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Fearful Faces Modulate Looking Duration and Attention Disengagement in 7-Month-Old Infants

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Abstract

The present study investigated whether facial expressions modulate visual attention in 7-month-old infants. First, infants' looking duration to individually presented fearful, happy, and novel facial expressions was compared to looking duration to a control stimulus (scrambled face). The face with a novel expression was included to examine the hypothesis that the earlier findings of greater allocation of attention to fearful as compared to happy faces could be due to the novelty of fearful faces in infants' rearing environment. The infants looked longer at the fearful face than at the control stimulus, whereas no such difference was found between the other expressions and the control stimulus. Second, a gap/overlap paradigm was used to determine whether facial expressions affect the infants' ability to disengage their fixation from a centrally presented face and shift attention to a peripheral target. It was found that infants disengaged their fixation significantly less frequently from fearful faces than from control stimuli and happy faces. Novel facial expressions did not have a similar effect on attention disengagement. Thus, it seems that adult-like modulation of the disengagement of attention by threat-related stimuli can be observed early in life, and that the influence of emotionally salient (fearful) faces on visual attention is not simply attributable to the novelty of these expressions in infants' rearing environment.

Keywords: Attention, Development, Emotion, Facial Expressions, Infants

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One of the functions of the emotional brain systems is to scan the environment for the presence of biologically relevant stimuli and to guide attention and processing resources towards these stimuli (Vuilleumier, 2005; Williams, 2006). In environments where multiple stimuli compete for attention, stimuli which are relevant to our core motivation to minimize danger and maximize pleasure are given precedence, and they are subjected to the most rapid processing (Williams, 2006). Indeed, behavioural studies with adults using facial expressions as emotional stimuli indicate that attention is preferentially allocated to threat-related stimuli (e.g., fearful faces) over simultaneously presented neutral stimuli (Holmes, Green, & Vuilleumier, 2005). Viewing fearful and angry faces may also cause a delay in disengaging attention from them, particularly in individuals with elevated levels of anxiety (Georgiou et al., 2005). Subcortical brain structures, especially the amygdala, have been suggested to play an important role in the recognition of fearful faces and in the interaction of emotional and attentional processes (Vuilleumier, 2005). With its dense connections with cortical and other subcortical areas, the amygdala subserves rapid alerting (Liddell et al., 2005) and allocation of attention to emotionally significant stimuli (Adolphs et al., 2005).

Although progress has been made in understanding emotion-attention interactions in adults, little is known, however, about how these interactions develop. The development of visual attention *per se* has been extensively studied and several paradigms to study attention in infants and young children have been developed (Colombo, 2001). Therefore, examining how emotionally significant stimuli affect infants' performance in these attention-sensitive tasks may provide important insights into the early development of emotion-attention interactions.

A component of spatial attention that emerges in the early stages of postnatal development and that may be susceptible to emotional influences is the disengagement of attention. Disengagement is considered as the stage of spatial orienting when the processing of a stimulus in a current location has to be terminated before shifting attention to a new location (Posner & Petersen, 1990). Between 1 and 3 months of age, infants show apparent difficulties in disengaging fixation from foveated stimuli in order to shift attention to peripherally presented stimuli ("sticky fixation"; Hood, 1995). In the following months, this tendency wanes gradually (Hunnius & Geuze, 2004). Such development has been associated with the maturation of frontal and parietal structures enabling greater cortical control over the disengagement and shifting of spatial attention (Johnson, 2005a). The development of attentional disengagement has been studied with the gap/overlap task (Aslin & Salapatek, 1975; Hood, Willen, & Driver, 1998). In a typical version of this task, the infant is first presented with a central fixation stimulus. After a short delay (e.g., 1000 ms), a peripheral target appears. On gap trials, the central stimulus is removed prior to the appearance of the target, whereas on overlap trials, the central stimulus remains present throughout the trial. The critical difference between these conditions is that on overlap trials, attention has to be disengaged from the central fixation, whereas on gap trials, disengagement from fixation is not needed (Colombo, 2001). Between 1 to 3 months of age, infants move their eyes to the peripheral target on only a small proportion of the overlap trials (ca. 20 % of trials; Hunnius & Geuze, 2004). By 6 months of age, however, the frequency and latency of orienting to targets on overlap trials reaches an adult level of performance (Csibra, Tucker, & Johnson, 1998; Hunnius & Geuze, 2004). However, it is currently not known whether the emotional significance of the central stimulus has an influence on the frequency or latency of attention disengagement in infancy.

Facial expressions may be particularly well suited stimuli to start examining whether emotional significance influences attention in infancy. Even newborns are able to perceive the difference between happy, surprised, and sad facial expressions (Field, Woodson, Greenberg, & Cohen, 1982), although it is possible that these discriminations are based on some salient low-level stimulus features (e.g., open vs. closed mouth). By the age of 5 to 7 months, infants are able not only to discriminate between facial expressions but also to categorize expressions posed by different models into a common class, although this ability may be limited to happy and surprised expressions (see Leppänen & Nelson, 2006, for a review). By the age of 5 to 7 months, infants also start to show some sensitivity to the emotional signal value of facial expressions. For example, in 5-month-old infants, the magnitude of an eye blink startle to loud noise is modulated by facial expressions, so that viewing angry faces augments and viewing happy faces reduces the magnitude of the blink (Balaban, 1995). Furthermore, 7-month-old infants show a visual preference for fearful faces over happy faces, i.e., the infants look longer at a fearful face when it is presented simultaneously with a happy face in a visual paired comparison task (VPC; Kotsoni, de Haan, & Johnson, 2001; Nelson & Dolgin, 1985). Greater allocation of attention to fearful faces has also been demonstrated in electrophysiological studies which have shown that the “Negative central” (Nc) component of the event-related potential (ERP) is larger for fearful than happy faces in 7-month-old infants (de Haan, Belsky, Reid, Volein, & Johnson, 2004; Leppänen, Moulson, Vogel-Farley, & Nelson, 2007; Nelson & de Haan, 1996). The Nc component is thought to reflect the orienting of processing resources to attention-grabbing stimuli (Nelson & Monk, 2001; Richards, 2003).

Although the preference for fearful faces implies that emotional significance modulates infants’ visual attention, there are open questions that require further clarification. First, in typical rearing environments, infants are exposed mainly to positive facial expressions and rarely to fearful faces (Malatesta & Haviland, 1982). This raises the possibility that it is the novelty of fearful faces rather than their emotional signal value that attracts infants' attention (Nelson & Dolgin, 1985). Second, although infants look longer at fearful faces, it is not known which specific component of attention is affected by fearful expressions. Research with adults (Georgiou et al., 2005) has shown delayed attentional disengagement from fearful faces, and infant studies (Colombo, 1995; Frick, Colombo, & Saxon, 1999) have shown that looking duration to non-emotional stimuli is positively correlated with attention disengagement latency. These findings may be taken to suggest that the commonly observed longer looking times to fearful faces in infants reflect an influence of fearful expressions on attentional disengagement.

In the present study, two behavioural tasks were used to examine the influences of emotional significance and novelty of facial expressions on looking duration and attention disengagement in 7-month-old infants. First, looking durations to individually presented fearful and happy facial expressions and to novel expressions were measured and compared to those for a control stimulus (scrambled face). Second, a gap/overlap paradigm was employed to examine the effects of facial expressions on the disengagement of attention. Based on previous data in infants (e.g., Ludemann & Nelson, 1988), we hypothesized that infants would look longer at fearful faces compared to happy faces and control stimuli. We also hypothesized that fearful faces would exert an influence on attention by inhibiting attention disengagement, i.e., infants would find it more difficult to disengage attention from fearful faces than from happy faces and control stimuli. Finally, to determine whether the effects of fearful faces on visual attention can be separated from the effects of novelty and unfamiliarity, we examined whether novel facial expressions and fearful expressions have similar effects on looking times and attention disengagement.

Methods

Participants

The final sample consisted of 28 7-month-old infants (14 boys; mean age 210 days; *SD* = 2.8; birth weight at least 2400 g). At the time of testing, the infants were healthy and free of visual or neurological abnormalities. An additional 3 infants were tested but excluded from all analyses due to prematurity (gestational age 37 weeks or less). The participants were recruited through Child Welfare Clinics. Parents who expressed their interest in participating in research were contacted by telephone.

Stimuli and Apparatus

The face stimuli (Figure 1) were colour images of two female models portraying a happy, fearful, or a novel facial expression. In the novel expression, lips were closed, cheeks were blown full of air, and eyes were clearly open. The control stimuli were face-shaped images that were created by randomizing the phase spectra of the faces of the two models while maintaining the amplitude and colour spectra constant (following the procedure described by Halit, Csibra, Volein, & Johnson, 2004). The faces measured 15.4º and 10.8º of vertical and horizontal visual angle, respectively.

The validity of the facial expressions was tested by asking 12 adults to rate the expressions on a scale from 1 to 7 depending on how happy, novel, and fearful the faces seemed to them. Besides the expressions used in the present study, happy and fearful facial expressions from an existing stimulus set (the NimStim Face Stimulus Set; Tottenham, Borscheid, Ellertsen, Markus, & Nelson, 2002) were included as reference stimuli. Importantly, as can be inspected from Table 1, happy and fearful faces were evaluated as good examples of the respective emotions, and the ratings obtained for the faces in the present study were highly similar to the ratings for stimuli taken from an existing stimulus set. The novel expressions were perceived as novel as the fearful faces but they were rated low on fearfulness and happiness.

The experimental session took place in a darkened room. Infants sat on their parent's lap in a 1m x 2m booth in front of a 17-inch computer monitor, with a distance of 60 cm between the infant's eyes and the monitor. The monitor was surrounded by black panels leaving only the screen visible for the infant. A hidden digital video camera was mounted above the monitor, and infants' eye movements were recorded throughout the experiment with the camera and a DVD recorder for off-line analyses. E-Prime software (Schneider, Eschman, & Zuccolotto, 2002) was used to control the stimulus presentation.

Insert Figure 1 about here

Procedure

Upon arrival to the laboratory, the experimental procedure was described, and all parents gave a written consent. The actual experiment consisted of a looking duration task and a gap/overlap task, presented in this order for all participants. Half of the participants saw images of face model A and the other half saw images of model B.

Looking duration task. Each of the 3 facial expressions and the control stimulus was presented once for a 20-second period on the centre of the screen. The order of the stimulus presentation was randomized across participants. Before each trial, the infant's attention was drawn to the centre of the screen by a red circle which expanded to 4.3º in a continuous fashion. The experimenter monitored the infant's behaviour between the trials, and initiated the next stimulus with a key-press when the child was attending to the red circle.

Gap/overlap task. This task was administered immediately after the looking duration task. Again, the experimenter initiated each trial when the child was attending to the red circle. The trial started with the presentation of the central stimulus (i.e., one of the 3 different faces or the control stimulus). 1000 ms after the onset of the central stimulus, a peripheral target was presented 13.6° equiprobably either to the left or right of the central stimulus. The target stimulus was a black-and-white checkerboard pattern, subtending a visual angle of 15.4º and 4.3º vertically and horizontally, respectively. The target was visible for 3000 ms. On gap trials, the central stimulus was removed 200 ms prior to the presentation of the target. On overlap trials, the central stimulus remained present on the screen throughout the trial (see Figure 2). The central stimuli (i.e., a happy, fearful, or a novel face, or the control stimulus) and the gap/overlap trials were presented in a random order with the constraint that none of the facial expressions was presented more than two times consecutively. The experiment was continued until the infant became inattentive or too fussy to continue (approximately 15 minutes).

Insert Figure 2 about here

Data Analyses

Video coding. The video records from both the looking duration task and the gap/overlap task were coded off-line by an independent observer who was blind to the stimulus condition. The analyses were carried out with the Queen’s Video Coder (Baron et al., 2001) which allowed frame-by-frame playback of the video recording.

For the looking duration task, a) total looking time to each image (i.e., the accumulated looking time from separate fixations toward the stimulus during the 20-second period), and b) the length of the longest individual fixation (i.e., peak look) to each image were calculated. The data from one infant were excluded from the looking time analyses due to excessive movements, thus leaving 27 participants (14 boys) for the analyses.

In the gap/overlap task, the infants completed an average of 40 trials. On average, 7.5 (*SD* = 5.6) trials were excluded due to excessive movements or anticipatory eye movements (i.e., eye movement latencies < 200 ms after target onset; Canfield & Haith, 1991). Infants with less than 2 scorable responses within any of the experimental conditions were excluded from the analyses, which resulted in the exclusion of 9 infants. A further 2 infants were excluded due to technical errors, thus leaving 17 infants (8 boys) for the analyses. The included infants had on average 4.93 (*SD* = 1.24) scorable trials per condition.[1] Of the scorable trials, the percentages of correct responses (i.e., the child moved his/her eyes toward the target), fixations (i.e., the child did not move his/her eyes from the central face during the trial), and false responses (i.e., the child looked to the opposite side of the target) were calculated. The percentages of correct and fixation responses were the primary dependent variable as false responses were nearly absent in both gap and overlap conditions. Additionally, the latency of the first saccade toward the target (i.e., the time interval from target onset to eye movement onset) was calculated. However, as many infants had too few correct responses on overlap trials (due to increased number of fixation responses), the analysis of the latency differences between different faces was considered uninformative (cf. Hood et al., 1998).

Statistical analyses. As the values of some of the test variables were not normally distributed, common transformation techniques (e.g., natural logarithm and square root) were employed in an attempt to normalise the data. As normal distribution was not obtained with the transformations for any of the other variables except the peak look data, nonparametric methods were used to analyse the data. Two-way factorial analyses were conducted using repeated-measures analyses of variance (ANOVAs) on rank transformed data (as described by Conover, 1999), one-way analyses by using Friedman's rank test and paired comparisons by using Wilcoxon's signed-ranks test. With the normally distributed peak look data, a repeated-measures ANOVA and t-tests (with Bonferroni correction) were used. For clarity, the figures show the untransformed values.

The reliability of the coding was ensured by having another independent observer (who was blind to the stimulus condition) to code 30% of the recordings. For the looking duration task, the Pearson correlations of the two observers' measurements of each infant's looking times to different stimuli were on average .96 and .97 for the total looking time and peak looks, respectively. For the gap/overlap task, the interobserver agreement (Cohen's kappa) for the infants' response on individual trials was on average .84.

Results

Looking Duration Task

The total looking times and the durations of peak looks are shown in Figure 3. The total looking times were marginally different for control (M = 12.9 s), happy (M = 13.4 s), novel (M = 14.0 s), and fearful (M = 14.7 s) stimuli, $F_R = 7.37$, $df = 3$, $p = .06$ (Friedman's test). Paired comparisons indicated that the difference between fearful faces and control stimuli was significant, $z = -2.81$, $p < .05$ (Wilcoxon's test), whereas the expected difference between fearful and happy faces or any of the other differences were not significant, all *p*s > .4.

The analysis of logarithmically transformed peak look times revealed significant differences between control (M = 5.9 s), happy (M = 7.2 s), novel (M = 7.2 s), and fearful (M = 8.6 s) stimuli, $F(3, 78) = 3.60$, $p < .02$. The peak looks were significantly longer to fearful faces than to control stimuli, $t(26) = 3.61$, $p < .01$. None of the other differences were significant, all *p*s > .6.

Insert Figure 3 about here

Gap/overlap Task

The eye movement latencies were generally shorter on gap trials than on overlap trials (434 ms vs. 594 ms), $z = -2.53$, $p < .01$. Figure 4 shows that this "gap effect" was also reflected in the higher percentage of correct responses in the gap as compared to overlap condition. A 2 (Condition: gap, overlap) x 4 (Stimulus: control, happy, novel, fear) ANOVA conducted on rank scores yielded a significant interaction, $F(3, 48) = 4.15$, $p < .02$. The percentage of correct responses on gap trials was generally high and there were no significant differences in the proportion of correct responses between different faces, all *p*s > .3. However, in the overlap condition, the proportion of correct responses differed significantly between stimuli, $F_R = 11.52$, $df = 3$, $p < .01$. There were significantly fewer correct responses in the overlap condition to fearful (44.5%) than to happy faces (65.8%), $z = -2.67$, $p < .05$ and to control stimuli (70.1%), $z = -2.95$, $p < .05$. A reverse pattern emerged for fixation responses, $F_R = 11.52$, $df = 3$, $p < .01$. Thus, on overlap trials, the infants fixated significantly more frequently to fearful (54.4%) as compared to happy faces (34.2%), $z = -2.61$, $p = .05$, and to control stimuli (28.9%), $z = -2.76$, $p < .05$. The novel face did not differ from the other stimuli in the percentage of correct (54.5%) and fixation (44.4%) responses, all *p*s > .2.

Insert Figure 4 about here

Correlational Analyses

To examine the possible associations between the performance in the two tasks (cf. Frick et al., 1999), looking time was correlated with the performance in the gap/overlap task. The correlations between both looking duration measures and the percentages of correct and fixation responses were generally in the expected direction, i.e., looking duration was negatively correlated with the mean percentage of correct responses and positively correlated with the mean percentage of fixation responses. However, none of these correlations was statistically significant, all *p*s > .05.

Discussion

The present results are generally consistent with the hypothesis that facial expressions exert an influence on infants' visual attention. Results from the looking duration task showed that looking times to fearful faces differed significantly from looking times to the control stimulus, whereas happy and novel faces were not looked longer as compared to the control stimulus. In contrast to hypotheses, the difference between fearful and happy faces was not significant. Although there is no ready interpretation for this unexpected result, two methodological points should be mentioned. First, in the present study, looking times were measured to four different stimuli, whereas previous studies have typically contrasted only happy and fearful faces. Second, we presented the stimuli sequentially, but it is possible that a paired stimulus presentation design would have been more sensitive in eliciting differential looking behaviour to happy and fearful faces (e.g., Kotsoni et al., 2001; Nelson & Dolgin, 1985). Nelson and Dolgin (1985) speculated that when the faces are seen individually, infants might not be able to differentiate the informational value between happy and fearful faces, as opposed to when the faces are presented simultaneously. Another possibility is, of course, that the visual differentiation of the facial expressions is more efficient when the faces are presented simultaneously as opposed to sequential presentation. One might also speculate that the visual preference for fearful over happy faces is most likely observed when there is a competition for attentional resources between stimuli. However, as both behavioural (de Haan & Nelson, 1998; Ludemann & Nelson, 1988) and ERP (de Haan et al., 2004; Leppänen et al., 2007; Nelson & de Haan, 1996) studies have reported fear preference with sequentially presented stimuli, the suggestion of the greater sensitivity of the paired presentation in eliciting differential allocation of attention should be considered as tentative.

The hypothesis concerning the effect of fearful faces on attentional disengagement was also supported. This was evidenced by an increased number of fixation responses (i.e., no movement) during overlap trials, when the foveated stimulus was a fearful face. Thus, it seems that adult-like modulation of the disengagement component of attention by threat-related stimuli can be observed as early as in 7-month-old infants. One might argue that the less frequent saccades toward the target during overlap trials with fearful faces could be due to a voluntary inhibition of saccades (i.e., the infants *wanting* to fixate on the fearful face), and not due to *difficulties* in disengaging fixation. However, this possibility seems rather unlikely, as in previous studies with 6-month-old infants, orienting toward the peripheral target has been consistently observed on approximately 80% of the overlap trials (e.g., Csibra et al., 1998; Hunnius & Geuze, 2004), even when the foveated stimulus has been meaningful and obviously interesting, such as the mother’s face talking and smiling or an abstract stimulus with motion (Hunnius & Geuze, 2004). Whether disengagement latencies from fearful faces are also longer in infants remains an open issue. A limitation of the present study was that there were too few correct responses on overlap trials to calculate the eye movement latencies for different stimuli (cf. Hood et al., 1998). It is also noteworthy that we can not make strong assumptions about the association between looking duration and attention disengagement on the basis of the present data. The correlations between looking duration and performance on overlap trials were in the right direction, albeit they were not significant. One possible explanation for this lack of significant correlation is that the association between looking duration and disengagement might dissipate by the age of 7 months, when infants already exhibit a rather well-developed ability to disengage attention (Blaga & Colombo, 2006).

What is it in a fearful face that captures infants’ attention? Besides conveying information about the presence of a potential threat, fearful faces are also novel stimuli to infants at this age (Malatesta & Haviland, 1982). Nevertheless, it appears that novelty *alone* is not sufficient to account for the previously observed behavioural and electrophysiological responses to fearful faces, as the novel face did not differ from the control image and the happy face in looking time and in the frequency of attention disengagement in the present study. However, the novelty hypothesis of infants' preference for fearful faces can not be completely ruled out, as a direct comparison did not reveal significant differences between fearful and novel faces in either tasks in the current study.

An alternative possibility remains that salient low-level features, such as wide open eyes, capture attention in infants (Nelson & Dolgin, 1985). It has been suggested that low-frequency information of the eye region (i.e., the size of the white sclera around the iris) is especially relevant in the detection and recognition of fear from faces (Adolphs et al., 2005; Johnson, 2005b; Whalen et al., 2004). Furthermore, infants show sensitivity to the information present in the eye region very early in development (Farroni, Csibra, Simion, & Johnson, 2002). Thus, fearful faces may be particularly suitable stimuli for drawing infants' attention to faces (Johnson, 2005b). In the present stimuli, the size of the eye white was largest in the fearful face, followed by the novel and happy faces. By inspecting the mean looking times and fixation percentages, it is interesting to note that the results follow a similar linear pattern (i.e., looking times and fixation percentages increase with respect how much eye white is visible). However, as not all of the differences were significant, caution should be retained when making inferences concerning the size of the eye whites on the basis of our findings.

It is also important to consider whether the findings of infants' enhanced attention are specific with respect to fearful expressions *per se*, or whether they extend to other negatively valenced expressions, such as anger. Interestingly, 7-month-old (Grossmann, Striano, & Friederici, in press) and younger infants (LaBarbera, Izard, Vietze, & Parisi, 1976) have been found to look less at angry as compared to happy faces. Furthermore, the finding of larger Nc amplitude to happy as compared to angry faces in 7-month-old infants (Grossmann et al., in press) also suggests that at this age, infants do not exhibit an attentional bias toward angry faces. Together, these findings can be taken to suggest that angry faces would not cause less frequent disengagement of attention in the gap/overlap task as was shown for fearful faces in the present study. However, it remains for future studies to empirically test this hypothesis.

The specific neural mechanisms which delay/inhibit disengagement from threatening stimuli are not known (Phelps, 2006). However, the amygdala is involved in contributing to an enhanced neural activation in the visual cortex when viewing fearful faces (e.g., Morris et al., 1998). When there is a competition for attentional resources (e.g., between a central face and a peripheral stimulus), such enhanced sensory representations may act to bias attentional selection in favour of emotional or threatening stimuli (Vuilleumier, 2005). There is also evidence (Pourtois, Schwartz, Seghier, Lazeyras, & Vuilleumier, 2006) suggesting that the activation of parietal areas involved in the shifting of attention is suppressed by threat-related stimuli, and such response may produce transient unresponsiveness to competing stimuli. Although it remains unanswered whether the amygdala modulates sensory processing in human infants, it is interesting to note that studies with macaque monkeys have shown that the reciprocal connections between the amygdala and different cortical regions are established soon after birth (Nelson et al., 2002). However, one should be cautious in making strong inferences, as, for example, amygdala responses have been shown to be stronger for neutral as compared to fearful faces in 11-year-old children (Thomas et al., 2001).

In conclusion, the present study showed that perceiving a fearful facial expression has an influence on attention disengagement in 7-month-old infants. This influence was not simply attributable to the novelty of these faces. These findings provide the first pieces of evidence that adult-like emotion-attention interactions can be demonstrated in young infants. The findings also encourage further use of facial expression stimuli together with established attention-sensitive paradigms in studying the development of emotion-attention interactions.

It also remains for future studies to determine whether the low-frequency information of the eye region is critical in attracting infants' attention to fearful faces.

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Footnote

[1]The mean number of scorable responses (with standard deviations in parentheses) for control, happy, novel, and fearful stimuli were 5.1 (1.5), 5.4 (1.5), 4.5 (1.3), and 5.0 (1.7) in the gap condition, and 4.9 (1.7), 4.5 (1.4), 5.0 (1.5), and 5.2 (1.3) in the overlap condition. The differences in the number of scorable responses were not significant between the gap and overlap conditions nor within these conditions, all *p*s > .4, except that on gap trials, novel faces had less scorable responses than happy faces, $t = 4.67$, $p < .01$. We note, however, that this difference did not affect the conclusions of the study, as the main analyses were based on the infants' performance on overlap trials.

Table 1.

Happiness, Novelty, and Fearfulness Ratings for the Stimuli Used in the Present Study (Scale 1-7). Ratings for the Stimuli from the NimStim Face Stimulus Set Are Shown in Parentheses.

	Face				
Rating	Happy	Novel	Fearful	*F(2, 22)*	Post-hoc Tests
Happiness	5.6 (5.2)	2.2	2.2 (1.8)	44.8**	Happy > Novel & Fear
Novelty	1.6 (1.8)	4.9	5.0 (5.0)	32.2**	Happy < Novel & Fear
Fearfulness	1.3 (1.2)	2.3	5.7 (5.8)	231.9**	Fear > Novel > Happy

Note. ** $p < .01$

Figure captions

Figure 1. Examples of the stimuli used in the present study.

Figure 2. Examples of gap and overlap trials with a novel face.

Figure 3. Total looking times and longest fixations to each stimulus in the looking duration task. *Note*. * $p < .05$. ** $p < .01$.

Figure 4. The percentages of correct and fixation responses (i.e., no movement) in the gap and overlap conditions.

Figure 1. Peltola et al.

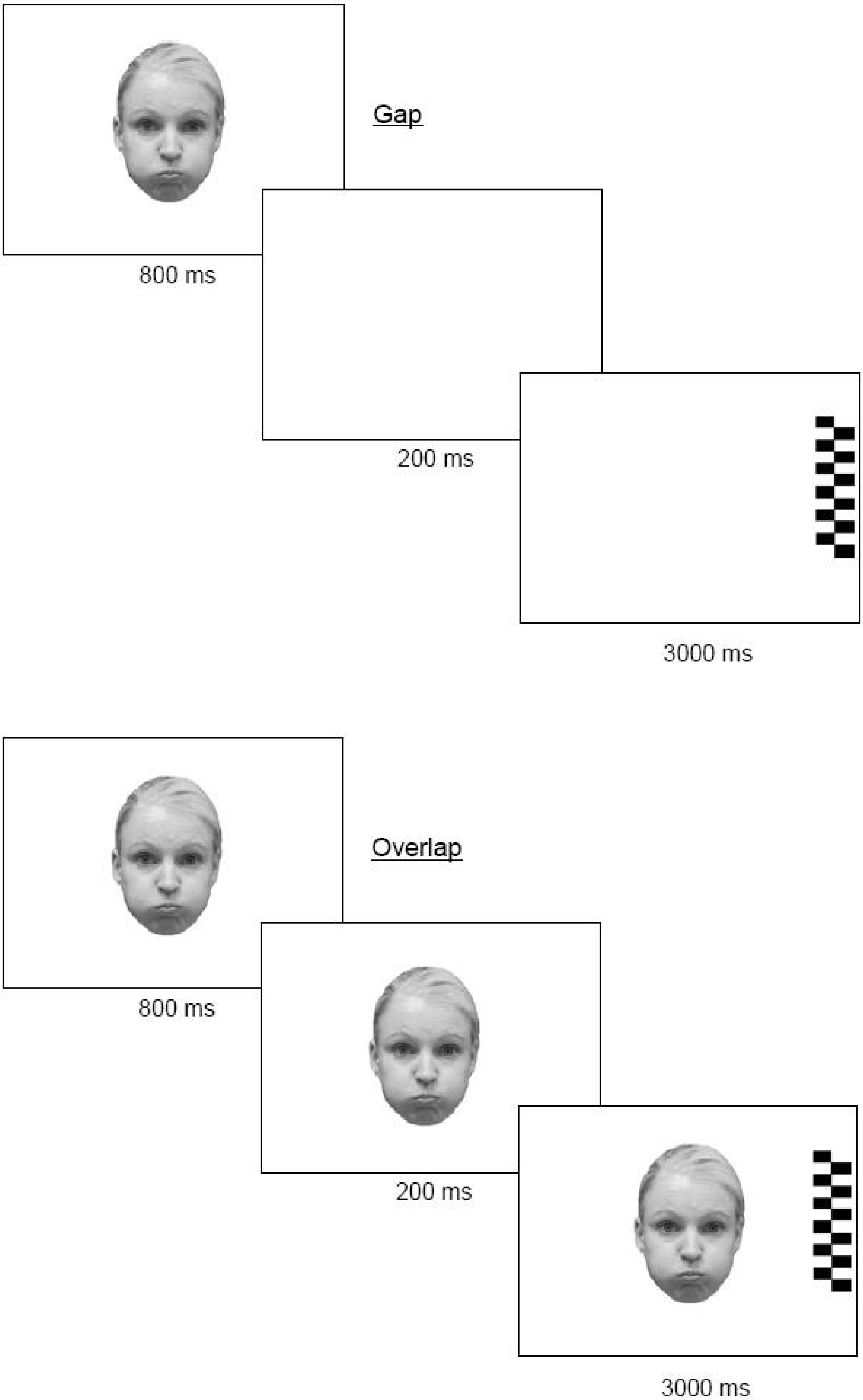


Figure 2. Peltola et al.

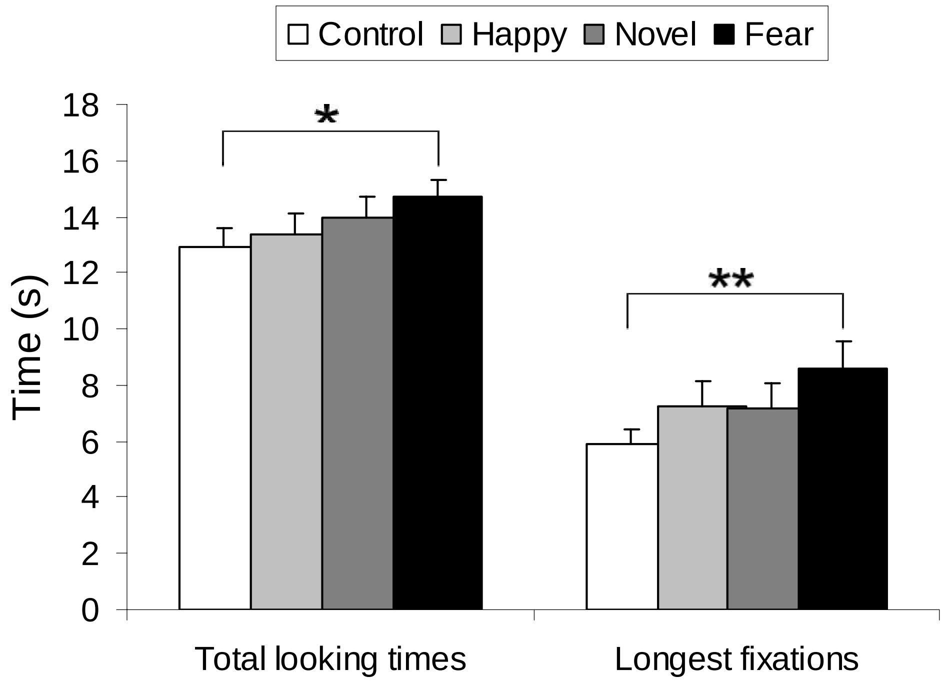
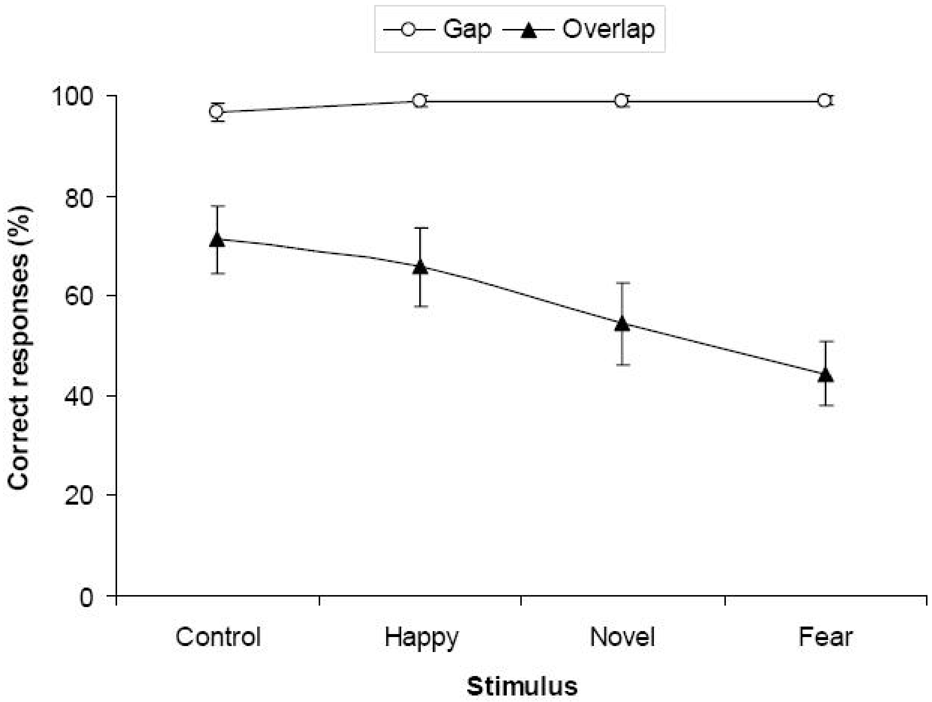


Figure 3. Peltola et al



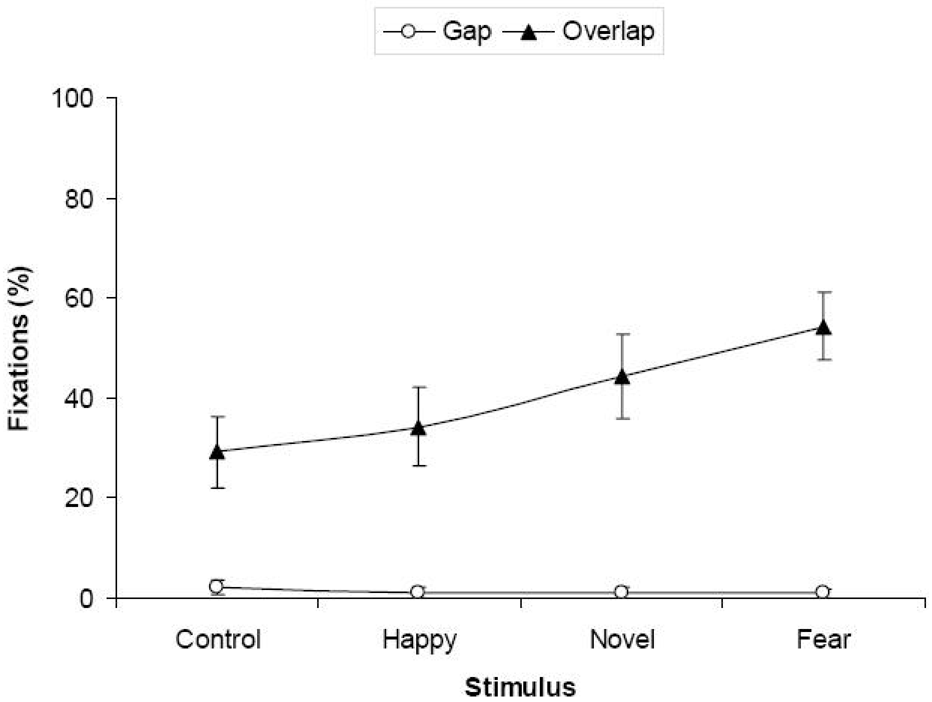


Figure 4. Peltola et al.