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Original Article

The effects of facial attractiveness and perceiver's mate value on adaptive allocation of central processing resources

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ABSTRACT

Faces capture cognitive resources, and more attractive faces capture more resources. But to be of adaptive value this proportionality should be modulated by properties of the perceiver, including their own level of attractiveness. Here we investigated the allocation of central processing resources for perceivers at different levels of mating market value (high, low) in response to target faces of different levels of attractiveness (attractive, unattractive). We tracked attention allocation by measuring event-related brain potentials (ERPs) from the scalp of men while they viewed and rated images of women's faces. As expected, a main effect of attractiveness was found such that attractive faces garnered the largest brain responses. However, perceiver's market value and target face attractiveness interacted, as brain responses to unattractive faces were significantly larger in the low-market-value condition compared to the high-market-value condition, whereas responses to attractive faces were stable across market values. Thus, for men at least, allocation of attention is adaptively modulated by both the attractiveness of a target face and their own market value. The more attractive an individual perceives themselves to be, the less processing resources they appear to devote to the unattractive faces in their environment.

1. Introduction

Physical attractiveness has been shown to be vital and influential in the context of mate seeking, both for the seeker and their target. Although the body and the face are both considered when people are evaluating the physical attractiveness of others, research has shown that assessments of facial attractiveness alone are deemed more important for both sexes when contemplating potential mate choice (Riggio, Widaman, Tucker, and Salinas, 1991; Peters, Rhodes, and Simmons, 2006; Currie and Little, 2009). The putative adaptive value of facial attractiveness is supported by observations that it is heritable (Cornwell and Perrett, 2008) and related to identifiable, quantifiable features including symmetry, sexual dimorphism and averageness (Alley and Cunningham, 1991; Langlois, Roggman, and Musselman, 1994; Perrett et al., 1998; reviewed by Little, Benedict, and DeBruine, 2011). Indeed, facial beauty has been demonstrated to be an indicator of reproductive and overall fitness, fundamental considerations when people are surveying potential mates (Gangestad, Thornhill, and Yeo, 1994; Shackelford and Larsen, 1999; Pflüger, Oberzaucher, Katina, Holzleitner, and Grammer, 2012). Put another way, facial attractiveness is an important factor in establishing an individual's value on the mating market (Little and Mannion, 2006). Given this, it is not surprising that humans allocate substantial central (i.e., cognitive) resources to processing facial attractiveness in potential mates (Maner, Gailliot, and DeWall, 2007; Jung, Ruthruff, Tybur, Gaspelin, and Miller, 2012). But to date this line of research has not incorporated the idea that one's "lower limit" for what they consider acceptable in terms of attractiveness in a potential mate appears to be proportional to their own attractiveness (Montoya, 2008). Thus the present study was designed to investigate whether one's own mating market value modulates the allocation of central processing resources toward target faces based on their attractiveness.

Given the powerfully adaptive and influential nature of facial judgments, it stands to reason that humans can assess attractiveness extremely quickly. Locher, Unger, Sociedade, and Wahl (1993) sought to understand whether the duration of time spent viewing a photograph of an individual could influence perceptions of physical attractiveness. Observers were remarkably similar in their ratings of the attractiveness of target images flashed for 100 ms compared to independent ratings made under no time restrictions. Olson and Marshuetz (2005) determined that even when images were displayed outside conscious awareness, ratings by participants were analogous to independent, conscious judgments of attractiveness. The images flashed so quickly (13 ms) that participants claimed they had not seen the image; however, their responses indicated better-than-chance ratings of attractiveness. Measures of brain electrical responses, which correspond to real-time estimates of neural activity, support the rapidity of attractiveness processing as waveforms peaking before 250 ms of stimulus onset have been shown to differentiate faces of varying levels of attractiveness

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(Werheid, Schacht, and Sommer, 2007; Marzi and Viggiano, 2010; van Hooff, Crawford, and van Vugt, 2011).

Although rapidly achieved, the processing of facial attraction has recently been shown to come with a cost, specifically the investment of cognitive resources that could otherwise be devoted to other tasks. For example, Jung et al. (2012) found that attractiveness judgments were hindered, that is slowed in a speeded reaction task, by a concurrent task involving pitch judgments of an auditory tone. In a complementary fashion, the presence of attractive faces can hinder performance of other tasks. Maner et al. (2007) found that performance on a dot-probe task was significantly slowed by the presence of highly attractive but task-unrelated faces compared to average task-unrelated faces. The standard way to interpret such a pattern from this classical type of task is that the attractive faces "capture" attentional resources, thus making it difficult to disengage attention and allocate it toward the assigned task. In support of this, Duncan et al. (2007) showed that reaction times on a change detection task were faster when the target stimuli were attractive compared to unattractive, at least for men viewing female faces. Like the studies discussed above, the attentional capture by attractive faces in that study was estimated indirectly by measuring the impact of attractiveness on another task: change detection in the case of Duncan et al. (2007); dot-probe interference in the case of Maner et al. (2007); or by the impact of another task on processing attractiveness for Jung et al. (2012).

The allocation of attention to processing facial attractiveness can also be assessed directly by measuring the amount of brain activity associated with the presentation of faces, and to date this line of research has generally supported the claim that attractive faces capture central resources in an adaptive manner. Specifically, the amplitude of event-related brain potentials (ERPs) in response to faces has shown proportionality such that the most attractive faces garner the largest brain responses, and the least attractive faces the smallest responses (Johnston and Oliver-Rodriguez, 1997; Marzi and Viggiano, 2010; van Hooff et al., 2011; Werheid et al., 2007; but see Schacht, Werheid, and Sommer, 2008). Although several different stages of processing (i.e., several different ERP waveform components) have been studied in this context, the late positive potential (LPP; also known as the late positive component/complex, or LPC) in particular has been useful for measuring the allocation of central attentional resources to stimuli based on their motivational salience including emotionality (Chavis and Kisley, 2012; Hajcak, Moser, and Simons, 2006; Schupp et al., 2004; reviewed by Olofsson, Nordin, Sequeira, and Polich, 2008). Of more specific relevance to the current study, the amplitude of this waveform (peaking between 400 and 700 ms post-stimulus onset) has been consistently shown to be proportional to the rated attractiveness of faces (Oliver-Rodriguez et al., 1999). From an evolutionary framework then, larger LPP responses to more attractive faces can be understood as the allocation of more processing resources, in this case attention, to stimuli based on their adaptive salience.

Although highly influential, physical attractiveness is not the only factor that determines how a face will be processed by the perceiver. In addition to internal variables such as hormone level and fertility (reviewed by Little et al., 2011), a perceiver's subjective opinion regarding their own level of attractiveness affects how they view others and their potential mate choices (Huston, 1973; Kowner, 1996; Little and Mannion, 2006; Montoya, 2008). Attractive individuals expect to, and in fact do compete more successfully on the mating market in the sense that they tend to mate with other attractive individuals (Walster, Aronson, Abrahams, and Rottmann, 1966; Feingold, 1988; Miner and Shackelford, 2010). While people desire the most highly attractive mate possible (Lee, Loewenstein, Ariely, Hong, and Young, 2008; Taylor, Fiore, Mendelsohn, and Cheshire, 2011), individuals of high attractiveness might tend to couple with each other leaving other lesser attractive individuals to mate among themselves (Kalick and Hamilton, 1986). It remains to be determined whether the cognitive costs of assessing attractiveness follow this putative dependency in an adaptive manner. In other words, does an individual with higher market value expend less central processing resources on less attractive faces in their environment?

The present study was designed to investigate the potential interaction between facial attractiveness of the target and mating market value of the perceiver on the allocation of central processing resources. To track attention allocation, the electrical activity of men's brains was recorded in response to women's faces of varying levels of attractiveness. Unlike other studies that included attractiveness ratings as a secondary or non-goal-related task that effectively distracted attention away from a primary task (Duncan et al., 2007; Maner et al., 2007; Jung et al., 2012), the current study used judgments of attractiveness as the primary and only task. Market value was experimentally manipulated such that each participant was recorded under "low" and "high" value conditions. In this way, we were testing for evidence of adaptive resource allocation *within* subjects, rather than *between* subjects as is often accomplished by testing for individual differences in a relevant variable (e.g., sex, or sociosexual orientation). We selected males for this investigation because men place a greater emphasis on physical attractiveness when judging mate value (Buss and Schmitt, 1993; Li, Bailey, Kenrick, and Linsenmeier, 2002; Miner and Shackelford, 2010) and further they exhibit stronger attention capture effects to attractive faces of the opposite sex (Duncan et al., 2007; Maner et al., 2007; van Hooff et al., 2011). We predicted a shift in resource allocation such that, in the higher-market-value condition, brain responses would exhibit greater prioritization of more attractive faces compared to less attractive faces. In addition to this novel prediction, we expected to replicate the main effect of attractiveness on resource allocation shown previously with ERP-based studies, such that brain responses would be larger overall in response to more attractive faces.

2. Methods

2.1. Participants

A total of 30 male undergraduate university students were awarded course extra credit in exchange for their participation. Participants' ages ranged from 18 to 34 years (mean $\pm$ SD = 21.30 $\pm$ 4.03 years). The Snellen visual acuity chart was utilized to ensure that all participants' vision was sufficient to see the stimuli presented on a computer monitor. Under self-selected natural or correct-to-normal vision, all participants tested 20/40 or better. Each participant rated images of female faces within the context of each condition (high and low market value) while behavioral and electrophysiological data were recorded. Participants were alternately counterbalanced for order of market value condition.

2.2. Materials

Images were presented on a 17-inch LCD monitor approximately 3 feet from the participant. E-Prime software (Psychological Software Tools, Inc. Pittsburgh, PA) was utilized to record behavioral responses during the task and to present the images. A photosensitive diode attached to the monitor enabled determination, within a millisecond, of the timing of stimulus presentation. Electroencephalographic data were recorded with a 74-channel sintered Ag/AgCl electrode cap (Electrode Arrays, El Paso, TX) connected to a multi-channel amplifier under the control of data acquisition software (Sensorium, Inc., Charlotte, VT). These data were converted into ERP waveforms and analyzed using EMSE software (Source Signal Imaging, Inc. La Mesa, CA).

Initially, 90 black and white images of female faces were selected from the Internet and tested in a pilot study to allow for sorting of