Psychology
2011. Vol.2, No.9, 931-935

DOI:10.4236/psych.2011.29140

No Race Effect (ORE) in the Automatic Orienting toward Baby Faces: When Ethnic Group does Not Matter

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Received September 14th, 2011; revised October 17th, 2011; accepted November 21st, 2011.

It was shown that own (vs. other) race baby faces capture attention automatically whereas other race babies do not (Hodsoll et al., 2010). Other literature provided evidence of an innate preferential response to baby faces (baby schema effect). We investigated whether infant (vs. adult) faces automatically attracted attention (exogenous orienting), and whether this was modulated by ethnicity. 30 students took part in this study. Their task was to decide whether a lateralized target was upright or inverted. Targets were preceded by 400 baby or adult (Caucasian vs. non-Caucasian) faces shortly flashed in the same location, thus acting as spatial cues (valid/invalid). Results showed no effect of the ethnic group but of face age in speeding up RTs to targets preceded by baby faces. Significant costs for invalid locations cued by baby faces were also found (difficulty in disengagement). The data indicate how visual attention is literally captured by baby schema, independent of baby race.

Keywords: Baby Schema, Face Processing, ORE Effect, Parental Instinct, Spatial Cueing, Automatic Orienting of Attention

Introduction

It is known that baby faces have stronger attentional capture capabilities than adult faces, or other visual objects. An automatic orienting of attention is observable when visual targets are preceded by baby (vs. adult) faces (Brosch et al., 2007; Hodsoll et al., 2010) or when voluntary attention is directed elsewhere and non-target infant (vs. adult) faces are presented (Hodsoll et al., 2010; Proverbio et al., 2011). The whole set of pedomorphic characteristics typical of an infantile face is called "baby schema" and includes a round face, high forehead, big eyes, small nose and mouth, chubby cheeks, and a large head as compared to the baby's shoulder (Lorenz, 1971).

Baby schema attention capturing effects are measurable, for example, in terms of detection times to targets presented in a space location preceded by a baby face (Brosch et al., 2008; Brosch et al., 2007). In some cases there is a dot to be detected, the so called "dot probe task" (Brosch et al., 2007), in other cases a triangle has to be evaluated to establish its orientation (pointing upward or downward) (Hodsoll et al., 2010).

Baby faces are perceived as cute and this is thought to increase the adult motivation to take care of infants (Glocker et al., 2009). Glocker and colleagues (Glocker et al., 2009) using functional magnetic resonance imaging found that perception of baby faces activates the nucleus accumbens, a structure of the mesocorticolimbic system mediating reward processing and pleasure perception. Other neuroimaging studies have investigated the neural circuits subtending the brain response to infant as opposed to adult faces identifying the neural circuit by which baby schema promotes human caregiving. This system includes, besides the accumbens nucleus, the fusiform gyrus (face fusiform area) and the medial orbitofrontal cortex (Kringelbach et al., 2008; Leibenluft et al., 2004; Nitschke et al., 2004; Proverbio et al., 2011). The response to infant faces seems independent of attention and is thought to be at the basis of parental instinct in humans (Kringelbach et al., 2008).

Some findings indicate that the special response to baby faces is limited to infants and toddlers, and it significantly decreases as children age increases. For example, a reduction in the amplitude of reward related orbito-frontal N2 ERP response to faces of pre-puberal children (as compared to infants) (Proverbio et al., 2011) was recently demonstrated. Again, it has been estimated that the perceived cuteness diminished after the age of 4.5 years (Luo et al., 2011) when the consistent baby growth significantly alters the infant face proportions.

The assumption underlying the concept of baby schema is that the adults' releasing response is regulated by a universal instinct devoted to the human species preservation, with the evolutionary function of enhancing offspring survival, although it also extends to juvenile animals and puppies. Therefore it shouldn't be diminished or limited by the diversities of facial characteristics typical of distinct human ethnic groups. Notwithstanding that, it has been recently shown that attentional capturing effects of infant faces (for the viewers) are limited to infants of own race (Hodsoll et al., 2010). According to the authors, own race baby faces do attract attention, but other-race infants do not, which is a quite strong conclusion. Hodsoll and colleagues (Hodsoll et al., 2010) interpreted this effect in the light of the literature on the so-called other-race effect (ORE), which consists in faster and better performance in race categorization tasks for own race (OR) than other race faces (Rhodes et al., 2009; Walker and Tanaka, 2003). This advantage of OR faces has been described as due to a difference in neural processing of OR vs. different race faces. The hypothesis is that the neural mechanism processing OR faces would be especially finely tuned, as indexed by N170 component of ERPs (Vizioli et al., 2011), probably as a product of visual experience and familiarity (Caldara et al., 2004).

Not being convinced that the baby schema advantage was dependent by perceptual expertise or familiarity, being present also in sexually immature children (Sanefuji et al., 2007), or directed to puppies of other species (Sanefuji et al., 2007), we decided to further investigate this matter.

In order to have a direct measure of attentional allocation, an exogenous orienting of attention paradigm (Mulckhuyse and Theeuwes, 2010; Posner, 1980) was devised where human faces (of both babies and adults) acted as cues, and a little tree, which could be upright or inverted in orientation, acted as target stimulus. A short ISI was chosen to avoid the inhibition of return phenomenon. Indeed, it has been shown that the subliminal perception of faces can attract attention, thus improving target processing at the cued location (Brosch et al., 2008; Pourtois et al., 2005). Had baby faces stronger attentional capture capabilities than adult faces, this would result in faster RTs to targets preceded by baby faces. Furthermore, we manipulated the ethnic group of faces by presenting 200 own ethnicity and 200 other ethnicity faces. Had the ethnic group (also called "race" in the literature) an effect on the attentional grabbing of attention, we would be able to quantify it by comparing OR with the other race condition.

Methods

Subjects

Thirty healthy undergraduate and graduate students (7 men and 23 women) participated in this study as unpaid volunteers. They earned academic credit for their participation. Their mean age was 26.9 years. All had normal or corrected-to-normal vision and reported no history of neurological illness or drug abuse. Their right-handedness and right ocular dominance were confirmed using the Italian version of the Edinburgh Handedness Inventory, a laterality preference questionnaire. The experiment was conducted with the understanding and written consent of each participant according to the Declaration of Helsinki (BMJ 1991; 302: 1194) and in compliance with APA ethical standards for the treatment of human volunteers (1992, American Psychological Association). The experimental protocol was approved by the ethical committee of the University of Milano-Bicocca.

One participant was excluded from data analysis for her bad performance (committed more than 20% of errors).

Stimuli and Procedure

The stimulus set comprised 400 color pictures of infant faces (200) and male and female adult faces (200) of comparable luminance (see Figure 1). Because all infants were anonymous, their age was actually unknown but, on the basis of infant appearance, we estimated that it was lower than 24 months. Except for the infant category (for which sex was sometimes indistinguishable), adult faces depicted an equal number of females (100) and males (100). All people were smiling or showing a positive facial expression.

Half individuals (200) had Caucasian somatic traits, whereas the other half (200) were non-Caucasian people (Black or Afro-American, American Indian, Asian, etc.). Stimulus size was 7.5 × 9 cm that is 3˚46'17" × 4˚31'32" of visual angle (193 × 225 pixels). Faces of various sex, age and ethnic group were presented randomly mixed to the left or the right of the fixation point (along the horizontal meridian), at the eccentricity of 3 cm: 1.5˚ to the left or right of fixation point. Each face was presented for 200 ms with an ISI of 200 ms between the face and the target. The colored drawing of a tree (same size and spatial distribution of face stimuli) was used as target stimulus.

Figure 1.
Example of stimuli from the two categories (*same vs. different ethnic group*), *and age classes* (*babies vs. adults*).

The tree could be presented in its standard orientation (upright) or downward (inverted orientation). The inter-trial interval was 1300 - 1500 ms. The outer background was dark gray.

Procedure

Participants were comfortably seated in a darkened and acoustically shielded test area, facing a computer screen located 114 cm from their eyes. Their task was to decide whether the tree presented right after the face was upright or inverted in orientation by pressing a key with the index finger (of either the left or right hand) to answer yes and with the middle finger to answer no. All faces had to be ignored. The two hands were used alternately during the recording session. The order of the hand and task conditions was counterbalanced across subjects. Participants were instructed to fixate on the center of the screen, where a small transparent circle served as fixation point, and to avoid any eye or body movements during the recording session.

Data Treatment and Analysis

For each participant reaction times (RTs) to targets, hit and error percentages (correct responses and incorrect categorizations) were recorded. Omissions were very infrequent, only 11 out of 29 Ss committed a few omissions, and omission rate was 0.31% (1.24/400 targets). Therefore omissions did not undergo statistical treatment. Error rate was about 4.5%. Error percentages were converted to arcsine values and subjected to a four-way repeated-measure ANOVA. Factors were: face age (baby, adult), ethnic group (same, different), cue validity (valid, invalid), target orientation (upright, inverted).

Reaction times faster than 140 ms, or exceeding the mean value ±2 standard deviations were discarded. Behavioral data were subjected to multifactorial repeated-measures ANOVA with four within factors. They were: face age (baby, adult), ethnic group (same, different), cue validity (valid, invalid), target orientation (upright, inverted).

Results

The ANOVA performed on error rates indicated a significant interaction of validity X target orientation ($F(1, 28) = 16.1$; $p < 0.0005$), demonstrating significantly fewer errors to valid than invalid targets for the standard orientation, as confirmed by post-hoc comparisons (see Figure 2).

The further interaction of face age X cue validity ($F(1, 28) = 5.33$; $p < 0.02$) showed greater costs for the invalid trials when cues were baby rather than adult face (see Figure 3), as proved by post-hoc comparisons among means.

RTs analysis showed the significant effect of face age ($F(1, 28) = 8.1$, $p < 0.0075$), with faster RTs to targets preceded by baby (502.8, SE = 9.99 ms) than adult faces (506 ms, SE = 9.77). The further interaction of validity X orientation ($F(1, 28) = 9.73$; $p < 0.0045$), and relative post-hoc comparisons, indicated the presence of faster RTs to upright targets presented at valid than invalid locations ($p < 0.01$), whereas no benefits were observed to validly-cued inverted trees, possibly because of a ceiling effect (see Figure 4).

No effect whatsoever of ethnic group (or "race") was found, both in error rates and RTs, nor per se, or in interaction with other variables.

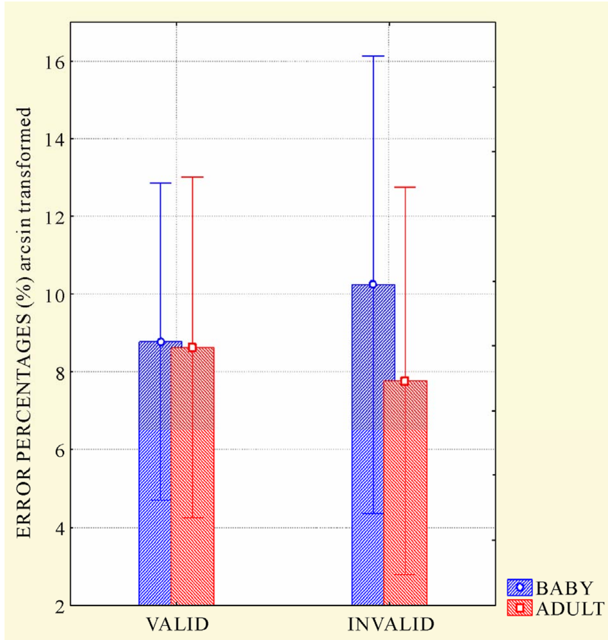

Figure 3.
Error percentages (arcsin transformed) recorded as a function of cue validity and face age (N = 29). This figure displays strong costs for invalid locations cued by baby faces (difficulty in disengagement). The data indicate how visual attention is literally captured by baby schema.

Discussion

Both response speed and error analyses showed an effect of spatial cueing for faces presented at valid locations, with significantly faster RTs and fewer errors at the cued location. The interaction of cue validity and target orientation indicated the presence of benefits for the attended location (both in terms of faster RTS and fewer errors) only for upright trees. Quite interestingly the error analysis showed that when attention was attracted to baby faces (the spatial cue was a baby face) and the trial was invalid (a re-orienting of attention was required toward the opposite visual field) costs were much stronger that

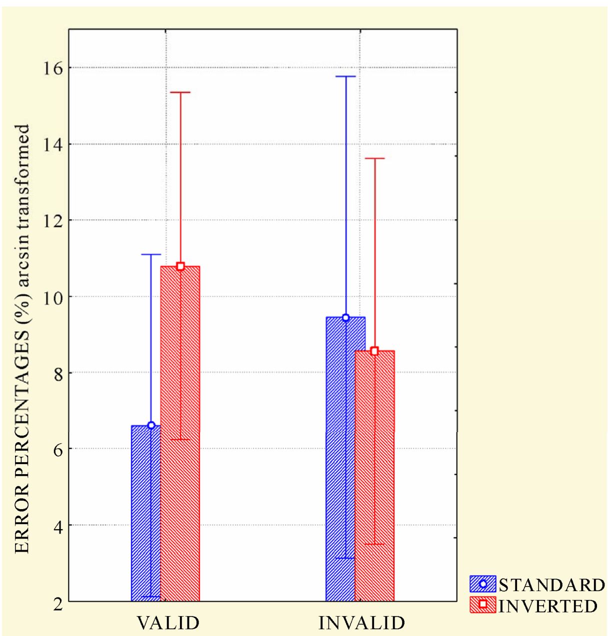

Figure 2.
Error percentages (arcsin transformed) recorded as a function of cue validity and target orientation (N = 29).

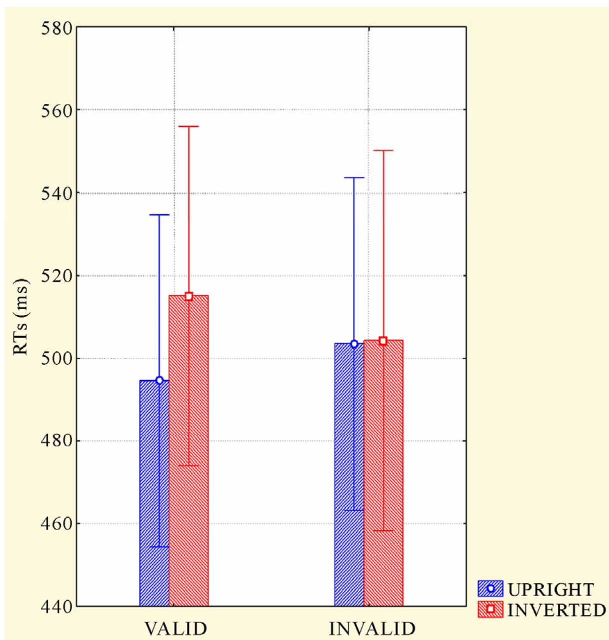

Figure 4.
Mean reaction times (in ms) recorded as a function of cue validity and target orientation (N = 29). Overall RTs were faster to baby than adult faces (regardless of ethnic group).

when the invalid cue was an adult face, thus suggesting a difficulty in attentional disengagement. These data support the hypothesis that baby faces have powerful attention-capture capabilities (Brosch et al., 2007), which resist attentional reallocation (Proverbio et al., 2011).

Our data also showed a strong effect of the face age per se in speeding up response times to targets, regardless of visual field of presentation, and ethnic group of face. In a similar study, where neutral and affective faces were bilaterally presented, it was found a greater d' in response to targets preceded by baby than adult faces (Brosch et al., 2008), associated with an increase in the P1 amplitude of ERPs recorded to valid trials. The results were interpreted in terms of an early sensory modulation due to attentional capturing mechanism for biologically relevant stimuli, similar for baby faces and aversive stimuli (fearful faces).

Our data showed no effect whatsoever of the ethnic group of the faces, nor per se, nor in interaction with age face. RTs were virtually identical for faces of all ethnic groups (Caucasian= 504.3 ms, other groups 504.4 ms) thus suggesting a complete lack of ORE effect, not only in the attentional capabilities of baby faces, but also in the spatial validity effects recorded for adult faces. It must be considered that the ORE effect has been interpreted in the literature has strongly linked to a difference in the perceptual familiarity of own vs. other races, especially in categorization task, based on featural analysis (Caldara et al., 2004; Rhodes et al., 2009; Vizioli et al., 2011; Walker & Tanaka, 2003). In the case of the present investigation, no analysis of face properties was required. Furthermore, a detailed face featural analysis was made more difficult by the short presentation time (200 ms) and by the immediate presentation of the target to be responded to. Therefore the baby face advantage has to be considered an automatic and prioritarized response of the visual system to biologically relevant signals. And indeed a recent ERP study (Proverbio et al., 2011) provided evidence of an increased visual N170 response to infant than adult faces (especially in the female brain), thus supporting the previous literature about a female preference for the image of infants below 24 months (Proverbio et al., 2006).

At this regard, it cannot be excluded that some previous data showing an effect of "race" on the response to baby faces might be partly due to the specific faces used in that study as stimuli, and their scarce number (i.e., only 8 "other race" and 8 "own race" baby faces were used in the study by Hodsall and coworkers (Hodsoll et al., 2010).

In our study, RTs were much faster in response to upright than inverted trees, which is a rather common finding in cognitive psychology literature (Shepard & Metzler, 1971), and has to do with object familiarity, mental rotation, and same/different effects (Logan, 1980). Target orientation also interacted with cue validity, possibly because the "different" response ("no", with the middle finger), negatively interacted, at higher order cognitive level, with the spatially-dependent attentional advantage for the cued location, thus requiring the additional, time-consuming, involvement of control systems, (such as, for example, the anterior cingulate and other prefrontal structures involved in conflict resolution, response monitoring and action regulation), but further investigation is certainly needed to get more light on this matter.

Conclusion

In summary, this study provides no evidence that faces (neither infantile nor adult) are processed differently as a function of their ethnic group, (also called "race", in some literature), when it comes to automatic attentional orienting. However, a powerful bias toward baby faces was found, with stronger cueing validity effects for baby than adult faces, thus further suggesting the existence of a fundamental social instinct that may be at the basis of human offspring caregiving. Other neuroimaging data, regarding the preferential auditory processing, in adults (and especially in women), of infant vocalizations such as laughing and crying, do support this hypothesis (Sander et al., 2007; Seifritz et al., 2003).

Acknowledgements

The study was funded by FAR2011 grant from University of Milano Bicocca.

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