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Original Article

Sex differences in visual attention toward infant faces ☆

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ABSTRACT

Parental care and alloparental care are major evolutionary dimensions of the biobehavioral repertoire of many species, including human beings. Despite their importance in the course of human evolution and the likelihood that they have significantly shaped human cognition, the nature of the cognitive mechanisms underlying alloparental care is still largely unexplored. In this study, we examined whether one such cognitive mechanism is a visual attentional bias toward infant features, and if so, whether and how it is related to the sex of the adult and the adult's self-reported interest in infants. We used eye-tracking to measure the eye movements of nulliparous undergraduates while they viewed pairs of faces consisting of one adult face (a man or woman) and one infant face (a boy or girl). Subjects then completed two questionnaires designed to measure their interest in infants. Results showed, consistent with the significance of alloparental care in human evolution, that nulliparous adults have an attentional bias toward infants. Results also showed that women's interest in and attentional bias towards infants were stronger and more stable than men's. These findings are consistent with the hypothesis that, due to their central role in infant care, women have evolved a greater and more stable sensitivity to infants. The results also show that eye movements can be successfully used to assess individual differences in interest in infants.

1. Introduction

Care for infants is a major evolutionary dimension of the biobehavioral repertoire of many species (Clutton-Brock, 1991). For human beings, its evolutionary importance is likely to have significantly shaped cognition to ensure that parents are sufficiently interested in and responsive to infants that they provide steadfast care (Burkart, Hrdy, & Van Schaik, 2009). The underlying cognitive mechanisms, however, are still largely unknown. Here we report a study designed to identify how attention might be attuned to the detection and processing of infant faces, and to examine how attention might vary in strength as a function of individual differences in interest in infants.

Primate infants are costly to rear because of the considerable energy and care they require and because their slow maturation requires care over an extended period (Kaplan & Lancaster, 2003; Kramer, 2005; Lancaster & Lancaster, 1987). By these criteria, human infants and children are the most costly by far (Hrdy, 1999, 2009; Kramer, 2005; Kuzawa, 1998). Despite these costs, humans reproduce at higher rates than the average for Great Apes (Galdikas & Wood, 1990; Sear & Mace, 2008; Sellen, 2007).

Humans reach these high rates through substantial maternal care and unusually high investment by alloparents and fathers. The amount and length of these investments suggest that there are psychological mechanisms to help ensure that children receive the required care. Studies indicate that these mechanisms are triggered, in part, by the qualities that make infants 'cute' and attractive (e.g., large head, large and low-lying eyes) (Gould, 1980; Lorenz, 1971; Tinbergen, 1951). Most adults, for instance, rate images of infants as cuter and more attractive than images of adults (Fullard & Reiling, 1976; Maestripieri & Pelka, 2002), smile more at infant images (Bradley, Codispoti, Sabatinelli, & Lang, 2001; Hildebrandt & Fitzgerald, 1978), look longer at cuter than at less cute infants (Hildebrandt & Fitzgerald, 1978, 1981), are more likely to use infant-directed speech with children with more infant-like features (Zebrowitz & Brownlow, 1992), and are more willing to care for cuter than less cute infants (Glocker et al., 2009a).

Despite advances in our understanding of the behavioral underpinnings of human infant care, little is known, as we said, about the cognitive mechanisms involved. One exception is studies using the dot-probe paradigm, which show that infant faces produce more efficient covert shifts of spatial attention than adult faces. In one study, the greater efficiency was indexed by faster detection of a target cued by an infant face (Brosch, Sander, & Scherer, 2007), in

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another study by greater amplitude of the P1 ERP component and improved discrimination of the orientation of a target cued by an infant face (Brosch, Sander, Pourtois, & Scherer, 2008). These studies suggest that basic attentional processes might be specifically tuned to infant stimuli. Some critical questions, however, remain.

First, the evidence shows that infant faces affect covert attention. It is unclear whether the results will be the same for overt attention. Attention allocation can be accomplished by gazing at a location of interest (overt attention) or by attending to peripheral regions without moving one's eyes (covert attention). Overt attention is sequential so that only one location is fixated at a time, whereas covert attention, at least under some circumstances, can be deployed simultaneously to several regions (Carrasco, 2011; Cave, Bush, & Taylor, 2010). While caring for an infant, the caregiver, as needed, sometimes attends to the infant overtly, including looking at it directly, other times covertly. In social-interactions, however, overt attention is what counts if, as seems likely, direct looks are more rewarding (Ewing, Rhodes, & Pellicano, 2010; Kampe, Frith, Dolan, & Frith, 2001). Mutual gaze is fundamental for nonverbal communication, and infants look longer at faces with direct gaze than averted gaze and show distinctive neural processing to faces with direct gaze (Farroni, Csibra, Simion, & Johnson, 2002; Grossmann et al., 2008). To our knowledge, no study has examined how infant faces affect sustained overt attention. This was one goal of the current study.

Second, questions remain about whether and how much these attentional biases vary between the sexes. Compared to men, women more often pick up and hold infants (Harris, Spradlin, & Almerigi, 2007; Lockard, Daley, & Gunderson, 1979) and, in laboratory studies, show higher interest in and responsiveness to infants (Blakemore, 1981; Feldman & Nash, 1978; Maestripieri & Pelka, 2002), more often use infant-directed-speech when talking to them (Zebrowitz & Brownlow, 1992), prefer their images (Fullard & Reiling, 1976; Maestripieri & Pelka, 2002), are more sensitive to cuteness differences in their faces (Lobmaier, Sprengelmeyer, Wiffen, & Perrett, 2010; Sprengelmeyer et al., 2009), and are faster and more accurate in recognizing their facial expressions (Babchuk, Hames, & Thompson, 1985).

These observations are consistent with comparative and cross-cultural data about parents and alloparents. Typically, mothers are the greatest contributors – about 50% – to direct infant care (Kramer, 2005; Marlowe, 2005), with siblings, grandmothers, and the father contributing to lesser extents (Marlowe, 2005). Human fathers, however, show greater parental investment than the males of other Great Ape species, although their investment is highly variable across individuals and societies (Geary, 2008; Gray & Anderson, 2010; Hewlett, 1992; Marlowe, 2005). Among the several factors that affect male parental investment are the degree to which it contributes to offspring survival and reproductive success, certainty of paternity, and the cost of loss of mating opportunities with other females (Geary, 2008). Thus, although we expect to find sex differences in cognitive mechanisms among humans, these differences are likely to be moderated by greater variability in interest in infants among men than women rather than in a complete lack of interest by men.

For all these reasons, the presumed cognitive architecture that subserves infant care should be sensitive to individual and sex-related differences among adults in how rewarding they think it will be to care for infants. If we consider attentional mechanisms, for instance, it is now widely accepted that the deployment of attention is accomplished through the interactions of two attentional systems (Corbetta & Shulman, 2002), a bottom-up, salience-based system and a top-down volitional system. The former is thought to operate fairly rapidly and automatically in a feed-forward manner (Theeuwes, 1992), whereas the latter system relies on re-entrant projections and therefore takes more time to exert its influence (Theeuwes, 1992; Treisman & Gelade, 1980; Wolfe, Cave, & Franzel, 1989). Studies have shown that both systems give attentional priority to rewarding stimuli (Anderson, Laurent, & Yantis, 2011; Hickey, Chelazzi, & Theeuwes, 2010; Raymond & O'Brien, 2009). Applying this model to the question of infant care, we can speculate that evolution has favored a general attentional bias toward infants that is modulated by individual differences (e.g., sex differences, mating strategies) and the socio-ecological circumstances under which caregiving occurs (e.g., viability, social support).

Although the attentional bias for infants can be expressed in both bottom-up and top-down systems, and although we do not preclude the possibility that infant-related reward can modulate bottom-up processing, we assume that individual differences are more evident in top-down attention because that system is intrinsically volitional and because reward facilitates volitional attention. If voluntary attention is driven by a reward system, attention to infants should be sensitive to the reward that adults ascribe to infants. To date, this hypothesis has not been tested.

The current study therefore had two main goals. The first was to examine how infant faces affect sustained overt attention. The second was to examine whether individual differences in interest in infants are associated with different patterns of overt attention to faces of different ages (infants vs. adults) and different sexes (male vs. female). To find out, we monitored subjects' eye movements while they looked at pairs of faces, one of an adult, one of an infant. The design assumes that both stimuli are competing for attentional resources. We manipulated the relative reward value of the infant faces on the premise that most young heterosexual adults would show special interest in adult faces of the opposite sex (Kranz & Ishai, 2006; Spreckelmeyer, Rademacher, Paulus, & Gründer, 2013). We then gave subjects two questionnaires designed to assess their interest in infants. Given the evolutionary significance of infant care, we predicted a general attentional bias to infants and that the degree of attentional bias will reflect individual, including sex-related, differences in interest.

2. Methods

2.1. Subjects

The subjects were 32 men (age: $M \pm SD = 19.38 \pm 1.18$) and 31 women (age: $M \pm SD = 19.29 \pm 1.68$), all undergraduates at Michigan State University, who participated for course credit. None were parents, and 1 woman reported that she was pregnant. All reported having normal or corrected to normal vision. All checked "white" on an ethnicity questionnaire. The sample was selected from a slightly larger sample (69 subjects) based on their descriptions of their sexual feelings and sexual fantasies on two 7-point Kinsey scales (Kinsey, Pomeroy, & Martin, 1948). The 63 selected reported being completely heterosexual ($N = 58$) or predominantly heterosexual ($N = 5$). Our intent in restricting the sample in this way was to simplify the interpretation of any potential differences in attention between same- vs. opposite-sex adult faces. Finally, one man was removed from the analyses because he acted "uninterested" during the study and inspection of his eye movement data showed that he did not comply with the task (e.g., he did not look at either face on many trials).

2.2. Stimuli

The stimuli for the eye-tracking test were frontal views of the faces of young adults and infants, all with neutral expressions. The adult faces (24 men, 24 women) were selected from the *Productive Aging Lab Face Database* (Minear & Park, 2004) and the *FERET* database (Phillips, Moon, Rizvi, & Rauss, 2000). The infant faces (24 boys, 24 girls, 3 to 6 months old) were selected from the website *Flickr* (www.flickr.com). All faces were of white individuals and, in each age and sex category, showed similar levels of masculinity/femininity and attractiveness (as rated by independent judges).