

The Role of Attachment Anxiety in Maternal Attentional Processing of their Child's Face: An Eye-Tracking Study

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Abstract

Although mother's attention to offspring is deemed important to support their offspring's secure attachment development, little research tested this association. The current study aimed to test the hypothesis that how mothers orient their attention to their offspring is linked to differences in offspring's attachment style. Additionally, we tested whether this association depended on which emotions children express. 29 mothers participated with their offspring (48.3% girls; ages 9 to 15 years, $M = 10.93$, $SD = 1.67$). Across two experimental blocks, eye movements were recorded as mothers viewed photographs of offspring and unfamiliar children showing neutral (block 1) and facial expressions of fearful, happy and sad (block 2). Offspring's self-reported attachment anxiety was related to increased maintained attention of the mother on the offspring's neutral face, while more attachment security was related to reduced maintained attention. With regard to emotional faces, mothers of more anxiously attached children showed more maintained attention on all emotional expressions of their offspring, including sadness. Furthermore, we found a positive attentional bias of mothers with more securely attached children; increased attention on the offspring's happy face was found. No attentional processes were found for attachment avoidance. Different attachment-related parenting behaviors, leading to a specific attachment style of the offspring, could be explained by these attentional allocations.

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Introduction

In the first years of life, each child develops a specific bond with his or her attachment figure (Bowlby, 1969/1982). Attachment research suggests that depending on the quality of interactions with parents, individual differences in attachment quality develop (Ainsworth, 1979). Parents that are more sensitive or in tune with the emotional states and needs of their offspring are more likely to raise securely attached children (Ainsworth, 1979). These children learn that they can trust on the availability of their parents' support, which allows them to more freely explore their environment, because they can easily seek parental support whenever they encounter severe distress (Dujardin, Bosmans, DeRaedt, & Breat, 2015). When parents fail to sensitively respond in tune with their offspring's emotional needs, children are more likely to develop more insecure attachments. Two different insecure attachment styles are identified depending on the type of interactions with parents. Children whose parents display increased levels of over-controlling behavior and who are less sensitive to their offspring are at increased risk of developing an anxious attachment, which reflects the extent to which children worry about the availability and responsiveness of the attachment figure (Brenning, Soenens, Braet, & Bosmans, 2012). Children of consistently unavailable parents are more at risk to develop avoidant attachment, which reflects the extent to which children tend to avoid close contact (Brenning et al., 2012; Mikulincer, Shaver, Sapir-Lavid, & Avihou-Kanza, 2009). Whereas traditionally these individual differences were considered categorical, increasing research suggests that these differences can be better captured with dimensional measures of secure versus insecure attachment or of anxious and avoidant attachment dimensions (Brennan, Clark, & Shaver, 1998).

Within the field of attachment research, there is an increasing awareness that both adults' and children's attachment-relevant behavior is strongly affected by information processing biases (Bosmans, Braet, Heylen, & De Raedt, 2015; Dykas & Cassidy, 2011). Most studies to-date focused on child's attentional processing of their parents (e.g. Kirsh & Cassidy, 1997; Bosmans, De Raedt, & Braet, 2007; Vandevivere, Braet, Bosmans, Mueller, & De Raedt, 2014).

Bosmans et al., (2007) used an exogenous cueing paradigm (ECT; Posner, 1980) to investigate the relation between children's attentional bias towards their mother and the child's attachment style. Children were asked to focus on a central cross on a computer screen. When the cross disappeared, a neutral photograph of the child's mother or an unfamiliar mother appeared either on the right side or the left side of the screen. After the photograph disappeared, a cue was shown on the right or the left side of the screen. Children had to push a button as soon as they noticed the cue. Results show that a less secure attachment is linked with more attention towards the mother and less attention towards unfamiliar mothers.

The reverse process, parents' attentional processing of their offspring's signals in relation to attachment quality is less studied. As these information processing biases were proven relevant to understand children's behavioral approach to their mothers (Bosmans et al., 2015), it is important to investigate the parental equivalent to these attentional processes in order to better understand the link between parents' relational approach and children's attachment (in)security. Grossmann, Scheuerer-Englisch, and Loher (1991) showed that mothers of avoidantly attached children were more likely to play with their offspring when their offspring was happy. When their toddler showed a negative emotion, by contrast, mothers tended to withdraw from the interaction. The opposite was observed for mothers of more securely attached children, indicating a parental focus on their offspring expressing negative emotions as opposed to positive emotions. A more recent study using a Stroop task showed (Atkinson et al., 2009) that mothers of disorganized attached children (high score on attachment anxiety and avoidance) experienced difficulties disconnecting their attention from negative attachment-related words (e.g., "abandon child").

Based on the importance of sensitive parenting for children's attachment development (Ainsworth, 1985), it seems reasonable to argue that children's attachment quality should be linked with how parents focus their attention on their offspring. Moreover, this focus should depend on whether the child expresses no emotions (neutral faces), negative emotions (fear, sadness), or positive emotions (happiness). During a securely attached relationship, if the child expresses no distress, the parent ideally provides the (psychological) space for free exploration which stimulates their autonomy. On the other hand, children's facial expressions that signal distress like sadness or fear should elicit increased attention in parents to allow sensitive support. Similarly, children's happiness should also be an important trigger for parental attention because it allows parents to enjoy their offspring's positive emotional state, which further constitutes a healthy attachment relationship (Hoffman, Marvin, Cooper, & Powell, 2006).

Yet, previous attentional processing studies are limited to test these hypotheses since they relied on paradigms based on reaction times that only implicitly assume the location of attention and are confounded by other non-attention processes, such as motor activity and response selection (Eizenman et al., 2003). Vandevivere, Braet et al., (2014) recently studied the defensive exclusion hypothesis in children on the basis of a validated eye tracking paradigm. Tracking eye movements can be seen as a proxy of attention since they are functionally related to each other and share the same functional anatomical areas in the human brain (Corbetta, et al., 1998). The eye fixations correspond to the information being internally processed and the duration of the fixation is related to the time needed to encode and process information (Just & Carpenter, 1976). Shifts in fixation positions closely follow and are guided by shifts in attentional focus (Kellough, Beevers, Ellis, & Wells, 2008). Furthermore, eye tracking methodology is ideally suited for assessing continuously the visual gaze for a longer period.

The Present Study

This study investigated parent's attentional processing of child-related information related to offspring's attachment representation. We used a free viewing eye tracking paradigm (e.g., Vandevivere et al., 2014; Eizenman et al., 2003) of faces with an idiosyncratic meaning (photographs of the parent's offspring) relative to unknown child faces. The study was presented in two experimental blocks, one in which parents viewed neutral facial expressions of their offspring and of unfamiliar children and one in which parents viewed emotional facial expressions (happy, fearful, and sad) of their offspring and unfamiliar children. Based on theory (Ainsworth, 1985), we hypothesized that mothers of securely attached children in the case of neutral (no threat or distress) signals, would show less total viewing time and less maintained attention on their own child in comparison with mothers of insecurely attached children. Moreover, we expected to observe a hyper focused strategy in mothers of anxiously attached children, reflected specifically as increased maintained attention. Conversely, given the impact of consistent absent care on children's avoidant attachment (Brenning, Soenens, Braet, & Bosmans, 2011b), we expected a reduced attentional focus on

their children for mothers of more avoidantly attached children. Second, with regard to emotional facial expressions (happy, fearful, and sad), based on theory (Bowlby, 1980), we anticipated for securely attached children, more maintained attention of mothers during emotional expressions of their offspring. Finally, also in this emotional condition, opposite findings were expected for attentional processing of mothers of more avoidantly attached children compared with anxiously attached children. With anxiously attached children a maternal hyper focused strategy is expected, reflected in increased maintained attention independent of the emotional state of the child.

Method

Participants

Participants (ages 9 to 15 years) were recruited from schools (fourth, fifth, and sixth grades of elementary school and first and second grades of high school) in the Flemish region of Belgium. A total of 42 families (78,6% mothers, 21,4% fathers) came to the university together with their child. Because gender of the parents could influence the findings, the data were analysed without the fathers ($n = 9$). In addition, a technical problem occurred during recording of eye movements of four participants who were removed from further analysis. The final sample consists of 29 mothers with their child (48.3% girls, ages 9 to 14 years, $M = 10.93$, $SD = 1.67$). The study was approved by the Institutional Board of the Faculty of Psychology at Ghent University. Both parent and child gave their informed consent to take part in the study.

Instruments

Experimental task.

Mothers completed an attentional task (Vandevivere et al., 2014) to investigate how they pay attention to different emotions from their offspring and unfamiliar children. Following Vandevivere and colleagues (2014), the task consisted of two blocks and a final rating segment. The trials consisted of matrices (24 cm x 21 cm) with each eight pictures (8 cm x 7 cm; 5.1° visual angle x 6.3° visual angle) and a central black square (8 cm x 7 cm; 5.1° x 6.3°). Each study slide was shown for 10 seconds and consisted of seven photographs of unfamiliar children and one photograph of the offspring. The location of the pictures was randomized. In between slides there was a white fixation cross (1cm x 1cm; 0.6° x 0.6°). The first block consisted of eight trials with faces having a neutral expression (see Figure 1). The second block consisted of nine trials with emotional facial expressions. The three emotions, happy, fearful, and sad, were each shown three times. The pictures of the unfamiliar children were taken from the validated Radboud faces database (Langner et al., 2010).

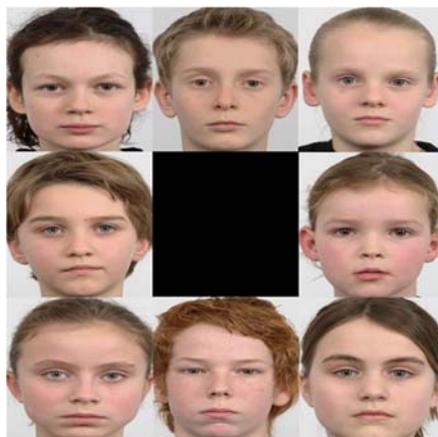


Figure 1: The attentional task block one (neutral faces) with pictures from the Radboud faces database. The array of images consisted of matrices (24 cm x 21 cm) with a central black square (8 cm x 7 cm), a picture of the offspring and 7 pictures of unfamiliar children (each 8 cm x 7 cm).

Photographs of the offspring were taken with a digital camera and the environment characteristics were identical to the pictures of the Radboud faces. Participating mothers and children gave their informed consent for taking and

using photos and the test procedure for their child. Mothers were aware that pictures of their child would be presented in the two blocks. Photos of the offspring, by which informed consent for usage was provided, were used in the trials. The pictures of the child were added to the matrix in a different room, so parents did not see the stimuli in advance.

Prior to the onset of each trial, a white fixation cross was presented for 2 seconds in the middle of a black screen. The following instructions were given to the mothers: look at the central fixation cross when it is shown. When the matrix containing pictures is shown, you are allowed to freely explore the photographs, you may look at the pictures the way you want. The instructions were the same for the two conditions. Eye movement data were collected using an infra-red based system, the Tobii TX300 Eye Tracker (Danderyd, Sweden), at a sampling rate of 300 Hz. Participants were seated at a distance of 60 cm in front of the 23 inch Tobii screen. The system has a visual accuracy of < 0.20 deg for a viewing distance of 60cm. Prior to the onset of the tasks, a 9 point calibration procedure covering a central midline point, one point above and below the midline point and three points (top, middle, bottom) on the left and right side each (the midline left and right points were 10.7° relative to central fixation and 6.0° to the top and bottom midline points) in which mothers had to subsequently follow a moving dot on the screen, was used.

Questionnaire measures.

Attachment anxiety and avoidance.

Attachment anxiety and avoidance were measured with the Experience of Close Relationships Scale-Revised Child version (ECR-RC; Brenning, Soenens, Braet, & Bosmans, 2011a). This is a child-friendly version of the Experience of Close Relationships Scale-Revised (ECR-R; Fraley, Brennan & Waller, 2000) and has demonstrated good psychometric properties in a group of 8-14 years-olds (Brenning et al., 2011a). The anxiety scale (18 items) taps into feelings of fear of abandonment and strong desires for interpersonal merger (e.g. I worry about being abandoned). The avoidance scale (18 items) taps into discomfort with closeness, dependence, and intimate self-disclosure (e.g. I prefer not to show how I feel deep down). Items are rated on a 7-point scale ranging from 'not at all' to 'very much'. The minimum score on this questionnaire is 36, the maximum score is 252. Cronbach's alpha in the current study was .68 for Attachment Anxiety and .88 for Attachment Avoidance.

Attachment security.

Attachment security was measured with the People In My Life Questionnaire (PIML; Ridenour, Greenberg, & Cook, 2006), a self-report measure designed to measure children's representations of attachment figures on a dimensional scale. The questionnaire consists of three subscales (Trust, Communication and Alienation) and only the first is used: the Trust subscale. The 10-item trust subscale provides a measure of positive affective and cognitive experience associated with accessible and responsive attachment figures, e.g. I trust my mother. Children respond on a 4-point Likert-scale ranging from 1 (almost never true) to 4 (almost always true). Minimum score on PIML is 15, maximum score is 60. Cronbach's alpha of Attachment Security in the current sample was .67.

Procedure

After arrival to the lab, pictures of the child were taken and the mother completed a demographic form. After that, the child received individual instructions about the questionnaires and was asked to fill these out. If necessary, questionnaires were read out loud. Meanwhile, photographs of the child were integrated in the study slides in a separate room. Next, mothers completed the attentional task and the validation task. At the end of the experimental session mothers and their offspring received two cinema-tickets for their participation.

Eye Movement Variables of Interest

Location and duration of all fixations were analysed off-line after the experiment. Eight different areas of interest (AOI) were defined for each study slide. Each AOI represented one of the eight pictures in the matrix. The two main dependent variables of interest were *total viewing time* and *maintained attention*, which were calculated for both the offspring and the unfamiliar children.

Total viewing time.

This is the total duration a participant fixated on one of the pictures independent of attentional shifts. The total viewing time for unfamiliar and familiar pictures was calculated by averaging the total viewing time over pictures and over trials.

Maintained attention.

This is the extent of time a mother's gaze remains fixated within the boundaries of a particular picture, taking into account the amount of attentional shifts, indicating maintenance of attention. Maintained attention on unfamiliar and familiar faces was calculated by dividing the total viewing time on a picture by the amount of fixations within that picture. This proportion was averaged over AOs (one for the offspring and seven for the unfamiliar children) and over trials.

Results

Data Analytical Method

Mothers' total viewing time and maintained attention were explored across the two blocks using ANCOVA with Familiarity (offspring versus unfamiliar child) as within-subjects variable (Block 1) and Familiarity and Emotion (happy, fearful and sad) as within-subjects variables (Block 2). To investigate the specific moderating role of child's attachment representations, the three attachment measures (Attachment Anxiety, Attachment Avoidance, Attachment Security) were added separately as covariates of interest to the ANCOVA. Indications of a moderating effect of attachment style on total viewing time and maintained attention of neutral and emotional faces, as reflected in a significant interaction between familiarity and indices of attachment, were explored using difference scores for eye movement measures between offspring and unfamiliar children and where higher scores indicate increased viewing time on offspring. Only statistically significant results will be reported ($p < .05$, two-tailed).

Missing Data

An error occurred when recording the eye movements of one mother in the second block. This mother is not included in the analyses of the second block, but included in the analyses of the first block. Moreover, two children did not fill out the ECR-RC. Therefore, these children were only included in the analysis with the covariate Attachment Security. Thus, 27 participants were included in the analysis of the first block with covariates Attachment Anxiety and Attachment Avoidance, 29 participants were included in the analysis with covariate Attachment Security. In the second block 26 participants were included in the analysis with covariates Attachment Anxiety and Attachment Avoidance, and 29 participants were included in the analysis with covariate Attachment Security.

Table 1: Descriptive statistics of the attachment-related questionnaires

	Mean	Standard deviation	Range
Attachment anxiety	34.75	9.92	38
Attachment avoidance	44.91	16.36	61
Attachment security	36.54	2.92	11

Descriptive Statistics

Table 1 gives an overview of the descriptive statistics of the attachment-related questionnaire measures. Attachment variables were not significantly associated with age or gender (all $F(2,32) < .51$, all $p > .60$) when added to the ANOCVA. Internal consistency for both attachment security and attachment anxiety were acceptable and for attachment avoidance Cronbach's alpha was good. Correlations among the attachment variables indicated a

statistically significant positive correlation between attachment anxiety and attachment avoidance ($r(27) = .39, p = .043$) and a marginally negative correlation between attachment anxiety and attachment security ($r(26) = -.38, p = .054$). Attachment avoidance and attachment security did not correlate with one another ($r(26) = -.18, p = .375$).

Preliminary Analysis

The effect of Familiarity on the dependent variables

Block 1: Neutral facial expressions.

To investigate the effect of Familiarity on the dependent variables, we ran an ANOVA with Familiarity (offspring vs. unfamiliar child) as within-subjects variable. There was a main effect of Familiarity for the dependent variable *total viewing time*, $F(1, 28) = 59.59, p < .001, \eta_p^2 = .68$. Mothers showed a longer *total viewing time* on their offspring across all slides in comparison with unfamiliar children. Also for the dependent variable *maintained attention*, there was a main effect of Familiarity, $F(1, 28) = 13.46, p = .001, \eta_p^2 = .33$, indicating more *maintained attention* on the offspring in comparison with unfamiliar children (Table 2).

Table 2: Eye movement performance (*total viewing time and maintained attention*) split according to emotional valence and familiarity of the face

		Familiar		Unfamiliar	
Mean (SD)		Total viewing time (sec)	Maintained attention (proportion)	Total viewing time (sec)	Maintained attention (proportion)
<i>Range</i>					
Block 1	Neutral	27.03	.43	6.52	.30
		(12.80)	(.21)	(1.78)	(.06)
		58.41	1.25	8.33	.31
Block 2	Happy	11.04	.38	2.25	.29
		(4.86)	(.11)	(.66)	(.06)
		18.27	.45	2.79	.23
	Fearful	10.68	.39	2.54	.29
		(4.05)	(.09)	(.64)	(.05)
		20.93	.38	3.81	.21
Sad	11.43	.36	2.21	.32	
	(5.12)	(.10)	(.71)	(.08)	
		21.88	.44	3.38	.36

Block 2: Emotional facial expressions.

To investigate the effect of Familiarity on the dependent variables, we ran an ANOVA with Familiarity (offspring vs. unfamiliar child) and Emotion (fearful, happy and sad) as within-subjects variables. There was a main effect of Familiarity for the dependent variable *total viewing time*, $F(1, 27) = 95.01, p < .001, \eta_p^2 = .78$, which indicated a longer *total viewing time* on the offspring in comparison with unfamiliar children independent of the emotion.

For the dependent variable *maintained attention* there was a main effect of Familiarity, $F(1, 27) = 39.13, p < .001, \eta_p^2 = .59$, indicating more *maintained attention* on the offspring in comparison with unfamiliar children. There was a significant interaction between Familiarity and Emotion, $F(2, 26) = 4.07, p = .029, \eta_p^2 = .24$. Follow-up t-tests showed

a significant difference between mother's attention to sad compared to fearful faces of the offspring $t(27) = 2.35, p = .026$, 95% CI [-.00, .06], with more attention to fearful faces. For unfamiliar faces, a significant difference was found between sad and fearful faces, $t(27) = -2.05, p = .052$, 95% CI [-.05, .00], with more attention to sad faces. Further, mothers gave significantly more attention to sad unfamiliar faces compared to happy unfamiliar faces, $t(27) = -2.17, p = .039$, 95% CI [-.05, .00] (Table 2).

The effects of age or gender on the dependent variables.

Block 1: Neutral facial expressions.

To investigate the effect of control variables on the dependent variables in Block 1, we used a model with the dependent eye movement variables with gender of the child as fixed factor, and age of the child as covariate. There were no significant gender or age effects for *total viewing time* or *maintained attention*.

Block 2: Emotional facial expressions.

As in Block 1, there were no significant age or gender effects for *total viewing time* or *maintained attention* in Block 2.

Block 1 Analysis: Associations Between Mothers' Attention to Familiar and Unfamiliar Neutral Faces and Child Self-Reported Attachment

Attachment anxiety.

In the ANCOVA with Familiarity (offspring versus unfamiliar child) as within-subjects variable and Attachment Anxiety as covariate, the main effect of Familiarity for *total viewing time* was significant, $F(1, 25) = 5.27, p = .030, \eta_p^2 = .17$, indicating more *total viewing time* on the offspring ($M = 27.48, SD = 12.92$) in comparison with unfamiliar children ($M = 6.41, SD = 1.75$).

For *maintained attention*, no main effect of Familiarity was found. However, the interaction between Familiarity and Attachment Anxiety was significant, $F(1, 25) = 4.97, p = .035, \eta_p^2 = .17$. To interpret this interaction effect, we calculated a difference score (*mean maintained attention offspring* – *mean maintained attention unfamiliar child*). A correlational analysis between the difference score and Attachment Anxiety showed that higher Attachment Anxiety of the offspring was associated with more maintained attention by the mother in comparison with unfamiliar children ($r(27) = .41, p = .035$).

Attachment avoidance.

In the ANCOVA with Familiarity (offspring versus unfamiliar child) as within-subjects variable and Attachment Avoidance as covariate, a main effect of Familiarity was found for *total viewing time*, $F(1, 25) = 13.03, p = .001, \eta_p^2 = .34$, which indicated longer *total viewing time* on the offspring in comparison with unfamiliar children.

Attachment security.

In the ANCOVA with Familiarity (offspring versus unfamiliar child) as within-subjects variable and the subscale Trust, a main effect of Familiarity was found for *maintained attention*, $F(1, 26) = 5.93, p = .022, \eta_p^2 = .19$, which indicated more *maintained attention* on the offspring in comparison with the unfamiliar children (cf. Table 2). There was also a significant interaction between Familiarity and Attachment Security, $F(1, 26) = 4.58, p = .042, \eta_p^2 = .15$. A difference score (*mean maintained attention offspring* – *mean maintained attention unfamiliar child*) was calculated to interpret the interaction effect. A correlational analysis between the difference score and Attachment Security showed that the more a child was securely attached, the less mothers maintained their attention on their offspring in comparison with unfamiliar children ($r(28) = -.39, p = .042$).

Block 2 Analysis: Associations Between Mothers' Attention to Familiar and Unfamiliar Emotional Faces and Child Self-Reported Attachment

Attachment anxiety.

In the ANCOVA with Familiarity (offspring versus unfamiliar child) and Emotion (happy, fearful and sad) as within-subjects variables, and Attachment Anxiety as covariate, a main effect of Familiarity was found for *total viewing time*, $F(1, 24) = 8.15$, $p = .009$, $\eta_p^2 = .25$, which indicated more *total viewing time* on the offspring in comparison with unfamiliar children (Table 2).

For *maintained attention* there was a significant interaction between Familiarity and Emotion, $F(2, 48) = 5.14$, $p = .009$, $\eta_p^2 = .18$. To interpret this effect, follow-up *t*-tests showed marginally significant differences in *maintained attention* between unfamiliar child sad and unfamiliar child happy faces, $t(25) = -2.04$, $p = .052$, 95% CI [-.05, .00], and between unfamiliar child sad and unfamiliar child fearful faces, $t(25) = -2.02$, $p = .055$ [-.06, .00]. Interestingly, the three-way interaction effect between Familiarity, Emotion and Attachment Anxiety was significant, $F(2, 48) = 3.74$, $p = .031$, $\eta_p^2 = .14$. To examine this interaction, a median split into low anxious and high anxiously attached children was performed. Follow-up *t*-tests revealed that for low anxiously attached children, mothers paid more maintained attention to fearful ($t(13) = 2.99$, $p = .010$) and happy faces ($t(13) = 2.70$, $p = .02$) than to sad faces of their offspring. By comparison, mothers of high anxious children paid equal amounts of maintained attention to all emotional expressions of their offspring. With regards to observing other children, mothers of low anxiously attached children paid more maintained attention to sad faces in other children relative to happy faces ($t(13) = 2.15$, $p = .051$) while mothers of high anxiously attached children paid more maintained attention to sad faces relative to fearful faces ($t(11) = 2.32$, $p = .04$) (see Figure 2).

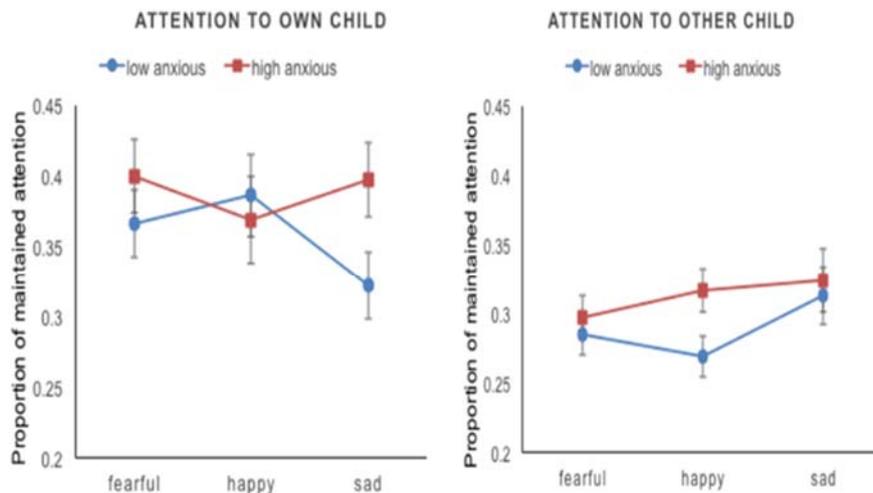


Figure 2: Three-way interaction between anxiety, emotion, and familiarity showing the maintained attention of mothers to emotional expressions of their offspring (left panel) versus unfamiliar (right panel) child faces for children reporting high and low anxious attachment.

Attachment avoidance.

In the ANCOVA with Familiarity (offspring versus unfamiliar child) and Emotion (happy, fearful and sad) as within-subjects variables, and Attachment Avoidance as covariate a main effect of Familiarity was found for *total viewing time*, $F(1, 24) = 23.22$, $p < .001$, $\eta_p^2 = .49$, which indicated more *total viewing time* on the offspring in comparison with unfamiliar children (Table 2). For *maintained attention* a main effect of Familiarity, $F(1, 24) = 5.95$, $p = .023$, $\eta_p^2 = .20$, indicated more *maintained attention* on the offspring in comparison with unfamiliar children.

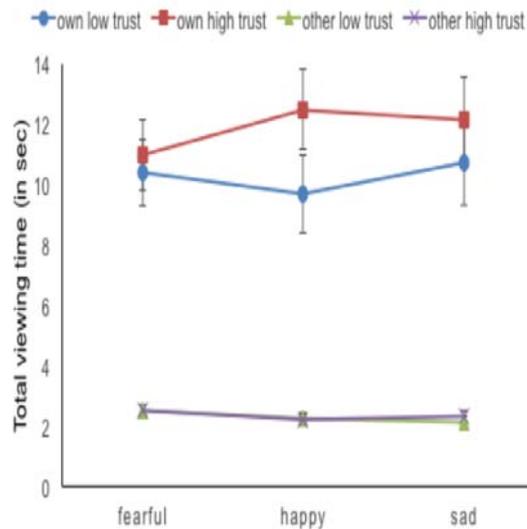


Figure 3: Three-way interaction between trust, emotion, and familiarity showing the total viewing time of mothers to emotional expressions of their offspring (upper half) versus unfamiliar (lower half) child faces for children reporting high and low attachment security.

Attachment security.

In the ANCOVA with Familiarity (offspring versus unfamiliar child) and Emotion (happy, fearful and sad) as within-subjects variables, and the subscale Trust as covariate a trend significant effect for *total viewing time* was found for Emotion: $F(2,50) = 2.88, p = .066, \eta_p^2 = .10$, for Emotion x Trust: $F(2,50) = 2.89, p = .065, \eta_p^2 = .10$ and, interestingly, there was a significant three way interaction of Familiarity x Emotion x Trust: $F(2, 50) = 3.18, p = .050, \eta_p^2 = .11$, indicating that mothers of secure attached children showed specifically more total viewing time for positive emotional expressions of their offspring, compared with mothers of low secure attached children (Figure 3).

With Trust as covariate in the ANCOVA for *maintained attention*, trend significant effects were found for Emotion, $F(2, 50) = 3.01, p = .058, \eta_p^2 = .11$, for Emotion x Trust $F(2, 50) = 2.918, p = .063, \eta_p^2 = .11$, Emotion x Familiarity $F(2,50) = 2.65, p = .081, \eta_p^2 = .10$ and Familiarity x Emotion x Trust: $F(2, 50) = 2.99, p = .059, \eta_p^2 = .11$.

Discussion

The present study investigated the relationship between a mother's attentional processing of child related information and their child's attachment representation during a naturalistic viewing task using eye tracking. Based on prior theory (Ainsworth, 1985), we had hypothesized direction-specific patterns of eye movements in the mother depending on whether their offspring is securely or insecurely attached. Several main findings became apparent. With regards to basic task performance, mothers spent longer looking at, and paid more attention to, their own children relative to other children during neutral facial expressions. During emotional expressions, mothers paid more attention to their own child when he/she had a fearful face but more time to other children when they expressed a sad face. With regard to attachment variables, children's attachment anxiety was related to more maternal maintained attention, while children's attachment security was related to reduced maintained attention of mother on the offspring's neutral face in comparison to unfamiliar children's neutral faces. With regard to emotional faces high scores on attachment anxiety indicated equal maintained attention of mothers for any emotional expression of their offspring. For low anxiously attached children, maintained attention of mother was reduced for sad expressions. Moreover, for total viewing time, mothers of more securely attached children showed increased attention for happy faces, compared with mothers of low secure attached children.

As predicted, attachment anxiety was positively associated with more maintained attention of mother towards the neutral face of her offspring in comparison with unfamiliar children. The reverse pattern was found for more securely attached children. The more securely attached the child, the less maintained attention of mother on the offspring's

face in comparison with unfamiliar faces. Our findings are in line with the hypothesis that more anxiously attached children have mothers with a hyper focused parenting strategy. Instead, parents of more securely attached children are supposed to provide the psychological space for free exploration to stimulate their autonomy (Brenning et al., 2011a). The current findings with maintained attention seem to support these claims. These findings go beyond the traditional studies that operationalize parenting approaches based on observed parenting behaviors that are subject to interpretation (De Wolff and Van IJzendoorn, 1997). Instead, the eye-movement data illustrates more directly how parents' focus on children are important to understand individual differences in children's (in)secure attachment. Contrary to our predictions, for avoidant attachment, no associations with maternal attentional focussing strategies could be found. In observational studies, parents of more avoidantly attached children typically are consistently absent in their care for children (Ainsworth, Blehar, Waters, & Wall, 1978). It could be that at the level of eye-movements this means that parents have no attentional preference for nor against their children. More research is needed to see whether this pattern of effects replicates, but it appears to suggest that eye movements of parents are in line with children's attachment related relational coping strategies. Specifically, anxious children being more hyper focused on the relationship with the mother and avoidant children being more disengaged from relationship with their mother (Brenning et al., 2012).

With regard to the emotional faces, we found that specifically in more anxiously attached children, an equal maintained attention of mother was found for any emotional expression of their own child. For less anxiously attached children the viewing time of mother was reduced for sad faces. These results suggest that anxiously attached children's parents' hyper focused strategy occurs independent of emotional state of the child. This result is in line with the observation of Main (2000) that these parents are less able to adjust their parenting strategies to the actual needs of their children. Instead, parents of avoidantly attached children did not show different eye movement patterns for different emotional expressions of their children. Again, this can be interpreted as a sign that these parents are less relationally engaged with their children. Interestingly, avoidant attachment is characterized by both creating distance from others and by deactivating or suppressing negative and positive emotions (Brenning et al., 2012). Therefore, the current findings support previous claims that differences between children's anxious and avoidant attachment styles depend on differences in parents' approach to their needs. According to these claims, more anxiously attached children are supposed to have experienced inconsistent and little adjusted parental availability and more avoidantly attached children are supposed to have experienced consistent absent care and availability (Ainsworth et al., 1978).

Mothers with more securely attached children had a longer total viewing time on happy faces of their own child relative to sad and fearful faces of their offspring. By comparison, there were no emotion-specific differences in the viewing patterns of unfamiliar children. This finding is in line with Hoffman et al., (2006) claim that an important characteristic of a sensitive parent is his/her ability to enjoy from their child's positive emotional state. Moreover, this observation is interesting because it could raise the question whether we observed a mechanism that explains why some children are better in focusing on and thriving from positive emotions (Raes, Smets, Nelis, & Schoofs, 2012). In light of the increasing interest in the role of attachment in the development of adaptive emotion regulation strategies (e.g., Brumariu, 2015) this finding could mean that this focus of mothers on their child's positive emotions represents one strategy through secure attachment relations might stimulate children's ability to benefit from positive experiences. Surprisingly, children's facial expressions that signal distress like sadness or fear did not elicit increased attention in parents of more securely attached children. Although more research is needed to see whether this effect replicates, this finding could be interpreted based on the changed relational dynamics in middle childhood attachment. More specifically, in middle childhood, we found that more securely attached children are actually those children who master (mild) negative emotions independently from the mother (Dujardin et al., 2015; Bosmans & Kerns, 2015). Therefore, it could well be that mothers' decreased attentional focus on children's negative emotions might help fostering this autonomy development.

Several strengths and limitations of the current study require discussion. The current study further contributes to the literature, by using continuous eye tracking to unobtrusively record the exact position of the mother's eye movements in a naturalistic viewing task. Child's attachment representations were measured with two different (correlation = .33) validated measures which let us differentiate between secure and insecure attachment and two insecure attachment dimensions: attachment anxiety and attachment avoidance. In addition, we recorded the attentional processes from

the main primary caregiver, the mother. While this helped us to exclude potential sex confounds, we could not examine the relation between attentional processes of father and the attachment relationship. An interesting avenue for future research might not only be to examine the role of the father, but also to examine how the on-line dyadic interactions between both caregivers will bias attention to their offspring. Other limitations are also worth mentioning. First, we do not have data on the parent's own history of secure or insecure attachment, which prevented us from examining the effect of own attachment history on current social information processing. Second, we acknowledge the relatively small sample size and specifically a reduction in power when adding covariates in the analyses for the separate blocks. Third, although we expect that insensitive parenting will lead to less securely attached children, we cannot rule out the possibility that more insecurely attached children elicit more attention from their parents, which results in vicious circles. Therefore, more longitudinal studies on parental attention to their offspring might uncover important shifts over time. Moreover, the assumption that only mothers of anxiously attached children show excessive attention to their offspring, which hinders their exploratory behavior is interesting but should be replicated, preferably in an observational task. Finally, given the amount of tests and (uncorrected) follow-up comparisons, caution has to be taken when interpreting the findings.

In summary, results indicate a different attentional processing of attachment-related information by mothers depending on the attachment style of the offspring. We found an attentional bias of mothers with more anxiously attached children. Those mothers had more maintained attention for her anxiously attached child, both when the child expressed neutral and sad faces. In contrast, we found positive attentional biases of mothers with more securely attached children. First, we found that neutral faces of a more securely attached child lead to less maintained attention of mother, which is adaptive since it gives children the freedom to explore the environment. Moreover, mothers of more securely attached children gave more attention to happy faces of their offspring, which might lead to more positive mother-child interactions. No relation between maternal attentional processes and attachment avoidance of the offspring was found.

References

- Ainsworth, M. D. S. (1979). Infant-mother attachment. *American Psychologist*, *34*, 932-937. <http://dx.doi.org/10.1037//0003-066X.34.10.932>
- Ainsworth, M. D. S. (1985). Patterns of infant-mother attachments: Antecedents and effects on development. *Bulletin of the New York Academy of Medicine*, *61*, 771-791.
- Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the Strange Situation* (2014 ed.). New York, NY: Psychology Press.
- Atkinson, L., Leung, E., Goldberg, S., Benoit, D., Poulton, L., Myhal, N., Blokland, K, & Kerr, S. (2009). Attachment and selective attention: Disorganization and emotional Stroop reaction time. *Development and Psychopathology*, *21*, 99-126. <http://dx.doi.org/10.1017/S0954579409000078>
- Bosmans, G., Braet, C., Heylen, J., & De Raedt. (2015). Children's Attentional Processing of Mother and Proximity Seeking. *PLoS ONE*, *10*(4). <http://dx.doi.org/10.1371/journal.pone.0124038>
- Bosmans, G., De Raedt, R., & Braet, C. (2007). The invisible bonds: Does the secure base script of attachment influence children's attention toward their mother? *Journal of Clinical Child & Adolescent Psychology*, *36*, 557-567. <http://dx.doi.org/10.1080/15374410701662717>
- Bosmans, G., Kerns, K.A. (2015). Attachment in Middle Childhood: Progress and Prospects. *New Directions for Child and Adolescent Development*, *148*, 1-14. <http://dx.doi.org/10.1002/cad.20100>
- Bowlby, J. (1969/1982). *Attachment and loss: Vol. 1. Attachment*. New York, NY: Basic Books.
- Bowlby, J. (1980). *Attachment and loss: Vol. 3. Loss*. New York, NY: Basic Books.
- Brennan, K. A., Clark, C. L., & Shaver, P. R. (1998). Self-report measurement of adult attachment: An integrative overview. In J. A. Simpson, & W. S. Rholes (Eds.), *Attachment theory and close relationships* (pp. 46-76). New York, NY: Guilford Press.
- Brenning, K., Soenens, B., Braet, C., & Bosmans, G. (2011a). An adaptation of the experiences in close relationships scale-revised for use with children and adolescents. *Journal of Social And Personal Relationships*, *28*, 1048-1072. <http://dx.doi.org/10.1177/0265407511402418>

- Brenning, K., Soenens, B., Braet, C., & Bosmans, G. (2011b). The role of depressogenic personality and attachment in the intergenerational similarity of depressive symptoms: A study with early adolescents and their mothers. *Personality and Social Psychology Bulletin*, 37, 284-297. <http://dx.doi.org/10.1177/0146167210393533>
- Brenning, K., Soenens, B., Braet, C., & Bosmans, G. (2012). Attachment and depressive symptoms in middle childhood and early adolescence: testing the validity of the emotion regulation model of attachment. *Personal Relationships*, 19(3), 445-464. <http://dx.doi.org/10.1111/j.1475-6811.2011.01372.x>
- Brumariu, L.E. (2015). Parent-Child Attachment and Emotion Regulation. *New Directions for Child and Adolescent Development*, 148, 31-45. <http://dx.doi.org/10.1002/cad.20098>
- Corbetta, M., Akbudak, E., Conturo, T.E., Snyder, A.Z., Ollinger, J.M., Heather, A.H., Linenweber, M.R., Petersen, S.E., Raichle, M.E., Van Essen, D.C., & Gordon, L.S. (1998). A common network of functional areas for attention and eye movements. *Neuron*, 21, 761-773. [http://dx.doi.org/10.1016/S0896-6273\(00\)80593-0](http://dx.doi.org/10.1016/S0896-6273(00)80593-0)
- De Wolff, M.S., & Van IJzendoorn, M.H. (1997). Sensitivity and Attachment: A Meta-Analysis on Parental Antecedents of Infant Attachment. *Child Development*, 68, 571-591. <http://dx.doi.org/10.1111/j.1467-8624.1997.tb04218.x>
- Dujardin, A., Bosmans, G., De Raedt, R., Braet, C. (2015). Children's attentional exploration of threatening information as related to trust in maternal support. *Developmental Psychology*, 51, 1341-1350. <http://dx.doi.org/10.1037/a0039500>
- Dykas, M. J., & Cassidy, J. (2011). Attachment and the processing of social information across the life span: Theory and evidence. *Psychological Bulletin*, 137, 19-46. <http://dx.doi.org/10.1037/a0021367>
- Eizenman, M., Yu, L. H., Grupp, L., Eizenman, E., Ellenbogen, M., Gemar, M., & Levitan, R. D. (2003). A naturalistic visual scanning approach to assess selective attention in major depressive disorder. *Psychiatry Research*, 118, 117-128. [http://dx.doi.org/10.1016/S0165-1781\(03\)00068-4](http://dx.doi.org/10.1016/S0165-1781(03)00068-4)
- Fraley, R. C., Brennan, K. A., & Waller, N. G. (2000). The response theory analysis of self-report measures of adult attachment. *Journal of Personality and Social Psychology*, 78, 350-365. <http://dx.doi.org/10.1037/0022-3514.78.2.350>
- Grossmann, K. E., Scheuerer-Engelisch H., & Loher, I. (1991). Die Entwicklung emotionaler organisation und ihre Beziehung zum intelligenten handeln. In M. J. Dykas & J. Cassidy, Attachment and the processing of social information across the life span: Theory and evidence, *Psychological Bulletin*, 137, 19-46. <http://dx.doi.org/10.1037/a0021367>
- Hoffman, K., Marvin, R., Cooper, G. & Powell, B. (2006). Changing toddlers' and preschoolers' attachment classifications: The Circle of Security Intervention. *Journal of Consulting and Clinical Psychology*, 74, 1017-1026. <http://dx.doi.org/10.1037/0022-006X.74.6.1017>
- Just, M.A., & Carpenter, P.A. (1976). Eye Fixations and Cognitive-Processes. *Cognitive Psychology*, 8, 441-480. [http://dx.doi.org/10.1016/0010-0285\(76\)90015-3](http://dx.doi.org/10.1016/0010-0285(76)90015-3)
- Kellough, J.L., Beevers, C.G., Ellis, A.J., & Wells, T.T. (2008). Time course of selective attention in clinically depressed young adults: An eye tracking study. *Behaviour Research and Therapy*, 46, 1238-1243. <http://dx.doi.org/10.1016/j.brat.2008.07.004>
- Kirsh, S. J., & Cassidy, J. (1997). Preschooler's attention to and memory for attachment-relevant information. *Child Development*, 68, 1143-1153. DOI: 10.1111/j.1467-8624.1997.tb01990
- Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & van Knippenberg, A. (2010). Presentation and validation of the Radboud Faces Database. *Cognition and Emotion*, 24, 1377-1388. <http://dx.doi.org/10.1080/02699930903485076>
- Main, M. (2000). The organized categories of infant, child, and adult attachment: flexible vs. inflexible attention under attachment-related stress. *Journal of the American Psychoanalytic Association*, 48, 1155-1196. <http://dx.doi.org/10.1177/00030651000480041801>
- Mikulincer, M., Shaver, P. R., Sapir-Lavid, Y., & Avihou-Kanza, N. (2009). What's inside the mind of securely and insecurely attached people? The secure-base script and its associations with attachment-style dimensions. *Journal of Personality And Social psychology*, 97, 615-633. <http://dx.doi.org/10.1037/a0015649>
- Posner, M. I. (1980). Orientation of attention. *Quarterly Journal of Experimental Psychology*, 32, 3-25. <http://dx.doi.org/10.1080/00335558008248231>

- Raes, F., Smets, J., Nelis, S., & Schoofs, H. (2012). Dampening of positive affect prospectively predicts depressive symptoms in non-clinical samples. *Cognition and Emotion*, 26 , 75–82.
<http://dx.doi.org/10.1080/02699931.2011.555474>
- Ridenour, T. A., Greenberg, M. T., & Cook, E. T. (2006). Structure and validity of people in my life: A self-report measure of attachment in late childhood. *Youth Adolescence*, 35, 1037-1053. <http://dx.doi.org/10.1007/s10964-006-9070-5>
- Vandevivere, E., Braet, C., Bosmans, G., Mueller, S. C., & De Raedt, R. (2014). Attachment and children's biased attentional processing: Evidence for the exclusion of attachment-related information. *PLoS ONE*, 9.
<http://dx.doi.org/10.1371/journal.pone.0103476>