Review

Attentional bias toward infant faces – Review of the adaptive and clinical relevance

Marta Knijnik Lucion [a], Vanessa Oliveira [b], Lisiane Bizarro [b], Adrianne Rahde Bischoff [c], Patricia Pelufo Silveira [d,f,*], Marcia Kauer-Sant'Anna [a,e]

[a] Programa de Pós-Graduação em Ciências Médicas: Psiquiatria, Faculdade de Medicina, Universidade Federal do Rio Grande do Sul. Rua Ramiro Barcelos, 2400 - 2° andar, CEP 90035-003 Porto Alegre, RS, Brazil
[b] Programa de Pós-Graduação em Psicologia, Instituto de Psicologia, Universidade Federal do Rio Grande do Sul. Rua Ramiro Barcelos, 2600 - Térreo, CEP 90035-003 Porto Alegre, RS, Brazil
[c] Departmental Clinical Fellowship, Division of Neonatology, Department of Pediatrics, University of Toronto and the Hospital for Sick Children, Toronto, ON, Canada
[d] Departamento de Pediatria, Faculdade de Medicina, Hospital de Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul. Rua Ramiro Barcelos, 2400, CEP 90035-003 Porto Alegre, RS, Brazil
[e] Laboratório de Psiquiatria Molecular and INCT for Translational Medicine. Centro de Pesquisa Experimental do Hospital de Clínicas de Porto Alegre. Rua Ramiro Barcelos, 2350 – sala 12117, CEP 90035-903 Porto Alegre, RS, Brazil
[f] Ludmer Centre for Neuroinformatics and Mental Health, Douglas Mental Health University Institute, Department of Psychiatry, McGill University, QC, Canada

ABSTRACT

Human survival depends on care received early in life. Infants need to capture adults' attention to have their basic needs met. Therefore, infant stimuli are prioritized by the attention system in adults, resulting in an attentional bias toward infant faces. We conducted a systematic review of the literature on behavioral measures of attentional bias toward infant faces. PubMed, PsycINFO, and ISI Web of Knowledge databases were used. The review suggests the existence of a measurable attentional bias toward infant faces and a positive correlation between attentional bias toward infant distress and the quality of mother-infant relationship. Depressive symptoms and breastfeeding modulate this behavior in women. Parental status and sex also influence the attentional prioritization of infant faces. Evidence indicates that differences in attentional bias are associated with clinical symptoms and variations in maternal behavior, reinforcing the potential use of attentional bias as a behavioral marker of clinical outcomes.

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1. Introduction

The human brain has specialized for preferentially perceiving survival- and reproduction-related stimuli even in complex environments (Sander et al., 2005; Bernat et al., 2006; Anderson, 2013). Attention allocation toward specific stimuli is a natural outcome of human evolution. Stimuli that are considered emotionally significant by attentional mechanisms receive enhanced processing and are prioritized in the competition for selective attention (Compton, 2003). The emotional value of stimuli varies among individuals, but threatening stimuli, such as snakes and spiders, are of universal emotional significance, and so are human faces (Palermo and Rhodes, 2007).

The perception of human faces is a highly specialized area of visual processing in humans and requires the activation of visual, limbic, and prefrontal regions (Haxby et al., 2000; Ishai et al., 2005). The perception of infant faces is of particular interest because of its adaptive value in the survival of the human species: human newborns cannot survive without care. Caregivers should be able to meet their infants' needs in a proper way and learn to recognize their cues, since communication in infancy is essentially nonverbal (Bowlby, 1979; Brazelton and Cramer, 1992; Barrett and Fleming, 2011). In this context, infant facial expressions are an important mean of communication between parents and their infants. An early, sensitive caregivers' attunement to their infants is, therefore, a central determinant of positive parenting and contributes to the children's physiological, cognitive, and social-emotional growth (Feldman, 2006; Feldman, 2007a, 2007b).

Ethologist Konrad Lorenz proposed the concept of 'baby schema' (kindchenschema), a specific set of infantile physical characteristics that motivates caretaking behavior and acts as a "social releaser" (Lorenz, 1943). The 'baby schema' includes features such as round face, large head, large eyes, high and protruding forehead, chubby cheeks, small nose and mouth, short and thick extremities, and plump body shape. 'Baby schema' features elicit positive emotions and caregiving responses (Sternglanz et al., 1977; Alley, 1981), motivate caretaking

behavior in adult parents and nonparents (Glocker et al., 2009a), and inhibit aggression, thus improving the chances of adults who are sensitive to the 'baby schema' effects of having their genes passed on to future generations. Some studies support the idea that women are more sensitive to the 'baby schema' effects than men (Fullard and Reiling, 1976; Hildebrandt and Fitzgerald, 1978; Berman, 1980; Maestripieri and Pelka, 2002; Glocker et al., 2009b; Sprengelmeyer et al., 2009).

The perception of infant faces, compared to adult faces, induces a specific pattern of activity in the medial prefrontal cortex, a region involved in reward processing (Kringelbach et al., 2008). Recent studies indicate that tenderness, elicited by cute images, is more than just a positive feeling. Stimuli characteristic of the 'baby schema' have been shown to activate another structure involved in reward processing: the nucleus accumbens (Glocker et al., 2009a). In addition, exposure to images of cute animals and babies has made people more careful about their motor behavior (Sherman et al., 2009; Nittono et al., 2012).

Attentional bias is an index of the difference in attention captured by two different stimuli. Greater cognitive engagement in a specific stimulus may be demonstrated by greater attentional bias toward the stimulus. The role of attentional biases has been extensively researched in the setting of addiction (Field et al., 2008; Field et al., 2013), anxiety (MacLeod and Mathews, 2012), and obesity (Castellanos et al., 2009; Renwick et al., 2013). Such studies provide evidence that individual differences in attentional bias are associated with clinically relevant behaviors. Interventions focusing on attentional bias modification have shown positive results in reducing anxiety and stress vulnerability (MacLeod and Mathews, 2012; Van Bockstaele et al., 2013).

The attention system plays an important role in eliciting appropriate parental behavior and, consequently, appropriate child development. Therefore, infant cues would be expected to have a high biological valence and be prioritized by the attention system in adults. The objective of this study is to review the existing evidence of behavioral measures of adults' attentional bias toward infant faces.

2. Method

We conducted a systematic review of the literature on behavioral measures of attentional bias toward infant faces. The literature search was conducted using MEDLINE/PubMed, PsycINFO, and ISI Web of Knowledge databases to locate all studies involving human subjects (search up to date January 20, 2016). The following search terms were used: "attentional bias" AND "infant". To broaden the scope of our findings, new searches were conducted using "attentional bias" AND "infant" OR "newborn" OR "toddler" OR "babies".

Two reviewers independently screened the title and abstract of each paper, and any discrepancies were resolved by consensus. A third reviewer was consulted if agreement could not be reached. In the second round of review, all selected articles were read in full by the two reviewers and independently assessed for eligibility. Any disagreements were resolved by consensus and, if necessary, a third reviewer was consulted.

Inclusion criteria were that eligible studies had to have used attention tasks to measure adults' attentional bias and had to have deployed infant faces as at least one of the stimuli. Studies focusing on infants' attentional bias toward stimuli were excluded. No date range or language restrictions were used. The reference lists of all selected articles were carefully reviewed for additional relevant studies. In addition, a last search was conducted using the name of the authors of all articles meeting the inclusion criteria for further identification of other potentially relevant studies.

3. Results

The searches yielded 193 citations in PubMed, 88 in PsycINFO, and 312 in ISI Web of Knowledge. A total of 403 articles had their title and abstract reviewed. Of these, only 10 articles were considered eligible for full-text review. The analysis of references in the literature obtained and additional search by authors' names yielded three additional publications for full-text review. Of those 13, three were excluded, totaling 10 articles on attentional bias and infant faces included in this review. Fig. 1 depicts the flowchart outlining the selection of studies included in the qualitative synthesis.

Of the 10 articles included, four were from the same first author, using the same attention task, and comparing attentional biases toward different infant emotions in pregnant women. Two studies compared attentional engagement in own-race vs. other-race infant and adult faces. The other four studies compared the attention retained by infant vs. adult faces using different tasks. Table 1 summarizes the main findings of each article.

Brosch et al. (2007) explored whether pictures of infant faces would have a facilitating effect on the attention system when compared to pictures of adult faces, and whether women and men would have different attentional bias toward infant faces (Brosch et al., 2007). For this purpose, they used a dot probe task including pictures of infants and adults with neutral facial expressions, kittens, adult cats, puppies, and adult dogs. Each trial started with the presentation of a fixation cross, followed by a pair of images that were randomly chosen and paired with others of the same "age" or same species. Then, a small dot appeared, replacing one of the images. Participants had to indicate whether the dot appeared in the left or right side of the screen. In a valid trial, the dot replaced the infant image; in an invalid trial, the dot replaced the adult image. When the target was presented in the left visual field, response times were statistically shorter in valid than in invalid trials only for human pictures. This result highlights that human infant faces capture more attention than adults and this has a species specificity, since other animal babies did not had the same effect on response times. This pattern of attention allocation was not observed when the target appeared in the right visual field. Another important finding of this study, is that attentional bias appears to be modulated by the arousal potential of a stimulus, since there was a very high correlation between arousal elicited by the image and the response time.

Hodsoll et al. (2010), in a later study, further investigated the influence of race on adults' attentional prioritization of infant faces. Also using a dot probe task, neutral infant faces were paired with neutral adult faces of the same race. Pictures of South Asian and Caucasian infants and middle-aged adults were used. Forty female undergraduate students participated in the study, half South Asian, and half Caucasian. The response time was shorter when the probe replaced infant pictures, but only when the infant's race was the same as that of the participant. The authors suggested that the attentional bias toward infant faces was race dependent.

Conversely, Proverbio et al. (2011) demonstrated that age impacts automatic allocation of attention, whereas ethnicity does not (Proverbio et al., 2011). The authors used as stimulus pictures of infant and adult faces of different ethnic groups, all of them showing a positive facial expression. Participants were asked to ignore the faces and answer whether the target (a picture of a tree) was presented upright or downward. The target was displayed on the screen right after the stimulus (face image) either in the same side of the stimulus (valid trial) or in the opposite side of the stimulus (invalid trial). Participants (30 undergraduate and graduate students) had shorter response times to targets preceded by infant than adult faces, suggesting greater attention allocation toward infant stimuli. Reinforcing this idea, participants committed more errors when the target was displayed on the other side of the infant face image, and the opposite occurred when adult faces were used as the stimulus. This suggests difficulty in disengaging attention from the infants' images. As opposed to Hodsoll et al. (2010) results, there was no effect of ethnic group on response times or error rates, suggesting that ethnicity did not influence attention allocation to infant faces.

In 2010, Pearson et al. (2010) published the first of a series of articles on attentional bias toward infant stimuli (Pearson et al., 2010; Pearson