Universiteit Leiden

Infants' Monitoring of Social Interactions: The Effect of Attachment

Aranka A. M. Elstgeest
S1154001

Algemene en Gezinspedagogiek
Leiden University
Supervisor: Szilvia Biro
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Abstract

It has been hypothesized that infants create, based on earlier experiences, expectations about the behavior and responsiveness of caregivers (Bowlby, 1982). We tested whether attachment security has an influence on 12-month-old infants' monitoring patterns of social interactions. We showed them animations which involved a separation of a small oval figure and a large oval figure. During this separation and the following response (returning or leaving) either a crying or a laughter sound was played. Eye-tracking was used to examine infants' looking pattern at the large figure, only during the separation segment. It showed that attachment security influenced the monitoring pattern of infants. Securely attached infants tended to look longer at the large figure than insecurely attached infants. We also found that securely attached infants fixated longer at the large figure during the separation in the last four movies than insecurely attached infants, but only when the large figure was unresponsive. These results suggest that secure and insecure infants have differential experiences with, and expectations about, the behavior and responsiveness of caregivers, which reflects in their monitoring of social interactions.

Keywords

Eye-tracking, attachment, information-processing, infant social cognition

Introduction

There is a lot of variety between infants in their proclivity to seek proximity and accept comfort and protection from their caregivers. One infant might rush to his or her mother to seek comfort when upset, while another infant might just turn away and refuse to be comforted (Johnson, Dweck, Chen, Ok, Stern, & Barth., 2010). Developmentalist Mary Ainsworth designed the Strange Situation procedure to capture these individual differences (Ainsworth, Blehar, Water, & Wall., 1978), guided by the theories of John Bowlby (1958, 1982). To this day Ainsworth's procedure remains one of the main instruments in the field. Infants classified as *securely* attached, according to the original descriptions (Ainsworth et al., 1978), easily seek proximity and accept comfort from their parents, probably due to sensitive and responsive caregiving (Main, 1995). Infants who are unwilling to seek proximity and comfort and avoid or ignore their parents are classified as *insecure-avoidant*, probably due to rejection from their parents. Finally, infants classified as *insecure-resistant* seek proximity and comfort but can't easily be settled by the parent, probably due to inconsistent caregiving. In line with this description de Wolff and van IJzendoorn (1997) found that infants are more likely to be securely attached when they have sensitive and responsive parents, than infants with parents who are insensitive and unresponsive. The behavior infants show in the Strange situation procedure is called *attachment behavior*. Attachment behavior is "any form of behavior that results in an infant attaining or maintaining proximity to the caregiver who is better able to cope with the world" (Bowlby, 1982, p. 668). These behaviors are most obvious whenever the infant is frightened or in distress.

Besides the variety between infants in their behavior, infants have differential experiences about the behavior of their parents or other adults. One infant might have the experience that in general parents or adults are responsive, while another infant might have the experience that they are not (Johnson & Chen, 2011). Bowlby (1982) argued that these

sorts of expectations stem from infant's early attachment experiences and internal working models of what they expect of and from the behavior of themselves, their caregiver(s) and other significant persons. The child's processing of social experiences has been thought to be influenced by these internal working models and to allow the child to adapt to, anticipate to and plan for his or her social world (Bowlby, 1982). Johnson and Chen (2011) stated in their latest work on socio-emotional information processing in infants that studies have found connections between children´s attachment security and their ideas of relationships. Infants with secure attachments are more likely to have more positive expectations of parental support and availability than insecurely attached infants (Bretherton, Ridgeway, & Cassidy, 1990; Cassidy, 1988; Fury, Carlson, & Sroufe, 1997; Main, Kaplan, & Cassidy, 1985; Ziv, Oppenheim, & Sagi-Schwartz, 2004). Infants who are insecurely attached tend to expect rejection or unresponsiveness in parent-child relationships. Other researchers found that securely attached infants are, more than insecurely attached infants, able to predict the negative emotions of another infant when that infants is separated from his or her parents (Bar-Haim, Sutton, Fox, & Marvin, 2000; Shouldice & Stevenson-Hinde, 1992).

In infancy, children are already part of social interactions but it will take some time before they are able to understand the mental states of the person who they are interacting with. The capacity to understand others' mental states: desires, perceptions, beliefs, intentions and so on (see Hughes, 2011), is called Theory of Mind. A lot of research has focused on the development of children's Theory of Mind. Laranjo, Bernier, Meins and Carlson (2014) investigated preschoolers and found that more securely attached boys, but not girls, performed better on a task in which it was necessary to understand the visual perspective of another person. Thus links between mother-child relationships and children's visual perspective taking abilities appear to be likely. The ability to take the visual perspectives of others is one

of the requisites for Theory of Mind or, in other words, to be able to understand that others' mental states can be different from one's own.

Besides the research on the Theory of Mind, many studies also investigated early understanding of social interactions by using the 'violation of expectation' method. This method is based on looking time differences during test events after habituation. It is known that infants are likely to look longer at new or unexpected events than at familiar or expected events (Spelke, 1985). Johnson, Dweck and Chen (2007) were the first researchers who were able to use the violation of expectation method to address individual differences in the domain of attachment relationships. They found that securely attached infants looked longer than insecurely attached infants at the test event in which the caregiver ignored the crying infant. For securely attached infants, an ignoring caregiver is the most unexpected or unfamiliar which makes them look longer at that test event. This study however had a small exploratory sample which makes it difficult to draw conclusions about the expectations of insecurely attached infants. Therefore, in 2010 Johnson and colleagues replicated their study with a larger sample size. The results of this study supported and clarified the findings of the earlier exploratory study in 2007. Depending on their attachment security, infants have different expectations about the responsiveness of a caregiver (Johnson et al., 2010). Secure infants expected the caregiver to be responsive, while insecure infants expected the caregiver to be unresponsive to the infants' cries.

To predict the behaviors of others, to form expectations about others' behavior and to prepare a reaction to particular behavior, it is necessary to be able to monitor social interactions of others (Biro, Alink, van IJzendoorn, & Bakermans-Kranenburg, 2014). Monitoring social interactions can provide information, for example about the goals or motives of the persons who are interacting. This information can affect the perception of the observed behavior and can influence which aspects of the situation deserves (more) attention.

A recent study by Biro and colleagues (2014) showed animated movies to 12-month-old infants (similar to the stimuli used in Johnson et al., 2007) to examine the effect of emotional cues (laughing or crying) on the monitoring of infants during the separation and the response segments of the movies. The result of this study was that infants looked longer at the larger figure during the separation when they heard the crying sound than when they heard the laughter sound, thus the crying sound drew the attention of the infant to the larger figure. This finding supported a *negativity bias* in information processing: the negative stimulus (i.e., crying) carries greater information value than positive stimulus (i.e., laughter), and thus greater attention is needed to process this information (Peeters & Czapinski, 1990).

In the current study 12-month-old infants were shown animated movies of social interactions (similar to the stimuli used in Biro et al., 2014) to investigate whether attachment security is related to the monitoring pattern of social interactions. At the beginning of the animations a large oval figure moved together with a small oval figure, then the small figure was left behind by the large figure. During the separation either the sound of a laughing or crying baby was played. After the separation the large figure moved further away from, or returned to the small figure (response segment). Infants' eye-movements were recorded to examine how they monitored the animations. Based on Bowlby's theory of internal working models (1982), which states that the relationship with a primary caregiver influences how we understand the social world around us, earlier research on the development of Theory of Mind, which showed a relationship between attachment and Theory of Mind abilities (Hughes, 2011; Laranjo et al., 2014) and the research of Johnson et al. (2007, 2010), it is hypothesized that securely and insecurely attached infants may show different patterns in their monitoring of social interactions. Thus we expect that attachment security can influence infants processing of social interaction.

In this study we focused on the separation segment only (where the large figure is on top of the first hill and the small figure is down the hill). Based on the finding of the study by Biro and colleagues (2013), we hypothesized that both securely and insecurely attached infants will look longer at the larger figure when they hear the crying sound, than when they hear the laughing sound. To be left behind can be a stressful or scary situation for the small figure. Because attachment behavior is most obvious whenever an infant is in distress or frightened (Bowlby, 1982), we hypothesize that differences between securely and insecurely attached infants in looking at the large figure will be more pronounced during the stressful social interaction between two animated figures.

It may also be possible that infants' monitoring will change during the repeated presentation of the movies because of familiarity with the display (Spelke, 1985) or because of associative learning. It is known that infants can associate objects with particular actions when they are 10 months old (Perone & Oakes, 2006). Because of this, it is interesting to explore whether infants in the current study could have learned that the large figure with a particular color (either red or dark blue) is the future returning figure or the future leaving figure. The infants were shown eight movies which were divided into two blocks of four movies each. To investigate whether infants' monitoring of the large figure, changed across repetitions, the looking pattern of both securely and insecurely attached infants in these two blocks were compared. If infants' looking at the large figure changes differently during the separation with the two types of future responses across the two blocks, it might indicate that infants associated the color with the future response of the large figure and this influenced their looking pattern. It is hypothesized that the changes in the looking pattern of securely and insecurely attached infants across repetition differ.

Method

Participants

The sample of this study was drawn from a larger study, our sample consisted of 40 healthy infants (17 boys and 23 girls, mean age = 12.49 months, *SD* = 0.29 months, range = 11.87-13.20 months). The mean age of the infants' caregivers was 33.68 years (*SD* = 3.55 years) and 7 caregivers only completed primary or high school, 20 went to college and 13 had a masters degree or higher. The families who participated in this study received a letter by mail, addresses were provided by the city council. The caregivers who were willing to participate were called to make an appointment for the study at the University of Leiden. Before the experiment the caregivers signed informed-consent forms. After the experiment the infants received a gift and the caregivers received reimbursement for their travel expenses if they wanted to.

Eye-tracker Stimuli

Infants watched eight animations of two abstract figures: two oval shapes, a small (2 cm x 1.5 cm) shape and a large (3.5 cm x 2.5 cm) shape (see Figure 1). The figures were moving on an abstract hill. Each animation started with the two figures moving together (Start segment 2.6 sec). The large figure then moved up hill and stopped on a platform, the small figure tried to follow but slipped back and was therefore not able to follow the large figure (Uphill segment 2.1 sec). During the Separation segment (11 sec) the small figure is still down the hill and the large figure is on the platform uphill, during this segment the figures did not move. Upon separation in half of the movies the sound of a crying baby was played and in the other half of the movies the sound of a laughing baby was played. When the sound started to play the small figure expanded a little (2 mm) and contracted three times. The figure's

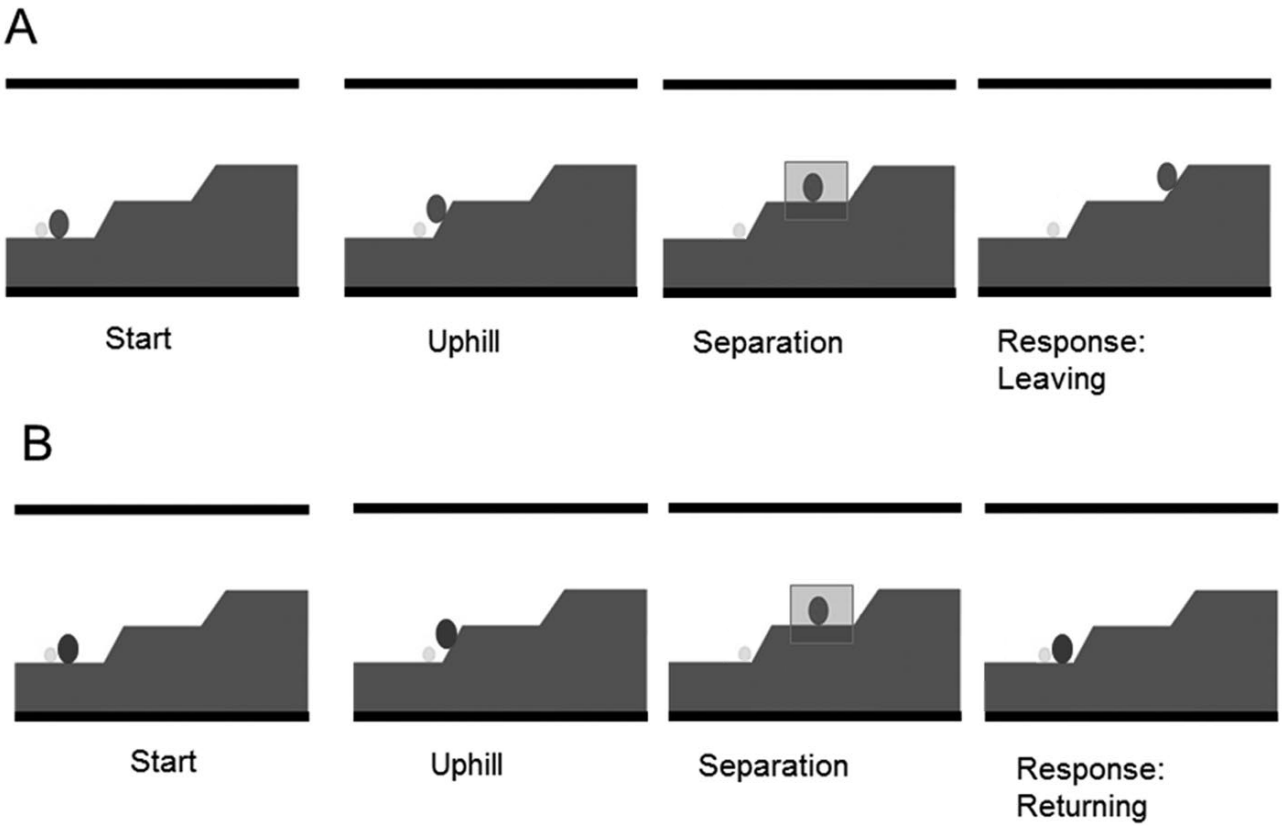

Figure 1. Frames of the animation: Start, Uphill, Separation, Leaving Response (A), and Returning Response (B) segments. Area of interest (AOI) for the large figure during the separation is shown.

color changed slightly together with the expansion and contraction (lasted for 2.8 sec), this gives the impression that the small figure is the source of the sound. In half of the movies the Separation segment was followed by the large figure moving down the hill and ending up next to the small figure (Return-response segment 4.3 sec), both for crying and laughter movies. In the other half of the movies (both for crying and laughter movies) the large figure moved further up the next hill and stayed on top of that platform (Leaving-response segment 4.3 sec). The color of the small figure was always light blue. The color of the larger figure was in half of the movies (either for returning or for leaving response) dark blue and in half of the movies red. The color of the large figure was thus counterbalanced across responses.

The infants were randomly assigned to four order conditions. In the first block, the infants watched the four different movies starting with either two animations where the crying sound was played or two animations where the laughter sound was played. The response of the large figure varied between every trial starting with either leaving or returning. The four movies were repeated in the second block, the order of the emotional signals (crying or laughter sound) was the same as in the first four trials in the first block but the opposite order of the response for the large figure was used.

Procedure

We use a Tobii T120x eye-tracker (Tobii Technology AB, Sweden) to record the eye-movement pattern of the infants. During the presentation of the movies the infants sat in a booth on the lap of their caregiver. The booth was closed by a curtain and the lights were dimmed to make sure that there was minimal distraction for the infant. The infants were in front of the 17" TFT monitor with the integrated eye-tracker. The height of the chair and position of the monitor were adjusted so that the distance between the infants' eyes and the monitor was approximately 60 cm and the infant looked at the monitor at a straight angle. Tobii Studio software was used for the calibration and the presentation of the animations. Before the animations were played a 5-point infant calibration procedure was carried out, after the calibration the presentation of the animations started. There were four different short attention-getting movies, one of these was played between the animations to maintain the attention of the infant. Before the caregivers took place in the booth they were informed about the procedure and were instructed not to talk to the infant, and to try to keep the infant from moving. The caregivers were asked to wear blinded sunglasses during the procedure to make

sure that the eye-tracker recorded the infants' eye-movements and not the caregiver's and to avoid that the caregivers influenced their babies by seeing what happens on the screen.

After the eye-tracking experiment caregivers and infants participated in the Strange Situation Procedure (Ainsworth et al., 1978) in the laboratory. In this procedure an infant is confronted with a stressful situation which is divided into eight episodes. In the first episode the caregiver and infant are together in a room which is a novel environment for the infant, after a few minutes a stranger enters the room (episode 2) and sits down next to the caregiver, the stranger talks to the caregiver for a minute, plays with the infant and after three minutes the caregiver leaves the room for the first time. The infant and stranger are playing together for three minutes (episode 3) and then the caregiver returns. The stranger leaves the caregiver and infant alone in the room (episode 4) and after three minutes the caregiver leaves the room again, then only the infant is in the room (episode 5). The infant is alone for a maximum of three minutes (episode 6) but when the infant gets upset the stranger enters the room early to comfort the child and tries to engage in a playful interaction with the infant for three minutes (episode 7). After these three minutes (or earlier if the infant is still upset) the caregiver returns again and the stranger leaves the room, the caregiver and infant are again alone in the room for three minutes (episode 8). If the stranger cannot comfort the child in episode 7 the caregiver is sent in to the room early so the infant would not get too upset. So within twenty minutes the infant has to deal with a new environment, a stranger who is trying to engage in a playful interaction and the caregiver who is leaving and returning 2 times (Kroonenberg & van IJzendoorn, 1987). Therefore it is not surprising that the infant gets stressed and will express his or her emotions in this situation. In all episodes the behavior of the child is scored on a number of scales and variables. Based on these scores the infant is rated as having an insecure-avoidant (A), secure (B) or insecure-ambivalent (C) attachment relationship with the caregiver (Kroonenberg, Basford & van Dam, 1995). The sample investigated in this study is

too small to use the distinction between insecure-avoidant and insecure-ambivalent attached infants for the analysis, so in this study we examined differences between securely (B) and insecurely (A+C) attached infants. In this sample 22 infants were categorized as insecurely attached to their primary caregiver and 18 infants were categorized as securely attached.

Data Analysis

To analyze the data obtained from the eye-tracker, fixation measures were calculated using the Tobii Studio software. A fixation filter was used and the threshold of velocity and distance was set to 35 pixels. In this study we measured the duration of fixations at the large figure in the separation segment only. An area of interest (AOI) was defined, which covered the large figure. The AOI was 5.73% of the entire area. In particular, a fixation duration ratio was calculated in each animation, this ratio score is the duration of fixations at the AOI of the large figure relative to the total duration of fixations. The measures were further analyzed by using SPSS. Repeated measures ANOVA was carried out on the fixation duration ratios at the large AOI during the separation segment with response (unresponsive and responsive), emotion (cry and laughter) and block (first four and last four movies) as within-subject factors and security category (secure and insecure) as a between-subject factor.

Results

Preliminary analysis showed that gender of the infant, $F(1, 38) = .17$, $p = .68$, $\eta_p^2 = .01$, age of the infant, $F(1,38) = .03$, $p = .88$. $\eta_p^2 = .00$, or age of the caregiver $F(1,38) = 2.53$, $p = .12$, $\eta_p^2 = .06$, order condition, $F(1,36) = 1.51$, $p = .23$, $\eta_p^2 = .11$, color of the large figure, $F(1,38) = .02$, $p = .89$, $\eta_p^2 = .00$, and the education of the caregiver, $F(1,37) = 1.04$, $p = .36$, $\eta_p^2 = .05$,

did not have an effect on the fixation measure. Because they did not have any effect they were omitted from further analysis.

We found no main effects of emotion, $F(1,38) = .06$, $p = 0.82$, $\eta_p^2 = .001$, response, $F(1,38) = .32$, $p = .58$, $\eta_p^2 = .01$, or block, $F(1,38) = .29$, $p = .60$, $\eta_p^2 = .001$. However, a strong tendency for security category was found (see Figure 2), $F(1,38) = 3.80$, $p = .06$, $\eta_p^2 = .09$).

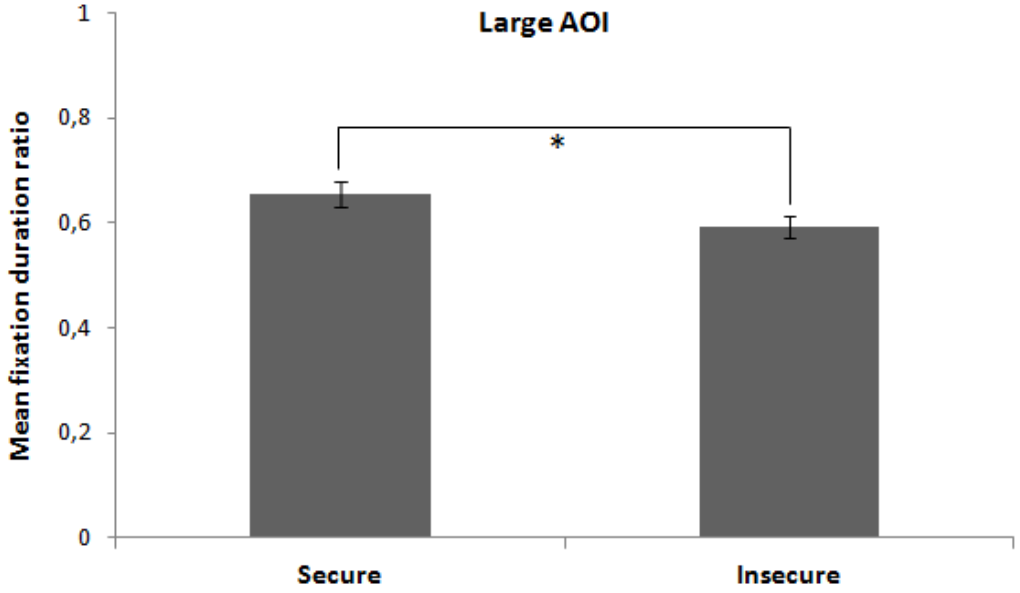

Figure 2. Mean duration fixation ratios for securely and insecurely attached infants at the large AOI in the separation segment (* $p < .10$).

This indicates that securely attached infants tend to look longer at the large figure than insecurely attached infants. A tendency for a three-way interaction was also found between response, security category and block, $F(1,38) = 3.76$, $p = .06$, $\eta_p^2 = .09$.

To explore this interaction further, repeated measures ANOVAs were carried out separately for the unresponsive and responsive animations with emotion and block as within-subjects factors and security category as a between-subject factor. For the responsive condition no significant interaction effect for security category and block was found, $F(1,38)$

= .15, p = .71, η_p^2 = .004. This indicates that there was no difference between infants who were securely and insecurely attached in duration of fixation at the large AOI when the figure was responsive, neither did they fixate differently in the first or second block. A significant interaction was however found during the unresponsive animations between security category and block, F (1,38) = 5.57, p = .02, η_p^2 = .13. By exploring how the fixation of securely and insecurely attached infants differed in the blocks, the data was split by security category first. Repeated measures ANOVAs revealed no block effect for the insecurely attached infants, F(1,21) = .30, p = .59, η_p^2 = .01, neither for the securely infants, F(1,17) = 2.72, p = .12, η_p^2 = .14. This indicates that infants both securely and insecurely attached fixated as long at the large AOI in block 1 as in block 2. To investigate whether there is an effect of security category in block 1 and block 2, repeated measures ANOVAs were carried out for block 1 and block 2 separately, with response and emotion as within-subjects factors and security category as a between-subject factor. No effect of security category was found in block 1, F(1,38) = 1.60, p = .21, η_p^2 = .04. But there was an effect of security category in block 2, F(1,38) = 4.97, p = .03, η_p^2 = .12 (see Figure 3). These findings suggest that there is no significant difference between securely and insecurely attached infants in how long they fixated at the large unresponsive AOI in block 1 but that there is a significant difference in how long securely and insecurely attached infants fixated at the large unresponsive AOI in block 2. In particular, infants with a secure attachment relationship fixated longer at the large unresponsive figure in the last four movies (block 2) than infants with an insecure attachment relationship in the separation segment.

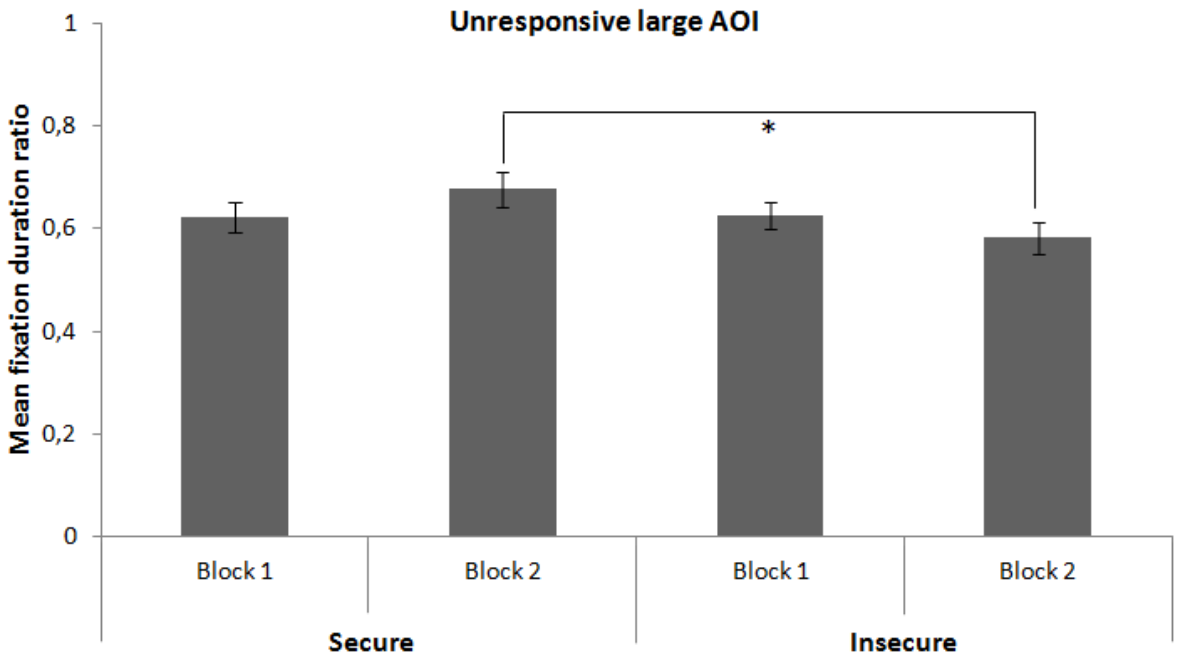

Figure 3. Mean fixation duration ratios (with standard errors) for securely and insecurely attached infants at the unresponsive large AOI during the two blocks of the separation segment (* $p < .05$).

Discussion

The aim of this study was to examine the differences between securely and insecurely attached infants in their monitoring of animated social interactions. We expected to find a difference between securely and insecurely attached infants in how long they fixated at the large figure. By investigating the looking patterns of secure and insecure infants we found a strong tendency for security category, indicating that securely attached infants tended to look longer at the large figure than insecurely attached infants. The results are likely to confirm our hypothesis that attachment security influences infants' processing of social interactions. As mentioned earlier Johnson et al. (2007, 2010) also investigated the influence of attachment security on infants' looking patterns. Although they used a habituation method and their aim was to investigate whether attachment security affects infants' expectation about the outcome

of a separation event, our findings are in line with the findings of Johnson et al.. They found that securely attached infants looked longer at the unresponsive outcome in which the large figure is leaving the small figure behind. We found that securely attached infants looked longer than insecurely attached infants at the large figure already during the separation, that is *before* they have seen what the outcome would be. This could mean that secure infants looked longer at the large figure because they had a stronger expectation that the figure should respond. When we take the broader context of attachment into account, another explanation for this feature could be that secure infants want to seek comfort from, and contact with the caregiver and therefore look longer at the large figure than insecure infants. This suggestion is supported by Susan Goldberg (2000), she mentioned that when a child has the expectation that the caregiver will be responsive in a stressful situation (for example separation from the caregiver), the experience of the child leads to active attempts to make contact with the caregiver. Insecure infants may have paid less attention to the large figure because they did not have certain expectations from the figure.

We also found that securely attached infants fixated longer at the large figure during the separation in the last four movies (block 2) than insecurely attached infants, but only when the large figure was unresponsive (moved further up on the hill). Thus as we expected the changes in the looking pattern of securely and insecurely attached infants differed across repetition. Earlier research (Johnson et al., 2010) found that securely attached infants looked longer at the unresponsive large figure because the action of the figure did not fit the expectations of the infant, namely for the large figure to return to the small figure. In this study however, we focused on the separation segment only and found that after repetition (in the second block) securely attached infants looked longer at the unresponsive large figure than insecurely attached infants. This finding suggests that securely attached infants might have learned from the repeated presentation which large figure (dark blue or red) is unresponsive.

Securely attached infants tend to expect responsiveness in parent-child interaction (Johnson et al., 2011), so when the large figure is unresponsive it violates their expectations and they look longer at the figure. In this vein it is interesting that we did not find the opposite pattern for insecurely attached infants. One might expect that if securely attached infants looked longer at the unresponsive figure across repetition, insecurely attached infants would look longer at the responsive figure across repetition because that is the most unexpected response to them. It remains unclear why we did not find such pattern for insecure infants. One could argue that perhaps insecure infants paid less attention to the large figure in general and thus paid less attention to the responsive figure too, or that it has something to do with the fact that we were not able to use the distinction between insecure-avoidant and insecure-ambivalent infants for analysis.

These suggestions are, when you relate our findings to the broader context of attachment and information processing, both in some way supported by Kobak and Sceery (1988). They claim that insecure-avoidant infants tend to exclude attachment relevant information from awareness and will limit their attention to the caregiver and focus on the environment. Insecure-resistant infants on the other hand are very alert to attachment relevant information and will focus on the caregiver only. So if our sample consisted of more insecure-avoidant infants who limit their attention to the large figure this could be an explanation why we did not find insecure infants to pay more attention to the responsive large figure. On the other hand when the sample consisted of more insecure-resistant attached infants there could be another explanation. Maybe insecure infants did not learn as fast as secure infants across repetition of the movies. This suggestion is supported by Crittenden (1995), she points out that secure and insecure-avoidant infants can make predictions about the behavior of their attachment figure because they experience predictable responses. They learn to trust their strategies. Insecure-resistant infants, on the other hand, are not able to make predictions about

the behavior of the attachment figure because their attachment figure is unpredictable. They learn to distrust their cognition and it may take more time for these infants to learn how a caregiver, or in our case, a figure would respond.

We expected that both securely and insecurely attached infants looked longer at the large figure when they heard the crying sound than when they heard the laughter sound. However, we found that the attention of the infants was not influenced by the type of emotional signal (crying or laughing). This means that infants fixated as long at the large figure when they heard the crying sound as when they heard the laughter sound. This finding does not support the finding of Biro and colleagues (2014), who found that during the separation segment, infants looked longer at the larger figure when they heard the crying sound than when they heard the laughter sound. Because they used the same measure (fixation duration ratio) and analysis as we did in the current study the contradictory findings could not be ascribed to differences in the methodology. It could be possible that the sample we studied was in some way different from the sample of the study of Biro et al. (2014). In particular, infants' temperament may have played a role in processing the animated social interaction. Kagan (1984) argued that *temperamental properties* such as activity, fussiness, fearfulness, attentiveness and strength of reaction seem to be related to future adaption of the child and that children vary in their degrees of reactivity and inhibition in unfamiliar and frightening situations. When the infants were shown the movies they were in a novel environment and among experimenters they did not know, one infant might be comfortable in a new situation while another infant gets easily aroused or distressed. Each infant deals with the setting, but also with the movies (the moving shapes and hearing the crying or the laughter sound), in his or her own way. There is a possibility that the sample of our study and the sample of the study of Biro et al. (2014) differed in terms of temperament of the infants. One could speculate that maybe the infants in our study were less sensitive for the crying sound or were just less

attentive. We also expected that differences between secure and insecure infants would be present during the movies in which a crying sound was played. As we discussed earlier, we did find an effect of attachment security but it was not specific to the distress separation situation thus, in which the infants heard the crying sound. This means that secure and insecure infants differed in how they monitored the crying movies but, there were differences in how they monitored the laughter movies too. Bowlby (1982) claimed that attachment behavior is most obvious in a stressful situation. It could be that the infants in our study were not that sensitive for the crying sound or that they did not defined the crying movies as a more stressful situation than the laughter movies. On the other hand, according to Bowlby's claim, attachment behavior of the infants might have been visible because they experienced both the crying and laughter separations as stressful situations in which they expected the large figure to respond to.

Our main aim was to examine the differences between securely and insecurely attached infants in their monitoring of animated social interactions. We found that securely attached infants tended to look longer at the large figure in the separation segment than insecurely attached infants. Furthermore, we found that securely attached infants fixated longer at the large figure during the separation in the last four movies than insecurely attached infants, but only when the figure was unresponsive. We can conclude that (1) infants with secure attachments looked longer at the large figure because they expect the large figure to be responsive and that (2) they looked longer than insecurely attached infants at the unresponsive figure after repetition because they might have learned that the response of the figure violates their expectations. This means that infants monitor social interactions differently, depending on their attachment security. In a broader context it is known that infants vary in their experiences with the social world and, based on these experiences, form expectations about how adults or caregivers will respond on their signals (Johnson et al., 2010; Johnson & Chen,

2011). The results of this study confirmed that the experiences and expectations of infants vary, depending on their attachment security. Secure and insecure infants have different expectations about how a caregiver will respond and based on the results of this study, we suggest that these different expectations are reflecting in their monitoring of a social interaction.

There are some limitations of this study that need to be discussed. First, although we found a main effect of security category, the distribution of securely and insecurely attached infants in our sample was not representative for the larger population. Overall two-third of the infants have secure attachment relationships and one-third of the infants have insecure relationships with a primary caregiver (van IJzendoorn, Goldberg, Kroonenberg, & Frenkel, 1992). In this sample there were more insecurely attached infants (n = 22) than securely (n = 18), which is remarkable. This distribution could be explained by the fact that the sample we examined was drawn from a larger sample. Although we randomly selected 40 participants, maybe the distribution of attachment security would be closer to the normative distribution if we had examined the whole sample. However, because this sample consisted of more insecurely attached infants this should have helped us to find more differences between secure and insecure infants. If we had a bigger sample, we would have been able to investigate the monitoring patterns of insecure-resistant and insecure-avoidant infants and maybe we could have found differences in the monitoring pattern between the resistant and avoidant insecure infants too.

Second, measuring eye-movements is a powerful tool to investigate differences in monitoring patterns but it is still hard to interpret fixation measures (Hayhoe, 2004). As an experimenter you do not know what the observer is doing and why, you just know where the observer is fixating on the screen. The fixation itself does not reveal the underlying cognitive processes of the observer. This interpretation issue leads us to the third limitation. We do not

know how the two shapes that are presented in the movies are represented by the infants. Specifically, we do not know whether the infants represent the large figure as being the "caregiver" and the small figure as being the "infant" and if they represent the two figures as being part of an interaction. It could be a problem when they do not, because then we cannot explain our findings by infants' attachment security and the expectations they have about caregiver responses based on their experiences of social interactions.

Finally, the measure we used (fixation duration ratio) was about how long infants looked at the large figure. We only included this measure because we hypothesized that securely and insecurely attached infants would mainly differ in their propensity to seek contact with the caregiver and in their expectations about the behavior of the caregiver. These differences were thought to be found in infants' looking times at the large figure. To have a more accurate picture of infants' monitoring pattern it might help to include for example, how long they looked at the small figure too or to calculate the looking time at the large figure relative to the small figure. This could have helped us to interpret the monitoring pattern further. Future research could examine the monitoring pattern of infants further by including those measures. One could find that the separation of the figure draws the attention of the infants to the large figure and not to the small figure, this could depend on the expectations infants have about the behavior of caregivers.

We have some more recommendations for future research on this topic. Susan Goldberg (2000) stated that infants within the securely attached group vary in their reactions and in the amount of distress they show in the strange situation procedure. Thus it is likely that not only attachment security determines the responses of infants but that temperament might have its influence too. In this vein temperament could also influence infants' monitoring of social interactions. It might be interesting for future research to examine the role of temperament on this topic.

Finally, as mentioned earlier there are indications that insecure-avoidant and insecure-resistant infants have different experiences with and expectations about caregiver responses (Crittenden, 1995; Kobak & Sceery, 1988). In this study we were not able to examine the monitoring patterns of insecure-avoidant and insecure-resistant infants because of the small sample size. Future research could focus on the differences in monitoring of social interactions between these infants and between secure infants.

In summary, this study demonstrated that secure and insecure attachment relationships with a caregiver have a differential influence on infants' monitoring of animated social interactions. Specifically, it sheds light on the differences between securely and insecurely attached infants concerning their experiences with, and expectations about, the behavior and responsiveness of caregivers.

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