

Adaptive allocation of attention: effects of sex and sociosexuality on visual attention to attractive opposite-sex faces[☆]

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Abstract

We tested the hypothesis that, compared with sociosexually restricted individuals, those with an unrestricted approach to mating would selectively allocate visual attention to attractive opposite-sex others. We also tested for sex differences in this effect. Seventy-four participants completed the Sociosexual Orientation Inventory and performed a computer-based task that assessed the speed with which they detected changes in attractive and unattractive male and female faces. Differences in reaction times served as indicators of selective attention. Results revealed a Sex×Sociosexuality interaction: Compared with sociosexually restricted men, unrestricted men selectively allocated attention to attractive opposite-sex others; no such effect emerged among women. This finding was specific to opposite-sex targets and did not occur in attention to same-sex others. These results contribute to a growing literature on the adaptive allocation of attention in social environments. © 2007 Elsevier Inc. All rights reserved.

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1. Introduction

To optimally solve any fitness-relevant problem, an organism must attend to fitness-relevant objects in the local environment. To escape from a predator, one must detect the presence of the predator in the first place; to obtain a desirable mate, one must first notice that he or she exists. This simple problem is complicated by the fact that other, potentially distracting objects are present in any perceptual environment, and by the fact that fitness-relevant objects may appear while perceivers are pursuing other, more

mundane goals. It is further complicated by the fact that attention is a limited resource.

1.1. Adaptive allocation of attention

Given the constraints of limited attentional capacity and the complexity of natural environments, it is likely that attentional mechanisms evolved in such a way that, even in information-rich environments, attention will be captured (and held) by objects particularly relevant to fundamental fitness-related needs. This appears to be the case. Among people, for instance, visual attention is selectively allocated to potential sources of predation, such as snakes and conspecifics with angry facial expressions (Fox, Russo, Bowles, & Dutton, 2001; Öhman, Flykt, & Esteves, 2001; Schupp et al., 2004).

This tendency for fitness-relevant stimuli to attract visual attention is not invariant. It follows from an evolutionary cost–benefit analysis that these phenomena are functionally flexible and should be probabilistically influenced by regulatory cues in the immediate environment (Gangestad

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& Simpson, 2000; Schaller, Park, & Kenrick, 2007). Regulatory cues may lie not only in individuals' external environments but also in the internal cognitive environments defined by attitudes, personality traits, and other dispositions. Attentional hypervigilance to snakes occurs more strongly among individuals who are more chronically fearful of snakes, and angry faces attract attention more strongly among chronically anxious individuals (Bradley, Mogg, & Millar, 2000; Fox et al., 2001; Öhman et al., 2001).

Although abundant empirical evidence suggests adaptive allocation of attention to potential perils in the immediate environment, relatively little empirical evidence pertains to the detection of opportunities that bear directly on reproduction. The research reported here helps to fill that gap by addressing two questions: Does a dispositional preference for restricted vs. unrestricted mating influence selective allocation of attention to attractive (vs. unattractive) members of the opposite sex? And, if so, does this relationship differ between men and women?

1.2. Sex, sociosexuality, and selective attention to attractive others

Most evolutionary models of human mating imply that, when choosing mates, men are likely to discriminate according to physical characteristics that (1) serve as indicators of fertility and reproductive value and (2) are manifested in the subjective perception of facial attractiveness (Buss & Schmitt, 1993; Kenrick, Sadalla, Groth, & Trost, 1990; Li, Bailey, Kenrick, & Linsenmeier, 2002). Women also value physical attractiveness—perhaps as an indirect indicator of a mate's genetic fitness (e.g., Gangestad & Simpson, 2000). But much evidence indicates that women, more than men, discriminate more strongly along a number of additional traits, such as status and intelligence, that are not indicated by facial appearance (Buss & Schmitt, 1993; Kenrick et al., 1990; Li & Kenrick, 2006). One implication is that, if there is any tendency among people to selectively attend to facially attractive (rather than unattractive) opposite-sex others, this selective attention bias may be stronger among men than among women.

If attention is selectively allocated to attractive opposite-sex faces, the logic of functional flexibility suggests that this may vary depending on the dispositional tendencies of individual perceivers. Specifically, the allocation of attention to attractive others is likely to be moderated by an individual's sociosexuality (Simpson & Gangestad, 1991; Schmitt, 2005). Individuals with a "restricted" sociosexual orientation tend toward long-term mating strategies; they prefer commitment and emotional closeness in a relationship before engaging in sexual activity. In contrast, those with an "unrestricted" sociosexual orientation tend toward short-term mating strategies; they are more comfortable with casual sexual encounters, seek more sexual variety, and are more chronically available to new mating relationships. Compared with sociosexually restricted individuals, unrestricted individuals place a higher premium on the physical

attractiveness of mates (Simpson & Gangestad, 1992; Simpson, Gangestad, Christensen, & Leck, 1999). Although men tend to be more sociosexually unrestricted than women, the effect of sociosexuality on the valuation of physical attractiveness is not simply a function of an individual's sex. The predictive effects of sociosexuality have been found independently among both men and women (Simpson & Gangestad, 1992). It is worth noting, though, that these effects of sociosexuality tend to be stronger among men than among women (Simpson & Gangestad, 1992; Simpson et al., 1999).

These lines of theory and evidence have implications for the adaptive allocation of visual attention. To the extent that an individual is especially motivated to seek out new mates and to use physical features to discriminate between potential mates, that individual is especially likely to selectively allocate attention to attractive opposite-sex others. This suggests that men may be more likely than women to selectively allocate attention to attractive opposite-sex others and that this effect is likely to be most pronounced among sociosexually unrestricted individuals. Or, to articulate the implied interaction effect differently, individual differences in sociosexuality are likely to influence the extent to which individuals selectively allocate attention to attractive opposite-sex others, and this effect is likely to be found especially among men.

1.3. Prior research

Two previous pieces of empirical research have addressed this hypothesis. These prior studies produced somewhat dissimilar results, and a general interpretation is restricted by the specific methods employed in each.

Maner et al. (2003) presented participants with an array of eight male faces on a computer screen, and another array of eight female faces. Within each array, there were four attractive faces and four unattractive faces. Each array of faces was presented for 40 s. Participants were asked simply to look at the screen; while they were doing so, an eye tracker measured the amount of time their eyes fixated on each face. Results revealed a modest, but significant, correlation between sociosexuality and the amount of time individuals' eyes fixated on attractive opposite-sex faces: Unrestricted individuals showed longer fixation times on attractive opposite-sex faces. There was no interaction with participant sex; the predictive effect of sociosexuality emerged approximately equally strongly among both men and women.

In another study (Maner, Gailliot, & DeWall, 2007), a visual cuing methodology was used to assess the extent to which attractive and unattractive faces held attention, and kept it from being directed elsewhere. Participants were presented with a series of reaction-time trials in which a single face (either male or female, and either attractive or unattractive) appeared somewhere on a computer screen for half a second, and then disappeared. Concurrent with the disappearance of the face, a geometric object appeared on the screen—either exactly where the face had been or elsewhere

on the screen. Participants were asked to respond (by striking a key on the keyboard) as soon as they saw the geometric object. The methods allowed Maner et al. (2007) to measure attentional bias toward attractive opposite-sex faces and to test whether that bias is predicted by individual differences. Among male perceivers, sociosexuality did correlate significantly with an attentional bias toward attractive opposite-sex faces, but no such effect emerged among female perceivers. Thus, in contrast to the results of Maner et al. (2003), these results did reveal an interaction between sex and sociosexuality in allocation of attention to attractive opposite-sex faces.

Given these differing results, it remains unclear whether the attentional consequences of sociosexuality are equivalent across sexes (as indicated by Maner et al., 2003) or whether sociosexuality and sex produce an interactive effect (as indicated by Maner et al., 2007). The interpretation of these previous results is also restricted somewhat by the nature of the experimental tasks. When assessing eye fixations, Maner et al. (2003) presented all-male and all-female arrays of faces, whereas many meaningful social environments include both men and women. Moreover, eye fixations were measured in a context that—in contrast to many real-life social situations—was unconstrained by any kind of competing attentional goal. The visual cueing task employed by Maner et al. (2007) did incorporate a competing attentional goal. But the task was structured in such a way that the perceptual environment included only one face at a time. Consequently, the results cannot directly address the question of whether attention is selectively allocated to some faces, rather than others, in a complex social environment.

Thus, it would appear informative to further examine the predictive effects of sex and sociosexuality on the selective allocation of attention to attractive (vs. unattractive) opposite- and same-sex faces. It might be especially informative to employ an attentional task that presented participants with attractive and unattractive male and female faces simultaneously, and also imposed the realistic constraint offered by some sort of competing attentional goal. The research reported here was designed to do exactly that.

1.4. Change detection as a means of measuring selective allocation of attention

We employed a method designed to assess change detection (Rensink, 2002). Previous research indicates that people often fail to notice changes in objects that occupy their visual field—even seemingly obvious changes—unless they specifically allocate attention to that object (for a vivid example, see Simons & Levin, 1998.). Change-detection methods have been used successfully in past research documenting allocation of attention to functionally important social objects (Davies & Hoffman, 2002; Ro, Russell, & Lavie, 2001). In the present study, we employed a change-detection task designed to assess the extent to which participants selectively allocated attention to attractive (vs. unattractive) opposite-sex and same-sex others—all of

whom were present simultaneously in the perceptual environment. By comparing response times to changes in attractive vs. unattractive targets, we directly tested the predictive effects of sex and sociosexuality on selective attention to attractive opposite-sex others.

2. Method

2.1. Participants

Seventy-four university students (53 women and 21 men) participated voluntarily for extra credit in undergraduate psychology courses.

2.2. Procedure

Participants were seated in front of a computer monitor and were told that they would be participating in a study on visual perception.

Before being presented with the primary change detection task, participants were presented with a practice task to familiarize themselves with the procedure. Then the primary change detection task—with facial photographs as stimuli—was introduced.¹

Participants were informed that on each of the 32 trials they would see an array of eight faces and that their task was to scan the screen visually in order to detect, as quickly as possible, any face that changed. They were informed that the changes they would see would involve a disappearance and reappearance of a facial feature (e.g., an eye, a nose) in one of the eight faces. They were instructed to press the spacebar when they detected a face that was changing. They were informed that the computer would automatically proceed to the next trial if they had not detected a change within 14 s. Furthermore, to prevent any tendency toward false responses, and to minimize any intrusive concerns that might arise from failures to detect changes, participants were told that there would not necessarily be a change to be detected on every trial. (In fact, however, there was a change to be detected on each of the 32 trials.) After ensuring that participants were ready for the task, the experimenter left the room and the participants completed the change-detection task alone.

Individual differences in sociosexuality were assessed with the Sociosexual Orientation Inventory (SOI) (Simpson & Gangestad, 1991), which was included in a larger package

¹ Immediately prior to the change-detection task, an experimental manipulation was introduced in an attempt to test an additional hypothesis that is conceptually distinct from that about individual differences in sociosexuality: Participants watched one of three brief movie clips—one designed to activate mate-seeking motivation, one designed to activate self-protective motivation, and another designed to serve as a motivation-neutral control. Some previous research has indicated that this kind of motivation manipulation may create temporary shifts in emotion states, which may in turn influence social inferences and attributions (Maner et al., 2005). Results revealed no effects of this manipulation on change-detection results.

of questionnaires that participants completed after the change-detection task. After completing these questionnaires, participants were debriefed.

2.3. Sociosexuality

The SOI measures the extent to which an individual's sexual attitudes are representative of a restricted or unrestricted orientation toward sexual behavior. Following scoring procedures described by Simpson and Gangestad (1991), low SOI scores indicate sexual restrictedness and higher SOI scores indicate a greater tendency toward sexual unrestrictedness.

2.4. Change-detection task

The change-detection task was presented on an Apple Macintosh desktop computer and employed the Vscope software program (Enns & Rensink, 1992).

Thirty-two facial photographs were used as stimuli for the change-detection task. All faces were of individuals of approximately the same age as participants. All photos were matched for size, color, contrast, and brightness; all faces had affectively neutral facial expressions. There were 16 female faces and 16 male faces. Within each gender, eight of the faces were physically attractive and eight were unattractive.²

On each of the 32 trials of the change-detection task, participants were presented with an array of eight faces: Two attractive male faces, two unattractive male faces, two attractive female faces, and two unattractive female faces. The actual set of eight faces changed from trial to trial, and each of the 32 faces appeared an equal number of times across the 32 trials. The spatial representation of the array also changed from trial to trial: On eight of the trials the eight stimulus faces were arranged in a circle; on another eight trials they were arranged in a square; on another eight trials they were arranged in cross; and on another eight trials they followed the arrangement depicted on, say, the eight of hearts in a deck of playing cards.

During each of the trials, exactly one face—the “target face”—changed, such that a prominent facial feature disappeared and appeared again; this oscillating change persisted throughout the duration of the trial. (On half the trials, the disappearing feature was the nose on the target face; on the other half of the trials, it was one of the eyes.) To achieve this effect, and also to introduce a visual flicker that suppresses the tendency for visual attention to be drawn reflexively to the apparent “motion” created by the disappearing/reappearing feature, each trial consisted of a pre-programmed sequential presentation of three screens. These screens were a blank gray screen (Screen O), a screen that presented the eight-face stimulus array in which the

target face was intact (Screen X), and a screen with the same eight-face array except that the “disappearing” feature of the target face had been blurred so as to appear missing (Screen X'). Blank screens (O) were presented for 107 ms and face-stimuli screens (X and X') were presented for 293 ms, and screens were presented in the following sequence: O, X, O, X, O, X', O, X'. This sequence was repeated until the participant pressed the spacebar or the entire sequence had run nine times (14.12 s), whichever came first.

In order to minimize practice effects and expectation effects, the actual placement of the “changing” target face within the stimulus array was variable and counterbalanced across trials.

The gender and attractiveness of the target face also varied and were counterbalanced across all 32 trials. Consequently, on eight trials each, the target was either an attractive male face, an unattractive male face, an attractive female face, or an unattractive female face.

The computer recorded the time elapsed from the start of each trial to the moment at which the participant pressed the spacebar to indicate detection of a change in the target face. (If no change was detected, the recorded reaction time was the entire duration of the trial, 14.12 s; this occurred on less than 1% of trials.) Based on reaction times recorded across all 32 trials, we computed four separate measures of conceptual interest: The mean time elapsed to detect a change in (a) attractive male faces, (b) unattractive male faces, (c) attractive female faces, and (d) unattractive female faces. These means were based on responses from eight trials each. Shorter reaction times indicated greater visual attention to a target face.

Because the primary conceptual hypothesis implicates differential attention to attractive vs. unattractive opposite-sex faces, we computed two additional indices. A measure of differential attention to attractive (vs. unattractive) *opposite-sex* faces was computed by subtracting the elapsed time to detect changes in attractive opposite-sex faces from the elapsed time to detect changes in unattractive opposite-sex faces. For the sake of comparison, we also computed a measure of differential attention to attractive (vs. unattractive) *same-sex* faces. For both the opposite-sex differential attention index and the same-sex differential attention index, more highly positive values indicated greater attention to attractive faces than to unattractive faces.

3. Results

Did sociosexual orientation predict differential attention to attractive (vs. unattractive) opposite-sex faces? If one ignores participants' own gender, the answer appears to be no; across all participants, SOI showed only a modest and nonsignificant correlation with the opposite-sex differential attention index ($r=.18$, $p=.12$). The answer changes dramatically when one considers the moderating impact of participants' gender. Among men, SOI was strongly

² A separate sample of 30 university students (15 men and 15 women) rated each face on a nine-point attractiveness scale, anchored by the endpoints (1 and 9) labeled “very unattractive” and “very attractive.” Mean ratings for the sets of facial stimuli were as follows: male unattractive=4.30; male attractive=6.83; female unattractive=4.04; female attractive=7.35.

positively correlated with the opposite-sex differential attention index ($r=.56$, $p=.008$): Compared with sexually restricted men, sexually unrestricted men tended much more strongly to devote differential attention toward attractive female faces. No such effect was found among women (if anything, the relation was reversed; $r=-.18$, $p=.19$). A Fisher's z test substantiated the conclusion that the predictive effect of SOI on differential attention to attractive opposite-sex faces is stronger among men than among women ($z=2.69$, $p=.007$).

We also used multiple regression techniques to simultaneously test the main and interactive effects of sex and SOI on this differential attention index. The inferential implications of this regression analysis are identical with those reported above: Main effects of sex and SOI were negligible, while the interaction effect ($\beta=.34$) was statistically significant ($t=2.98$, $p=.004$). Visual examination of regression lines revealed that substantial sex differences in differential attention were found only among high-SOI (unrestricted) individuals. Moreover, only high-SOI men (but not women or low-SOI men) showed a substantial tendency to selectively attend to attractive opposite-sex others.

Given the preceding results, one might ask whether, among men, the predictive effects of SOI are due to (a) faster detection of changes in attractive female faces, (b) slower detection of changes in unattractive female faces, or (c) both. Among men, higher levels of SOI were associated both with quicker detection of changes in attractive opposite-sex faces ($r=-.35$) and slower detection of changes in unattractive opposite-sex faces ($r=.34$). Among women, no such effects were observed; indeed, if anything, these linear trends were reversed (r 's=.11 and $-.14$).

Finally, it is important to ask whether the predictive effect of SOI (found among men but not among women) is specific to the perception of opposite-sex faces, or whether it generalizes to the perception of same-sex faces. The results indicate that the effect is specific to opposite-sex faces. For both male and female participants alike, there were negligible correlations between SOI and differential attention to attractive (vs. unattractive) same-sex faces (r 's=.11 and $-.07$, respectively, p 's $>.6$). A Fisher's z test substantiated the observation that, among men, the effect of SOI was greater on the opposite-sex differential attention index ($r=.56$) than on the same-sex differential attention index ($r=.11$, $z=1.91$, $p=.056$).

4. Discussion

We tested the hypothesis that individuals with an unrestricted sociosexual orientation would be especially likely to selectively allocate visual attention to physically attractive opposite-sex others. We also tested for sex differences in this effect. Results showed that sociosexually unrestricted men did indeed allocate attention selectively to

attractive opposite-sex others, but that no such effect emerged among women.

This interactive effect of sex and sociosexuality is consistent with results reported by Maner et al. (2007). Using a very different visual attention task, they also found that sociosexuality predicted attentional effects among men, but not among women. However, given the nature of their attention task—in which participants were presented with just one face at a time—those results cannot be interpreted as bearing directly on *selective* allocation of attention. No such interpretational ambiguity attends the present findings. In general, the cumulative weight of evidence now indicates that individual differences in sociosexuality do predict the selective allocation of visual attention toward attractive (and away from unattractive) opposite-sex others, but that this effect occurs primarily among men rather than among women.

And what of the earlier results reported by Maner et al. (2003), which showed no sex differences in the relation between SOI and eye fixations? One possibility is that those results (at least the results found among women) were simply an anomaly. Another possibility is that the results reported by Maner et al. (2003) are meaningful, but are specific to perceptual contexts that are unconstrained by other attentional goals. Recall that Maner et al. (2003) simply asked perceivers to look at the computer screen. In contrast, Maner et al. (2007) provided participants with an explicit attentional goal (to detect a geometric shape somewhere on the computer screen) that was independent of the facial stimuli to which they were exposed. Similarly, our participants examined arrays of faces with a specific goal in mind (to detect the face with the disappearing/reappearing facial feature), and this goal too was entirely independent of whatever underlying adaptive goal might be served by attention to attractive opposite-sex others. It is possible that, among both women and men, an unrestricted sociosexual orientation inclines individuals to attend to attractive opposite-sex faces, but this tendency may be disrupted or overridden more easily among women than among men. Thus, the predictive effect of sociosexuality may emerge for both men and women under circumstances in which individuals are simply surveying their social environment without any particular objective. But under circumstances in which attentional resources must be deployed toward the successful attainment of some goal that is independent of (or at odds with) unrestricted mating, unrestricted women may more efficiently disengage from their dispositional tendency to attend to attractive opposite-sex faces, whereas unrestricted men may not. For unrestricted men, mating concerns may more readily trump other goals.

If sex differences are more likely to emerge when competing attentional goals are aroused, it is possible that they may also emerge more strongly when the perceptual environment is more complex—because complex environments have the potential to elicit additional goals. Compared to the Maner et al. (2007) study, in which participants were

presented with a single face on each trial, the current study presented participants with a substantially more complex perceptual environment. The current study also found, among men, a more powerful relation between SOI and attentional bias favoring attractive opposite-sex others ($r=.56$ in the current study vs. $r=.26$ reported by Maner et al., 2007). One must be cautious when comparing effect sizes across studies. But if there is any merit to this apparent difference, it suggests that the interactive effects of sex and sociosexuality may be more evident in perceptual contexts that impose greater attentional demands on perceivers.

Our results also revealed that, to the extent that sex differences were observed, they emerged only among individuals who scored at the high end of the SOI. Common cultural stereotypes might suggest that, whereas women are not so likely to have their attention captured by the physical features of a man, men will tend to ogle a beautiful woman. Our results suggest that this stereotype, like many stereotypes, obscures reality by painting the sexes with too broad a brush. Thus, along with the results of other research into variables that moderate psychological responses that bear on reproductive fitness (e.g., Gangestad & Simpson, 2000; Pillsworth, Haselton, & Buss, 2004), these results caution against any tendency to draw overly simple conclusions about sex differences.

Finally, this research extends a growing body of evidence implicating the adaptive nature of low-level attentional processes (Kenrick, Delton, Robertson, Becker, & Neuberg, 2007; Schaller et al., 2007). This perspective implies predictable ways in which evolved perceptual processes are flexibly engaged in response to contextual cues, including cues provided by the perceiver's own chronic dispositions. Much previous research has documented specific ways in which attention is adaptively allocated so as to avoid specific kinds of fitness-relevant perils (e.g., Schupp et al., 2004). The present results suggest that attention is also adaptively allocated in such a way as to promote the attainment of specific kinds of reproductive prospects.

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