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Regulation and Attachment in Infancy:

Still-Face Paradigm and Joint Attention

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Abstract

Regulation and Attachment in Infancy:

Still-Face Paradigm and Joint Attention

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Attachment with the primary caregiver, the mother, in infancy is essential to later socioemotional development because its quality is carried forward to other important relationships. Attachment theorists argue that the attachment with the mother is formed and can be reliably measured by the first year of life. Prior to this point, infants develop internal-working models of the relationship with their mothers through repeated interactions. Infants' regulation capacities before the first year reflect the internal-working models, and thus, may predict attachment security with the mother at the end of the first year.

The present study assessed infants' attachment security with the mother at 12 months and its associations with infants' regulation in two different interaction contexts: emotion regulation in still-face paradigm at 6 months and

attention regulation in joint attention at 9 months. The correlation analyses revealed that infants' positive affect expressions and self-comforting behaviors during still-face paradigm at 6 months were positively correlated with supported joint attention at 9 months and attachment security at 12 months. The multiple regression analyses showed that the same variables at 6 months significantly predicted attachment security. Additionally, marginally significant moderator effect was found between infants' positive affect expression at 6 months and attachment security at 12 months with coordinated joint attention at 9 months as a moderator.

Keywords: still-face paradigm, emotion regulation, joint attention, attention regulation, internal-working models, attachment

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

The early mother-child attachment is essential in laying out the foundation for the social abilities and relationships later on (Goldberg, 2000). Attachment theorists argue that the crucial period for the formation and development of this mother-child attachment is first 12 months of life. According to Bowlby (1973), during this period, infants develop internal working models of the infant-mother relationship, which refer to a set of representations that guide infants' expectations, interpretations and interactions with attachment figures. Therefore, the clear-cut attachment with the mother emerges and is consolidated as a special relationship (Goldberg, 2000), and this attachment quality can be effectively measured (Bowlby, 1969) by the first year of life. Before the completion of the clear-cut attachment, the internal working model of the infant-mother relationship is established through repeated interactions with the mother (Bowlby, 1973).

If the infant-mother attachment is formed and solidified by the first year through previous history of the interactions with her, is there any way to detect signs of infants' internal working models prior to the end of the first year? In fact, an increasing number of researchers and theorists have posed that there are

possible associations between infant-mother attachment and the infants' regulation ability (Braungart & Stifter, 1991; Braungart-Rieker et al., 2001; Bridges & Grolnick, 1994; Cassidy, 1994; Cummings & Davies, 1996; Fox & Calkins, 1993; Kobak & Sceery, 1988; Thompson, Flood, & Lundquist, 1995). Nevertheless, previous research concerning the relationships between infant-mother attachment and the infants' regulation mainly examined the regulation in a single interaction context, which undermines the infants' regulations in different contexts and their contributions to the infant-mother attachment (Braungart-Rieker et al., 2001; Braungart-Rieker, Zentall, Lickenbrock, Ekas, Oshio, & Planalp, 2014). Therefore, considerations of the infants' regulation in different infant-mother interaction contexts would provide a more complete and integrated picture of the relationship between the attachment quality and the regulation. The current study examined the association between the infant-mother attachment and two different types of the infants' regulation: the emotion regulation measured by the still-face paradigm at 6 months of age and the attention regulation measured by the joint attention during free-play at 9 months of age.

1. Attachment with the Mother

Bowlby (1979) defined attachment as an affectional bond one has with another from which feelings of security is achieved. Attachment theorists argue that among these affectional bonds, the most important bond is that with primary caregiver (Ainsworth, Blehar, Waters & Wall, 1978; Bowlby, 1969; Braungart-Rieker, Garwood, Powers & Wang, 2001), who is usually the mother.

According to Bowlby (1979), this early mother-child attachment has its significance in the "strong causal relationship between an individual's experiences with his parents [attachments] and his later capacity to make affectional bonds." Indeed, a number research revealed that the attachment relationship established between mother and child is associated with various socioemotional functioning and is "carried forward" to other important social relationships later in life (Berlin, Cassidy, & Appleyard, 2008; Cox, Mills-Koonce, Propper, & Gariepy, 2010; Sroufe and Fleeson, 1986, 1988).

1-1. Importance in Later Relationships

First, early mother-child attachment quality was known to extend and affect the quality of relationship with other family members. More specifically, studies found that the mother-child attachment was related to relationships with other siblings (Berlin, Cassidy, & Appleyard, 2008). For example, a study demonstrated the association between infant-mother attachment security and less problems and troubles with siblings after 5 years (Volling & Belsky, 1992). Another study showed that infants who had secure attachment with mother treated their older siblings more positively (Teti & Ablard, 1989).

Not only does the attachment with mother lead to the relationship with close family members, but it is also linked to the important social competences which affect other relationships greatly. The manifold social qualities that are associated with mother-child attachment include self-efficacy and self-esteem (Sroufe, Egeland, & Carlson, 1999; Sroufe, Egeland, Carlson & Collins, 2005), empathy (Sroufe & Fleeson, 1986), internalizing and externalizing behaviors (Lyons-Ruth, Easterbrooks, & Cibelli, 1997), and especially, relationships with peers (Booth, Rose-Krasnor, & Rubin, 1991; Kerns, 1994).

Early attachments may contribute to the peer relationships in general, which do not necessarily involve affectional bond. The research findings

repeatedly confirm that children with secure mother-child attachment receive higher regard from their acquaintances and get along with them more harmoniously during preschool and elementary school years (see Berlin & Cassidy, 1999, for a review).

In addition to overall peer relationships, numerous investigations with different measures show the clear positive associations between early mother-child attachment and close friendships in toddlerhood and childhood (Pierrehumbert, Ianotti, Cummings, & Zahn-Waxler, 1989; Kerns, 1994, Park & Waters, 1989; see Berlin, Cassidy, & Appleyard, 2008 for review). Furthermore, these associations were not limited to the quality of friendships; early attachment with mother also had influence on the number of friends children had (Elicker, Englund, & Sroufe, 1992; Grossman & Grossman, 1991; Lewis & Feiring, 1989).

Moreover, early attachment with the mother is known to influence romantic relationships as adults, the most intimate and affectionate relationships (Bowlby, 1979). According to a finding of the longitudinal Minnesota Study of Risk and Adaptation from Birth to Adulthood, attachment security with mother at 12 and 18 months predicted relationship security with romantic partners at 20-21 years of age (Roisman, Collins, Sroufe, & Egeland, 2005). Another study with the subsample of the same Minnesota study, the link between infant-mother attachments at 12 months and relationship quality with romantic partners at ages

20 and 23 was mediated by peer competence in elementary school and secure representations of close friendships at 16 years of age (Simpson, Collins, Tran, & Haydon, 2007).

1-2. Development of Infant-Mother Attachment

Ainsworth (1973) proposed that there exist three phases in infancy related to the formation of the infant-mother attachment: ‘preattachment,’ ‘attachment-in-the-making’ and ‘clear-cut attachment.’ Even apart from attachment theory, there is consistent agreement that for the first few weeks of life, signals that are distinctively directed at the primary caregiver are not clear, whereas for the first 6-7 months, preferences towards specific caregivers are observed, which are shaped into a special relationship (Goldberg, 2000).

From attachment theory’s perspectives, Ainsworth (1973) suggested that during the ‘preattachment’ phase, neonates demonstrate behaviors such as orienting, crying, and clinging to any adult, not specifically directed toward the primary caregiver. During this phase, infants manifest interest in features of human adults in general, such as preference towards face-like stimuli over other patterns and ability to hear human voice better than other sounds. However, even

during this phase, infants show a head-turning preference towards the odor of their own mother's breast pad over that of a stranger (McFarlane, 1975; Porter, Makin, Davis & Christensen, 1992).

The second phase named 'attachment-in-the-making' is characterized by ability to distinguish familiar and unfamiliar faces and voices, the establishment of patterns of interaction with the caregivers, and development of expectations of their behaviors and the responses of the caregivers (Goldberg, 2000). Infants begin to show preferences towards familiar figures by discriminately smiling more at them than strangers. Furthermore, as their cognition and locomotive ability develop, the concepts of the infant-mother relationship that are prerequisites for attachment are constructed. Although attachment patterns cannot be measured directly during this phase, infants' responses during the interactions with the mother reflecting the attachment can be observed (Braungart-Rieker et al., 2014; e.g., Conradt & Ablow, 2010). The process of the formation of the internal-working models in this phase leads to the subsequent phase of 'clear-cut attachment,' during which the patterns of the infant-mother attachment can be reliably measured (Ainsworth et al., 1978).

2. Regulation in Infancy and Attachment

The word “regulation” refers to “control” over something or someone with regularity. Therefore, regulation of the self signifies the “exercise of control over oneself, especially with regard to bringing the self into line with preferred (thus, regular) standards” (Vohs & Baumeister, 2004). As the body temperature is regulated to optimal and regular degrees through the body’s homeostasis processes, psychological regulation requires efforts to maintain the self at the optimal states.

Investigations regarding regulation support the notion that infants develop regulatory capacities through interactions with the caregiver. During the interactions, the infant-mother dyads mutually regulate in order to reach a state of reciprocity. This process of repair towards the reciprocity instills the regulatory skills in infants (Ginano & Tronick, 1988; Tronick & Weinberg, 1997). Moreover, according to Sroufe and Waters (1976), infants’ regulation is fostered as infants and mothers exchange communicative signals to be at the appropriate levels of arousal while interacting with each other.

As previously mentioned, attachment theorists posit that the infant-mother attachment is achieved by development of an internal working model of the dyad’s relationship through repeated infant-mother interactions during the first

year of life (Bowlby, 1973). If interactions with the mother were continuously positive and satisfying, infants would develop a positive internal working model of the mother that she reliably provides care and comfort, which leads to secure attachment. On the other hand, if the interactions with the mother were negative, infants would develop a negative working model that the mother is not dependable in providing comfort (Bretherton & Munholland, 2008).

The internal working model, a set of systematically intertwined schemes, aids the infant to organize the representations of the mother, influences his or her responses in the relationship with her, and develops with the repetition of interactions and the maturity of the infant (Bowlby, 1973). Infants' regulation in the contexts of their interactions with the mother might reflect their internal-working models of the infant-mother relationship (Braungart-Rieker et al., 2014). For example, Cassidy (1994) found that infants who formed the secure attachment demonstrated better regulatory capacities via their optimal levels of recovery during situations that might trigger the attachment system.

In order to examine the associations between infants' early regulation and later attachment during the clear-cut attachment phase, we investigated two different regulation abilities in different contexts of interactions with the mother. Regulation is usually described in terms of regulating thoughts, desires, task performances, emotions, and attentional processes (Vohs & Baumeister, 2004).

In the current study, we focused on the infant's emotion and attention regulation.

2-1. Emotion Regulation and Attachment

Emotion regulation means the system of "initiating, avoiding, inhibiting, maintaining, or modulating the occurrence, form, intensity, or duration of internal feeling states, emotion-related physiological process, emotion-related goals, and/or behavioral concomitants of emotion" (Eisenberg, 2002; Eisenberg & Morris, 2002). In early infancy, emotion regulation takes the forms of reorientation of gaze (Rothbart, Ziaie, & O'Boyle, 1992) and self-comforting behaviors (Stifter & Braungart, 1995) to modulate levels of distress. The mother plays the central role in helping the infant acquire the ability to regulate emotions by recognizing, interpreting and responding to the infant's emotions (Feldman, Greenbaum & Yirmiya, 1999; Kopp, 1989). Therefore, emotion regulation may be linked to experiences that form attachment patterns with the mother.

According to Sroufe and Waters (1977), attachment is "an organizational construct," and emotion regulation of "secure" feeling is an essential component of attachment. Therefore, in times of distress and anxiety, the securely attached infant uses the caregiver as a resource for comfort based on previous emotional

experience in order to regulate his or her emotion (Ainsworth et al., 1978). Since emotion regulation of felt security is a significant part of attachment, we can expect that early regulatory capacity of emotions in the phase of 'attachment in the making' will predict consolidated attachment security. One way to measure the infant's emotion regulation in a mildly distressing situation is the method of still-face paradigm devised by Tronick, Als, Adamson, Wise & Brazelton (1978).

Responses in Still-Face Paradigm as Emotion Regulation

The still-face paradigm was designed by Tronick and his colleagues (1978) for testing the hypothesis that infants participate in social interaction more actively than thought before. Even though the detailed procedures may vary based on the purposes of the studies, in most cases, the still-face paradigm is performed in the following three steps with an adult who is mostly the mother (Mesman, van IJzendoorn, & Bakersmans-Kranenburg, 2009): (1) normal interaction episode in which the mother plays with the infant as usual, (2) the 'still-face' episode in which the mother holds the emotionless face and does not respond to the infant, and (3) the reunion in which the mother tries to rebuild the normal interaction. According to Moore, Cohn, and Campbell (2001), infants'

responses in the still-face paradigm are relatively stabilized by 6 months of age, during which infants begin to develop stable representations of their social relationships (Stern, 1985, 1989).

During the still-face episode, the emotional separation due to the unresponsiveness of the mother causes mild stress in the infant. Infants typically respond to the stress by showing the "still-face effect," which includes the decrease in positive affect, increase in negative affect, and increase in self-comforting behaviors (Adamson & Frick, 2003; Gianino & Tronick, 1988; Toda & Fogel, 1993; Tronick et al., 1978). More specifically, infants' smiling and positive vocalizations decline, while their crying and negative facial expressions increase (Adamson & Frick, 2003). They also manifest behaviors such as gaze aversion and thumb sucking in attempts to regulate their emotions during still-face episode (Stifter & Braungart, 1995).

According to Tronick and Gianino (1986), in everyday interactions, mothers assist infants to regulate the infants' arousal by exaggerating vocal and facial expressions when infants are involved and reducing them when infants are uninvolved. Nevertheless, faced with unresponsive mothers during the still-face episode, infants eventually turn to their own internally driven regulatory behaviors. Therefore, infants' responses and behaviors in the still-face paradigm reflect their internal emotion regulatory capacities.

Responses in Still-Face Paradigm and Attachment Security

Several studies examined the relationship between infants' responses in the still-face paradigm and later attachment security. One of the first studies conducted by Tronick, Ricks & Cohn (1982) found that infants who attempted to elicit responses from their mothers at 6 months of age were mostly securely attached when they became 12 months, while none of the infants who did not attempt such eliciting behavior was securely attached later on. Cohn, Campbell, & Ross (1991) measured infants' negative elicit expressions (i.e., cry and fuss), and their positive elicit expressions (i.e., smiles or play-face) during the still-face procedure when they were 2, 4, and 6 months old. Results showed that positive expressions at the age of 6 months predicted secure attachment at the age of 12 months. Braungart-Rieker et al. (2001) also revealed that infants classified as B1-B2 groups at 12-13 months displayed more positive and less negative affect during the still-face paradigm at 4 months and showed more regulatory behaviors than the infants classified as C group.

Similar associations were found in the risk groups. For example, in a study of 48 premature infants and their mothers in Portugal (Fuertes, Dos Santos, Beeghley & Tronick, 2006), securely attached infants at 12 months were more likely to demonstrate positive responses to their mothers during the still-face

paradigm than the infants who were classified otherwise. In another study with the same premature infants' sample (Fuertes, Lopes-dos-Santos, Beeghley, & Tronick, 2009), infants' regulatory behaviors during the still-face paradigm were further subdivided into three types: positive other-directed coping such as smile and positive vocalizations towards their mothers, negative other-directed coping including angry vocalizations and cry, and self-directed coping such as closing their own eyes and turning away from their mothers. Results confirmed the findings of the other studies by showing that securely attached infants at 12 months showed more positive other-directed coping responses when they were 3 months old.

Therefore an array of studies supports the notion that infants' positive affect and behaviors are related to the later attachment security (Mesman et al., 2009). However, only a few studies consider the dynamic nature of the behaviors in the still-face paradigm in relation to the attachment. Although the original studies of the still-face paradigm describe that infants attempt to elicit responses from their mothers, these attempts decrease while negative affect and regulatory behaviors increase, which indicates the changes within the still-face episode (Tronick et al., 1978). However, Ekas, Haltigan & Messinger (2013) argued that in most cases, changes in infants' responses in the still-face paradigm are considered changes from episode to episode. Therefore, the need for taking the

qualitative features within the still-face episode into consideration is addressed. For example, how infants' behaviors in the beginning, middle, and end of the still-face episode respectively contribute to the prediction of later attachment would be useful information in these studies.

2-2. Attention Regulation and Attachment

While emotions are the source of the organizing energy of internal-working models, cognitive processes sustain and adjust the contents of the models. At some point in the second half of the first year, infants develop the cognitive ability for concepts required for attachment formation (Goldberg, 2000). In order to cognitively form the representations of the internal-working models, people need selective attention to information, obtaining or limiting access to it, in order to predict what will happen in the future and plan their actions accordingly (Main, Kaplan, & Cassidy, 1985).

Studies of attention regulation in psychology mainly focus on examining mechanisms through tasks that require different attention functions, including maintaining vigilance to external events, selecting among information, or excluding attention from conflicting signals (Broadbent, 1958; Rueda, Posner, &

Rothbart, 2004; Titchener, 1909). In the natural world with plethora of visual signals and information, attention regulation serves to select the input that influences behaviors greatly (Corbetta & Shulman, 2002; Posner, 1980).

Over the first year of life, whereas emotion regulation emerges from early on (Harman, Rothbart, & Posner, 1997), attention regulation might come about later. In fact, findings of fMRI studies regarding attention regulation suggest that attention regulation requires not only the sensory part of the brain, but also the areas related to processing of words, storing information, and generating emotions (Posner & Raichle, 1994, 1998).

Differences in the attention regulation, through which mental representations are formed along with cognitive development, are the important features of attachment patterns (Goldberg, 2000).

Joint Attention as Attention Regulation

Joint attention refers to the ability to share or coordinate attention with a social partner such as the mother (Bakeman & Adamson, 1984; Bruner, 1981; Mundy & Gomes, 1997; Tomasello, 1995). As infants' social cognition advances in the first year of life, infants make a remarkable move from face-to-face

interactions to interactions involving other objects in the surroundings (Kaye & Fogel, 1980; Travarthem & Hubly, 1978). In this period, infants' joint attention emerges by the ninth month, enabling them to alternate looks between the social partner and objects, use communicative gestures, and follow the gaze of the other person (Tomasello, 1999a, 1999b). Since then, infants' joint attention with a social partner develops rapidly for the last quarter of the first year (Tomasello, Kruger, & Ratner, 1993).

The joint attention with the mother during the free-play can be divided into two types: supported joint attention and coordinated joint attention (Bakeman & Adamson, 1984). Supported joint attention is a type of joint attention where the infant and the mother are engaging in the same object, but the infant does not display much awareness of the mother's participation or even her presence. Mothers actively try to engage their infants into this state by manipulating the given toys to lure the infants' attention. The second type of joint attention with the mother is called coordinated joint attention, where the infant is engaged both with the object and the mother. In this state, the infant coordinates his or her attention to the object and the mother, acknowledging her participation and presence in the interaction. Carpenter & Liebal (2011) referred to the coordinated joint attention as "truly joint".

Brune (2004) argued that in order for the infant to manifest joint attention,

he or she needs to possess three types of competences. First is the comprehension of attentional relation, the ability to understand that the other person is paying attention to a specific object. Furthermore, the infant needs to have competence in social engagement, the ability to follow the other person's attention and draw that person into his or her own attention. The final component of joint attention is attention regulation. In other words, the infant should be able to not only understand another person's intention and engage socially, but also have competence to regulate his or her own attention towards the object and the social partner. Therefore, joint attention is an indicator of the infant's attention regulation ability in the social interaction contexts.

Joint Attention and Attachment Security

Only a scant number of studies investigated the link between joint attention and attachment security. In one study by Claussen, Mundy, Mallik, & Wiloughby (2002), infants' joint attention at 12 and 18 months measured in a 20 minutes videotaped structured assessment (ESCS; Mundy, Hogan, & Doehring, 1996; Seibert, Hogan, & Mundy, 1982) was analyzed in relation to the quality of attachment status with the mother when they were 15 months of age. Results

showed that the infants classified as disorganized attachment with the mother were less likely to initiate joint attention at 18 months. However, such trend was not found for joint attention at 12 months. Another study (Meins, Fernyhough, Arnott, Vittorini, & Turner, 2011), infants' joint attention with the stranger was assessed with the same method as above when they were 8 and 15 months of age, and their attachment security and joint attention with the mother was measured at 15 months. The findings revealed that low levels of joint attention behaviors with the mother such as pointing, showing, and giving were associated with the insecure-avoidant attachment. In these studies, however, joint attention was not distinguished between supported joint attention and coordinated joint attention. Therefore, further investigations using the method of free-play observations are needed in order to distinct contributions of supported joint attention and coordinated joint attention.

Moreover, few studies examined the links between infants' responses in the still-face paradigm and joint attention. According to Striano & Rochat (1999), infants who demonstrated more engaging behaviors with the experimenter during the still-face paradigm also showed the most joint attention behaviors such as joint engagement, attention following, and attention monitoring at 7 and 10 months of age. In another study conducted by Yazbek & D'Entremont (2006), infants who showed more still-face effect at 6 months were more likely to follow

the attention of the social partner. Although paucity of the related studies makes it difficult to determine the patterns of these associations, it is worthwhile to examine the links between these two regulation behaviors and their contributions to attachment security with the mother.

The Current Study

The current study investigated the relationship between infant-mother attachment and infants' early regulation capacities in different interaction contexts. For the infant's regulation competences, emotion regulation in the still-face paradigm at 6 months and attention regulation in joint attention at 9 months were chosen, because they are types of regulation prominent in each age (Moore et al., 2001; Tomasello, 1999a, 1999b). Moreover, the infant-mother attachment security was measured at the age of 12 months, because by that time, the attachment system is known to be solidified as a 'clear-cut attachment' (Bowlby, 1969).

Previous studies regarding the relationship between regulation and attachment mainly focused on a single context of interaction for regulation, which signifies the need for considering infants' regulation across the different interaction contexts (Braungart-Rieker et al., 2014; Braungart-Rieker, 2001). Only few studies considered the descriptive characteristics of infants' behaviors in the still-face paradigm and joint attention in terms of attachment. Fewer studies found the link between infants' different regulation competences. Therefore, the main goal of the current study is to consider different types of infants' regulation and descriptive qualities of each in relation to attachment.

The following research questions were the focus of the study:

1. Investigation of the relationship between infants' regulation competences and attachment security with the mother
    1) Do early emotion regulation and attention regulation both affect attachment security?
    2) Is one type of regulation more related to the attachment security than the other?
    3) How do they differ in their contributions to attachment security?

2. Descriptive qualities of emotion regulation and attachment
    1) Are different emotion regulation behaviors in the still-face paradigm related to one another?
    2) How are emotion regulation behaviors related to attachment security?
    3) How do the emotion regulation behaviors in the beginning, middle, and end of the still-face episode differ in their associations with attachment security?

3. Descriptive qualities of joint attention and attachment
    1) Are supported joint attention and coordinated joint attention related to one another?
    2) How are these two joint attention related to attachment security differently?

4. Link among emotion regulation, joint attention, and attachment security
    1) Are these variables linked to each other?
    2) Does joint attention moderate the relationship between emotion regulation and attachment security?

Method

1. Participants

81 mother-infant dyads (45 girls, 36 boys) visited the laboratory to participate in the present study. They were participants of a longitudinal study since they were 1 month old, and were assessed at 6, 9, and 12 months for the current study. 20 of the infants were excluded from the study because they cried or showed extreme frustration at 6 months' still-face procedure. Of the remaining dyads, a total of 52 dyads remained in the study until the last visit at 12 months.

The average age of the infants who were included in the study were 6 months, 9 months, and 12 months, respectively. Most of the mothers (75.6%) attended college or received education above college.

2. Procedures and Measures

All of the procedures for the present study were conducted in a laboratory at a university. Still-face paradigm at 6 months lasted for

approximately 5 minutes. Mother was informed about the experiment before the procedure began. After receiving the explanation, she went into the laboratory with her infant, put the infant on the chair in the laboratory, and sat down on a chair across the infant to face him/her. Joint attention at 9 months was measured in a free-play situation, in which mother and infant played with the given toys in the laboratory. The observation lasted for about 10 minutes. Both experiments were recorded by video cameras. Attachment security at 12 months was reported by mothers via Attachment Q-Sort (Waters, 1987).

2-1. Emotion Regulation: Still-Face Paradigm

Still-Face Paradigm Procedure

Infants' emotion regulation was assessed with still-face paradigm devised by Tronick and his colleagues (1978). In order to conduct the experiment, infant's chair was attached to a board that is 75cm high and 46cm wide in a room that is 340 x 340 cm size. Infant was placed on the chair and was secured with belt. The distance between mother and infant was about 70cm. The chair's height was adjusted so that mother and infant could face each other.

One camera was placed behind the curtain in the back of the right side of mother to shoot the infant's face and mother's hand. The second camera was set in front of mother's left side to film mother's facial expressions and gestures.

After the experimenter gave signal, mother began interaction with the infant. After 90 seconds, experimenter tapped on the table to signal the mother to continue to the still-face episode. During this episode, mother smiled mildly for few seconds and kept the neutral "still-face" without making any vocal expression or touching the infant. After 90 seconds, experimenter gave signals again, and mother resumed normal interaction with her infant.

One experimenter and three other assistants who were trained for the experiment took turn to record the interaction with the cameras.

Coding of Still-Face Paradigm

Based on the previous studies (Tarabulsy et al., 2003; Toda & Fogel, 1993), infants' responses were classified into positive affect expression, negative affect expression, and self-comforting behaviors. Infant's responses were considered as positive affect expressions if infant demonstrated positive vocalization, smile or

laughter. Negative affect expression was coded if infant exhibited negative vocalization less than 5 seconds, negative facial expression, fusses, frowns or distress. Self-comforting behaviors were coded if infant showed self-soothing behaviors such as sucking on his or her thumb or gazed away from mother to see something else on the wall. The descriptions in detail are shown in table 1.

Infants' responses during still-face episode were coded every 10 seconds. Frequency for each category was scored. For total of 90 seconds of still-face episode, scores for each category was also divided into beginning (0-30 seconds), middle (31-60 seconds), and end (61-90 seconds).

Coding for still-face responses was performed by two undergraduate students who were not aware of the experiment and whose major was different. They were trained by an experimenter. On the first day, experimenter explained to the coders about definitions of positive affect expression, negative affect expression, and self-comforting behaviors for 90 minutes. Examples were shown with the videotapes of the experiment. On the following day, experimenter checked if coders correctly made distinctions among three categories of infants' responses as they pointed out each behavior in the videotapes to the experimenter. The second training also took about 60 minutes.

In order to check the inter-coder reliability, responses of 25% of infants were coded repeatedly. The inter-rater reliability for each behavior was .84 for

positive affect expression, .92 for negative affect expression, and .96 for self-comforting behaviors.

Table 1. *Categories of infant's responses during the still-face episode* (Kim & Kwak, 2009; Tarabulsy et al., 2003; Toda & Fogei, 1993)

Categories	Examples of behaviors
Positive Affect Expression	· Positive vocalizations which may be accompanied by expressions of interest or surprise. · Positive affect with squinted eyes.
Negative Affect Expression	· Fusses: Negative vocalizations (cries, whines, or vocal expressions of discomfort) that did not last more than 5 seconds). · Frowns: Facial expressions of discomfort. · Extended fusses: Behaviors coded as fusses but that lasted more than 5 seconds. · Moderate distress: Behaviors coded as fusses which include expressions of sadness, anger or fear. Crying. · Extreme distress: Behaviors coded as extended fusses or intense cries
Self-Comforting Behaviors	· Behaviors which included thumb or finger-sucking, playing with a part of the infant seat or clothing. · Gazes away from mother to focus on something on the wall.

2-2. Attention Regulation: Joint Attention

Joint Attention Procedure

Mother-infant dyads visited the laboratory when the infants were 9 months old to participate in a free-play. The procedure for the free-play situation was based on that of Bakeman & Adamson(1984).

For mother-infant free-play situation, a ball, a picture book, two toy telephones, and a set of house play toys. Mothers were instructed to play with their infants freely as usual. Mother and infant sat down facing each other with the prepared toys in a basket between them. The free-play procedure continued approximately for 10 minutes. A video camera was set outside the play room to record their interactions.

Coding of Joint Attention

Two observers who were previously trained according to the coding scheme of Bakeman and Adamson(1984) coded infant's attention during mother-infant interaction for the free-play situation.

Out of 10 minutes of recorded free-play, 5 minutes in the middle excluding first 2 minutes and last 3 minutes were used for coding and analysis, because it takes a while for infants to get adjusted to a new environment and play like they usually do at home. Furthermore, due to infants' young age, their attention was dispersed as time passed, or some of them were moving outside the camera angle at the end of the episode.

Observers divided those 5 minutes into 5 seconds' segments and classified infants' attention states which lasted for more than 3 seconds into the following 6 categories: unengaged, on-looking, person-engagement, object-engagement, supported joint attention, and coordinated joint attention. The specifics of the classifications are represented in table 2. These categories are mutually exclusive periods that are described by the infant's engagement with objects and/or other person in the environment.

Among these six categories, supported joint attention and coordinated joint attention indicate two different types of joint attention. Supported joint attention is when the infant is actively engaged in the same object with the mother, but there is little awareness of the mother's involvement. This type of joint attention is more prominent in infants who are at this age of 9 months. Coordinated joint attention, on the other hand, indicates the type of joint attention where the infant is "actively involved with and coordinates his or her

attention to both another person and the object that person is involved with" (Bakeman & Adamson, 1984), and thus, is a true form of joint attention (Carpenter & Liebal, 2011). For the current study, supported joint attention and coordinated joint attention were used for analysis.

The inter-coder reliability was established by repeated coding procedure of 10 participants. The reliability among raters was .64 in Kappa.

Table 2. *Classifications of infant's attention states during free-play* (Bakeman & Adamson, 1984; Jeong & Kwak, 2005)

Categories	Definition	Examples of Behaviors
Unengaged	The infant seems uninvolved with any person, object, or activity.	· Sits still and is uninterested in anything. · Scans the environment.
Onlooking	The infant observes another person's activity, and yet is not partaking in the activity.	· Looks at the mother playing with toys.
People Engaged	The infant is engaged only with the other person without showing any interest in the other objects in the environment.	· Pays attention only to the mother's eyes or body.
Object Engaged	The infant actively explores the environment and pays attention to the objects only.	· Focuses on the toys in hand and plays with them only.

Supported Joint Attention	The infant and the other person are actively attending the same object, but the baby exhibits little awareness in the other person's participation.	· The infant is involved in the toys and plays with them, while the mother looks at the infant and the toys and helps the infant. However, the infant is not aware of the mother's attention and only focuses on the toys.
Coordinated Joint Attention	The infant is actively engaged with and coordinates his or her attention to both the other person and the object the person is involved with.	· The infant and the mother alternate their stares between each other and the toy. · The infant points to the toy and looks at the mother. · The mother responses by looking at the toy with the infant.

2-3. Attachment Security: Attachment Q-Sort

Attachment Q-Sort (AQS; Revision 3.0: Waters, 1987), which was developed by Waters and Dean (1985), was used to measure the attachment security. The experimenter visited the participants' homes when the infants reached the age of 12 months. Mothers received instructions on how to sort the given cards based on infants' behaviors at home.

The AQS has several benefits in that it provides the attachment scores as a continuous variable, it may have higher ecological validity because it is based on

observations in the home, and it is not stressful by nature (van IJzendoorn, Vereijken, Bakermans-Kranenburg, & Riksen-Walraven, 2004). The AQS consists of 90 cards which describe the infant's attachment-related behaviors. For example, the items include statements such as "child readily shares with mother or lets her hold things if she asks to" or "when he is upset or injured, child will accept comforting from adults other than mother" (Waters, 1987). These items are sorted into piles which range from the most descriptive of the participant to the least descriptive of the participant. This process is usually performed in several steps; mothers sort the cards into three piles and then subdivide them into nine piles (Waters & Dean, 1985; Waters, 1987).

The scores for attachment security are derived by comparing the results with the behavioral profile of a secure child described by the attachment experts. The comparison is made by calculating the correlation between the AQS score and the score of the prototypically secure child described by the experts. Therefore, the range of the AQS score is from -1.0 to +1.0, in other word, from the perfect negative correlation to the perfect positive correlation. The AQS scores indicate to what degree the child fits the description of a secure child, and thus, there is no distinction between secure and insecure children (van IJzendoorn et al., 2004).

Results

In the current study, infants' regulation capacities in early infancy were examined in relation to attachment security. First, descriptive statistics of infants' emotion regulation and attention regulation were provided. Their emotion regulation at the age of 6 months was subdivided into positive affect expressions, negative affect expressions, and self-comforting behaviors, which were further divided into beginning, middle, and end. Infants' attention regulation was divided into supported joint attention and coordinated joint attention. Secondly, the relationship between emotion regulation and attention regulation was examined. Correlation analyses and multiple regression analyses were performed for the investigation. Next, the associations between infants' regulation and attachment security were examined. Again, the correlation analyses and multiple regression analyses were conducted in order to find the relationship. Total scores of infants' emotion regulation behaviors were included in the multiple regression analysis first, and then the subdivided scores were entered into the second multiple regression equation. Lastly, moderation analyses were performed in order to reveal how attention regulation moderates the relationship between infants' emotion regulation and attachment security.

1. Descriptive Statistics: Emotion Regulation, Attention Regulation, and Attachment Security

Table 3 presents the descriptive statistics for emotion regulation measured by still-face paradigm at 6 months, attention regulation measured by joint attention at 9 months and attachment security measured with the Q-Sort at 12 months.

In still-face episode, infants demonstrated self-comforting behaviors (M = 7.42, SD=3.63) the most, followed by negative affect expressions (M = 4.96, SD=4.78). The least prevalent among three types of responses was positive affect expressions (M = 1.37, SD=1.81). For joint attention, infants demonstrated supported joint attention (M = 21.92, SD=11.51) more frequently than coordinated joint attention (M = 2.16, SD=3.39). The mean score for attachment security at 12 months of age was .17 with standard deviation of .19.

Table 3. *Descriptive statistics of Emotion Regulation, Attention Regulation, and Attachment Security*

Measure	Mean	S.D.	Range
Responses in SF paradigm at 6 months			
Positive affect expression(PE)_total	1.37	1.81	0-7
PE_beg	.53	.93	0-4
PE_mid	.39	.84	0-3
PE_end	.45	.81	0-3
Negative affect expression(NE)_total	4.96	4.78	0-18
NE_beg	1.41	1.76	0-6
NE_ mid	1.71	1.85	0-6
NE_end	1.83	1.96	0-6
Self-comforting behaviors(SC)_total	7.42	3.63	0-15
SC_beg	2.57	1.43	0-6
SC_mid	2.42	1.24	0-5
SC_end	2.47	1.48	0-6
Joint attention at 9 months			
Supported joint attention (SJA)	21.92	11.51	0-48
Coordinated joint attention (CJA)	2.16	3.39	0-14
Attachment security at 12 months (Secure)	.17	.19	-.46-.61

Note. _beg=first 30 seconds of still-face episode; _mid=second 30 seconds of still-face episode, _end=last 30 seconds of still-face episode

The bivariate correlations among still-face responses are presented in table 4. Total score of positive affect expressions had significant negative correlation with total score of negative affect expressions (r = -.31, p < .05), and yet, it did not show any significant correlation with total score of self-comforting behaviors. Furthermore, only the score of positive affect expressions in the end was negatively correlated with the total score of negative affect expressions (r = -.30, p < .05) and the end score of negative affect expressions (r = .-31, p < .05). Total score of negative affect expressions was negatively correlated with total score of self-comforting behaviors (r = -.64, p < .01). Additionally, all of the scores of the negative affect expressions had negative correlations with all of the scores of self-comforting behaviors as shown in table 4. Supported joint attention at 9 months of age was positively correlated with coordinated joint attention (r = .32, p < .05).

Table 4. *Correlations among Response in Still-Face Paradigm*

	1	2	3	4	5	6	7	8	9	10	11	12
1. PE_total	-	**.64****	**.76****	**.70****	**-.26***	**-.31***	-.24	-.13	-.03	-.00	-.04	-.06
2. PE_beg		-	.18	.08	-.02	-.24	-.03	.19	-.25	-.20	-.16	**-.29***
3. PE_mid			-	**.45****	-.24	-.18	-.24	-.21	.12	.12	.01	.15
4. PE_end				-	**-.30***	-.21	-.26	**-.31***	.06	.07	.06	.03
5. NE_total					-	**.86****	**.90****	**.81****	**-.64****	**-.62****	**-.57****	**-.47****
6. NE_beg						-	**.76****	**.48****	**-.56****	**-.60****	**-.54****	**-.30***
7. NE_mid							-	**.58****	**-.51****	**-.46****	**-.51****	**-.34***
8. NE_end								-	**-.60****	**-.55****	**-.43****	**-.56****
9. SC_total									-	**.87****	**.86****	**.85****
10. SC_beg										-	**.67****	**.56****
11. SC_mid											-	**.59****
12. SC_end												-

Note. PE=positive affect expressions; NE=negative affect expressions; SC=self-comforting behaviors; _beg=first 30 seconds of still-face episode; _mid=second 30 seconds of still-face episode; _end=last 30 seconds of still-face episode

*$p<.05$. **$p<.0$

2. Relationship between Emotion Regulation and Attention Regulation

Bivariate relationships between emotion regulation at 6 months and attention regulation at 9 months are presented in table 5. Coordinated joint attention at 9 months was not related to any of the infant's responses during the still-face episode at 6 months. However, for supported joint attention, negative correlation was found with negative affect expressions in the beginning (r = -.32, p < .05). In addition, negative correlation between supported joint attention and total score of negative affect expressions was marginally significant (r = -.24, p = .08). Furthermore, there were positive correlation between supported joint attention and self-comforting behaviors in the beginning (r = -.33, p < .05) and marginally significant positive correlation between supported joint attention and self-comforting behaviors' total score (r = -.24, p = .08).

Table 5. *Correlations between Infants' Responses in SF Paradigm and Joint Attention*

	Supported Joint Attention	**Coordinated Joint Attention**
Positive affect expression total	.03	-.13
PE_beg	.10	-.01
PE_mid	-.03	-.18
PE_end	.01	-.07
Negative affect expression total	**-.24**	-.10
NE_beg	**-.32***	-.03
NE_mid	-.13	-.01
NE_end	-.18	-.21
Self-comforting behaviors total	**.24**	.10
SC_beg	**.33***	.17
SC_mid	.16	.02
SC_end	.16	.15

Note. PE=positive affect expressions; NE=negative affect expressions; SC=self-comforting behaviors; _beg=first 30 seconds of still-face episode; _mid=second 30 seconds of still-face episode; _end=last 30 seconds of still-face episode
*$p<.05$.

In order to find out if the infant's responses during still-face episode at 6 months could predict joint attention at 9 months, a multiple regression was performed with negative affect expressions in the beginning and self-comforting behaviors in the beginning as predictors of supported joint attention. These variables from still-face episode were selected because they had significant correlations with supported joint attention. However, they were not significant predictors of joint attention.

Table 6. *Multiple Regression Analysis for Joint Attention: SF Responses as Predictors*

Variable	B	SE	β	*t*	R^2
Supported Joint Attention					.13
NE_beg	-1.25	1.06	-.18	-1.17	
SC_beg	1.95	1.36	.22	1.42	

Note. NE=negative affect expressions; SC=self-comforting behaviors; _beg=first 30 seconds of still-face episode
*p<.05.

3. Relationship between Emotion and Attention Regulation and Attachment Security

Correlation analyses were performed between regulation (both emotion and attention) and attachment security (Table 7). Total score of positive affect expressions at 6 months was positively correlated with attachment security at 12 months (r = -.30, p < .05). Among the scores divided by time segment, especially positive affect expressions in last 30 seconds was positively correlated with attachment security (r = -.27, p < .05).

There was also positive correlation between total score of self-comforting behaviors and attachment security (r = .31, p < .05). More specifically, self-comforting behaviors in the middle was positively correlated with attachment security (r = .29, p < .05).

Among scores of negative affect expressions, the beginning score was marginally significant with negative correlation (r = -.22, p = .09).

Table 7. *Correlations among Infants' Responses in Still-Face Paradigm, Joint Attention, and Attachment Security*

	Attachment Security
PE_total	**.30***
PE_beg	.15
PE_mid	.20
PE_end	**.27***
NE_total	-.21
NE_beg	**-.22**
NE_mid	-.17
NE_end	-.15
SC_total	**.31***
SC_beg	**.24**
SC_mid	**.29***
SC_end	**.23**
Supported Joint Attention	.00
Coordinated Joint Attention	-.02

Note. PE=positive affect expressions; NE=negative affect expressions; SC=self-comforting behaviors; _total=total score; _beg=first 30 seconds of still-face episode; _mid=second 30 seconds of still-face episode; _end=last 30 seconds of still-face episode
*$p<.05$.

Multiple regression analyses were performed to examine which regulation variables significantly predict attachment security. First, total scores of the infant's responses during still-face episode that were significantly related to attachment security were entered. Next, subdivisions of these responses that were also significantly predicted attachment security,

The first model with total scores of still-face responses as predictors of attachment security was found to be significant, explaining 19% of the total variance of attachment security, $R^2 = .19$, F (2, 53) = 0.003, $p < .01$. Infants who showed more positive affect during the still-face episode ($\beta = .31$, $t = 2.52$, $p < .05$) were more securely attached to their mothers at 12 months of age. Also, infants who exhibited more self-comforting behaviors during the still-face episode ($\beta = .32$, $t = 2.61$, $p < .05$) were also more secure in their attachment with their mothers (Table 8).

The Second multiple regression analysis was performed with positive affect expression in the end and self-comforting behaviors in the middle as predictors of attachment security. The overall model significantly explained 13% of the variance of the infant's attachment security, $R^2 = .13$, F (2, 52) = 0.02, $p < .05$ (Table 9). Positive affect expressions in the end marginally predicted attachment security ($\beta = .25$, $t = 1.98$, $p = .05$). Self-comforting behaviors in the middle also marginally predicted attachment security ($\beta = .23$, $t = 1.83$, $p = .07$).

Table 8. *Multiple Regression Analysis for Attachment Security: Total Scores of Still-Face Responses as Predictors*

Variable	B	SE	β	*t*	R^2
Attachment Security					.19
PE_total	.03	.01	**.31***	2.52	
SC_total	.01	.00	**.32***	2.61	

Note. PE=positive affect expressions; SC=self-comforting behaviors; total=total score

*p<.05. **p<.01.

Table 9. *Multiple Regression Analysis for Attachment Security: Specific Scores of Still-Face Responses as Predictors*

Variable	B	SE	β	*t*	R^2
Attachment Security					.13
PE_end	.06	.03	**.25**	1.98	
SC_mid	.03	.02	**.23**	1.83	

Note. PE=positive affect expressions; SC=self-comforting behaviors; _mid=second 30 seconds of still-face episode; _end=last 30 seconds of still-face episode

*p<.05.

4. Moderation Analyses among Emotion Regulation, Attention Regulation and Attachment Security

Although direct relationship between joint attention and attachment security was not found in the current study, moderator analyses were performed in order to examine possible contribution of joint attention in the relationship between emotion regulation and attachment security.

Total scores of positive affect expressions and negative affect expressions were examined in the analyses. Two types of joint attention (supported joint attention and coordinated joint attention) were considered as moderator variables between still-face responses and attachment security.

As shown in table 10, the model with the total score of positive affect expressions as a predictor and coordinated joint attention as moderator was found to be significant, explaining 15% of the variance of the infant's attachment security, $R^2 = .15$, F (3, 49) = 2.97, $p < .05$. The interaction effect between the total score of positive affect expressions and coordinated joint attention was marginally significant ($p = .053$).

Table 10. *Multiple Regression Analyses for Interaction between Still-Face Responses and Joint Attention as Predictors of Attachment Security*

Variable	B	SE	β	*t*	R^2
Attachment Security					.14
PE_total	.02	/01	.26	**2.01**	
SJA	.00	.00	.01	.07	
PE_total * SJA	.00	.00	.23	**1.76**	
Attachment Security					.15
PE_total	.04	.01	.43	**2.88****	
CJA	.00	.00	.16	1.08	
PE_total * CJA	.01	.00	.32	**1.98**	
Attachment Security					.04
SC_total	.01	.00	.22	1.50	
SJA	-.00	.00	-.09	-.59	
SC_total * SJA	.00	.00	-.10	-.68	
Attachment Security					.03
SC_total	.01	.00	.20	1.32	
CJA	.00	.00	-.06	-.34	
SC_total * CJA	.00	.00	.05	.29	

Note. PE=positive affect expressions; SC=self-comforting behaviors; total=total score; SJA=supported joint attention; CJA=coordinated joint attention
*p<.05. **p<.01.

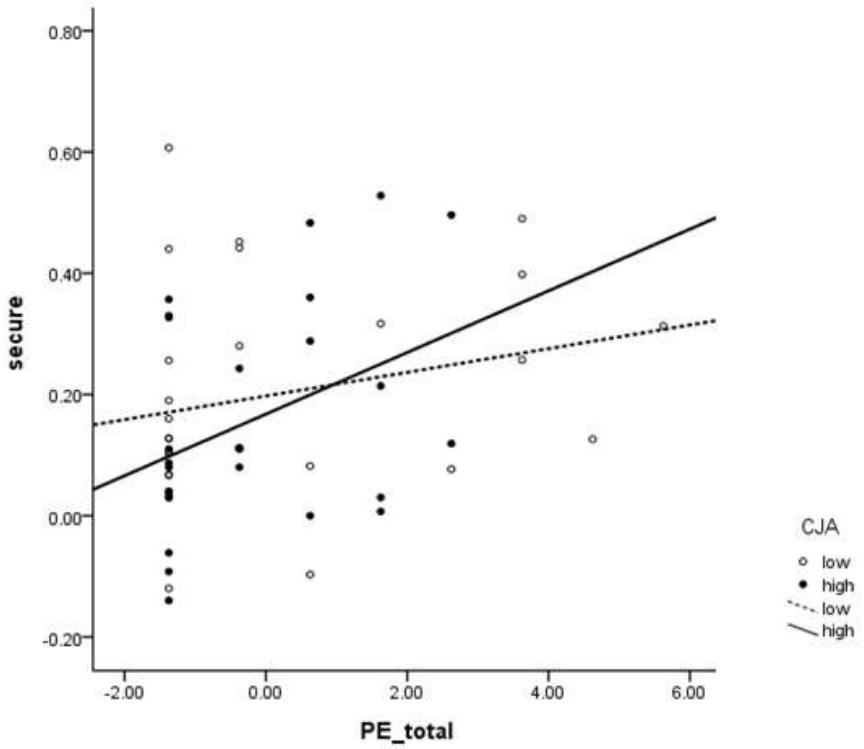

Figure 1. *Moderation Analysis: Coordinated Joint Attention as Moderator of the Relationship between Positive Affect Expressions and Attachment Security*

Discussion

1. Summary of Key Findings

The current study explored the relationship between the infants' regulation capacities and attachment security with the mother through a series of correlation analyses, multiple regression analyses, and moderator analyses. The results showed that attachment security was mainly associated with the components of emotion regulation, not attention regulation. This is probable because the attachment security especially involves the process of maintaining the secure feelings when faced with anxiety and fear (Sroufe & Waters, 1977).

Relationship between two regulation competences was examined. Results found that negative affect expressions in the beginning of the still-face episode was negatively correlated with supported joint attention, while self-comforting behaviors in the beginning was positively correlated with supported joint attention. However, they did not significantly predict the attachment security.

Infants' positive affect expressions and self-comforting behaviors predicted attachment security at 12 months, while no such association was found with negative affect expression. To be more specific, their positive affect

expressions at the end of the still-face episode and their self-comforting behaviors in the middle of the still-face episode both predicted the attachment security.

Although joint attention did not directly affect the attachment security, it moderated the relationship between emotion regulation and attachment security. To be exact, coordinated joint attention moderated the link between positive affect expressions and attachment security.

2. Emotion and Attention Regulation

Among the scores of three different responses in the still-face paradigm indicative of emotion regulation, positive affect expressions had the lowest mean scores, while self-comforting behaviors had the highest mean scores. Furthermore, descriptive results of these responses in beginning, middle, and end of the still-face episode demonstrated a trend consistent with the still-face effect, by showing the decrease of positive affect expressions from beginning to the end, and the increase of negative affect expressions from beginning to the end. Positive affect expression variables were negatively correlated with negative affect expressions and positively correlated with self-comforting behaviors. In

turn, negative affect expressions had negative correlations with self-comforting behaviors.

For joint attention indicating attention regulation, mean scores of supported joint attention was higher than coordinated joint attention, which is consistent with the previous findings that supported joint attention is more prominent at this point, while coordinated joint attention emerges at a slower rate (Bakeman & Adamson, 1984). Supported joint attention and coordinated joint attention were positively correlated with each other.

3. Emotion Regulation as Predictor of Attachment

Infants who showed more positive affect expressions during the still-face episode at 6 months were more securely attached to their mothers at 12 months. At the same time, infants who demonstrated more self-comforting behaviors were more secure in their attachment with mothers later. This finding confirms the previous research examining link between responses in the still-face paradigm and attachment security. Publications consistently show that positive affect during the still-face paradigm is associated with attachment security (Braungart et al., 2001; Cohn et al., 1991; Fuertes et al., 2006, 2009; Mesman et

al., 2009; Tronick et al., 1982). Furthermore, the link between self-comforting behaviors and attachment security supports the notion that regulatory capacities in the absence of the regulator may reflect the regulatory competence established through interactions with the mother (Tronick and Gianino, 1986).

For positive affect expressions, the score in the end of the still-face episode predicted the attachment security, whereas for self-comforting behaviors, score in the middle was significant predictor for attachment security. In other words, infants who maintained positive affect in the end of the still-face episode were more securely attached to their mother later. Main (1990) emphasized the strategy of positive affect expression because it is a "direct way to restore felt security." If the infant has built the internal working model with expectation that the mother will response effectively to the distress, the experience of such uncomfortable feelings will arouse the infant to continue the attempts to contact the mother. Therefore, the fact that the positive attempts to restore the interaction prolonged to the end of the still-face episode might indicate the infant's positive internal working model towards the mother.

Additionally, self-comforting behaviors in the middle of the still-face episode are also a plausible response of the infant who will later form secure attachment, because the infant might have captured the anomaly of the episode by then and effectively turned to their internally driven regulatory capacities

(Tronick and Gianino, 1986).

We may also pay attention to the absence of significant relationship between negative affect expressions and attachment security. One might expect that the negative correlation would exist between these two variables. However, according to Cassidy (1994), the securely attached infant learns to express a wide range of emotions, not just positive emotions, because negative affect signals to the caregiver that the infant is in distress. Therefore, attachment security does not necessarily reflect lack of negative affect expressions.

4. Attention Regulation as Moderator between Emotion Regulation and Attachment Security

Another interesting finding was that there was a marginally significant moderation effect of coordinated joint attention in the relationship between the total score of positive affect expressions and attachment security. As indicated in figure 1, coordinated joint attention might strengthen the relationship between the other two variables. In other words, for the infants who demonstrated high levels of coordinated joint attention, the positive relationship between positive affect expressions and attachment security was marginally stronger than the

infants who displayed low levels of coordinated joint attention.

Coordinated joint attention is a true form of joint attention (Carpenter & Liebal, 2011). Infants who demonstrate this type of joint attention actively coordinate the attention with their mother to engage in the third object. Although it develops at a relatively slower rate, coordinated joint attention effectively exposes attention regulation ability which leads to an array of later social and cognitive competences (Carpenter, Nagell, & Tomasello, 1998; Dunham, Dunham, & Curwin, 1993; Moore, 1996; Werner & Kaplan, 1963).

As mentioned earlier, the relationship between positive affect responses and attachment security was consistently found (Braungart et al., 2001; Cohn et al., 1991; Fuertes et al., 2006, 2009; Mesman et al., 2009; Tronick et al., 1982), because positive elicits and attempts to reengage the mother into interaction reflect the positive internal-working models of the mother. The finding of the current study suggests that coordinated joint attention might strengthen the relationship between these two variables.

Previous studies have suggested infants' propensity to share positive affect in joint attention context (Adamson & Bakeman, 1985; Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy, Kasari, & Sigman, 1992). For example, Adamson and Bakeman (1985) found that infants at the age of 6-18 months demonstrated high rates of positive affect when they jointly engaged with object and mothers.

Furthermore, Carpenter and Liebal (2011) argued that the mutual awareness of positive affect between infants and their mothers signals to the infants that they are mutually aware of the interactions. Therefore, coordinated joint attention may foster the proper context for sharing positive affect, which leads to positive internal-working model of infant-mother attachment.

Plus, secure attachment has been related to interactive competence (Thompson, 1999), while insecure and disorganized attachment classifications have been linked to poor interactive competences competence (Moss, St. Laurant, & Parent, 1999; Solomon and George 1999). Such interactive competence may develop as the mother and the infant actively participate in interactions with each other, possibly through coordinated joint attention (Raver & Leadbeater, 1995).

5. Implications and Limitations

There are several implications for the present study. First, the study provides a more integrated depiction of the association between attachment security and earlier regulation by considering multiple contexts of interactions with the caregiver. Second important implication of the study is that it provides descriptive qualities of each regulation variable and their distinct associations

with attachment security. Third, the study suggests possible influence of coordinated joint attention on the relationship between positive affect expressions and attachment security. Lastly, the study implies the possibility to use a combination of measuring tools in early infancy that can predict later social development.

The study found that although infant's attachment security is firmly established and can be measured by the first year since birth (Bowlby, 1969), their making of the attachment process can be successfully assessed even before the first year through their regulatory behaviors. The earlier regulation can be observed by and even prior to 6 months of age through their emotion regulatory responses in the still-face paradigm. By 9 months, their attention regulation can be also assessed with their joint attention ability. Crittenden (1995) argued that the security of attachment is achieved by balanced approach that combines both emotional and cognitive information. Although the association between joint attention and attachment is weak, the need for integrating different regulation abilities is addressed in the current study.

Moreover, the study focused on the descriptive qualities of each regulation variable. In the still-face paradigm, infants' responses were divided according to the time segments (the beginning, middle, and end). Their unique relationships to attachment security suggest that in addition to the type of responses, the timing

of those responses can be a proper indicator of attachment security.

Furthermore, the role of coordinated joint attention in the link between positive responses in the still-face episode and attachment suggests that the efforts of the infant and the mother to jointly coordinate attention can strengthen the tie between positive attachment representations and attachment security. Coordinated joint attention requires paying attention to the caregiver and the object in the surroundings, and this integration of attention is acquired slowly in infancy (Bakeman & Adamson, 1984). However, it is known to foster different social and cognitive abilities, providing opportunities to learn about the reciprocity of interactions, important information concerning the object and the environment (Bakeman & Adamson, 1984; Baldwin, 1995; Carpenter, Nagell, & Tomasello, 1998; Hesse & Main, 2006). Therefore, efforts to develop the coordinated joint attention might be helpful in promoting the positive internal-working models the infants already have.

Additionally, the study used tools to measure infants' regulation even as early as 6 months in order to predict the attachment security, a base for later relationships and social development. At 6 months of age, infants' emotion regulation was measured using the still-face paradigm, which was Infants' responses in the still-face paradigm were known to predict not only the attachment security with the mother but also a variety of social-emotional

variables, which includes internalizing and problems (Moore et al., 2001), social-emotional behaviors (Kim & Kwak, 2009), and compliance (Hill & Braungart-Rieker, 2002). Joint attention measured in infancy was also found to be related to social cognition (Carpenter et al., 1998; Tomasello, 1995) and affect regulation in infancy (Morales et al., 2005). In addition, joint attention was also associated with variables measured in early childhood such as theory of mind (Kim, Jeong, & Kwak, 2009; Aschersleben, Hofer, & Jovanovic, 2008; Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2000; Mundy, Sigman, & Kasari, 1994), and social competence (Hecke, Mundy, Acra, Block, Delgado, Parlade, Meyer, Neal, & Pomares, 2007). Furthermore, a number of studies support the associations between joint attention and autism; autistic children were less capable of joint attention than their normally developing counterparts (Bono, Daley, Sigman, 2004; Bruinsma, Koegel, & Koegel, 2004; Delinicolas & Young, 2007; Goldsmith & Rogoff, 1997; Landry, 1995; Rauner, 2002; Raver & Leadbeater, 1995). Thus, the measures in the current study are implied to be used in early infancy as screening tools for later social-emotional development, problem behaviors, and even disorders.

The study also has several limitations. First, although the study focused on the infants' responses during the still-face episode, their responses in all three episodes of the still-face paradigm would provide a better picture of the dynamic

nature of their regulation. Especially, their regulatory behaviors in the reunion episode would be helpful to detect signals of their internal working models of infant-mother attachment. In addition, the study used the Attachment Q-Sort (Waters, 1987) to measure the attachment security between the infant and the mother. The attachment security is taken as a continuous variable in this method to provide the degrees of security. However, AQS is limited in a sense that it cannot distinguish the different attachment classifications. Furthermore, there is need to consider the infant's temperament and the mother's sensitivity (e.g., Kim & Kwak, 2005). Plus, other variables that can be measured in the still-face paradigm such as diverse treatments of the mother's touch (e.g., Kwak, Kim, & Jeong, 2005) can be investigated in terms of its relationship with later social-emotional development. Future studies regarding different regulation abilities and attachment can overcome such limitations by controlling for those variables in order to see the sole influence of the regulation on the attachment.

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국문초록

영아기 주 양육자인 어머니와의 애착은 다른 관계들로 이어지기 때문에 사회정서적 발달에 중요한 역할을 한다. 애착 이론가들은 어머니와의 애착은 생후 일 년이 되었을 때 굳어지며 측정 가능해진다고 주장한다. 그 전까지 영아들은 어머니와의 관계에 대한 내적 작동 모형을 어머니와의 반복적인 상호작용을 통해 발달한다. 생후 1 년 전 영아의 조절 능력은 이러한 내적 작동 모형을 반영하여 생후 1 년 때 애착 안정성과 연관성을 가진다.

본 연구는 영아의 12 개월 애착 안정성과 두 가지 다른 상호작용 맥락에서 영아의 조절 능력과의 연관성을 살펴보았는데, 바로 6 개월 still-face 패러다임에서 영아의 정서조절과 9 개월 공동주의에서 영아의 주의조절을 살펴보았다. 그 결과, 6 개월 still-face 패러다임에서 영아의 긍정적 정서 표현과 자기조절 행동은 이후 9 개월 지지적 공동주의 및 12 개월 애착 안정성과 정적 상관이 있는 것으로 나타났다. 중다회귀분석 결과, 6 개월 때의 같은 변인들이 12 개월 애착 안정성을 예측하는 것으로 나타났다. 추가적으로, 영아의 6 개월의 긍정적 정서 표현과 12 개월의 애착 안정성 간의 관계에서 9 개월의 협응적 공동주의가 근접하게 유의한 조절 변인으로 작용하는 것으로 나타났다.

주요어: still-face 패러다임, 정서 조절, 공동주의, 주의 조절, 내적 작동 모형, 애착

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