and smoking habits during pregnancy. Following the birth of the baby, mothers provided information regarding birth complications, type of birth (i.e., vaginal vs. cesarean), the gestational age of the infant, as well as infant height and weight.

Maternal Anxiety.

Maternal anxiety was assessed during and after pregnancy using the State-Trait Anxiety Inventory (STAI, Spielberger et al., 1970). This questionnaire consists of two factors, including state anxiety (20 items, e.g., "I am presently worried over possible misfortunes"); and trait anxiety (20 items, e.g., "I worry too much about something that does not really matter"). Instructions for the state anxiety subscale ask participants to indicate how they feel "right now, that is, at this moment." Instructions for the trait anxiety subscale ask participants to indicate how "they generally feel." During pregnancy, participants completed only the state anxiety subscale ($\alpha = .93$). Three months after the birth of the child, mothers completed both the state anxiety ($\alpha = .96$) and trait anxiety subscales ($\alpha = .93$).

Child Temperament.

Approximately three months after birth, mothers completed the Infant Behavior Questionnaire (IBQ, Rothbart, 1981). This 94-item questionnaire was developed to assess various domains of infant temperament. Subscales include attention-span (11 items, $\alpha = .72$, e.g., "How often during the last week did the baby stare at a mobile, crib bumper or picture for 5 minutes or longer?"), activity level (17 items, $\alpha = .73$, e.g., "During feeding how often did baby lie or sit quietly?"), distress to novelty (17 items, $\alpha = .80$, e.g., "When face was washed how often did the baby fuss or cry?"), distress to limitations (20 items, $\alpha = .84$, e.g., "After sleeping, how often did the baby play quietly in the crib?"), soothability (11 items, $\alpha = .84$, e.g., "Have you tried any of these soothing techniques in the last two weeks-rocking?"), and positive affect (15 items, $\alpha = .85$, e.g., "When put into the bath water how often did the baby smile?").

RESULTS

Preliminary Analyses

Demographic Variables.

Correlations were conducted to examine the relations between prenatal demographic variables (i.e., maternal age, parental education) and the various measures of maternal anxiety (antenatal state anxiety, postnatal state anxiety, trait anxiety). No significant associations were indicated (although the correlation between maternal education and antenatal state anxiety approached significance, $r = -.26$, $p = .06$). As a result, demographic variables were not controlled for statistically in subsequent data analyses.

Characteristics of the Pregnancy.

Health related issues measured during pregnancy included prior pregnancies, pregnancy complications, smoking and drinking habits. Fifty-two women were pregnant with a first-born child, whereas 8 participants had been pregnant prior to the current pregnancy. There were 48 women who reported no prior pregnancy complications, whereas 12 women reported minor pregnancy complications

(e.g., high blood pressure, vaginal bleeding). Fifty-nine women did not smoke during the pregnancy and one participant reported smoking more than 10 cigarettes during the entire pregnancy. There were 48 women who indicated they did not drink alcohol during the pregnancy, whereas 12 women reported drinking less than 10 drinks during the entire pregnancy. The next set of analyses examined potential differences in the various forms of maternal anxiety as a function of (1) birth order of the unborn child (first pregnancy vs. not first pregnancy); (2) pregnancy complications experienced (yes vs. no); and, (3) alcohol consumption by the mother (never vs. <than 10 drinks during pregnancy). Results from a series of t-tests revealed no significant differences between any of the groups for any of the anxiety types. As a result, these variables were not controlled for statistically in subsequent prenatal data analyses. Obstetric variables assessed included infant birth weight (M=7.52 lbs, SD = 1.21, range from 4.1-9.8 lbs), length of infant (M = 20.52 cm, SD = 1.53, range from 14-22.7 cm), and infant gestational age (M = 39.48 weeks, SD = 1.68, range from 34.2-41.5 weeks). Eighty-three percent of mothers gave birth vaginally, whereas 17% had cesarean births. Thirty-seven mothers reported no complications during the birth while ten reported minor birth complications (e.g., minor fetal distress, forceps delivery, induced labor). Correlations were conducted to examine the relations between obstetric variables and the various forms of maternal anxiety. Significant correlations were found between infant height at birth and both antenatal state anxiety ($r = -.55, p < .01$), and postnatal state anxiety ($r = -.42, p < .01$). However, since height of infant was not significantly associated with any of the infant temperament subscales, this variable was not controlled for statistically in subsequent data analyses. The final set of preliminary analyses examined potential differences in the various forms of maternal anxiety as a function of (1) birth complications (yes vs. no); and (2) type of delivery (vaginal vs. cesarean). Results from a series of t-tests revealed no significant differences for any of the anxiety types. As a result, these variables were not controlled for statistically in subsequent prenatal data analyses. Relations between anxiety types. Results from correlational analyses revealed significant associations between the various forms of maternal anxiety. Maternal prenatal anxiety was significantly and positively associated with both postnatal state anxiety ($r = .45, p < .01$) and trait anxiety ($r = .47, p < .01$). As well, postnatal state anxiety was highly correlated with trait anxiety ($r = .77, p < .001$).

Table 1
Correlations Between Different Forms of Maternal Anxiety and Infant Temperament Characteristics (N = 46)

	<i>Prenatal State Anxiety</i>	<i>Postnatal State Anxiety</i>	<i>Trait Anxiety</i>
Infant Temperament			
Attention-span	-.33*	.07	-.13
Activity level	.11	.49**	.24
Distress to novelty	-.03	.21	.25+
Positive affect	-.36*	-.03	-.20
Distress to limitations	.23	.31*	.42**
Soothability	-.10	-.21	-.31*

**p < .01

*p < .05

+p < .10

Relations Between Maternal Anxiety and Infant Temperament Results from correlations between different forms of maternal anxiety (prenatal state anxiety, postnatal state anxiety, trait anxiety) and infant temperament characteristics (positive affect, soothability, distress to novelty, distress to limitations, attention-span, activity level) are displayed in Table 1. Results indicated a somewhat differential pattern of associations between different forms of maternal anxiety and child temperament characteristics. Prenatal state anxiety was significantly and negatively associated with infant positive affect and attention-span. Postnatal state anxiety was significantly and positively correlated with infant activity level and distress to limitations. Finally, trait anxiety was significantly and positively correlated with infant distress to limitations, significantly and negatively associated

with soothability, and a positive relation with distress to novelty approached significance. Regression analyses. The goal of the next set of analyses was to explore the unique association between state anxiety (both prenatal and postnatal) and child temperament controlling for the contribution of trait anxiety. Prenatal state anxiety had demonstrated a significant association with infant positive affect and attention-span. As such, two separate regression analyses were computed to predict each of these temperamental characteristics, with trait anxiety entered at Step 1, and prenatal state anxiety entered at Step 2. Results are displayed in Table 2. Maternal prenatal anxiety continued to predict less positive infant affect and lower attention span even when controlling for the effects of maternal trait anxiety.

Table 2
Prediction of Positive Affect and Attention Span from
Prenatal State Anxiety and Trait Anxiety

<i>Dependent Variable: Positive Affect</i>			
<i>Variable</i>	<i>B</i>	<i>SE B</i>	<i>β</i>
Step 1			
Trait Anxiety	-0.02	0.17	-.20
Step 2			
Prenatal State Anxiety	-.03	0.19	-.35*
Note. $R^2 = .040$, <i>ns</i> for Step 1; $\Delta R^2 = .090$, $p < .06$, for Step 2.			
<i>Dependent Variable: Attention Span</i>			
<i>Variable</i>	<i>B</i>	<i>SE B</i>	<i>β</i>
Step 1			
Trait Anxiety	-0.01	0.14	-.15
Step 2			
Prenatal State Anxiety	-.03	0.15	-.34+
Note. $R^2 = .147$, <i>ns</i> for Step 1; $\Delta R^2 = .088$, $p < .06$ for Step 2.			
* $p < .05$			
+ $p < .06$.			

Postnatal state anxiety had demonstrated a significant association with infant activity level and distress to limitations. As such, two separate regression analyses were computed to predict each of these temperamental characteristics, with trait anxiety entered at Step 1, and postnatal state anxiety entered at Step 2. Results are displayed in Table 3. Maternal postnatal anxiety continued to predict infant activity level even when controlling for the effects of maternal trait anxiety. DISCUSSION The goal of the current study was to explore the relations between different types of maternal anxiety (antenatal state anxiety, postnatal state anxiety, and trait anxiety) and infant temperament measured 3 months after birth. To begin with, consistent with previous research results (e.g. Brouwers et al., 2001; Gunter, 1986; Van den Bergh, 1990; Van den Bergh & Marcoen, in press), assessments of state and trait anxiety were highly inter-related. However, results also indicated different patterns of associations between different forms of maternal anxiety and infant temperamental characteristics. Moreover, both antenatal and postpartum anxiety continued to be associated with infant temperament even when controlling for trait anxiety. These findings add to the growing literature linking maternal anxiety during pregnancy and child outcomes (e.g., Brouwers et al., 2001; Huizink et al., 2002; O'Connor et al., 2002; O'Connor et al., 2003; Van den Bergh & Marcoen, in press).

Table 3
Prediction of Activity Level and Distress to Limitations from
Postnatal State Anxiety and Trait Anxiety

<i>Dependent Variable: Activity Level</i>			
<i>Variable</i>	<i>B</i>	<i>SE B</i>	<i>β</i>
Step 1			
Trait Anxiety	0.02	0.14	.27+
Step 2			
Postnatal State Anxiety	.05	0.15	.70**

Note. $R^2 = .072$, $p < .08$, for Step 1; $\Delta R^2 = .199$, $p < .01$, for Step 2.

<i>Dependent Variable: Distress to Limitations</i>			
<i>Variable</i>	<i>B</i>	<i>SE B</i>	<i>β</i>
Step 1			
Trait Anxiety	0.03	0.11	.43**
Step 2			
Postnatal State Anxiety	.06	0.14	-.09

Note. $R^2 = .183$, $p < .01$, for Step 1; $\Delta R^2 = .004$, *ns*, for Step 2.
 + $p < .08$
 ** $p < .01$

Maternal Trait Anxiety and Infant Temperament In the present study, maternal trait anxiety (as assessed 3 months after pregnancy) was related to greater infant distress to limitations and distress to novelty, and more difficulty soothing at 3 months of age. These results are consistent with previous findings linking maternal trait anxiety and child temperament. For instance, Field, Diego, Hernandez-Reif, Schanberg, Kuhn, et al. (2003) reported that newborns of women higher in trait anxiety had higher withdrawal scores and lower motor organization and autonomie stability scores (on the Brazelton Neonatal Behavior Assessment Scale). In their study trait anxiety was measured prenatally, but results from previous research have indicated a high degree of association between prenatal and postnatal trait anxiety scores (Gunter, 1986). In addition, Van den Bergh and Marcoen (in press) found an association between maternal postnatal trait anxiety and internalizing difficulties in 8- and 9-yearold children. There are a number of possible explanations for the relation between maternal trait anxiety and child temperament. First, it is possible that genetics plays a role in determining children's temperamental traits (Rothbart & Bates, 1998). For example, Goldsmith et al. (1999) found a genetic substrate to fear of unfamiliar people in infants. In support of this notion, in the current study, maternal trait anxiety was related to infant distress to novelty. Inhibition to the unfamiliar in childhood is widely considered to be a risk factor for the later development of anxiety problems (e.g., Hirschfeld, Rosenbaum, Biederman, Bolduc, Faraone et al., 1992; Schwartz, Snidman, & Kagan, 1999; Van Ameringen, Mancini, & Oakman, 1998). Moreover, as mentioned previously, there appears to be a genetic component to the inter-generational transmission of anxiety disorders (Kendler et al., 1992; McClure et al., 2001). Notwithstanding the direct genetic contribution of maternal trait anxiety to infant temperament, maternal anxiety may also indirectly affect child outcomes via its influence on maternal behaviors, beliefs, and the quality of the mother-child relationship. For example, as infants get older and become more aware of maternal behaviors, they may begin to model their mother's anxious behaviors (Field et al., 1988). Mothers who are more anxious may also be more likely to see the world as more threatening, and thus more likely to perceive their infants more negatively. In support of this notion, Gunter (1986) reported that maternal trait anxiety (measured both in the prenatal and postnatal periods) was related to both anticipation of negative infant difficulties prior to delivery and perception of negative infant behaviors in postpartum. Finally, Agterberg, Hunfeld, Wladimiroff, and Passchier (1997) found that women high in trait

anxiety had difficulties adapting to the mother role and more frequently visited their infants just to check on them. These factors may contribute to the development of inadequate attachment relationships between anxious mothers and infants. Thus, maternal trait anxiety may directly (e.g., genetic influence) and indirectly (disruption of maternal behaviors and beliefs) steer the child down a pathway towards later socio-emotional difficulties particularly along the internalizing dimension. This is consistent with the results of previous research relating maternal psychopathology with negative child outcomes (see Zahn-Waxler, Duggal, & Gruber, 2002, for a recent review). For example, children of mothers with clinically diagnosed anxiety disorders are at increased risk for later developing anxiety, depression, and other forms of psychopathology (e.g., Spence, Najman, Bor, O'Callaghan, & Williams, 2002; Turner, Beidel, & Costello, 1987; Whaley et al., 1999).

Prenatal State Anxiety and Child Temperament It is becoming increasingly accepted that there are biological mechanisms in place linking maternal anxiety during the third trimester of pregnancy and infant temperament. Results from animal research (Huizink et al., 2004) suggest that these mechanisms may involve changes in the HPA axis, reduced blood flow, and/or uterine artery resistance (e.g., Glover & O'Connor, 2002; O'Connor et al., 2003). Results from the current study were in keeping with this notion. Maternal state anxiety during pregnancy uniquely predicted infant less positive affect and lower attention-span in three-month old infants, even when controlling for postnatal trait anxiety. These findings are consistent with previous research results linking antenatal anxiety during the third trimester of pregnancy and aspects of child temperament characteristics (e.g., Buitelaar et al., 2003; O'Connor et al., 2002; O'Connor et al., 2003; Van den Bergh, 1990). For example, our results mirror the findings of Huizink and colleagues (2002), who reported a negative relation between prenatal anxiety and infant attention regulation (at both 3 and 8 months of age) even after controlling for postnatal stress and postpartum depression. It should be noted that other models linking antenatal anxiety and child outcomes have also been forwarded. For example, it has been argued lower birth weights often associated with antenatal anxiety could contribute towards child mental and behavioral problems (Glover & O'Connor, 2002). As well, maternal anxiety is often accompanied by co-morbid depression (Brouwers et al., 2001; Field, Diego, Dieter, Hernandez-Reif, Schanberg, et al. 2001; Field et al., 2003). Moreover, maternal anxiety during pregnancy has also been found to predict subsequent postpartum depression, which itself is related to a number of negative child outcomes (Glover & O'Connor, 2002; Wijma, Ryding, & Wijma, 2002).

Postnatal State Anxiety and Child Temperament To our knowledge, this is the first study in the literature that has specifically examined the relations between maternal postnatal state anxiety and child temperament. Most previous research concerning postpartum mood has focused on maternal depression, and its negative effects on the mother-child attachment relationship and prediction of child behavior problems (e.g., Hay, Pawlby, Angold, Harold, & Sharp, 2003; Luoma, Tamminen, Kaukonen, Laippala, Puura et al., 2001; Murray, Cooper, Wilson, & Romaniuk, 2003; Righetti-Veltema, Bousquet, & Manzano, 2003). In the current study, postnatal state anxiety was related to infant distress to limitations and increased activity level (even when controlling for trait anxiety). These findings are consistent with previous research results linking postpartum depression with maternal perceptions of child fussiness (Edhborg, Seimyr, Lundh, & Widstroem, 2000; Whiffen, 1990). It is possible that infants are responding to maternal increased postnatal anxiety by becoming more fussy and irritable (Field et al., 1988). However, it seems plausible that mothers with an already existing tendency towards anxiety might become more anxious postpartum in response to having infants with more challenging temperamental traits. Temperamental traits such as high reactivity, difficulty in soothing, and activity level are more likely to elicit negative reactions from parents (Carson & Bittner, 1994; Rutter, 1987), and appear to directly contribute towards increased family stress (e.g., Coplan, Bowker, & Cooper, 2003; Hagekull & Bohlin, 1990; Oestberg & Hagekull, 2000). Of course, it is also possible that highly anxious mothers simply perceived their infants behaviors as more problematic (Calkins, 2002; Esdaile & Greenwood, 1995; McMahan et al., 1997). Indeed, women who exhibit high postnatal anxiety have been found to have negative attitudes toward their baby (Engle, Scrimshaw, Zambrana, & Dunkel-Schetter, 1990).

Limitations and Future Research Results from the present study highlight the importance of

distinguishing between different types of maternal anxiety when considering links with child temperament. However, some limitations need to be considered. To begin with, the small sample size and subsequent subject attrition is of central concern. There are also issues surrounding shared-method variance, as mothers completed self-report measures of anxiety and also reported on their infant's temperament. The future use of observational and other-source assessments of child temperament is clearly warranted. In addition, although different types of anxiety were assessed in the present study, a measure of postpartum depression was not included. This may be important given the high degree of association between depression and anxiety (Brouwers et al., 2001; Field et al., 2001; Field et al., 2003). However, it should be noted that previous researchers have reported links between maternal anxiety and child outcomes even when controlling for postpartum depression (Huizink et al., 2002; O'Connor et al., 2002). Maternal anxiety during pregnancy appears to influence children's behavior problems into early (O'Connor et al., 2002) and middle childhood (O'Connor et al., 2003; Van den Bergh & Marcoen, in press). The results from the present study provide some preliminary illustrations of the potential importance of examining specific types of maternal anxiety as they relate to child temperament. We found evidence of a complex set of inter-relations between infant temperament and state and trait anxiety as assessed both during and after pregnancy. Further longitudinal studies are clearly required in order to explore the potential unique and differential effects of specific types of maternal anxiety on children's longer-term emotional and behavioral well-being.

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