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Biases in Attention for Social Stimuli in Children are Associated with Patterns of Infant Attachment: A Brief Report

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Abstract

The way an individual attends to social information has implications for his/her ability to regulate behavior in social settings. The results of the present investigation suggest that early experiences in parent–child relationships contribute to later differences in the deployment of attention to social information. The quality of the mother–child relationship was assessed at one-year-of-age. At seven to eight years of age, a dot-probe paradigm assessed immediate and delayed attention to pictures of faces vs. pictures of neutral objects. Children who were more avoidant with their mother in infancy attended to neutral objects over social stimuli at delayed but not immediate time frames. This finding suggests that individual differences in attention to social stimuli in childhood are associated with the quality of the prior attachment relationship with a primary caregiver.

Keywords: attachment; attention/joint attention; early experience; infancy; individual differences

The link between differences in attentional deployment to internal and external stimuli and the ability to effectively regulate behavior and emotion has recently been a focus in psychological research (e.g., Eldar, Ricon, & Bar-Haim, 2008; Gross & Thompson, 2007; Ochsner, Silvers, & Buhle, 2012). Individual differences in the deployment of attention to external and internal stimuli may reflect both genetic differences (e.g., Osinsky, Losch, Hennig, Alexander, & Macleod, 2012; Wetherill et al., 2012) and/or differences in the quality of early experiences with primary caregivers (Bowlby, 1969). Specifically, some have suggested that the quality of parent–child interactions in infancy may influence how a child directs attention to social information and/or emotion (Dykas & Cassidy, 2011; Main, 1990, 2000).

Within early parent–child relationships, or *attachment relationships*, infants develop different strategies to obtain care on the basis of their past interactions with the primary caregiver (Ainsworth, Blehar, Waters, & Wall, 1978). For example, an infant with a rejecting mother might learn to avoid her when distressed to reduce

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the likelihood of being rejected. By contrast, an infant may learn to exaggerate expressions of distress to obtain care from an unpredictable mother. A fundamental question then is whether differences in the way infants learn to obtain care, referred to as *patterns of attachment*, might shape later differences in the deployment of attention to social information and/or emotion (Bowlby, 1980; Main, 1990). The goal of the study described here was therefore to investigate whether patterns of attachment—indicative of the quality of mother–child interactions—are associated with differences in attention to social information and/or emotion beyond infancy.

Patterns of attachment were assessed with the Strange Situation Paradigm (SSP) when infants were one year of age (Ainsworth et al., 1978). This 20-minute procedure involves two separations and reunions of the mother and child. Observations of infant behavior upon reunion in the SSP yield three patterns of infant attachment behavior—*secure*, *insecure-avoidant*, and *insecure-resistant*—each robustly linked to a particular quality of mother–child interactions in the home (Ainsworth, Bell, & Stayton, 1971; Neufeld, Waters, Pederson, & Moran, 1999; Pederson & Moran, 1996). Upon reunion with the mother, infants in secure relationships approach the mother, maintain contact until calm, and then return to play. In the home, mothers of secure babies exhibit sensitivity—interpreting infant signals properly, and responding promptly and appropriately (Ainsworth et al., 1978; Pederson, Gleason, Moran, & Bento, 1998; Wolf & van IJzendoorn, 1997). By contrast, infants in insecure-avoidant attachment relationships avoid the mother upon reunion, and those in insecure-resistant attachment relationships mix strong proximity seeking, contact maintenance and resistance to contact. Mothers of avoidant infants are consistently rejecting of bids for attention involving infant distress whereas the mothers of resistant infants are inconsistently responsive to infant distress—either accessible or neglecting but not rejecting (Ainsworth et al., 1978; Pederson & Moran, 1996; Wolf & van IJzendoorn, 1997). These individual differences in attachment security have been linked robustly to a range of developmental outcomes (e.g., Groh, Roisman, van IJzendoorn, Bakermans-Kranenburg, & Fearon, 2012).

According to attachment theory, avoidant and resistant infants may develop different ways of attending to negative emotional expressions and/or social information, and these differences in attention may be internalized beyond infancy (Bowlby, 1969; Dykas & Cassidy, 2011; Main, 2000). Specifically, avoidant infants may come to direct attention away from displays of negative emotion in order to inhibit their own distress (Main, 2000). Moreover, because these infants direct attention away from their mother in the SSP regardless of her emotional expression, they may come to direct attention away from social stimuli more generally (e.g., the mother, faces, other people, etc.) so as to avoid the risk of communicating distress. This inhibition of distress (and related emotion) is thought to reduce the likelihood of rejection by the primary caregiver (Main, 1981). By contrast, the resistant infant may develop a tendency to focus on others' displays of negative emotions to exaggerate their own distress (Main, 2000). These infants also focus on their mothers during reunions in the SSP regardless of her emotional expression. This tendency may therefore apply to social stimuli more generally to prolong social engagement and exaggerate the communication of distress, and therefore, increase the likelihood of care from an inconsistently responsive caregiver (Main, 1990). Thus, in the context of early attachment relationships, avoidant and resistant infants may develop different styles of deploying attention to displays of negative emotions and related

social stimuli. Once internalized, these contrasting styles are thought to carry forward into the years beyond infancy (Main, 2000).

To the extent that attention to social stimuli or emotion reflects an interplay between quick *bottom-up* processes and slow *top-down* processes (e.g., Bishop, Duncan, Matthew, & Lawrence, 2004; Corbetta & Shulman, 2002; Derryberry & Reed, 2002; Fernandez-Duque & Posner, 1997; Jordan & Morton, 2012; Posner & Rothbart, 2007), differences in attention to emotion or social stimuli could be evident in an immediate response to a stimulus and/or later in time, after a stimulus has been more fully processed. Bottom-up processes are thought to be automatic and driven by the qualities of a stimulus (e.g., the loudness of a stimulus, Jordan & Morton, 2012), whereas top-down processes are slow, effortful and voluntary (Fernandez-Duque & Posner, 1997). The former support rapid responses to emotion or social cues whereas the latter regulate/modulate initial bottom-up responses (Bishop et al., 2004; Corbetta & Shulman, 2002; Derryberry & Reed, 2002; Fernandez-Duque & Posner, 1997; Jordan & Morton, 2012; Mezzacappa, 2004; Ochsner & Gross, 2005). In theory, when avoidant and resistant children are frightened, they inhibit or exaggerate a dominant tendency to express distress by differentially attending to emotional and/or social stimuli. This manipulation of a dominant tendency implies the use of top-down processes to inhibit or exaggerate a response. Because the later stages of an attentional response are more likely to be influenced by slower top-down processes, differences between avoidant and resistant children's attention to stimuli might therefore be more evident in the later than in the earlier phases of an attentional response.

To examine both these immediate and delayed attentional responses to social and/or emotional stimuli, children who had been assessed in the SSP at one-year-of-age were brought back to the lab at age eight-years-of-age and participated in the *dot-probe paradigm* (Macleod, Matthews, & Tata, 1986). On trials of the dot-probe paradigm two pictures are presented. The pictures then disappear and one is replaced by a dot. Participants indicate the location of the dot as quickly as possible by means of a button press. Responses should be faster on trials in which the dot replaces the attended stimulus relative to trials where the dot replaces the unattended stimulus. In the present investigation, face pictures with various emotional expressions (negative, positive, or neutral) were paired with neutral object pictures on trials of the dot probe paradigm. These stimuli were presented for short durations (e.g., 200 ms) to assess quick bottom-up attentional reactions, and longer durations (e.g., 1250 ms) to assess comparatively slower top-down regulatory processes (Bar-Haim et al., 2007; Bradley, Mogg, Falla, & Hamilton, 1998; Koster, Verschuere, Crombez, & Van Damme, 2005; Mogg & Bradley, 1999, 2006; Mogg, Millar, & Bradley, 2000).

The following predictions were made. Given the hypothesis that avoidant infants learn to direct attention away from expressions of negative emotion, avoidance at one-year-of-age should be associated with a bias away from pictures of negative emotional expressions and favoring neutral object pictures. Given the hypothesis that resistant infants focus attention on expressions of negative emotion, resistance at one-year-of-age should be associated with a bias toward pictures of negative emotional expressions over neutral object pictures. Moreover, these biases may apply to social stimuli more generally regardless of emotional valence (negative, neutral, or positive), because avoidant and resistant infants in the SSP ignore/focus on their mother regardless of her emotional expression. Secondly, to the

extent these biases reflect effortful attentional strategies, they should be more pronounced in delayed rather than in immediate responses to stimuli.

Method

Participants

Thirty-six children were administered the dot-probe between seven and eight years of age. The original sample of 66 children and their mothers were mostly low-risk and middle-class. Family incomes ranged from CAN $10 000 to CAN $80 000. The majority of mothers were married (N = 51; 77.3 percent) and between the ages of 20.20–40.75 ($M = 30$, $SD = 4.88$). All children were full-term and healthy at the time of birth.

Of the 30 children who did not return from the original sample, five declined to participate, and 25 could not be contacted. In these latter cases, at least four attempts at contact were made prior to exclusion from the study. Two of the children who did return were excluded because they were coded as 'Cannot Classify' (Hesse, 2008) in the SSP at 13 months of age. Three additional children were excluded. One refused to separate from his/her mother; one intentionally, unambiguously, and deliberately pressed incorrect response buttons; and another had a cold and repeatedly stopped during trials of the dot-probe paradigm. A final sample of 31 children was used in analyses presented here.

Materials and Equipment

The dot-probe paradigm was administered with a Dell Latitude D830 laptop with a 15.4 inch display running E-Prime software. Dot-probe stimuli included 30 infant faces (10 expressing distress or emotional need, 10 happiness, and 10 neutral) and 30 neutral objects. The 10 pictures of infants expressing distress were included in order test hypotheses regarding biases in attention for negative emotion expressions. The happy/neutral infant faces were included to see if these biases generalize to other social stimuli, regardless of emotional content. Infant face stimuli were selected from a larger sample of stock baby images. Three researchers ranked each picture from the most to least distressed, happy, and calm, respectively. The 10 pictures with the highest average rank for each category were selected. Neutral object pictures were composed of items that could be found in a North American household (e.g., a spoon, a chair, etc.).

Measures

Strange Situation Paradigm

To assess each child's pattern of attachment, mother-infant dyads visited the lab and were administered the SSP when the child was 13 months of age. This paradigm is a 20-minute procedure involving two separations and reunions between mother and infant (See Ainsworth et al., 1978 for a detailed description of the procedure). Reunions lasted three minutes, and separations were curtailed if the infant became too distressed. All infants were classified as secure, insecure-avoidant, and insecure-resistant attachment patterns by trained coders in accordance with the Ainsworth et al. (1978) coding scheme. Children were also assigned scores on four seven-point interactive behavior scales—proximity seeking, contact maintenance,

Table 1. Inter-rater Correlations for Interactive Scales

Scale	Reunion 1	Reunion 2
Proximity seeking	.94***	.85***
Contact maintenance	.92***	.88***
Avoidance	.93***	.94***
Resistance	.76***	.94***

avoidance, and resistance—for each reunion (Ainsworth et al., 1978). *Proximity seeking* assesses the strength of a child's efforts to gain contact with the mother. *Contact maintenance* assesses a child's persistence in maintaining contact once it has been achieved. *Avoidance* assesses the extent to which a child avoids the mother upon reunion, and *resistance* assesses the extent to which a child mixes signals for and resistance to contact. Avoidant infants by definition exhibit high avoidant scores, and resistant infants exhibit high resistance scores (Ainsworth et al., 1978). Note that attachment disorganization (Main & Solomon, 1986) was not included in analyses because the hypotheses tested here apply specifically to avoidant and resistant organized patterns of attachment. Of the original 66 dyads, thirty-eight (58 percent) were classified by a second reliability coder. Agreement was 100 percent on classification. Inter-rater reliability for the interactive scales was also excellent (Table 1).

Dot-Probe Paradigm

Seven to eight-year-old children were administered the dot-probe paradigm during a separation from their mother. Testing was computer-based and conducted in the presence of a male experimenter. Children sat 50 cm from a computer monitor. On each trial, a fixation cross with dimensions 24 × 24 mm was presented centrally for 1000 ms. The cross then disappeared and two pictures with dimensions 100 × 100 mm appeared to the left and right of the fixation location. These pictures then disappeared, one was replaced by a dot, and the child was asked to press a button corresponding to the side on which the dot appeared. Children completed 10 practice trials followed by 160 experimental trials. The 160 experimental trials were divided into 40-trial blocks. Each infant face picture appeared four times and was paired with a different neutral picture in every appearance. Each face picture was matched as closely as possible for size with the neutral object. Note that in the present investigation, face pictures were paired with neutral object pictures because the theory concerns biases in attention toward emotional/social stimuli or toward the environment (and away from social/emotional stimuli; Main, 2000). Additionally, each block contained 10 neutral-neutral pairings so that an infant face picture would not appear on every trial. Thus, all four experimental blocks had 10 neutral item-neutral item pairs, 10 happy infant face-neutral item pairs, 10 distressed infant face-neutral item pairs, and 10 calm infant face-neutral item pairs. Picture pairs were presented in random order within each block for each participant. All infant face pictures had an equal probability of appearing on either side of the computer screen (left vs. right), and the dot appeared with equal probability on either side of the screen (left vs. right). Moreover, across all blocks each infant face picture

appeared four times in all possible picture and dot location pairings. Finally, pictures were presented randomly for 200 and 1250 ms to assess the attentional response at immediate and delayed time points.

Results

Attrition Analyses

Dyads who did not return for the second phase of the study exhibited no differences in attachment security in the SSP at one year of age, $\chi^2(2) = 1.76$, NS, child gender, $\chi^2(1) = 1.65$, NS, maternal years of education, $t(64) = 1.13$, NS, paternal years of education, $t(63) = -.31$, NS, maternal marital status $\chi^2(2) = 1.20$, NS, or the number of caregivers in infancy, $t(64) = -1.05$, NS. There was however a difference in income level, $t(64) = 2.45$, $p < .05$. The dyads who did not return had an average family income of CAN $40 000 to CAN $49 999 whereas the dyads who returned averaged CAN $50 000 to CAN $59 999.

Primary Analysis

Errors and responses of latency greater than 2000 ms and/or three standard deviations above each child's mean were excluded. *Bias scores* were then calculated from the remaining data for each child by subtracting the average reaction time when the dot replaced the neutral object picture from the average reaction time when the dot replaced the infant face picture (distressed, happy, or calm). If a child was quicker on trials where the dot replaced the neutral object, this calculation would yield a positive score—indicating a bias toward neutral objects. If a child was quicker on trials where the dot replaced the face picture, this calculation would yield a negative score—indicating a bias toward a particular infant picture. Next, avoidance dimension and resistance dimension scores were calculated for each child by averaging avoidance and resistance scores across the first and second reunions, respectively (Fraley & Spieker, 2003). These continuous scores rather than categories were used as a result of small sample sizes within each SSP classification (7 avoidant, 19 secure, and 5 resistant). Within the sample described here, avoidance and resistance dimension scores were not significantly correlated ($r(21) = -.14$, $t(29) = -.79$, NS)—suggesting that they do indeed measure discrete factors. Bias scores for each child were then submitted to a univariate ANCOVA with Trial Duration (200 or 1250 ms) and Face Type (distressed, happy, and calm) entered as repeated measures factors. Within this ANCOVA, the between-subjects continuous variables of Avoidance and Resistance were entered as covariates to test interactions between these variables and the repeated measures factors (Trial Duration and Face Type). No other covariates were entered. Means and standard deviations for the repeated measures conditions are presented in Table 2.

The Trial Duration × Avoidance interaction was significant, $F(1, 28) = 4.82$, $p < .05$, $R^2 = .12$, $r = .36$, suggesting that the effect of Avoidance was moderated by Trial Duration. There was also a significant main effect of Trial Duration such that children irrespective of attachment group were more biased toward the infant face stimuli in the 200 ms condition than in the longer duration condition, $F(1, 28) = 4.70$, $p < .05$, $R^2 = .12$, $r = .35$. All other main effects and interactions were not significant.

Table 2. Means and Standard Errors for Face Type/Trial Duration Conditions

	Face Type			
Trial Duration	Distressed	Happy	Calm	Average
200 ms	−21.01 (10.03)	−10.74 (24.05)	−29.47 (12.49)	−20.41 (6.01)
1250 ms	−.29 (12.09)	−7.46 (10.62)	−11.01 (10.11)	−1.09 (6.32)
Average	−10.69 (7.90)	−9.10 (6.71)	−9.23 (8.38)	−9.66 (6.17)

To better understand the Trial Duration × Avoidance interaction, the simple main effects of Avoidance were tested within each level of Trial Duration. There was a significant simple main effect of Avoidance within the 1250 ms condition, $F(1, 29) = 5.41$, $p < .05$, $R^2 = .16$, $r = .40$ (Figure 1) but not in the in the 200 ms condition, $F(1, 29) = .95$, NS (Figure 2). Thus, more avoidant children were more likely to look toward neutral objects over all face types in the 1250 ms condition.

In summary, then, avoidance was positively associated with biased attention to neutral stimuli in the 1250 ms condition, but not in the 200 ms condition. Taken together these findings support the idea that avoidant children direct their attention away from social stimuli irrespective of emotional valence in the later stages of an attentional response. Resistance was not associated with attentional bias.

Discussion

The present investigation provided support for the idea that early mother–child interactions influence how a child attends to social stimuli—in this case faces.

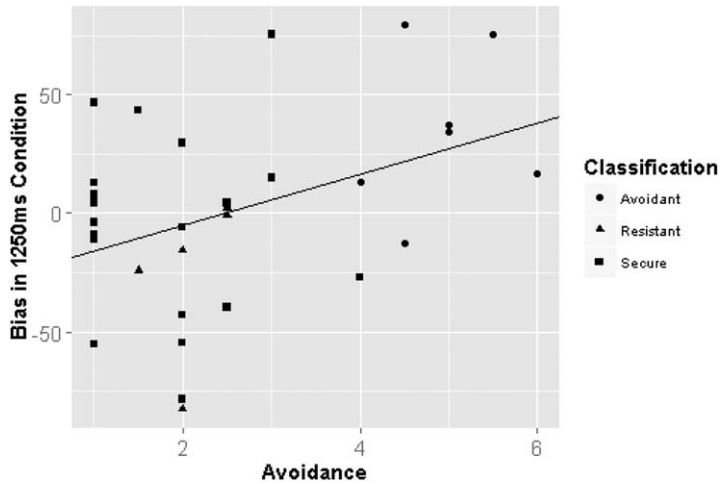

Figure 1. Bias Score in the 1250 ms Condition Averaged Across All Face Types by Average Avoidance Score for Each Child. Marker Shape is Used to Depict Categorical Attachment Pattern (Avoidant, Resistant, and Secure). Categorical Attachment Pattern was not Included in Analyses due to Low Sample Sizes.

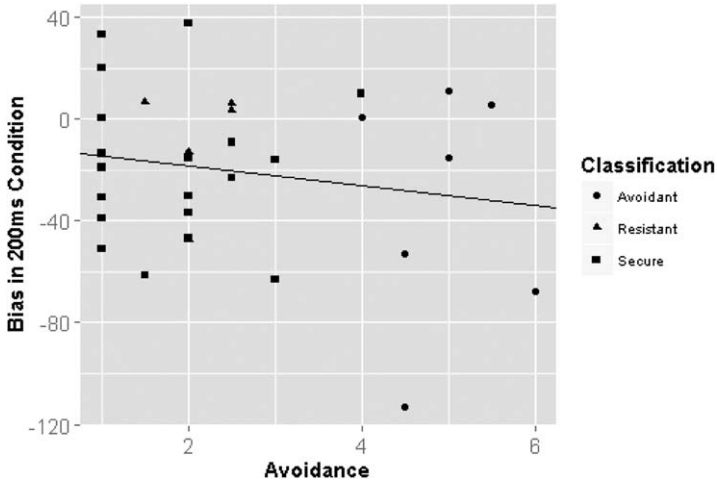

Figure 2. Bias Score in the 200 ms Condition Averaged Across All Face Types by Average Avoidance Score for Each Child. Marker Shape is Used to Depict Categorical Attachment Pattern (Avoidant, Resistant, and Secure). Categorical Attachment Pattern was not Included in Analyses due to Low Sample Sizes.

According to attachment theory, avoidant infants experience consistent maternal rejection (Ainsworth et al., 1978) and learn to attend away from feelings of distress and/or social stimuli to inhibit or prevent expression of distress when frightened. In the present investigation, children who were more avoidant in infancy were more likely to attend to neutral object stimuli over infant face stimuli at a delayed stage in their attentional response. This finding supports the notion that avoidant children develop biases with regard to social stimuli—irrespective of emotional valence—as a function of early interactions with the mother. Conversely, attachment theory suggests that infants in resistant relationships are likely to learn to attend excessively to social stimuli and/or emotion due to unpredictable or inconsistently responsive mothers (Ainsworth et al., 1978). In the present investigation, children who were more resistant did not exhibit a bias in attention. Therefore this assertion was not supported.

Whereas children on average quickly attended to infant face pictures, differences in attention were associated only with avoidance and only at a delayed stage in children's attentional response. This suggests that a general short latency attentional preference for social stimuli might sometimes be modified by avoidant children with slower top-down processes. Combined with previous research linking attachment patterns to mother–child interactions (e.g., Ainsworth et al., 1978; Pederson & Moran, 1996), this finding provides evidence for the idea that avoidant children learn to regulate attention to social stimuli as a function of previous experience.

The present investigation is important because it provides evidence that patterns of attachment in infancy—indicative of the quality of mother–child interactions—influence attention to social stimuli. It is essential that the study be replicated, however, given its relatively low sample size and other methodological considerations. These considerations include the fact that attention was not assessed concurrently with the SSP at one year of age, and patterns of attachment were not assessed when the children returned to the lab for the dot-probe paradigm. We therefore cannot yet

discern when differences in attention to social stimuli emerged—concurrently, before, or after patterns of attachment were assessed in infancy—and we cannot differentiate between the effects of early attachment or concurrent attachment on attention.

Subsequent investigations might focus on the psychological mechanisms underlying the differences in attention described for avoidance. A shift in attention from social stimuli to neutral objects may indicate an aversive response to social stimuli. This *vigilance-avoidance* response could have implications for the development and maintenance of social anxiety disorders in avoidant children (Amir, Foa, & Coles, 1998; Derakshan, Eysenck, & Myers, 2007; Mogg & Bradley, 2006; Mogg, Bradley, Miles, & Dixon, 2004; Vassilopoulos, 2005). Moreover, future investigations might target samples with a higher representation of resistance. In the present investigation, only three children exhibited resistance scores above 4, and therefore, definitive conclusions about the association between resistance and biases in attention cannot be drawn. Finally, it is also important to note that biases may be more or less pronounced with same age children or adult faces. This cannot be determined from the infant stimuli used in the present investigation. Additionally, it is unclear how video footage rather than static images of emotional expressions may have modified the findings presented here.

In summary, the present investigation provides support for the suggestion that patterns of attachment in infancy—indicative of the quality of mother–child interactions—influence attention to social stimuli in middle childhood. Children who were more avoidant at one year of age were more likely relative to other children to attend to neutral object stimuli over infant face stimuli at a later stage in their attentional response. This link between early experiences and attention has implications for a child's regulation of behavior and emotion in social settings (e.g., Gross & Thompson, 2007).

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