

## ABSTRACT

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INFANT ATTACHMENT SECURITY:  
A TEST OF THE DIFFERENTIAL  
SUSCEPTIBILITY HYPOTHESIS

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A major tenet of attachment theory is that the stability of the caregiving environment drives the stability of infant attachment security. The research investigating the factors related to the stability and change of infant attachment is limited by its lack attention to infant characteristics related to attachment stability outcomes. The newly developed differential susceptibility hypothesis posits that temperamentally difficult children are more influenced by their caregiving environment. In the present study, I examine infant irritability as a moderator of the link between changes in maternal (a) depressive symptomatology, (b) life satisfaction, and (c) parenting self-efficacy on changes in infant attachment security between 12 and 18 months.

FACTORS RELATED TO CHANGES IN INFANT ATTACHMENT SECURITY:  
A TEST OF THE DIFFERENTIAL SUSCEPTIBILITY HYPOTHESIS

By

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## Factors Related to the Stability and Change of Infant Attachment Organization:

### A Test of the Differential Susceptibility Hypothesis

Bronfenbrenner and Evans (2000) have defined developmental science as “...the systematic scientific study of the conditions and processes producing **continuity and change over time** in the biopsychological characteristics of human beings—be it over the life course, across successive generations, retrospectively through historical time, or prospectively in terms of implications for the course of human development in the future” (p.117, bold typeface in the original text). This emphasis on the study of continuity and change over time is evident not just in Bronfenbrenner and Evans’s definition of developmental science but also in the research of developmental scientists who have contributed to the large body of literature investigating this issue.

In fact, a search of the top two developmental science journals, *Child Development* and *Developmental Psychology*, for the term “continuity” yielded 473 empirical articles published within the last 10 years that sought to investigate continuity and change over time. Of these 473 articles, 284 investigated the continuity and change of attachment over time. It is clear from this literature search that attachment researchers have recognized the importance of studying the continuity of attachment over time.

This well-established line of research investigating attachment continuity and change can be seen as stemming directly from Bowlby’s developmental pathways model. In his chapter, “Pathways for the Growth of Personality,” from his second volume of *Attachment and Loss*, Bowlby (1973) detailed his viewpoint on the continuity and change of attachment. Bowlby’s developmental pathways model describes development as a journey traveling along a set of branching pathways. This journey begins at conception

with the total array of pathways potentially open to an individual being established by her genotype. The particular pathway along which the individual initially travels is determined by an interaction between the genotype of the newly formed zygote and the intra-uterine environment. As development progresses via a series of interactions between the individual as she hitherto has developed and the environment in which she currently finds herself, the pathways available to her diminish and branch farther apart making diversion from the current developmental trajectory more difficult and less likely. Thus, according to Bowlby "...the developmental process is conceived as able to vary its course, more or less adaptively, during the early years, according to the environment in which development is occurring; and subsequently, with the reduction of environmental sensitivity as becoming increasingly constrained to the particular pathway already chosen" (1973, p. 367).

Over 30 years of research on the continuity and change of attachment organization has stemmed from the theoretical groundwork laid out in Bowlby's developmental pathways model. These studies investigating the continuity of attachment organization, for the most part, have tested the hypothesis that the stability of the environment is associated with the stability of infant attachment classifications such that stable environments are linked to stable infant attachment classifications and unstable environments are linked to lawful changes in infant attachment classifications. Some of these studies have demonstrated the lawful stability of infant attachment organization under stable environmental conditions (Vaughn, Egeland, Sroufe, & Waters, 1979); other studies have demonstrated the lawful change of infant attachment classifications under relatively unstable environmental conditions (Egeland & Farber, 1984; Owen,



Easterbrooks, Chase-Lansdale, & Goldberg, 1984); and, other studies, despite expectations to the contrary, have reported a lack of infant attachment stability (Belsky, Campbell, Cohn, & Moore, 1996; Thompson, Lamb, & Estes, 1982).

Most of the research on the continuity and change of infant attachment organization, regardless of their results, has made the assumption that all children are equally susceptible to the influences of their environments. This assumption, however, has been newly challenged by developmentalists who have established and empirically investigated the “differential susceptibility hypothesis.” The differential susceptibility hypothesis, as Belsky (2005) describes it, is built upon the idea “that children vary in their susceptibility to rearing influence” (p. 139). This burgeoning field of differential susceptibility research has generated substantial empirical support that children do, indeed, vary in their susceptibility to rearing influences. Belsky further explains that by determining which aspects of the environment are most influential for which children, it is possible to disentangle the mixed results that so frequently emerge when investigating the link between the environment and child development outcomes.

The goal of the present paper is to theoretically and empirically address the issues inherent in assuming that all children are equally susceptible to changes in their environment while investigating the continuity and change of infant attachment organization. Rather than assuming that all children are equally affected by environmental stability and change, I seek to determine which children, if any, are most susceptible to environmental change in terms of infant attachment stability outcomes between 12- and 18-months-of-age. First, I begin with an overview of the theoretical considerations related to the study of infant attachment stability and change. Second, I

review pertinent empirical research on the continuity and change of infant attachment organization. In this review I devote attention to the rates of infant attachment stability, the conditions associated with the stability and change of infant attachment organization, and research that has failed to find infant attachment classification stability when stability was expected. Third, I discuss the major assumption underlying this current body of literature on infant attachment stability and change. Fourth, I discuss and describe the theoretical basis for the differential susceptibility hypothesis. Fifth, I review the empirical support and evidence for the differential susceptibility hypothesis. Sixth, I conclude my introduction by discussing the gaps in the stability and change of infant attachment literature and describe how the present study, through a test of the differential susceptibility hypothesis, will add to the extant literature. In this section, I also discuss my research goals. Next, I describe my method followed by my statistical tests of the differential susceptibility hypothesis after which I conclude by discussing my findings and directions for future research.

### *The Stability and Change of Infant Attachment: Theoretical Considerations*

Core to the idea of the stability and change of infant attachment organization is Bowlby's (1973) concept of the internal working model (IWM), or mental representation, of an infant's relationship with his mother<sup>1</sup>. According to Bowlby, an infant's IWM of his relationship with his mother is constructed based on his interactions with her. Infants whose interactions with their mothers are characteristically well-timed and appropriate develop IWMs of mother as available and responsive when needed (a secure IWM of mother). On the other hand, infants whose interactions with their mothers are

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<sup>1</sup> For ease of understanding, I use the convention of referring to the infant as male and the primary caregiver, or mother-figure, as female.

characteristically ill-timed and inappropriate develop insecure IWMs of their mother. Once the infant's IWM of mother has formed, usually by the end of his first year, his mental representation will guide his affect, behavior, cognitions, and expectations of mother in novel situations (Main, Kaplan, & Cassidy, 1985).

IWMs, once established, are also subject to revision based on interactions with mother. Therefore, it can also be expected that for infants who experience considerable changes in the caregiving environment, infant attachment representations of mother should change accordingly. On the other hand, given a relatively stable caregiving environment in which the infant experiences repeated and reinforcing interactions with mother, the infant's IWM of mother should remain stable. Thus, infant attachment should change or remain stable according to the stability of the environmental conditions.

Following the development of the Strange Situation Procedure by Ainsworth and her colleagues (Ainsworth, Blehar, Waters, & Wall, 1978; Ainsworth & Wittig, 1969), it became possible to test Bowlby's theory (outlined above) regarding the stability and change of infant attachment organization. Furthermore, with the initiation of large-scale longitudinal studies designed to test the major tenets of attachment theory, an extensive body of research has developed over the past three decades documenting the rates of infant attachment stability and the conditions under which change can be expected. These tests of infant attachment stability and the environmental conditions surrounding stability and change, by and large, have supported the idea of the lawful stability and change of infant attachment. In what follows, I review studies designed to test the lawful stability of infant attachment. Then, I discuss studies designed to test the lawful changes of infant attachment. Next, I review studies designed to test the effects of maternal

employment and non-maternal care on the stability of infant attachment. Finally, I conclude my review with a discussion of an assumption of “universal susceptibility” common to this literature.

*Infant Attachment Organization: Lawful Stability*

Early empirical research on the continuity of infant attachment classifications was undertaken by Connell (1976) and Waters (1978) in response to critics who claimed that individual differences in attachment as assessed with the Strange Situation were neither stable, coherent, nor of any practical value (Waters, Hamilton, & Weinfield, 2000). These studies, which assessed infant attachment in the Strange Situation at both 12 and 18 months, obtained remarkable results for the continuity of infant attachment organization. Specifically, Connell found a concordance rate of 80.1% and Waters found a concordance rate of 96%. Both Connell and Waters, however, only presumed environmental stability based on the samples’ middle-class socioeconomic status and did not measure it directly. Thus, these studies left unanswered the question of whether environmental stability is related to the stability of infant attachment organization.

Similar to Connell (1976) and Waters (1978), Belsky et al. (1996) also tested the lawful stability of infant attachment classifications under conditions of assumed environmental stability in two separate longitudinal samples. Unlike Connell and Waters, however, Belsky et al. failed to find significant infant attachment stability. The first sample, collected at the Pennsylvania State University (PSU), consisted of working and middle-class, maritally intact Caucasian families rearing first-born sons. A relatively stable environment was assumed and continuity of infant attachment organization was expected because the PSU families were considered low-risk and should have had a

relatively stable environment. The second sample, collected at the University of Pittsburgh (Pitt), consisted of low-risk, middle-class, maritally intact, primiparous mothers and their infants recruited for a study on post-partum depression and infant development. All infants were observed in the Strange Situation at 12 and 18 months with mother, and additionally, the PSU infants were observed at 13 and 20 months with father. Results indicated that 46% of infants in the Pitt sample maintained their respective secure, avoidant, and resistant classifications with their mother at both 12 and 18 months. The PSU sample obtained concordance rates of 52% for mother-infant relationships and 46% for father-infant relationships. Numerous additional analyses were run in light of these unexpected and remarkably low rates of stability, among which were a comparison of the stability of infant attachment organization when reconfigured into secure versus insecure classifications, inclusion of the disorganized category in the analysis with the Pitt sample, and analysis of the Pitt sample excluding those cases for which the mother was classified as depressed. Despite these additional tests, no stability was found.

#### *Infant Attachment Organization: Lawful Changes*

Data on the stability of infant attachment organization obtained from the Minnesota Parent-Child Project, an ongoing longitudinal study of development and adaptation in an impoverished urban sample at risk for poor developmental outcomes, were able to provide insight into whether or not the stability of infant attachment organization is related to the stability of the environment. Using a subsample of the Minnesota Parent-Child Project, Vaughn et al. (1979) published the first study from this dataset on the stability and change of infant attachment. Results indicated that 62% of

infants seen in the Strange Situation with their mothers at 12 and 18 months maintained their respective secure, avoidant and resistant attachment classifications. In addition, Vaughn et al. also found that changes in infant attachment were related to greater levels of maternal life stress between 12 and 18 months. These findings, taken together with the lower rates of attachment stability Vaughn and his colleagues found in this at-risk sample compared to those obtained by Connell (1976; 80.1% concordance) and Waters (1978; 96% concordance), demonstrate support for the theory that infant attachment should change according to a substantially changed environment.

Of the studies on infant attachment stability and change conducted with data collected from the Minnesota Parent-Child Project, Egeland and Farber (1984) provide the most comprehensive investigation by including measures of maternal characteristics, infant characteristics, mother-infant interactions, mothers' relationships and living arrangements, and measures of stressful life events. Utilizing the entire sample of the Minnesota Parent-Child Project, Egeland and Farber obtained a stability rate (60%) comparable to Vaughn et al.'s (1979) earlier analysis. Results indicated that several maternal variables were predictive of the continuity and change of infant attachment organization. Specifically, maternal education was related to changes from secure to avoidant such that mothers of infants who were secure at 12 months and avoidant at 18 months had lower levels of education than mothers of stable secure infants. Maternal life stress was associated with the continuity and change of infant attachment organization. Results revealed that mothers whose infants changed from secure to resistant experienced an increase in life stress between 12 and 18 months, whereas mothers of infants in the stable secure group experienced a decrease in life stress. In addition, anecdotal

information obtained from open-ended responses during interviews with the mothers suggested that mothers whose infants changed from insecure to secure reported increased maternal self-efficacy and feeling less depressed. These open-ended responses also suggested that mothers whose infants changed from secure to insecure reported feeling more depressed and dissatisfied with their lives.

Infant characteristics were also related to the continuity and change of infant attachment organization such that infants who changed from secure at 12 months to resistant at 18 months demonstrated less optimal overall functioning as assessed by the Neonatal Behavioral Assessment Scale (Brazelton, 1973) at 2 days after birth as compared to stable secure infants. Furthermore, infants who changed from resistant at 12 months to secure at 18 months had higher levels of overall mental and motor development at 9 months as assessed by the Bayley Scales of Infant Development (Bayley, 1969) as compared to infants who were classified as resistant at both 12 and 18 months.

Living arrangements and mothers' relationships were also related to the continuity and change of infant attachment organization. Results indicated that changes from secure to resistant were associated with the mothers' status as a single mother such that 70% of the infants in the secure to resistant group had single mothers who were not living with their boyfriends as compared to only 15% of mothers of infants in the stable secure group who were single. Living arrangements also affected the continuity of infant attachment organization such that 82% of infants classified as avoidant at 12 months and secure at 18 months lived with their mothers' boyfriends or husbands, whereas only 20% of infants

classified as avoidant at both 12 and 18 months lived with their mothers' boyfriends or husbands.

Although Egeland and Farber's (1984) is certainly the most thorough investigation of the factors related to the stability and change of infant attachment organization, several problems remain to be addressed. In particular, Egeland and Farber largely do not address whether changes for the better in the environment are associated with changes for the better in infant attachment security and vice versa. The only change in the environment that was tested in relation to changes in infant attachment organization was changes in maternal life stressors between 12 and 18 months. Furthermore, these analyses were conducted in a piecemeal fashion with four pair-wise comparisons (i.e., stable secure vs. secure to resistant, stable secure vs. secure to avoidant, stable avoidant vs. avoidant to secure, and stable resistant vs. resistant to secure). In addition, all analyses predicting changes in infant attachment were conducted using three-way infant attachment classifications without examining factors related to stability and change using two-way infant attachment classifications. In sum, it remains to be tested whether infant attachment security versus insecurity changes or remains stable in relation to changes in the environment.

#### *The Special Case of Maternal Employment and Non-Maternal Care*

Thompson et al. (1982) assessed infant attachment stability in the Strange Situation between 12.5 and 19.5 months with infants and mothers from middle-class families. Of the 43 middle-class infants and their mothers observed in the Strange Situation at 12.5 months and 19.5 months, 53% of the infants were assigned to the same attachment classification at both assessments. Results also indicated that mothers' return



to work between 12.5 and 19.5 months was associated with changes in infant attachment organization as evidenced by changes in attachment classification for 4 of the 5 infants whose mothers returned to work between Strange Situation assessments. Furthermore, of the 20 infants whose attachment classification changed, 12 (60%) had mothers who returned to work by the 19.5 month assessment. On the other hand, of the 23 infants with stable attachment classifications, only 3 (13%) had mothers who returned to work before the 19.5 month Strange Situation. These findings, however, are based on both (a) mothers who returned to work before any Strange Situation assessment, and (b) mothers who returned to work between the first and second Strange Situation; both groups of mothers were compared to those who maintained their employment status both prior to and between Strange Situation assessments. Thus, it cannot be said with any certainty whether these results are due to changes in maternal employment status that may have occurred near one or both Strange Situation assessment(s) or whether they resulted from maternal employment outside the home more generally.

Owen, et al. (1984) also assessed infant attachment stability in a predominantly middle-class, sample of college educated, primiparous mothers and their infants. In addition to assessing infants in the Strange Situation with their mothers at 12 and 20 months, Owen et al. also assessed changes in maternal employment status and whether changes in maternal employment status are related to changes in infant attachment. A mother's employment status was defined as stable if she maintained her employment status from three months *prior* to the 12 month Strange Situation *and* through the 20 month Strange Situation. On the other hand, a mother's employment status was defined as having changed if her employment status changed *between* attachment assessments.

Overall, infant attachment classifications remained stable between 12 and 20 months with 46 out of 59 infants (78%) maintaining their initial 12 month classification at the 20 month assessment. Furthermore, results revealed no changes (that is, 100% stability) in attachment classifications for the 14 infants whose mothers changed work status during the 8 month time lapse between Strange Situation assessments.

The results reported by Thompson et al. (1982) and Owen et al. (1984) reviewed above leave unanswered whether or not maternal employment and non-maternal child care are related to changes in infant attachment classifications. These studies were both based on middle-class samples for which environmental stability could be assumed; yet, these studies differ on both (a) their overall rates of infant attachment stability, and (b) whether maternal employment was linked to changes in infant attachment. A more recent test of the effects of child care arrangements on attachment stability with a much larger sample size than those utilized by both Thompson et al. and Owen. et al lends evidence to the idea that changes in child care arrangement do, indeed, influence attachment stability outcomes.

The National Institute of Child Health and Human Development (NICHD) Early Child Care Research Network (2001) assessed 787 children and their mothers in the Strange Situation at 15 months and again at 36 months with a modified Strange Situation Procedure as outlined by Cassidy, Marvin, & MacArthur Attachment Working Group (1992). Mothers were also asked at 3-month intervals, beginning when their infants were 3 months old, about their current child care arrangements. The overall rate of attachment stability is comparable to that obtained by Thompson et al. (1982; 53%) with 55% of children maintaining their 15 month attachment classification into their 36<sup>th</sup> month. Also

comparable to the results obtained by Thompson et al. are those that indicated that enrolling in at least 10 hours a week of non-maternal child care between the 15 and 36 month attachment assessments was associated with changes from secure to insecure. Changes in child care arrangements were not associated, however, with changes from insecure to secure. As these results reported by the NICHD Early Child Care Research Network most closely parallel those reported by Thompson et al, it seems reasonable to conclude that non-maternal child care may influence the stability of infant attachment organization.

*An Assumption of "Equal Susceptibility"*

The literature reviewed above on the stability and change of infant attachment organization largely rests on an assumption that can be called "equal susceptibility." In other words, this literature has assumed that all children are affected in the same manner and to the same degree by changes in their environment. Specifically, this research has paid little attention to the role that the infant has on developmental outcomes and has thus also failed to examine whether "...individuals...differ markedly in their susceptibility to environmental agents," (Hinde, 1988, p. 369). As a result, it remains unknown whether "[a]pparent continuity or discontinuity...depends upon a small group of extreme individuals," (Hinde, p. 369). Thus, stated in terms of the present study, it has yet to be determined whether the apparent stability of infant attachment organization (as demonstrated by Connell, 1976, and Waters, 1978) depends upon data collected from a subset of infants who demonstrate extreme stability. The contrary is also true, such that it has yet to be determined whether the apparent *instability* of infant attachment

organization, especially in the cases in which stability was expected (as Belsky et al, 1996 reported), depends on infants who are more sensitive to environmental change.

*Differential Susceptibility: Theoretical Considerations*

A growing body of parenting-by-infant temperament research indicates that children are not equally susceptible to their environment (for reviews, see Belsky, 2005, and Boyce & Ellis, 2005). Nevertheless, it has remained the case that research on the continuity and change of infant attachment organization has focused almost entirely on the main effects of parenting without examining the interactive effects of the infant and the environment (Belsky, 2005). As the literature reviewed above demonstrates, this main effects analysis has generated mixed findings. Belsky's differential susceptibility hypothesis addresses the prospect that developmental processes operate differently in different ecological niches and is supported by empirical evidence that different individuals may be affected differently by the same ecological niches (Belsky, 1997).

Belsky (2005) begins his argument for the differential susceptibility hypothesis by pointing out that in the environment of evolutionary adaptedness (Bowlby, 1969) parents could not have known entirely the psychological and behavioral traits that would most increase their children's reproductive fitness, thereby improving their own inclusive fitness. Thus, it is possible that parents can unconsciously and unintentionally direct their children down developmental dead ends. Belsky provides as an example the murder of thousands of intellectuals in the "killing fields" of Cambodia. In all likelihood, the parents of the intellectuals killed in Cambodia encouraged their children's intellectual curiosity and educational attainment which had extreme unintended reproductive fitness costs. These parents' best guess as to which parenting strategy would prove most useful

was the one best suited to the current situation. They could not have predicted the unstable and tumultuous future; therefore, these parents reared their offspring according to standards that, under stable environmental conditions, would have optimized their children's success.

Knowing that it is possible for parents unintentionally to rear offspring in a way that is maladapted to the conditions of the unforeseen future, Belsky (2005) argues that it seems sensible to assume that natural selection would have designed a strategy to reduce the costs of these "mistakes in guidance." The strategy designed by natural selection to ensure that one's genetic future is insured against misguided rearing efforts is the basis for his formalization of the differential susceptibility hypothesis—that children vary in their susceptibility to rearing influences. Thus, if a particular parenting approach proves to be a costly investment because it is maladapted to future environments, the reproductive fitness of the parents and the inclusive fitness of their offspring would remain somewhat protected under the condition that their children were not equally susceptible to their parenting efforts (Belsky, 2005).

Belsky (2005) supports his evolutionary-inspired proposition that some children are more affected by their environments than other children with empirical evidence from the temperament-by-environment (or gene-by-environment) literature. In his review, Belsky observed that highly negative children disproportionately benefit from supportive rearing environments and disproportionately are harmed by unsupportive rearing environments. Based on this observation and Belsky's original establishment that highly negative infants are more susceptible to *both* supportive *and* unsupportive parenting, Belsky, Bakermans-Kranenburg, & van IJzendoorn (2007) offered a more detailed and

specific definition of differential susceptibility, which states, "...that some children, for temperamental or genetic reasons, are actually more susceptible to *both* (a) the adverse effects of unsupportive parenting *and* (b) the beneficial effects of supportive rearing (Belsky et al., 2007, p. 300; italics in original text).

Nevertheless, results reported within the temperament-by-environment interaction (T×E) literature have focused disproportionately on *either* the positive influences of supportive parenting *or* the negative influences of unsupportive parenting for temperamentally negative children. Belsky's (2005) original establishment of the differential susceptibility hypothesis was synthesized, for the most part, from his integration of these separate studies which reported on either the beneficial effects of positive parenting or the detrimental effects of negative parenting for temperamentally negative children. These studies that highlight either the positive or the negative aspects of T×E interactions demonstrate at least partial support for the differential susceptibility hypothesis in that they identify temperamentally negative children as being more affected by the environment than other less temperamentally negative children; therefore, the expansive body of studies that demonstrated an environmental effect being moderated by a characteristic of the child (be it temperamental or genetic) have supported "a necessary condition for differential susceptibility but not a sufficient one" (Belsky et al., 2007, p. 302). Although T×E interactions demonstrate that highly reactive children are more affected by *either* positive *or* negative rearing environments, these studies are not, according to Belsky et al., sufficient evidence of differential susceptibility because they have not established *in a single sample* the "for better *and* for worse" predictions of the differential susceptibility hypothesis (Belsky et al., 2007). *Thus, evidence supporting the*

*more stringent criteria for differential susceptibility would be data from a single sample confirming that temperamentally negative children are both more susceptible to the effects of both positive and negative rearing environments than other less temperamentally negative children.*

In what follows, I review T×E interactions that Belsky (2005) cited as empirical support for his position that negatively emotional children are more affected by the environment than other less negatively emotional children. Whereas T×E interactions support the necessary condition of an organismic characteristic of the child moderating the influence of an environmental factor, these interactions are not sufficient evidence of differential susceptibility. Thus, following my review of T×E interactions, I review studies that support Belsky et al.'s (2007) more specific “for-better-*and*-for-worse” predictions of the differential susceptibility hypothesis.

*Differential Susceptibility: Temperament-by-Environment Interactions*

Empirical support for a temperament by environment interaction can be derived by Kochanska's (1993) test of the hypothesis that the development of self-control would be affected by maternal discipline for fearful, inhibited, and negatively emotional preschoolers to a greater extent than their less negatively emotional counterparts. Results indicated that maternal discipline explained only 1% of the variance in low negative preschoolers' ability to refrain from playing with forbidden toys, whereas a significant 23% of the variance in refraining from playing with forbidden toys was explained by maternal discipline in the case of high negatively emotional preschoolers.

A subsequent investigation with 8-to 10-month-old infants further demonstrated maternal discipline to be a significant predictor of self-control for the more negatively

emotional children but not for the less negatively emotional children (Kochanska, Mordhorst, & Reschly, 1997; as cited in Belsky, 2005). In fact, maternal discipline explained a significant 41% of the variance in self-control for the top quartile of negatively emotional infants, whereas the corresponding figure in the case of the bottom quartile of negatively emotional infants revealed a non-significant 2% explanation of the variance.

Belsky, Hsieh, and Crnic (1998), who sought to predict inhibition and externalizing behavior problems at 36 months of age from measures of positive and negative parenting between 24 and 36 months and infant negative emotionality at 12 months, provide further support that negatively emotional children are influenced by the environment differently than less negatively emotional children. Belsky et al.'s results converged with the results of Suomi (1997), Kochanska (1993), and Kochanska et al. (1997) such that the variance explained by positive and negative parenting in predicting inhibition and externalizing behavior problems was greater for children who had been rated as highly negative at 12 months as compared to less negative infants (27% vs. 4% for inhibition and 14% vs. 4% for externalizing behavior problems).

Research focused on the environmental effects of attachment outcomes has also recognized the importance of studying parenting-by-temperament interactions effects. For example, Crockenberg (1981) studied the hypothesis that maternal social support would enhance maternal sensitivity which, in turn, would foster the development of a secure infant attachment. Results indicated that social support was predictive of secure infant attachment, but only for highly irritable infants. These results support the idea that children high in negative affect are influenced differently by their rearing environment



such that low maternal social support is associated with non-optimal attachment outcomes only for highly reactive infants.

Only one study to date has directly tested whether attachment outcomes are more likely to be affected by environmental changes for highly negatively emotional infants as assessed by maternal reports of temperament. Velderman, Bakermans-Kranenburg, Juffer, and van IJzendoorn (2006) investigated whether the influence of maternal sensitivity on the formation of infant attachment is greatest for highly irritable infants. Their attachment-based intervention proved most effective for highly reactive infants and their mothers, thus indicating that highly reactive infants are most susceptible to environmental changes in maternal sensitivity.

If it is the case that children are differentially susceptible to the influences of their environment (as the studies reviewed above suggest), then reports of only the main effects of environmental change and infant attachment stability outcomes may both over- and underestimate this association (Belsky, 2005). More specifically, by failing to distinguish between children who are more or less susceptible to changes in their environment, the statistics linking environmental change to infant attachment stability outcomes may underestimate the effects of the environment for highly susceptible children *and* overestimate the effects for relatively less susceptible children (Belsky, 2005).

*Differential Susceptibility: “For Better and for Worse”*

Empirical support for differential susceptibility can be derived from Suomi’s (1997) studies with rhesus macaques selectively bred to vary in their fearfulness and anxiousness. In this work, highly fearful and anxious monkeys (“uptight” monkeys) and

their less fearful counterparts were cross-fostered to either highly skilled foster mothers or average skilled foster mothers. The results showed dramatic rearing effects, but only for the *highly* anxious and fearful monkeys. At six months of age when Suomi's monkeys moved into larger social groups, the uptight monkeys reared with highly nurturant foster mothers were able to rise to the group's dominance hierarchy and maintain these positions. In contrast, uptight monkeys reared with average foster mothers tended to remain at the bottom of this same dominance hierarchy. Especially relevant to the differential susceptibility hypothesis is that no such rearing effects were found for the less uptight monkeys. The developmental outcomes for these uptight monkeys were both for better *and* for worse as compared to their more "laid-back" counterparts.

More recently, in work with human infants Kochanska, Aksan, and Joy (2007) reported that highly fearful 15-month-olds whose fathers displayed power-assertive discipline were most likely to cheat in a game at 38-months-of-age as compared to less fearful infants. Moreover, highly fearful infants whose fathers displayed supportive parental discipline manifested the most rule-compatible conduct during the game at 38 months as compared to less fearful infants. These results indicate that not only are highly fearful infants most susceptible to paternal discipline, but that these highly fearful infants have the most optimal outcomes when cared for in a supportive manner and the least optimal outcomes when cared for in a power-assertive manner in comparison to their less fearful counterparts.

Additionally, Bakermans-Kranenburg and van IJzendoorn (2006) investigated the role of the 7-repeat DRD4 allele as a moderator of the link between externalizing behavior problems and maternal sensitivity. This test of the interaction between the

presence of the DRD4 7-repeat allele and maternal sensitivity on child externalizing behavior revealed that children with the 7-repeat DRD4 allele who had insensitive mothers demonstrated the highest levels of externalizing behavior as compared to children without the 7-repeat allele. Furthermore, children with the DRD4 7-repeat allele who had sensitive mothers demonstrated the lowest levels of externalizing behavior. Thus, children with the 7-repeat DRD4 allele (a genetic risk-factor associated with ADHD in childhood and pathological impulsive behavior and substance abuse in adulthood) are differentially susceptible to both the positive effects of sensitive mothering and the detrimental effects of insensitive mothering (Bakermans-Kranenburg & van IJzendoorn, 2007).

Gilissen, Koolstra, van IJzendoorn, Bakermans-Kranenburg, & Van der Veer (2007) also provided a recent test of the differential susceptibility hypothesis. Gilissen et al. assessed temperamental reactivity as a susceptibility moderator of the association between attachment security and physiological responses to fear-inducing stimuli. Participating preschoolers watched fear-inducing film clips while their skin conductance and heart rate variability were measured. Temperamentally reactive children demonstrated both more positive and more negative physiological stress reactivity outcomes than less reactive children. Reactive children with a *less* secure primary attachment relationship had the *highest* levels of skin conductance, whereas reactive children with a *more* secure primary attachment relationship showed the *lowest* levels of skin conductance. These same dramatic effects for attachment security on physiological stress response outcomes were not observed for less reactive children. These results are in support of the for better and for worse predictions of the differential susceptibility

hypothesis such that temperamentally reactive infants are more susceptible to both the positive and negative effects of sensitive parenting in terms of physiological stress responsiveness.

Bakermans-Kranenburg and van IJzendoorn (2006; van IJzendoorn & Bakermans-Kranenburg, 2006) offer more recent evidence for the differential susceptibility hypothesis. In their study of the 7-repeat DRD4 allele as a moderator of the link between parental unresolved loss or trauma and infant disorganized attachment, Bakermans-Kranenburg and van IJzendoorn reported a significant interaction between the presence of the 7-repeat allele and parental unresolved loss or trauma. Children with the 7-repeat DRD4 allele who were raised by mothers with unresolved loss or trauma were significantly more at risk for attachment disorganization as compared to children without the 7-repeat allele; children with the 7-repeat DRD4 allele were the most susceptible to the detrimental effects of mothers' unresolved loss or trauma. Additionally, children with the 7-repeat allele who were raised by mothers without unresolved loss or trauma were significantly less likely to demonstrate attachment disorganization as compared to children without the allele; children with the 7-repeat DRD4 allele were the most susceptible to the beneficial effects of their mothers not having unresolved loss or trauma.

The most recent evidence of the differential susceptibility hypothesis comes from data collected as part of the NICHD Study of Early Child Care (for a description see NICHD ECCRN, 2001). Bradley and Corwyn (2008) examined the differential susceptibility hypothesis in their study of the links between infant temperament, maternal sensitivity, and externalizing behavior. Results indicated that maternal reports of infant

temperament at 1 and 6 months moderated the effects of maternal sensitivity observed at 6, 15, 24, 36, and 54 months on teacher reported externalizing behavior in first grade. Further probing of this interaction provided support for the differential susceptibility hypothesis such that children rated as having difficult temperaments in infancy were more influenced by maternal sensitivity in terms of externalizing behavior both for the better and for the worse. Specifically, when mothers of temperamentally difficult children were highly sensitive their children showed the lowest levels of externalizing behaviors, whereas when their mothers were less sensitive their children showed the highest levels of externalizing behaviors compared to children who were rated as less temperamentally difficult infants.

#### *The Present Study*

As previously noted, Egeland and Farber (1984) suggested several maternal psychosocial functioning variables that may influence changes in infant attachment security. Specifically, Egeland and Farber's reports of mothers' answers to open-ended questions regarding their romantic relationships, social life, work status, and feelings about caring for their baby suggested that (a) mothers whose infants changed from insecure to secure reported increased maternal self-efficacy and reduced feelings of depression, and (b) mothers whose infants changed from secure to insecure reported feeling more depressed and more dissatisfied with their lives. These findings point to maternal depressive symptomatology, maternal life satisfaction, and maternal parenting self-efficacy as possible predictors of changes in infant attachment security.

In addition, the current literature on infant attachment stability is limited in three ways: (a) by largely failing to investigate infant secure versus insecure attachment

classifications change or remain stable in relation to changes in the environment, (b) by a lack of attention to the role that the infant has in shaping attachment stability outcomes, and (c) an assumption that all children are equally affected by changes in their environment. The studies reviewed earlier as support for differential susceptibility are diverse in terms of their sample characteristics, environmental predictors, developmental outcomes, and methodology. Interestingly, however, these diverse studies converge on one point in particular—that it may be highly irritable infants who are the most susceptible to rearing influences (Belsky, 1997). Specifically, Belsky (2005) and his colleagues (2007) observed that irritable infants demonstrated disproportionately more positive developmental outcomes in supportive environments as well as disproportionately more negative developmental outcomes in unsupportive environments compared to less irritable infants. Based on Egeland and Farber's (1984) reports that maternal depressive symptomatology, maternal life satisfaction, and maternal parenting self-efficacy were associated with changes in infant attachment security and evidence that highly irritable infants may be more susceptible to environmental influences compared to less irritable infants, **the purpose of the present study is to determine whether highly irritable infants are differentially susceptible to the impact of changes in maternal psychosocial functioning on changes in attachment security as compared to less irritable infants.** For differential susceptibility to be present, highly irritable infants, compared to less irritable infants, must be more likely (a) to become securely attached when their mother's psychosocial functioning improves, (b) to become insecurely attached when their mother's psychosocial functioning worsens, (c) to remain securely attached when their mother demonstrates stable high levels of psychosocial functioning,

and (d) to remain insecurely attached when their mother demonstrates stable low levels of psychosocial functioning.

The present study is unique in that it integrates the previously disparate literature examining infant attachment continuity and the research investigating differential susceptibility. In doing so, the present study is the first to investigate the interactive effects of infant temperament on the link between changes in maternal psychosocial functioning and changes in infant attachment security. The present study is also the first to test whether secure versus insecure infant attachment classifications change or remain stable in relation to changes in measures of maternal psychosocial functioning. As such, the present study seeks to advance our knowledge of the conditions under which infant attachment security can be expected to change or remain stable, and broadens the differential susceptibility hypothesis to include knowledge of whether the temperament-by-environment interaction extends to predicting changes in infant attachment security.

## Method

### *Sample*

The present study utilizes 73 mother-infant dyads from the control group of a randomized control trial of an attachment-based intervention for irritable infants and their economically-stressed mothers (Cassidy, Woodhouse, Sherman, Stupica, Ziv, & Lejuez, 2009). All pregnancies were uncomplicated and mothers received no more than routine medication. Infants were full-term, first-born singletons. Dyads were selected based on two criteria. First, mothers had to be economically-stressed as indicated by one of two criteria: (a) an annual household income of less than \$50,000 for mothers who were married or living with the infants' father or (b) a Hollingshead (1975) occupational prestige score of 6 or lower (technicians and semi-professionals) for mothers who were single head of household. Second, infants had to be irritable as assessed by the Neonatal Behavioral Assessment Scale (NBAS; Brazelton & Nugent, 1995) administered within the first 30 days postpartum. Infants' peak of excitement, rapidity of buildup, and irritability items were averaged for each NBAS administration to create an irritability composite score (Kaye, 1978). Infants whose combined irritability composite scores placed them in the top 20% were considered irritable and selected for participation.

Infants (45.2% girls) weighed between 2262 and 4309 grams at birth ( $M = 3362.14$  grams,  $SD = 418.78$  grams) and most were delivered vaginally (79.5%). More than half of the infants were irritable at only the first (46.4%) or second (15.5%) NBAS examination; the remaining 38.1% were irritable at both NBAS examinations. At birth, mothers were between 18 and 39 years of age ( $M = 24.33$ ;  $SD = 5.19$ ). More than half of mothers (60.2%) were married or living with the infant's father, had attended some



college (72.3%), and reported an annual household income of less than \$31,000 (53.0%). The self-identified racial/ethnic background of the mothers was 45.2% Black or African American, 25.0% White, 19.0% Hispanic, 4.8% Asian, 1.2% Native North American or Native Pacific Islander, and 4.8% were another race or ethnicity. All parents signed informed consent forms (see Appendix A for IRB approval).

### *Procedure*

Data for the present investigation were collected during two home visits within the first 30 days postpartum and two laboratory visits at infant ages 12 and 18 months. Infant irritability and demographic information (see Appendix B) were collected at the two home visits. Infant attachment to mother and maternal self-efficacy, maternal life satisfaction, maternal stress, and maternal depressive symptomatology were assessed at both the 12 and 18 month lab visits.

### *Measures*

#### *Infant Irritability*

Infants were assessed for irritability twice within the first 30 days postpartum in their home using Brazelton's Neonatal Behavioral Assessment Scale (NBAS; Brazelton & Nugent, 1995). The procedure took approximately 20 minutes to administer. Infant scores on the peak of excitement, rapidity of buildup, and irritability items were combined separately for each NBAS administration to form an irritability composite score as identified by Kaye (1978). Infants were considered to be highly irritable if their irritability composite score was 6 or greater for both NBAS exams (van den Boom, 1994; Cassidy et al., 2009), whereas infants were considered to be less irritable if their irritability composite score was 6 or greater for only one NBAS exam.

Four research assistants were trained and certified to administer the NBAS by the Brazelton Institute after achieving a good level of reliability. Two NBAS examiners were present and independently coded 8.7% of the NBAS administrations that were conducted while screening infants for irritability. The inter-coder reliability for the irritability composite score was high with an intra-class correlation coefficient of .96.

### *Infant Attachment*

Infant attachment to mother was assessed using the Ainsworth Strange Situation Procedure (Ainsworth et al., 1978). This 20-minute standardized laboratory procedure assesses infant attachment with two brief separations and reunions from mother. Classifications are based principally on infants' behavior during the two reunions with mother. *Securely attached* infants demonstrate strong proximity-seeking and/or contact-maintaining behaviors on reunion with mother, whereas *insecure-avoidant* infants actively avoid proximity and interaction on reunion with mother, and *insecure-ambivalent* infants show angry resistant behaviors on reunion (Ainsworth et al., 1978). Infants classified as *insecure-disorganized/disoriented* appear to lack a coherent attachment strategy, and display behaviors in the presence of mother that lack an observable goal or explanation (Main & Solomon, 1986).

All Strange Situation procedures were coded from videotapes by coders with formal training who had achieved an acceptable level of reliability and had extensive coding experience. Different reliable coders were used for the 12 and 18 month Strange Situations such that coders coded only one Strange Situation procedure for each infant. A randomly selected 34.3% ( $n = 58$ ) of the 12 month and 26.8% ( $n = 41$ ) of the 18 month Strange Situations were coded independently by two coders; disagreements were resolved

by conference. Inter-coder reliability for the 12 and 18 month Strange Situation was high with coders agreeing on 86.2% at 12 months ( $\kappa = .724, p < .01$ ) and 80.5% at 18 months ( $\kappa = .605, p < .01$ ) for secure versus insecure classifications.

The reliability and validity of the Strange Situation have been well-documented (for reviews see Belsky & Cassidy, 1994, and Solomon & George, 2008). As I discussed earlier, the test-retest reliability of the Strange Situation under conditions in which stability is expected have obtained concordance rates as high as 96% (Waters, 1978). Furthermore, the Strange Situation has also shown to be a sensitive instrument such that this instrument detects changes in infant attachment organization when changes are expected (see Vaughn et al., 1979, and Egeland & Farber, 1984). In addition, inter-coder agreement for coders trained by Ainsworth or her students tends to be very high, ranging from 85 to 95% (Solomon & George, 2008).

The most critical test of the psychometric properties of the Strange Situation concerns its construct validity. In particular, the individual differences discerned when using the Strange Situation have demonstrated to relate to attachment antecedents, concomitants, and outcomes in theoretically consistent ways. In terms of relating to the antecedents and concomitants of attachment security, De Wolff and van IJzendoorn's (1997) meta-analysis of the association between maternal behavior and infant Strange Situation classifications demonstrated to be moderately strong ( $r(1,097) = .24$ ). In regard to the Strange Situation's predictive validity, strong evidence comes from its ability to predict subsequent adult attachment assessed with the Adult Attachment Interview (AAI; George, Kaplan, & Main, 1985). Hamilton (2000) reported a 77% stability rate ( $\kappa = .49, p < .01$ ) between attachment assessed with the Strange Situation at

12-months-of-age and with the AAI when participants were between 17- and 19-years-of-age. Waters, Merrick, Treboux, Crowell, and Albersheim (2000) also reported a high stability rate (72%,  $\kappa = .44$ ,  $p < .01$ ) between attachment measured with the Strange Situation in infancy and the AAI when participants were between 20- and 21-years-of-age.

In addition, the Strange Situation has also demonstrated predictive validity with regard to its theoretically consistent associations with later child development outcomes. Bowlby (1973) predicted that secure IWMs eventually come to guide expectations regarding relationships with others such that those with secure IWMs will have positive expectations regarding relationships with others as well as the affect and behavioral capacities that promote social competence (for a review, see Sroufe, Egeland, Carlson, & Collins, 2005). For example, infants classified as securely attached in infancy with the Strange Situation were observed to be more empathic and to have deeper, more mutual friendships in preschool than their insecurely attached counterparts. In adolescence, these securely attached individuals were more frequently elected as spokespersons and most frequently looked to by other group members at critical junctures in discussion (Englund, Levy, Hyson, & Sroufe, 2000).

#### *Maternal Psychosocial Functioning*

*Maternal depressive symptomatology.* The Beck Depression Inventory (BDI) is a 21-item self-report inventory designed to measure the intensity of symptoms and attitudes characteristic of depression (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; see Appendix C). Mothers rated each item on a 4-point scale ranging from zero to three with zero corresponding to a statement with the lowest symptom or attitude severity and three

corresponding to a statement with the highest symptom or attitude severity. Mothers were asked to choose one statement in each group that best described the way they had been feeling in the past week. For example, one item designed to assess mood provided the following statement choices: “0 – I do not feel sad.”; “1 – I feel sad.”; “2 – I am sad all the time and I cannot snap out of it.”; and “3 – I am so sad or unhappy that I can’t stand it.” The sum of all item scores indicates the severity of depressive symptomatology with possible scores ranging from 0 to 63 with higher scores indicating greater depressive symptomatology.

Internal consistency for the BDI as reported by Beck, Steer, and Garbin (1988) ranges from 0.73 to 0.92 with a mean of 0.86 for nonpsychiatric samples. In addition, there is extensive support for the validity of the BDI. Beck et al.’s review of the psychometric properties of the BDI included eleven studies that demonstrated that the BDI was capable of discriminating between dysthymia and major depressive disorder. The BDI has also been validated against other measures of depression. For instance, correlations between the BDI and the Hamilton Rating Scale for Depression (a 21-item questionnaire for clinicians to rate the severity of their patients’ depression; Hamilton, 1960) were strong (.73 and .80) for nonpsychiatric samples (Beck et al., 1988). Internal consistency for the 12 and 18 month time points were .89 and .86, respectively.

*Maternal life satisfaction.* Mothers’ global life satisfaction was assessed with the Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985; see Appendix D). Mothers indicated on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree) their agreement with the following five statements: 1) “In most ways my life is close to my ideal.”; 2) “The conditions of my life are excellent.”; 3) “I am

satisfied with my life.”; 4) “So far I have gotten the important things I want in life.” 5) “If I could live my life over, I would change almost nothing.” Total scores were calculated by summing individual item scores across the five items. Possible scores ranged from 5 to 35 with high scores indicating high life satisfaction.

Pavot and Diener (1993) cite numerous studies to support the validity of the SWLS among which included studies indicating a negative relationship with depression (Arrindell, Meeuwesen, & Huysse, 1991), anxiety (Arrindell, et al., 1991), and negative affect (Larsen, Diener, & Emmonds, 1985). This measure has also shown good internal consistency with a mean Chronbach’s alpha of .78 across 62 studies (Vassar, 2008). Internal consistency for the 12 and 18 month time points were .87 and .81, respectively.

*Maternal parenting self-efficacy.* The Maternal Efficacy Questionnaire (MEQ; Teti & Gelfand, 1991; see Appendix E) is a 10-item self-report questionnaire designed to assess maternal self-efficacy according to Bandura’s conceptualization of self-efficacy as being highly situational and linked to specific parenting tasks. Mothers were asked at both 12 and 18 months to rate how they feel about the way they handle their baby on a 4-point scale ranging from 1 (not good at all) to 4 (very good) in response to items such as “How good do you feel you are at feeding your baby?” and “How good do you feel you are at getting your baby to sleep?” Total MEQ scores are calculated by summing across items resulting in possible scores ranging from 10 to 40 with high scores indicating high maternal self-efficacy. Teti and Gelfand reported a high level of internal consistency ( $\alpha = .86$ ) as well as a strong correlation with the Sense of Competence subscale of the Parenting Stress Index (Abidin, 1989). Furthermore, this measure of maternal self-efficacy has demonstrated to act as a mediator between various psychosocial variables

(including infant temperamental difficulty and depression) and maternal competence.

Internal consistency for the 12 and 18 month time points were .81 and .82, respectively.

## Results

I present my results in four sections. In the first section, I present my assessment of and method for handling missing data. In the second section, I present descriptive statistics and preliminary analyses conducted to determine the extent to which infant attachment security and measures of maternal psychosocial functioning were characterized by stability or change and to identify possible covariates to statistically control for in my principal analyses. In the third section, I describe the statistical technique I used to conduct my principal analyses. Lastly, in my fourth section, I present results from my principal analysis in which I examined whether infant irritability moderated the link between changes in measures of psychosocial functioning and changes in infant attachment security.

### *Missing Data*

Infant attachment classifications at both 12 and 18 months were available for 73 mother-infant dyads. Of these 73 dyads, only 45 had complete maternal psychosocial functioning data. Given the extent to which maternal psychosocial functioning data were missing (38.4%), I conducted a missing values analysis following current conventional recommendations (e.g., Acock, 2005; Collins, Schafer, & Kam, 2001; Graham, 2009; Hair, Black, Babin, Anderson, & Tatham, 2006; Schafer & Graham, 2002; Widaman, 2006) in order to determine whether missing data were missing completely at random (MCAR), missing at random (MAR), or missing not at random (MNAR). Although missing data was extensive, analyses revealed that data were MCAR. Specifically, Little's MCAR test (Rubin & Little, 1986) was not statistically significant,  $\chi^2(33) = 37.458$  ( $p = .272$ ), indicating that the distribution of missing data did not differ



significantly from the normal distribution. Additionally, bivariate statistics revealed that missingness was not related to infant sex, birth weight, delivery type, income, mothers' age, education, marital status, or race/ethnicity (see Table 1).

The most popular approach to handling missing data, especially when data are MCAR, is complete case analysis, also known as listwise deletion (Graham, 2009, Shafer & Graham, 2002; Hill, Waldfogel, Brooks-Gunn, & Han, 2005). This approach to handling missing data, however, is recommended only if missing data do not exceed 5%, as complete case analysis reduces sample size which can substantially decrease the precision with which parameters are estimated. As such, I applied the expectation-maximization (EM) algorithm using all available data in the present study to estimate missing values. These estimated values were saved as a new dataset and used for all subsequent analyses herein resulting in a final sample size of 73.

Table 1  
*Comparison of Mother-Infant Dyads with Complete versus Incomplete Maternal Psychosocial Functioning Data*

Baseline Characteristic	Maternal Psychosocial Functioning Data		Test Statistic
	Complete	Incomplete	
Infant Sex			$\chi^2(1) = .01$
Girls	21 (46.7%)	12 (42.9%)	
Boys	24 (53.5%)	16 (57.1%)	
Delivery Type			$\chi^2(1) = .07$
Vaginal	35 (79.5%)	23 (82.1%)	
Caesarian	9 (20.5%)	5 (17.9%)	
Birth Weight (grams)	$M = 3390$ ( $SD = 456$ )	$M = 3274$ ( $SD = 392$ )	$t(71) = 1.12$
Annual Income (\$)			$\chi^2(2) = 2.08$
Less than 21,000	11 (24.4%)	8 (29.6%)	
21,000 - 45,000	25 (55.6%)	17 (63.0%)	
More than 45,000	9 (20.0%)	2 (7.4%)	
Mothers' Age	$M = 24.89$ ( $SD = 5.31$ )	$M = 22.81$ ( $SD = 4.74$ )	$t(71) = 1.67$
Marital status			$\chi^2(1) = 1.14$
Single	19 (42.2%)	8 (29.6%)	
Married/Live with Father	26 (57.8%)	19 (70.4%)	
Education			$\chi^2(1) = .81$
Some College or Less	31 (68.9.0%)	22 (81.5%)	
College or More	14 (31.1%)	5 (18.5%)	
Race/Ethnicity			$\chi^2(1) = .79$
African American/Black	18 (40.0%)	15 (53.6%)	
Other	27 (60.0%)	13 (46.4%)	

*Note.* Percentages represent percentage of column total.  
 $p > .05$  for all test statistics.

*Descriptive Statistics and Preliminary Analyses*

Of the 73 dyads whom data were available for analyses, 28 (38.4%) of these infants were considered highly irritable as assessed by the NBAS. At 12 months, 35 infants (47.9%) were classified as secure with the remaining 38 infants (52.1%) classified as insecure (12 avoidant, 12 ambivalent, 14 disorganized). At 18 months, 45 infants (61.6%) were classified as secure with the remaining 28 infants (38.4%) classified as insecure (15 avoidant, 4 ambivalent, 9 disorganized).

Prior to analyses related to the primary goal of the present study, I also examined whether infant attachment security and measures of maternal psychosocial functioning were characterized by stability or change between 12 and 18 months. First, I examined infant attachment security. As seen in Table 2, 49 infants (67.1%) were either stable secure or stable insecure. Following Belsky et al. (1996), I used coefficient lambda to quantify the predictive association between 12 and 18 month infant attachment. Results indicated that the probability of correctly predicting 18 month infant attachment security was not significantly increased over chance when 12 month infant attachment security is known ( $\lambda = .143, p = .204$ ). This finding indicates that there is sufficient variability in infant attachment security between 12 and 18 months to justify further analyses aimed at predicting change over time.

Next, I examined whether maternal depressive symptomatology, life satisfaction, and parenting self-efficacy were characterized by stability or change between 12 and 18 months. I performed t-tests using mothers' absolute raw difference scores for each measure of psychosocial functioning to test whether the mean of mothers' absolute raw change for each measure of maternal psychosocial functioning was significantly greater

than zero. Results indicated that mothers' absolute raw change scores for depressive symptomatology,  $t(72) = 8.59$  ( $p < .001$ ), life satisfaction,  $t(72) = 10.22$  ( $p < .001$ ), and parenting self-efficacy,  $t(72) = 8.80$  ( $p < .001$ ), were significantly different from zero. The results of these t-tests indicate that maternal psychosocial functioning scores evidence sufficient variability between 12 and 18 months to justify including them in analyses designed to assess changes over time.

Lastly, I examined baseline demographic variables as possible covariates to include in subsequent analyses by examining their relations with 12 and 18 month infant attachment security. Results indicated that infant sex was associated with both 12 month ( $\chi^2(1, N = 73) = 5.94, p < .05$ ) and 18 month ( $\chi^2(1, N = 73) = 7.49, p < .05$ ) infant attachment security such that girls were more likely than boys to be secure. As such, I include infant sex as a covariate in subsequent analyses. Birth weight, delivery type, family income, and mothers' marital status, education, and race/ethnicity were not associated with either 12 or 18 month infant attachment security (all  $p$ 's  $> .05$ ; see Table 3). In addition, all maternal psychosocial functioning variables were mean centered to reduce multicollinearity and aid in interpretation in principal analyses (Aiken & West, 1991; Cohen, Cohen, West, & Aiken, 2003).

Table 2  
*Concordance of Infant Attachment Security at 12 and 18 Months*

12 month infant attachment security	18 month infant attachment security	
	Insecure	Secure
Insecure	21 (28.8%)	17 (23.3%)
Secure	7 (9.6%)	28 (38.4%)

*Note.* Percentages represent the proportion of the total ( $N = 73$ ).

Table 3  
*Infant Attachment Security at 12 and 18 Month as a Function of Baseline Characteristics*

Variable	Infant Attachment Security			
	12 month		18 month	
	Insecure	Secure	Insecure	Secure
Infant Sex	$\chi^2(1) = 5.94^*$		$\chi^2(1) = 7.49^{**}$	
Girls	12 (31.6%)	21 (60.0%)	7 (25.0%)	26 (57.8%)
Boys	26 (68.4%)	14 (40.0%)	21 (75.0%)	19 (42.2%)
Delivery Type	$\chi^2(1) = 1.16$		$\chi^2(1) = .90$	
Vaginal	28 (75.7%)	30 (85.7%)	21 (75.0%)	37 (84.1%)
Caesarian	9 (24.3%)	5 (14.3%)	7 (25.0%)	7 (15.9%)
Birth Weight (grams)	$t(71) = -0.76$		$t(71) = -0.09$	
	$M = 3309$	$M = 3386$	$M = 3340$	$M = 3349$
	$(SD = 430)$	$(SD = 439)$	$(SD = 387)$	$(SD = 464)$
Annual Income (\$)	$\chi^2(2) = 1.17$		$\chi^2(2) = 2.82$	
Less than 21,000	11 (28.9%)	8 (23.5%)	9 (32.1%)	10 (22.7%)
21,000 - 45,000	20 (52.6%)	22 (64.7%)	13 (46.4%)	29 (65.9%)
More than 45,000	7 (18.4%)	4 (11.8%)	6 (21.4%)	5 (11.4%)
Mothers' Age	$t(71) = -0.04$		$t(71) = 0.38$	
	$M = 24.08$	$M = 24.13$	$M = 24.36$	$M = 23.89$
	$(SD = 5.38)$	$(SD = 4.94)$	$(SD = 5.19)$	$(SD = 5.17)$
Marital status	$\chi^2(1) = .37$		$\chi^2(1) = .25$	
Single	16 (42.1%)	11 (32.4%)	12 (42.9%)	15 (34.1%)
Married/Live with Father	22 (57.9%)	23 (67.6%)	19 (57.1%)	29 (65.9%)
Education	$\chi^2(1) = .06$		$\chi^2(1) = .00$	
Some College or Less	27 (71.1%)	26 (76.5%)	20 (71.4%)	33 (75.0%)
College or More	11 (28.9%)	8 (23.5%)	8 (28.6%)	11 (25.0%)
Race/Ethnicity	$\chi^2(1) = .02$		$\chi^2(1) = .01$	
African American/Black	18 (47.4%)	15 (42.9%)	13 (46.4%)	20 (44.4%)
Other	20 (52.6%)	20 (57.1%)	15 (53.6%)	25 (55.6%)

*Note.* Percentages represent percentage of column total.

\*  $p < .05$ . \*\*  $p < .01$ .

### *Overview of Analyses*

Given that mothers and infants were each assessed twice using the same measures (i.e., maternal psychosocial functioning and infant attachment security), a repeated measures approach was necessary to account for the dependence between scores collected within each participant. Of the statistical techniques available for conducting repeated measures analyses (e.g., repeated measures ANOVA, mixed design ANOVA, and SEM Latent Growth Curve Modeling), only Generalized Estimating Equations (GEE) are designed to accommodate categorical outcome variables. Thus, GEE were the most appropriate statistical technique to conduct my principal analyses, given that my outcome, infant attachment security, was binary (secure vs. insecure). In addition, this statistical technique also allowed me to address whether infant irritability moderated the link between changes in maternal psychosocial functioning and changes in infant attachment security with improved power to detect significant changes over time and less biased regression parameters as compared to Ordinary Least Squares regression techniques (Diggle, Liang, & Zeger, 1994; Duncan, Duncan, Hops, & Stoolmiller, 1995; Hipwell, Keenan, Kasza, Loeber, Stouthamer-Loeber, & Bean, 2008; Keselman, Algina, & Kowalchuk, 2001; Liang & Zeger, 1986; Walls, & Schafer, 2006).

I conducted three separate GEE analyses (one for each maternal psychosocial functioning variable) examining changes in infant attachment security (secure vs. insecure) between 12 and 18 months as a function of infant irritability (highly irritable vs. less irritable) and changes in maternal (a) depressive symptomatology, (b) life satisfaction, and (c) parenting self-efficacy. Just as one would include time as a factor in other repeated measures techniques, I also included time (12 months vs. 18 months) as a

factor in each GEE analysis in order to test the effect of change between 12 and 18 months (Hardin & Hilbe, 2003; Molenberghs & Verbeke, 2005). Controlling for infant sex, I modeled each analysis to estimate (a) the main effects for infant irritability, time, and the maternal psychosocial functioning variable of interest, (b) the effects for all the two-way interactions between infant irritability, time, and the maternal psychosocial functioning variable of interest, and (c) the effects for the three-way interaction between infant irritability, time, and the maternal psychosocial functioning variable of interest.

I conducted my tests of significance using a standard alpha level of  $p < .05$  for two reasons. First, it is not an agreed upon standard among researchers that familywise error should be controlled based on its inconsistent application across studies. Second, the reduction in alpha that is required to adjust for familywise error would have the undesirable effect of reducing my power to detect true significant effects (O'Keefe, 2003).

### *Principal Analyses*

Results from each of the three GEE analyses I conducted indicated that the main effects for infant irritability, time, and each of the three measures of maternal psychosocial functioning were not statistically significant (all  $p$ 's  $> .05$ ; see Tables 4, 5, and 6). These results indicate that infant attachment security was not associated with (a) infant irritability or (b) maternal depressive symptomatology, maternal satisfaction with life, and maternal parenting self-efficacy. In addition, the lack of a significant effect for time indicated that infant attachment security at 12 months was not predictive of infant attachment security at 18 months. Moreover, this finding parallels results obtained earlier

using the lambda coefficient to quantify the association between 12 and 18 month infant attachment security.

Results revealed that the effects of the two-way interactions between infant irritability, time, and each respective measure of maternal psychosocial functioning also were not statistically significant (all  $p$ 's > .05). Specifically, the interaction between time and irritability indicated that changes in infant attachment security were not a function of infant irritability. In addition, the two-way interactions between each measure of maternal psychosocial functioning and time indicated that changes in infant attachment security were not a function of changes in maternal (a) depressive symptomatology, (b) life satisfaction, or (c) parenting self-efficacy. Furthermore, the two-way interactions between each measure of maternal psychosocial functioning and infant irritability indicated that infant irritability did not moderate the links between infant attachment security and (a) maternal depressive symptomatology, (b) maternal life satisfaction, and (c) maternal parenting self-efficacy.

Lastly, results also revealed that none of the three-way interactions was statistically significant (all  $p$ 's > .05). Specifically, the interactions between infant irritability, time and each measure of maternal psychosocial functioning indicated that infant irritability does not moderate the impact of (a) changes in maternal depressive symptomatology, maternal life satisfaction, and maternal parenting self-efficacy on (b) changes in infant attachment security. In terms of the differential susceptibility hypothesis, these results revealed that highly irritable infants were not differentially susceptible to the impact of changes in (a) maternal depressive symptomatology,



maternal life satisfaction, and maternal parenting self-efficacy on changes in (b) infant attachment security as compared to less irritable infants<sup>2</sup>.

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<sup>2</sup> Principal analyses were also conducted using a listwise deletion approach ( $n = 45$ ) and using NBAS irritability composite scores as a continuous variable. Substantive findings from these analyses do not differ, however, from those reported using the dataset obtained by applying the EM algorithm, nor do they differ from those reported using infant irritability as a dichotomous variable. The replication of the principal analyses using only complete cases can be found in Tables 7, 8, and 9.

Table 4  
*Generalized Estimating Equations Analysis of the Effects of Infant Irritability and Changes in Maternal Depressive Symptomatology on Changes in Infant Attachment Security*

Predictor	<i>B</i>	<i>SE</i>	Wald $\chi^2$	Odds Ratio
Infant Sex	-1.36**	.42	10.34	.26
Irritability	-0.55	.79	.48	.58
Time	0.51	.74	.46	1.66
BDI <sup>a</sup>	0.01	.06	.04	1.01
Irritability × Time	-0.25	1.03	.06	.78
Irritability × BDI	0.05	.09	.32	1.05
Time × BDI	0.00	.07	.00	1.00
Irritability × Time × BDI	0.09	.10	.77	1.09

Note. *N* = 73.

<sup>a</sup>Maternal depressive symptomatology.

\*\* *p* < .01.

Table 5  
*Generalized Estimating Equations Analysis of the Effects of Infant Irritability and Changes in Maternal Satisfaction with Life on Changes in Infant Attachment Security*

Predictor	<i>B</i>	<i>SE</i>	Wald $\chi^2$	Odds Ratio
Infant Sex	-1.22**	.41	8.72	.29
Irritability	0.66	2.32	.08	1.93
Time	-0.78	1.63	.22	.45
SWL <sup>a</sup>	-0.10	.06	2.59	.90
Irritability × Time	2.53	2.55	.98	12.58
Irritability × SWL	-0.04	.09	.13	.96
Time × SWL	0.06	.07	.60	1.05
Irritability × Time × SWL	-0.09	.10	.72	.91

Note. *N* = 73.

<sup>a</sup>Maternal satisfaction with life.

\*\* *p* < .01.

Table 6  
*Generalized Estimating Equations Analysis of the Effects of Infant Irritability and Changes in Maternal Parenting Self-Efficacy on Changes in Infant Attachment Security*

Predictor	<i>B</i>	<i>SE</i>	Wald $\chi^2$	Odds Ratio
Infant Sex	-1.30**	0.42	9.49	0.27
Irritability	1.75	6.73	0.06	5.77
Time	-3.38	4.93	.47	0.03
PSE <sup>a</sup>	-0.01	0.11	0.01	0.98
Irritability × Time	3.93	7.68	0.26	51.19
Irritability × PSE	-0.05	0.18	0.08	0.94
Time × PSE	0.10	0.13	0.61	1.11
Irritability × Time × PSE	-0.10	0.21	0.22	0.90

Note. *N* = 73.

<sup>a</sup>Maternal parenting self-efficacy.

\*\* *p* < .01.

Table 7  
*Generalized Estimating Equations Analysis Using Only Complete Cases on the Effects of Infant Irritability and Changes in Maternal Depressive Symptomatology on Changes in Infant Attachment Security*

Predictor	<i>B</i>	<i>SE</i>	Wald $\chi^2$	Odds Ratio
Infant Sex	-1.79*	.56	9.96	.16
Irritability	0.35	.56	.40	1.43
Time	-0.37	.72	.25	.69
BDI <sup>a</sup>	0.01	.07	.04	1.01
Irritability × Time	1.12	.92	1.46	3.06
Irritability × BDI	-0.07	.13	.35	.92
Time × BDI	0.12	.14	.82	1.13
Irritability × Time × BDI	0.24	.19	1.59	1.27

Note. *N* = 45.

<sup>a</sup>Maternal depressive symptomatology.

\* *p* < .05.

Table 8  
*Generalized Estimating Equations Analysis Using Only Complete Cases on the Effects of Infant Irritability and Changes in Maternal Satisfaction with Life on Changes in Infant Attachment Security*

Predictor	<i>B</i>	<i>SE</i>	Wald $\chi^2$	Odds Ratio
Infant Sex	-1.57*	.57	7.37	.20
Irritability	0.46	.62	.53	1.58
Time	-0.43	.79	.29	.64
SWL <sup>a</sup>	-0.14	.07	3.32	.86
Irritability $\times$ Time	1.65	1.24	1.78	5.24
Irritability $\times$ SWL	0.13	.10	1.86	1.14
Time $\times$ SWL	-0.08	.12	.43	.91
Irritability $\times$ Time $\times$ SWL	-0.27	.15	3.24	.76

Note.  $N = 45$ .

<sup>a</sup>Maternal satisfaction with life.

\* $p < .05$ .

Table 9  
*Generalized Estimating Equations Analysis Using Only Complete Cases on the Effects of Infant Irritability and Changes in Maternal Parenting Self-Efficacy on Changes in Infant Attachment Security*

Predictor	<i>B</i>	<i>SE</i>	Wald $\chi^2$	Odds Ratio
Infant Sex	-1.67*	.60	7.68	.18
Irritability	0.53	.56	.90	1.70
Time	-0.55	.66	.70	.57
PSE <sup>a</sup>	0.14	.14	1.05	1.16
Irritability $\times$ Time	0.92	.80	1.33	2.52
Irritability $\times$ PSE	0.144	.17	.68	1.15
Time $\times$ PSE	-0.280	.23	1.46	.75
Irritability $\times$ Time $\times$ PSE	-0.06	.25	.05	.94

Note.  $N = 45$ .

<sup>a</sup>Maternal parenting self-efficacy.

\* $p < .05$ .

## Discussion

I present my discussion of the present study in three sections. First, in my overview of the present study, I provide a brief review of the purpose of the present study and the findings. Second, I discuss alternative designs for investigating differential susceptibility in the context of how environmental changes influence infant attachment stability outcomes. Lastly, I conclude with a brief summary of my discussion and recommendations for future research.

### *Overview of the Present Study*

The purpose of the present study was to determine whether highly irritable infants were differentially susceptible to the impact of changes in maternal psychosocial functioning on changes in infant attachment security between 12 and 18 months. In doing so, the present study was the first to investigate the interactive effects of infant temperament on the link between changes in measures of maternal psychosocial functioning and changes in infant attachment security. Analyses examined the main and interactive effects of (a) infant irritability, (b) time, and (c) three measures of maternal psychosocial functioning (i.e., depressive symptomatology, life satisfaction, and parenting self-efficacy) on infant attachment stability outcomes. All failed to reach statistical significance. Therefore, contrary to expectations, the present study did not find that highly irritable infants are differentially susceptible to the impact of changes in maternal psychosocial functioning on changes in infant attachment security.

### *Alternative Tests of Differential Susceptibility*

Despite the lack of statistically significant findings, it remains possible that temperamentally difficult infants are more affected, both for the better and for the worse,

by environmental influences on changes in their attachment security. The many possible ways that this model of differential susceptibility can be examined underscore this possibility. In what follows, I discuss several alternative designs that seem particularly relevant for future research to examine. First, I discuss several environmental factors that are important to consider in future studies. Second, I discuss infant temperament factors that are pertinent to the study of whether infants are differentially susceptible to the impact of changes in their environment on changes in their attachment security.

### *Environmental Factors*

It remains possible that aspects of the environment that were not assessed in the present study are related to changes in infant attachment, and that this link is moderated by infant irritability. Results ruled out only changes in maternal depressive symptomatology, life satisfaction, and parenting self-efficacy between 12 and 18 months as predictors of changes in infant attachment security. Thus, there are a wide range of environmental conditions that may account for changes in infant attachment security.

There are two ways, in particular, that the present study may not have effectively assessed environmental changes. First, the present study's method of assessing maternal depressive symptomatology, life satisfaction, and parenting self-efficacy may not have been sufficient for predicting changes in infant attachment. For instance, assessing changes in maternal depressive symptoms using clinical interviews may demonstrate links to changes in infant attachment security. Atkinson, Paglia, Coolbear, Niccols, Parker, and Guger's (2000) meta-analysis of depression and attachment points to the importance of future research examining changes in clinical levels of depression. Atkinson and colleagues found that the link between maternal depression and infant

attachment security was stronger in samples of mothers with a clinical diagnosis of depression than nonclinical samples. In fact, the effect size for clinical mothers was .27, whereas the effect size for nonclinical mothers was only .09. Thus, it would be of interest for future research to examine the influence of changes in clinical levels of maternal depression on changes in infant attachment security. Moreover, given the discrepancy between clinical and nonclinical samples, randomized control trials that test whether improvement in mothers' clinical depression *causes* infant attachment security to change from insecure to secure seem especially promising.

In addition, it is also possible that the present study did not effectively assess changes in the environment because one or more necessary predictors of changes in infant attachment security were omitted. In what follows, I discuss several environmental predictors that seem especially relevant for future work to examine.

*Maternal stress.* To begin, the present study was unable to test changes in maternal stress as a predictor of changes in infant attachment security. This is certainly a limitation given findings that indicate that decreases in maternal stress between 12 and 18 months are associated with changes towards security, whereas increases are associated with changes away from security (Egeland & Farber, 1984). Future work should examine child temperament as a moderator of the link between changes in maternal life stress and changes in infant attachment.

*Maternal social support.* Maternal social support is another environmental predictor that may be related to changes in infant attachment security. As previously noted, Crockenberg (1981) found that higher levels of maternal social support predicted later infant attachment security for irritable infants only. Thus, it seems reasonable that

changes in maternal social support may be related to changes in infant attachment security, and that this link may hold only for irritable infants. No study to date (the present study included) has been able address whether this proposed link between changes in maternal social support and changes in infant attachment is moderated by infant irritability. Given that a temperament-by-environment interaction is a necessary condition for differential susceptibility to be present, future research investigating whether temperamentally difficult infants are differentially susceptible to the impact of changes in their environment on changes in attachment security would do well to include changes in maternal social support as an environmental factor.

*Maternal caregiving quality.* In addition, theory and research point to maternal caregiving quality as an important predictor of infant attachment security (Ainsworth et al., 1978; Bowlby, 1973; De Wolff & van IJzendoorn, 1997; Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003); however, no study to date, including the present study, has been able to address whether changes in maternal caregiving quality are linked to changes in infant attachment security. As such, it would be germane for future research to examine changes in maternal caregiving quality predict changes in infant attachment security, and whether infant irritability moderates this link.

*Maternal caregiving quality and psychosocial functioning.* Furthermore, theory and research also demonstrate that maternal caregiving quality is a function of the mother's internal state, which includes her psychosocial functioning (for reviews see Belsky & Fearon, 2008; Belsky & Jaffee, 2006; Cassidy, 2008); thus, another design alternative that remains to be tested is one that includes maternal psychosocial functioning *and* caregiving quality as predictors of infant attachment security.



### *Infant Temperament Factors*

It also remains possible that aspects of infant temperament that were not assessed in the present study moderate the link between changes in the environment and changes in infant attachment security. The present study's findings indicate only that highly irritable versus less irritable infants as assessed within the first 30 days post-partum using the NBAS are not differentially susceptible to the impact of changes in maternal psychosocial functioning on changes in attachment security. Thus, there are several domains of infant temperament that may interact with changes in the environment to predict infant attachment stability outcomes. In what follows, I discuss three aspects of infant temperament that seem especially important for future research to address.

*Irritable and non-irritable infants.* One alternative design that remains to be tested is whether irritable infants in comparison to *non-irritable* infants demonstrate differential susceptibility to the impact of changes in the environment on changes in attachment security. Specifically, the present study may not have been able to detect a significant temperament-by-environment interaction because non-irritable infants were excluded from participation. For the most part, studies that have found either a temperament-by-environment interaction or differential susceptibility did not select *only* irritable children. In particular, recall that the present study selected only those infants who scored in the 80<sup>th</sup> percentile and above on Kaye's (1978) NBAS irritability composite measure. In contrast, Crockenberg (1981), who found that the interaction between the NBAS and maternal social support was a significant predictor of infant attachment security, did not select only irritable infants. As such, the irritability of her sample represented irritable as well as non-irritable infants. Thus, it is possible that the

present study did not find that infant irritability moderated the link between changes in maternal psychosocial functioning and changes in attachment security because environmental influences are larger for irritable infants only in comparison to non-irritable infants. Future research should examine whether irritable infants are differentially susceptible to changes in infant attachment security in samples that exhibit a wider range of infant irritability.

*Infant fearfulness.* It is also possible that assessing infant temperament using measures other than the NBAS may demonstrate differential susceptibility. Several studies that have found a significant temperament-by-environment interaction have examined infant fearfulness as a temperamental moderator of environmental influences on child development outcomes (e.g., Kochanska, 1995, 1997). Given evidence that fearful infants may be differentially susceptible to the impact of environmental changes on changes in attachment security, it is advisable for future work to examine infant fearfulness as a moderator of the link between changes in the environment and changes in infant attachment security.

*Concurrent assessments of infant temperament and environment.* Lastly, it is also possible that infant irritability assessed closer to the time that the environmental influence is measured may moderate the link between environmental change and infant attachment stability, and that this interaction may demonstrate differential susceptibility. In particular, infant irritability that is assessed months before the caregiving environment is assessed may not be able to capture the infant's susceptibility to this influence for two reasons: (a) *how* it is that temperamentally difficult infants may be more influenced by their environment, and (b) infant temperament is not highly stable across early childhood.

The question of *how* it may be that temperamentally difficult infants are more influenced by their environment was not addressed by the differential susceptibility hypothesis. One possible that remains to be examined is that temperamentally difficult children are more susceptible to rearing influences because their temperaments increase the frequency with which they direct attachment behaviors towards their mother. By increasing the frequency with which they direct attachment behaviors towards mothers, irritable infants may build stronger associations between the directing their attachment behaviors towards mother and the likely outcome (e.g., being comforted or being rejected) because the two are paired more frequently. Evidence from a large body of research investigating infant temperament and attachment indicates that temperamentally difficult children, do, in fact, direct more attachment behaviors towards their mothers (for a review see Vaughn & Bost, 1999). Therefore, if this proposed mechanism for *how* irritable infants are more influenced by their environment is correct, it stands to reason, then, that measures of infant temperament assess the infant's susceptibility to environmental influences by indexing the frequency that the infant directed his attachment behaviors towards the mother.

However, given that infant temperament is not highly stable across infancy (Roberts & DelVecchio, 2000; Rothbart, 1988, 1989; Rothbart & Bates, 2006; Rothbart, Posner, & Hershey, 1995), assessments of infant temperament in early infancy may not be the best proxy of an infant's susceptibility months later. Rather, measures of infant temperament that are conducted around the same time that the environmental influences are assessed may best be able to estimate the infant's susceptibility to those influences. In fact, most of the studies reviewed herein as support for differential susceptibility assessed

infant temperament after the first 30 days of life. As such, future investigations of whether irritable infants are differentially susceptible to the impact of changes in the caregiving environment on changes in attachment security may benefit from measuring infant temperament after the 30 days post-partum or immediately before or concurrent to the time that the environment is assessed.

### *Summary and Future Directions*

Previous research on the factors related to the stability and change of infant attachment rested on the assumption that all children were equally susceptible to changes in their environment. The present study was the first to investigate infant irritability as a moderator of the link between changes in maternal psychosocial functioning and changes in infant attachment security. Although, the present study did not find evidence of differential susceptibility, there are many alternative designs for investigating whether infants are differentially susceptible to the impact of environmental changes on attachment stability outcomes that remain to be tested before conclusions can be drawn about whether children are equally susceptible to the impact of changes in the environment on changes in their attachment security.

Several factors may be especially important for researchers to examine in future tests of whether temperamentally difficult infants are more susceptible to the influence of changes in their environment on changes in their attachment security. In particular, future work should measure of changes in maternal stress, social support, and caregiving quality. In addition, research should also explore whether changes in maternal caregiving quality *and* maternal psychosocial functioning predict changes in infant attachment security. It is also important for future studies to investigate whether a sample of irritable

and non-irritable infants demonstrates differential susceptibility. Research also points to infant fearfulness as an aspect of infant temperament that may have utility in future work. Lastly, future studies should also examine whether concurrent measurements of infant temperament and environmental influences moderate the link between changes in the environment and changes in infant attachment.

## Appendix A

*Institutional Review Board Approval*

UNIVERSITY OF  
MARYLAND

INSTITUTIONAL REVIEW BOARD

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College Park, Maryland 20742-5121  
301.405.4212 TEL 301.314.1475 FAX  
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April 10, 2008

**MEMORANDUM**

*Application Approval Notification*

**To:** Dr. Jude Cassidy  
Katie Babcock  
Laura Jernigan  
Brandi Stupica  
Sarah Halcrow  
Heidi Butler  
Fatima Ramos-Marcuse  
Yair Ziv  
Susan Woodhouse  
Matthew Dykas  
Department of Psychology

**From:** Roslyn Edson, M.S., CIP *TB for Roslyn Edson*  
IRB Manager  
University of Maryland, College Park

**Re:** IRB Application Number: # 00556  
Project Title: "At-Risk Irritable Infants"

**Approval Date:** April 9, 2008

**Expiration Date:** April 9, 2009

**Type of Application:** Renewal

**Type of Research:** Nonexempt

**Type of Review For Application:** Expedited

The University of Maryland, College Park Institutional Review Board (IRB) approved your IRB application. The research was approved in accordance with 45 CFR 46, the Federal Policy for the Protection of Human Subjects, and the University's IRB policies and procedures. Please reference the above-cited IRB application number in any future communications with our office regarding this research.

**Recruitment/Consent:** For research requiring written informed consent, the IRB-approved and stamped informed consent document is enclosed. The IRB approval expiration date has been stamped on the informed consent document. Please keep copies of the consent forms used for this research for three years after the completion of the research.

**Continuing Review:** If you intend to continue to collect data from human subjects or to analyze private, identifiable data collected from human subjects, after the expiration date for this approval (indicated above), you must submit a renewal application to the IRB Office at least 30 days before the approval expiration date.

**Modifications:** Any changes to the approved protocol must be approved by the IRB before the change is implemented, except when a change is necessary to eliminate apparent immediate hazards to the subjects. If you would like to modify the approved protocol, please submit an addendum request to the IRB Office. The instructions for submitting a request are posted on the IRB web site at:  
[http://www.umresearch.umd.edu/IRB/irb\\_Addendum%20Protocol.htm](http://www.umresearch.umd.edu/IRB/irb_Addendum%20Protocol.htm).

**Unanticipated Problems Involving Risks:** You must promptly report any unanticipated problems involving risks to subjects or others to the IRB Manager at 301-405-0678 or [redson@umresearch.umd.edu](mailto:redson@umresearch.umd.edu).

**Student Researchers:** Unless otherwise requested, this IRB approval document was sent to the Principal Investigator (PI). The PI should pass on the approval document or a copy to the student researchers. This IRB approval document may be a requirement for student researchers applying for graduation. The IRB may not be able to provide copies of the approval documents if several years have passed since the date of the original approval.

**Additional Information:** Please contact the IRB Office at 301-405-4212 if you have any IRB-related questions or concerns.

## Appendix B

*Demographic Questionnaire*

1. Involved in romantic relationship?

- Single (not involved in a steady relationship)  
 Never Married     Separated     Divorced  
 Married  
 Engaged to be married  
 Steady Dating Relationship (but not married)

2. (If not single) Living with romantic partner?     Yes     No

3. (If you work) Who takes care of your baby during the day? \_\_\_\_\_

## Appendix C

*Beck Depression Inventory (Beck et al., 1961)*

On this questionnaire are groups of statements. Please read each group of statements carefully. Then pick out the one statement in each group which best describes the way you have been feeling the past week, including today. Circle the number beside the statement you picked. If several statements in the group seem to apply equally well, circle the higher number. Be sure to read all the statements in each group before making your choice.

- 1 0 I do not feel sad.
  - 1 I feel sad.
  - 2 I am sad all the time and I can not snap out of it.
  - 3 I am so sad or unhappy that I can't stand it.
  
- 2 0 I am not particularly discouraged about the future.
  - 1 I feel discouraged about the future.
  - 2 I feel I have nothing to look forward to.
  - 3 I feel that the future is hopeless and that things cannot improve.
  
- 3 0 I do not feel like a failure.
  - 1 I feel I have failed more than the average person.
  - 2 As I look back on my life, all I can see is a lot of failures.
  - 3 I feel I am a complete failure as a person.
  
- 4 0 I get as much satisfaction out of things as I used to.
  - 1 I don't enjoy things the way I used to.
  - 2 I don't get real satisfaction out of anything anymore.
  - 3 I am dissatisfied or bored with everything.
  
- 5 0 I don't feel particularly guilty.
  - 1 I feel guilty a good part of the time.
  - 2 I feel quite guilty most of the time.
  - 3 I feel guilty all of the time.
  
- 6 0 I don't feel I am being punished.
  - 1 I feel I may be punished.
  - 2 I expect to be punished.
  - 3 I feel I am being punished.
  
- 7 0 I don't feel disappointed in myself.
  - 1 I am disappointed in myself.
  - 2 I am disgusted with myself.
  - 3 I hate myself.



- 8 0 I don't feel I am any worse than anybody else.  
1 I am critical of myself for my weaknesses or mistakes.  
2 I blame myself all the time for my faults.  
3 I blame myself for everything bad that happens.
- 9 0 I don't have any thoughts of killing myself.  
1 I have thoughts of killing myself, but I would not carry them out.  
2 I would like to kill myself.  
3 I would kill myself if I had the chance.
- 10 0 I don't cry anymore than usual.  
1 I cry more now than I used to.  
2 I cry all the time now.  
3 I used to be able to cry, but now I can't cry even though I want to.
- 11 0 I am no more irritated now than I ever am.  
1 I get annoyed or irritated more easily than I used to.  
2 I feel irritated all the time now.  
3 I don't get irritated at all by the things that used to irritate me.
- 12 0 I have not lost interest in other people.  
1 I am less interested in other people than I used to be.  
2 I have lost most of my interest in other people.  
3 I have lost all of my interest in other people.
- 13 0 I make decisions about as well as I ever could.  
1 I put off making decisions more than I used to.  
2 I have greater difficulty in making decisions than before.  
3 I can't make decisions at all anymore.
- 14 0 I don't feel I look any worse than I used to.  
1 I am worried that I am looking old or unattractive.  
2 I feel that there are permanent changes in my appearance that make me look unattractive.  
3 I believe that I look ugly.
- 15 0 I can work about as well as before.  
1 It takes an extra effort to get started at doing something.  
2 I have to push myself very hard to do anything.  
3 I can't do any work at all.

- 16 0 I can sleep as well as usual.  
1 I don't sleep as well as I used to.  
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.  
3 I wake up several hours earlier than I used to and cannot get back to sleep.
- 17 0 I don't get more tired than usual.  
1 I get tired more easily than I used to.  
2 I get tired from doing almost anything.  
3 I am too tired to do anything.
- 18 0 My appetite is no worse than usual.  
1 My appetite is not as good as it used to be.  
2 My appetite is much worse now.  
3 I have no appetite at all anymore.
- 19 0 I haven't lost much weight, if any, lately. I am purposely trying  
1 I have lost more than 5 pounds. to lose weight  
2 I have lost more than 10 pounds. by eating less.  
3 I have lost more than 15 pounds. Yes\_\_\_\_ No\_\_\_\_
- 20 0 I am no more worried about my health than usual.  
1 I am worried about physical problems such as aches and pains, or upset stomach,  
or constipation.  
2 I am very worried about physical problems and it's hard to think of much else.  
3 I am so worried about my physical problems that I cannot think about anything  
else.
- 21 0 I have not noticed any recent change in my interest in sex.  
1 I am less interested in sex than I used to be.  
2 I am much less interested in sex now.  
3 I have lost interest in sex completely.

## Appendix D

*Satisfaction with Life Scale (Diener et al., 1985)*

Please take a moment to think about how your life is going right now. Below are five statements that you may agree or disagree with. Please indicate the extent to which you agree or disagree with each of the following statements by circling the appropriate number on the scale below each item. Please be open and honest in your responding.

1. In most ways my life is close to my ideal.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree

2. The conditions of my life are excellent.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree

3. I am satisfied with my life.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree

4. So far I have gotten the important things I want in my life.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree

5. If I could live my life over, I would change almost nothing.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree

## Appendix E

*Maternal Efficacy Questionnaire (Teti & Gelfand, 1991)*

We want to begin asking you some questions about yourself and your baby. We are trying to get a general idea of how you feel about the way you handle different situations with your baby. We all do better in some situations than in others. We would like to have you think about some situations that all mothers encounter. Please circle the response that best describes how you feel.

1. When your baby is upset, fussy, or crying, how good do you feel you are at soothing your baby?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

2. How good do you feel you are at understanding what your baby wants or needs; for example, when your baby needs to be changed or wants to be fed?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

3. How good do you feel you are at feeding your baby?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

4. How good do you feel you are at getting your baby to pay attention to you; for example, getting your baby to smile or laugh with you?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

5. How good do you feel you are at bathing your baby?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

6. How good do you feel you are at knowing what your baby will enjoy; for example, what toys and games your baby will like?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

7. How good do you feel you are at keeping your baby content when you need to do something else?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

8. How good do you feel you are at getting your baby to sleep?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

9. How good do you feel you are at getting your baby to smile or laugh at objects, animals, or other people?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

10. In general, how good a mother do you feel you are?

1	2	3	4
Not good at all	Not good enough	Good enough	Very good

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