

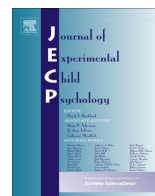


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The development of attention to dynamic facial emotions



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ABSTRACT

Appropriate processing of emotions is paramount for successful social functioning. Adults' enhanced attention to negative emotions such as fear is thought to be a critical aspect of this adaptive functioning. Prior studies indicate that increased attention to fear relative to positive or neutral emotions begins at around 7 months of age, and it has been suggested that this negativity bias is related to self-locomotion. However, these studies mostly used static faces, potentially limiting information available to the infants. In the current study, 3.5-month-olds ($n = 24$) and 5-month-olds ($n = 24$) were exposed to dynamic faces expressing fear, happy, or neutral emotions and a distracting peripheral checkerboard. The 5-month-olds looked proportionally longer at the face compared with the checkerboard when the face was fearful than when it was happy or neutral. Conversely, the 3.5-month-olds did not differentiate their attention as a function of emotion. These results indicate that the onset of enhanced attention to fear occurs between 3.5 and 5 months of age. This finding raises questions about the developmental mechanisms that drive attentional bias given that the idea of the onset of self-locomotion being a catalyst for the development of negativity bias might no longer hold.

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Introduction

The ability to process emotions, whether in the face, voice, or body, is essential for infants' successful interactions with the environment. Individuals who experience difficulty in processing emotions, such as individuals with autism spectrum disorder, may continue to demonstrate deficits or impairments in social functioning even into adulthood (Philip et al., 2010). However, gaps remain in our understanding of the typical progression of emotion perception during infancy. In particular, there is uncertainty about the nature of development of infants' attention to emotions. This issue is significant because it has been suggested that differential attention to emotions (e.g., enhanced attention to negative emotions such as fear) has survival value and is readily seen in adults (Bannerman, Milders, de Gelder, & Sahraie, 2009). Moreover, developmental changes in attention to emotions have been associated with critical aspects of motor development such as the onset of self-locomotion (Leppänen & Nelson, 2009; Vaish, Grossmann, & Woodward, 2008). However, most studies that previously addressed this issue during infancy have used static images, which may have failed to provide a realistic picture of the development of infants' attention to emotions. In the current study, we investigated whether infants' heightened attention toward negative emotions (i.e., to fear relative to happy or neutral emotions) has a different developmental profile than documented previously when using more ecologically valid dynamic expressions of emotion.

Attention to negative emotional stimuli

During the first year of life, infants appear to undergo a transition in which they switch from demonstrating heightened attention to positive emotions in their environment to instead paying greater attention to negative emotions (Vaish et al., 2008). It has been suggested that this negativity bias incurs survival value when one is faced with potentially threatening situations (for reviews, see Leppänen & Nelson, 2009; Vaish et al., 2008). Many studies have examined the timing of the development of enhanced attention to threat-related negative emotions (e.g., fear, anger). For example, research by Peltola, Leppänen, and their colleagues shows that 7-month-olds, but not 5-month-olds, attend more to fearful faces than to happy or neutral faces in the presence of a competing stimulus (Forssman et al., 2014; Leppänen et al., 2010, 2011; Peltola, Forssman, Puura, van Ijzendoorn, & Leppänen, 2015; Peltola, Hietanen, Forssman, & Leppänen, 2013; Peltola, Leppänen, Palokangas, & Hietanen, 2008; Peltola, Leppänen, Vogel-Farley, Hietanen, & Nelson, 2009). These studies led to the conclusion that the onset of enhanced attention to negative emotions occurs at around 7 months of age. Moreover, studies using threat-related but non-face stimuli such as snakes (e.g., LoBue & DeLoache, 2010) and those using social referencing paradigms that involve adults' response to novel objects with fear (e.g., Hoehl, Palumbo, Heinisch, & Striano, 2008; Hoehl & Striano, 2010) suggest that, starting at around 6 to 7 months of age, infants exhibit enhanced attention not only to negative facial emotions but also to threat-relevant objects and animals.

Although the studies outlined above have found an increase in visual attention to fear compared with happy or neutral expressions, we are aware of at least one study in which infants attended to fearful faces *less* than to other expressions. Serrano, Iglesias, and Loeches (1992) found that 4- to 6-month-olds' attention to static faces expressing fear was lower compared with anger or surprise during habituation in an infant-control habituation task. However, the authors acknowledged the possibility that infants at that age might not find fear to be as familiar to them as surprise or anger. The studies reviewed above found increased attention to fear but primarily focused on infants 7 months of age and older, so the results from Serrano and colleagues' study do not necessarily contradict these findings. Moreover, it is unclear how the use of static faces in their study, rather than realistic dynamic faces, may have affected infants' typical response to these emotions.

Moreover, in comparison with the large number of studies examining threat-related negative emotions such as fear and anger, few studies have focused on other negative emotions such as sadness. Kahana-Kalman and Walker-Andrews (2001) found that 3.5-month-old infants were able to successfully match sad and happy faces and voices, but only when it was their own mother expressing the emotion. In addition, infants looked longer at happy faces than at sad faces overall. In a social

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