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Wilson Merrell
Macalester College

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Selective attention, group-face, or both? Examining the group attractiveness effect through eye-tracking

Wilson Merrell

Professor R. Brooke Lea, Psychology

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Abstract

The group attractiveness effect refers to when the rated attractiveness of a group of people is greater than the average attractiveness of the group's members. Two theories have been proposed to explain this phenomenon: selective attention, and the creation of a group-face. From an evolutionary standpoint, it is adaptive for people to selectively attend to the most attractive members in a group, which provides an evaluation of group attractiveness based on a weighted, as opposed to arithmetic, average. When people perceive a group of faces, they use their peripheral vision to gain general information about stimuli outside of their direct gaze. By blending general features from their peripheral gaze into specific perceptions from their foveal gaze, people implicitly create a single group-face that combines the characteristics of all members in a group. Imperfections in the faces are normalized as features are pooled from the entire group, which is why the group-face is more attractive than the average rated attractiveness of the individuals. Using eye-tracking technology I, examined how selective attention and group-face worked independently as well as in tandem to impact the group attractiveness effect by manipulating use of foveal and peripheral gaze. I was able to replicate the group attractiveness effect as suggested in previous findings, however I was not able to make significant conclusions about the role selective attention and group-face play in this effect.

Selective attention, group-face, or both? Examining the group attractiveness effect through eye-tracking

Group perception has been studied in domains ranging from emotion to likability since the early 1960s. Anderson (1965) proposed a general rule for the evaluation of groups, regardless of domain, called the averaging rule. Under this rule, the evaluation of a trait for an entire group is based on a composite average of each individual group member's trait evaluation. This rule has held when evaluating facial emotions (Haberman and Whitney 2009), and when gauging likability (Anderson, Lindner, and Lopes 1973), but it is not supported when looking specifically at evaluations of physical attractiveness (Van Osch, Blanken, Meijs, and Van Wolderen 2015).

The averaging rule would predict that the perceived physical attractiveness of a group is equal to the average of the perceived physical attractiveness of each individual member. However, Van Osch et al. (2015) showed that the physical attractiveness of the group is often judged to be higher than the average of its members. Although findings supporting this effect are robust, the underlying causes of this group attractiveness (henceforth, GA) effect are still unknown. In this study I will attempt to uncover the causes of the group attractiveness effect, and expand upon existing theories on group attractiveness.

Selective attention

One possible explanation for the GA effect is that people selectively attend to the most attractive members of a group[1], and this additional attention exerts an upward bias on the group mean. That is, participants return a group-based value that represents perceived attractiveness based on which individuals drew their attention the most. This selective attention account stems from literature in evolutionary, cognitive, and social psychology (Gangestead 1993, Maner et al. 2003). Maner et al. (2003) proposed that since physical attractiveness is highly relevant when it comes to mating-related success, it is adaptive, from a reproductive standpoint, for heterosexual individuals to be able to quickly pick out and focus on the most attractive members of the opposite sex in a group. The authors examined this by conducting a study where participants were shown group photographs containing 15 faces for four seconds each, and then asked to estimate the number of attractive people in that set of 15 (Study 1). When looking at female faces, both men and women overestimated the number of attractive women they were shown. According to the authors, this happened because the presentation time was not long enough for them to attend to all 15 faces individually, so their estimates were based on the faces they attended to the most, i.e., the most attractive faces. This selective attention to attractive individuals was confirmed when they replicated the study using eye-tracking technology. Dwell times on and around the most attractive faces were, on average, longer than those around less attractive individuals. The authors

[1] Since attractiveness is in the eye of the beholder, it would be more accurate to describe these individuals as "the members of the group who were perceived to be the most attractive" instead of the "the most attractive members of a group." For the sake of simplicity, however, I will occasionally use the latter wording with the understanding that, in the context of this research, variance in attractiveness is empirically, not aesthetically, defined.

also conjecture that it is common for heterosexual individuals to selectively attend to attractive same sex individuals in a group due to intrasexual vigilance (fear of having their mate stolen). This vigilance is seen more strongly in heterosexual women than men (Maner, Gailliot, Rouby, and Miller 2007).

Building off of Maner et al. (2003), Van Osch et al. (2015) conducted nine studies to examine the selective attention account of the GA effect. They formed six specific hypotheses on how selective attention should impact the GA effect:

(1) Increased attention on all members of the group, not just the few attractive ones, should eliminate or attenuate the GA effect.

(2) If people pay attention to the more attractive group members rather than the less attractive group members, they should be better at remembering the more attractive group members rather than the less attractive group members.

(3) The attractiveness ratings of the most attractive group members should be most predictive of group rating.

(4) If group members do not differ much in the extent to which they are seen as physically attractive, a smaller GA effect should occur than when there is great variation in attractiveness.

(5) Selective attention should be reflected in how long people look at the relatively attractive individuals in a group. The longer people look at the most attractive group member, the larger the GA effect should be.

(6) Holding presentation time constant, larger groups should result in larger GA effects.

Within their nine studies, the authors were able to confirm all of these hypotheses. In Study 5 (p. 564) participants were asked to first rate the individuals in a group and then the group as a whole. This made participants more aware of the variation in the group, and, as hypothesized, led to an attenuated GA effect (Hypothesis 1, above). Study 5 also showed that variation in perceived attractiveness had a positive relationship with the strength of the GA effect (Hypothesis 4), and that, within subjects, the more attractive individual ratings were more predictive of the group ratings than were the less attractive individuals (Hypothesis 3). In study 8 (p. 567), participants first rated the test group of faces in parallel, were then shown 12 additional faces in serial (six they had seen before and six they had not), and finally were asked which faces were in the original set. Participants struggled to identify the less attractive faces; they were no better at recalling these than faces they had not been shown, but they were quite adept at recognizing the attractive faces from the original group (Hypothesis 2). Through their meta-analysis of all nine studies, Van Osch et al. (2015) also determined that the GA effect was stronger when the group size of the individuals was larger (Hypothesis 6). Study 9b (p. 568) utilized eye-tracking technology to indicate that there is also a positive relationship between dwell time on the most attractive individuals and size of the GA effect (Hypothesis 5).

Through the confirmation of these six hypotheses it appears that the selective attention account plays a role in the GA effect. However, one significant finding was incongruent with the selective attention account: some participants rated the group even higher than the most attractive individual of that group (Van Osch et al. 2015).

Selective attention can explain why the most attractive member of the group provides an upward anchor for the group as a whole, but it cannot explain why the group would ever be rated as more attractive than that anchor. This indicates that the selective attention account by itself is insufficient to completely explain the GA effect.

Creating a group-face

To explore this further, let us get away from faces and think about other groups of objects. Suppose someone is presented with ten lines of varying lengths on a piece of paper. Asking them to compute how long the lines would be when added together (a summing task), just from looking at them, is a difficult task, and it is unlikely that the estimate will be accurate (Ariely 2001). However, asking for a mean line length (an averaging task) of the 10 lines is a much easier question, and people generally are proficient at making this estimation accurately. An accurate average can be obtained with presentation times as short as 1500 ms (Ariely 2001). The effect is paradoxical if only because, arithmetically, arriving at a mean entails computing the sum first, before dividing by N. This putatively innate averaging skill is called ensemble coding, and it applies for more than just the lengths of lines.

Ariely (2001) showed that it is easy to ensemble code to create a visual representation in working memory, and Haberman and Whitney (2009) wanted to examine if a similar process takes place for higher-level visual stimuli as well. They hypothesized that when confronted with a number of people, it is helpful to know whether, on average, they are either happy or angry. Being able to judge these emotions at a glance is helpful for an individual's survival since it can be dangerous to be confronted with an angry mob, while it can be protective to be surrounded by friends rather than foes (Maner et al. 2003). Haberman and Whitney (2009) confirmed this hypothesis by having participants judge the average emotion of a set of 15 faces, and then having them judge the emotion of one morphed image of those 15 faces. They found that the two ratings were similar, indicating that people are able to ensemble code high-level groups (facial emotions) as well as low-level groups (line length).

More recent literature has continued to examine ensemble coding for groups of faces, but has focused on physical attractiveness rather than valence of emotion. In particular, the cheerleader effect, according to which people seem more attractive when they are in a group than when they are by themselves (Walker and Vul 2013), appears to be driven by the ensemble coding of group attractiveness. Under the assumption that people ensemble code attractiveness as they ensemble code emotions, the perception of a group of faces implicitly creates one average, morphed face containing the attractiveness of all the faces.

This morphed face is a representation of the average characteristics of the group, and contains elements of each individual face. The individual cannot be evaluated without the implicit consideration of the ensemble, so evaluation of an individual item is therefore biased towards the morphed face (Brady and Alvarez 2011). With regard to attractiveness, the rating of each individual face is driven not just by one person's attractiveness, but also the average attractiveness of the entire group. By this account, the cheerleader effect assumes an upward bias because average faces are attractive (Langlois and Roggman 1990).

The group-face account could explain why, in some GA-effect studies, evaluation of group attractiveness was even higher than the single most attractive individual within the group. While people selectively attend to the most attractive members, these attractive members are subject to comparison to the group-face, making them even more attractive in the group rating condition. Although participants create the group-face implicitly when presented with a group, it is not accessed when participants rate each individual because it is not task relevant. Group-face becomes task relevant when participants rate the group as a whole, because they are comparing each attended individual to the mean of the group (Walker and Vul 2013).

How selective attention and group-face fit into the visual system

To examine the role selective attention and group-face play in the GA effect it is necessary to tease them apart, examining one independent of the other. In order to do this let us examine how the visual system, specifically foveal vision and peripheral vision, influence these two theories. Foveal vision (direct gaze), the central viewing area of about 2°, is used for detecting fine detail and is the vision used when focusing on specific stimuli. In the selective attention account, foveal vision is used to perceive the features of the most attractive faces. Peripheral vision, a wider viewing area of between 60°-180°, grasps general information at a lower spatial resolution for stimuli scattered across the visual plane, and helps to inform where to next focus direct gaze (Itti and Koch 1999). In addition to informing which stimuli to attend to next, peripheral vision allows people to quickly and effortlessly ensemble code the features of a scene (Balas, Nakano, Rosenholtz 2010). When viewing a group of faces, both foveal and peripheral visions are used, and selective attention and group-face can be used when asked to evaluate attractiveness. However, if foveal vision is restricted, selective attention is impossible, while if peripheral vision is restricted, group-face is impossible. Such a restriction is possible (Appendix A) through the utilization of gaze contingent displays, which, using eye tracking technology, blurs out either the central 2° (for foveal restriction) or the fringe 58°-178° (for peripheral restriction). While gaze is restricted, people can still actively view the screen, as the display adapts to wherever the person is looking.

I propose that a combination of selective attention and group-face processes explain the GA effect. While selective attention can account for much of the GA effect, the boosting effect that a group-face comparison can contribute may explain why group evaluations are occasionally higher than the most attractive member of the group. First I aim to replicate the findings of Van Osch et al. (2015) in that a) the physical attractiveness of the group is greater than the average of its members and b) people attend longer to the most attractive member in the group. Then I predict that when people can both selectively attend and create a group-face, the GA effect will be largest, with some group ratings exceeding ratings for the most attractive individuals. When one of these processes is restricted, however, there should be a significantly smaller GA effect, and if both processes are restricted there should be no GA effect present at all. If there is a significant GA effect when selective attention and group-face are restricted, that may indicate another cause for the GA effect.

Methods

Participants

The participants were 27 undergraduate students (5 male, 22 female) at Macalester College aged 18-22. They were recruited through SONA systems, which is a pool of current psychology students at Macalester. Participants completed the experiment for partial course credit.

Materials

All pictures used in this study were obtained from creativecommons.org, a website specializing in the dissemination of photos through the public domain. The pictures chosen were meant to mirror those used by van Osch et al. (2015). To control for as many variables as possible, ethnicity and gender were kept as consistent as (visibly) possible within and between the pictures. Since intrasexual vigilance is stronger in heterosexual women than heterosexual men (Maner, Gailliot, Rouby, and Miller 2007), I chose groups composed entirely of females in order to gain reliable perspectives from participants of different genders and sexual orientations. Images used in the experiment are presented in Appendix B.

An EyeLink1000 eye-tracking device manufactured by SR Research (Ottawa, Ontario, Canada) was used to create a gaze contingent display, which allowed the manipulation of foveal and peripheral vision, and record fixations to measure selective attention. This eye tracker takes 1000 measurements per second to compute gaze duration and fixations, and uses infrared sensors to detect pupil movements as well as dilations. The device was mounted directly in front of the monitor that the participants were looking at, and the researcher controlled the experiment from a monitor directly adjacent to, but at a perpendicular angle, to the participant's. This configuration ensured privacy of what the participant was looking at and how they were rating each face and was done to minimize any self-consciousness that might arise by the task of publically assigning numeric ratings to the attractiveness of unknown faces .

To restrict gaze, pictures were blurred in Adobe Photoshop. Blur was set at a Gaussian filter of 50 units (which was deemed "moderate" by Ryu et al (2014)). For the gaze contingent display, we created a gaze contingent circle in SR Experiment Builder with a radius of 2.5°, and then overlaid the blurred and not blurred pictures to create the window and mask conditions. For the individual rating condition numbers were placed above the heads of each individual in the group to designate which member of the group the participant should be evaluating. In the fixed viewing condition, the photos were blurred except for one face in each picture, and the participant viewed the unblurred face for three seconds before a different face was unblurred (example in Appendix A).

Design

The experiment used a 4 (viewing condition: regular, window, mask, fixed) x 2 (rating condition: group rating, individual rating) design; the latter variable was manipulated within-subjects while the former was between-subjects. The dependent variables were the gaze duration on individual faces to measure the degree of selective attention, the ratings of the groups, and the ratings of individual faces.

Procedure

Participants were calibrated on the eye tracker so that their fixations could be accurately monitored. This calibration involved following a small white circle in the middle of a larger black circle as it moved around the screen. After the participants completed calibration, eye position errors were less than 0.5°. They were then shown 16 groups of Caucasian females. Each participant saw the same 16 groups, but the prompt ("Please evaluate the physical attractiveness of individual X in this group" or "please evaluate the physical attractiveness of this group as a whole") and their viewing condition (normal, window, mask, fixed) varied. Picture order was randomized across four different lists.

The four viewing conditions were designed to restrict or permit selective attention and group-face. In the normal viewing condition, participants were able to view the group obstructed by blur. This allowed them to both selectively attend (using their foveal vision) and create a group-face (using their peripheral vision). The window condition blurred everything in the peripherals, only allowing participants to see clearly in their fovea. Since their peripherals were obstructed participants were unable to create a group-face and could only selectively attend. The mask condition blurred foveal vision, but allowed for normal vision in the peripherals. This prevented participants from selectively attending but allowed them to create a group-face. The final condition was a fixed viewing condition, where all people in the picture were blurred except for one face, which was clear. The participants were asked to look at this individual for three seconds before a different face became the only visible one. This viewing condition was created so that participants could not selectively attend (each person was revealed for exactly three seconds) or create a group-face (no peripherals to blend features).

For pictures where participants were asked to rate individuals, the numbers above or below the faces of each person in the group indicated which one was to be rated. To eliminate any difficulty in identifying which person is associated with which number (particularly in the mask condition), the gaze contingent display was not applied to the numbers.

To rate attractiveness of the groups, participants manipulated a sliding scale ranging from "relatively unattractive" to "relatively attractive" using the mouse. Unlike past studies, I did not use numbers because I wanted to avoid having the participants assign an explicit number values to the faces.

After they rated sixteen groups in the varying conditions, participants were asked their age, gender, and sexuality before being debriefed. The experiment lasted approximately 30 minutes.

Results

Data and data manipulations

Data from two dependent variables were collected from participants: attractiveness ratings of either individual faces or of groups of faces, and participant fixation time on faces, in particular the percentage of dwell time on face rated to be the most attractive and the face rated to be the least attractive in each group. Raw attractiveness ratings were on a scale from 0 to 100 (with "relatively unattractive" corresponding to 0 and "relatively attractive" corresponding to 100). A potential bias arises with rating when participants do not use the full range of scores on a scale. For example, one participant might rate the most attractive person close to 100, and least attractive person around 50, whereas someone might use the entire scale and rate the most attractive near 100 and the least attractive close to zero. The problem occurs when one examines a raw score of, say, 60 which, for one participant indicates a face that, in their opinion, is above average in attractiveness, but for the other represents a face that they judge to be well below average. This problem can be addressed by transforming the raw scores into standardized (z) scores based on the distribution of each participant's scores. This methodology is similar to how other studies examining physical attractiveness have treated their rating data (e.g. Walker and Vul 2013). The decision to use standardized scores in the inferential statistics was made before the data were collected. For ease of comprehension, all descriptive statistics will be presented graphically in the form of raw scores.

Mean attractiveness ratings were computed for each participant in the eight conditions. To determine which individual was rated as most attractive, I looked at the average ratings on each individual in the different groups. To the size of the effect across the four viewing conditions, I also computed difference scores (viewing condition group – viewing condition individual).

The data were trimmed in two ways. First, any rating that was more than three standard deviations away from the participant mean was deleted; this process was repeated until no outliers remained. The second trimming procedure was required to adjust for rating scores that were recorded by the computer but that did not reflect participant behavior. The fixed view group rate condition required participants to enter a rating after each face was revealed for three seconds. When I graphed the fixed-group data I noticed that they contained almost no variance. A closer look at the data record revealed that many subjects had not moved the scale tab from its default starting position until after they had viewed the last face in the fixed-view condition, which is exactly what they were supposed to do. However, the computer recorded the default score, 48, for all but the last face in a group. As a result, the huge majority of responses in the fixed view group rate condition was exactly 48. This pattern appeared for all participants, and wherever there was a 48 in the fixed view group rate condition the data were dropped.

Replication of Van Osch et al. (2015)

To replicate the finding that participants rate groups as more attractive than the average of the individuals within the group (Van Osch et al. 2015), I compared the means of regular view group rate and regular view individual rate. Figure C1 shows the means for these two conditions. A paired samples t-test on rating showed that participants rated the group (M=58.02, SD=5.70) significantly more attractive than the average of the individuals within the group (M=52.73, SD=2.45); $t(27)=3.10$, SEM=537.31, p=.005, replicating the GA effect that Van Osch et al. (2015) found in their study.

Another important result has been the finding that in some cases the attractiveness of the group was rated to be even higher than the attractiveness of the most attractive individual within the group. Van Osch et al. (2015) posited that this finding indicated that there is more to the GA effect than just selective attention. To examine whether there were any instances of this occurring in my data I compared the mean ratings for the most attractive individual and the mean ratings for the group in the regular condition and found that $M_{Group} < M_{Most\ attractive\ individual}$ for every item. A detailed table of these results can be found in Appendix D (Table D1).

Additionally, Van Osch et al. (2015) found that, in line with the selective attention account, participants had proportionally longer dwell times on and around the faces of the most attractive rated compared to the least attractive rated individuals in each group. Looking at dwell times in my study, depicted in Figure C2, I also found that average dwell time around the most attractive rated faces (*M*=.12, *SD*=.053) was greater than the least attractive rated faces (*M*=.08, *SD*=.06). A paired samples t test revealed that this difference is significant, $t(27)=3.536$, SEM=671.91, $p=.001$.

Beyond Van Osch

I proposed that the GA effect would be largest in the regular viewing condition, a significantly smaller but still reliable GA effect in both the window and mask conditions, and no effect in the fixed condition. For these hypotheses to be supported, there would need to be a GA effect in the regular, window, and mask viewing conditions, a significant rating condition X viewing condition interaction, and no GA effect in the fixed condition, respectively. This pattern was only partially found in the data. First let us ignore the fixed condition, and consider the ratings for the regular, window, and mask viewing conditions. The mean attractiveness ratings for these three viewing conditions are presented in Figure C3. Window view group rate (*M*=.47, *SD*=.412) is larger than window view individual rate (*M*=.24, *SD*=.255), mask view group rate (*M*=.18, *SD*=.526) is larger than mask view individual rate (*M*=-.09, *SD*=.238), and as stated before, regular view group rate is larger than regular view individual rate. A repeated measures 3x2 ANOVA (Figure C4) confirmed the apparent main effect for rating condition, *F(26)*=12.756, *MSE*=649.2, *p*=.001. From this ANOVA, I was also able to conclude that there was no viewing condition X rating condition interaction, *F(26)*=.08, , *MSE*=1.525, *p*=.921. This indicates that any differences in the size of the GA effect among viewing conditions was not reliable.

Surprisingly, fixed view group rate (*M*=.13, *SD*=.628) was also significantly higher than fixed view individual rate (*M*=-.25, *SD*=.310), *t*(20)=3.554, *p*=.002. These results indicate the presence of the GA effect in all four of the viewing conditions, not just the regular, window, and mask conditions as I originally predicted.

Discussion

This study was designed to examine the determinants of the group attractiveness (GA) effect, where the rated attractiveness of a group is higher than the average attractiveness rating of the group's individuals. I proposed that two accounts, selective attention and group-face, work in tandem to facilitate this effect. I aimed to tease these two theories apart by using gaze contingent display on an eye tracker to control how participants view the faces. In the different conditions participants could: selectively attend and create a group-face (regular viewing condition), only selectively attend (window viewing condition), only create a group-face (mask viewing condition), or neither of the above (fixed viewing condition). As a replication of Van Osch et al. (2015) I predicted that ratings in the regular view group rate condition would be higher than in the regular view individual rate condition, participants would dwell longer on the more attractive than the less attractive individuals, and there would be instances where the group was rated higher than the most attractive individual. Additionally, I predicted an interaction between viewing condition and rating condition, where the GA effect would be largest in the regular viewing condition, and smaller in the window and mask conditions.

Implications of findings

Results showed a significant and comparable GA effect in all four of the viewing conditions, which was not hypothesized. The most surprising result comes in fixed viewing, where the participants could not, in theory, selectively attend or create a group-face, which I proposed where the two mechanisms that lead to the GA effect. One possible explanation for this unexpected result is that creating group-face and/or selectively attending to the most attractive face is not a requirement for the GA effect – a potentially exciting new finding. This would indicate going back to the drawing board and thinking about mechanisms completely independent of selective attention and group-face that can lead to the GA effect. A more likely explanation for this result, however, is considerably less interesting: it may be an artifact of the design for fixed viewing trials. In this condition, the participant's gaze could fixate on one unblurred face until they rated that face (individual rating) or three seconds had passed (group rating). In order to create this fixed-viewing condition, Adobe Photoshop was used to blur each face except for one (see Appendix A for an example screen shot). The goal of this condition was to restrict fixations to only faces, and in doing so I succeeded in blocking selective attention and the creation of group-face. By taking complete control over the visual scene, however, I may have inadvertently created an unnatural viewing condition in which participants could only passively process, as if presented with a slide show, what is presented on the screen. By inhibiting participants' ability to actively scan the screen, the fixed viewing condition created a perceptual environment different than that of the other three conditions. Future studies should think about other gaze contingent ways to restrict foveal and peripheral gaze without altering the viewing of the materials too much.

Just as in Van Osch et al.'s (2015) study, participants did spend significantly more time looking at the more attractive faces than the less attractive faces in all four viewing conditions. This replication supports the selective attention account, and indicates there is a relationship between looking longer at the most attractive individuals in a group and the GA effect. However, contrary to Van Osch's findings with some pictures, no group was rated as more attractive than the most attractive individual in the group. Recalling the premise of my study, this anomaly that Van Osch et al. (2015) reported was a key motivation in examining effects in addition to selective attention for the explanation of the GA effect. This failure to replicate may be due to drawbacks in the sample of items and participants used in this study. I return to this issue later in the discussion.

There was no interaction between viewing condition and rating condition. That is, the way participants viewed the stimuli did not lead to significant differences in the GA effect. This was not in line with my original hypothesis, and implies that the GA effect cannot be explained with just group-face and selective attention.

Another explanation - Gestalt psychology

Van Osch et al. (2015) supposed that principles from Gestalt psychology could also help to explain the GA effect. A Gestalt is a group that is perceived differently than the sum of its individual parts. One thing the evaluation of a stimulus depends on is the principle of similarity. The more similar elements are to each other, the more likely they are to be evaluated as a group rather than as individuals (Van Osch et al. 2015). I tried to control for as many variables as possible by selecting pictures similar to the materials used by Van Osch et al. (2015), which mainly consisted of white women in their late teens and early 20s. By the Gestalt view, such homogenous elements would make it easy to evaluate groups as an entity, even with restrictions on vision in the window and mask conditions. While Van Osch et al. (2015) found no support for tenets of Gestalt psychology in their studies, it is possible that this additional factor could explain why the GA effect was statistically the same in the regular, window, and mask conditions. Future studies should consider Gestalt principles in the design process, possibly through altering the homogeneity of the pictures.

Possible Drawbacks

Other experimenters studying physical attractiveness have been able to create their own stimuli by taking pictures of students at the university or hired models. I opted to use stock photos from the internet rather than create my own materials because, coming from a small liberal arts school (2000 students), it would be hard to recruit students to be in the pictures whose faces were unfamiliar to the participants. Given more time and resources, it would have been ideal to recruit students from another university to pose in pictures. That way, as Van Osch et al. (2015) did, I would have been able to control for clothing, body posture, emotion, and background environment. While all women in my pictures were as homogenous as possible, there was still variation in attire, group size, and environment. As an example, please refer to F5_College and F11_Soccer (Appendix B) for items that were particularly contrasting. Lack of complete control over each item could have impacted how participants viewed the different pictures, since, in addition to different faces, clothing worn and setting changed between items. Future studies should try to copy Van Osch et al.'s (2015) methodology by creating pictures themselves.

Additionally, the averaging of gaze data and attractiveness ratings across all participants, across all items, may have had an unnecessary effect of normalizing a number of different effects (cf. wisdom of the crowds). Further analysis conducted looking at specific participants could have yielded instances where the group was rated as more attractive than even the most attractive individual, and perhaps other intricacies regarding the window, mask, and fixed conditions would be revealed.

24 out of 28 participants were female. Of those 24, 20 identified as heterosexual. This means that 86% of the participants could have been rating the pictures not purely from a perspective of mate searching, but from a perspective of mate guarding (Maner et al. 2003). There were not enough heterosexual male or homosexual-identifying female participants to analyze their data as a group. Future

research should try to account for this, either by having participants only rate the gender(s) of potential sexual partners, or having all participants rate both genders.

Where to go next – Extensions

We still do not fully understand the causes of the GA effect, but this study introduced a new technique with the implementation of a gaze contingent display. The manipulation of a participant's vision I used was not able to attenuate the GA effect, however future research might consider modifying the degree of blur used (what happens to the GA effect when the picture is more blurred? Less blurred?) so that the levels of the "view-type" variable are more nuanced, and perhaps continuous. The size of the gaze contingency (how does the effect change in the window and mask condition with a 1cm circle? A 10cm circle?) is another factor that might be explored. These modifications of the gaze inhibitions might shed more light on why I did not see the intended interaction in my study.

In general, work on physical attractiveness needs to be extended to include more races and genders. Numerous interesting questions can be asked with regard to how the GA effect changes when groups are composed entirely of minority ethnic groups, when there are groups with more than one race present, or when there are mixed-gender groups. We live in a diverse world, and evaluating the effect for only one race and only one gender limits the generalizability of any significant results that are found.

Other interesting study extensions came up through my work, although I unfortunately have no time to pursue them. These include examinations of how attentional adhesion, which is how long it takes a person to pull their gaze a way from an attractive face (Maner et al. 2007), impacts the GA effect, manipulating which face the participant sees first in the trial using drift checks that vary by location, and manipulating mate-search/mate-guarding GA effects in a homosexual population. For more thoughts on what these last three extensions could look like, please refer to Appendix E.

Conclusion

This study replicated some of the findings set forth by Van Osch et al. (2015) with regards to the GA effect. Using gaze contingent display I manipulated how participants viewed pictures, but was not able to draw conclusions about the role that selective attention and group-face play in this effect. The eye-tracking component of this work adds an exciting dimension to understanding the perception of physical attractiveness, and I hope that this work can help to inform future research on the GA effect.

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References

Anderson, N.H. (1965). Averaging versus adding as a stimulus combination rule in impression formation. *Journal of Experimental Psychology, 70* pg. 394-400.

Anderson, N.H., Lindner, R., and Lopes, L.L. (1973). Integration theory applied to judgments of group attractiveness. *Journal of Personality and Social Psychology, 26* pg. 400-408.

Ariely, D. (2001). Seeing sets: Representation by statistical properties. *Psychological Science, 12* pg. 157-162.

Balas, B., Nakano, L., Rosenholtz, R. (2010). A summary-statistic representation in peripheral vision explains visual crowding. *Journal of Visual Psychology, 9(12)* pg. 1-18.

Brady, T.F., Alvarez, G.A. (2011). Hierarchical encoding in visual working memory: Ensemble statistics bias memory for individual items. *Psychological Science, 22(3)* pg. 384-392.

Gangestad, S. W. (1993). Sexual selection and physical attractiveness. Implications for mating dynamics. Human Nature, 4, 205-235.

Haberman, J., Whitney, D. (2009). Seeing the mean: Ensemble coding for sets of faces. *Journal of Exploring Human Perceptual Performance, 35(3)* pg. 718-734.

Itti, L., & Koch, C. (2000). A saliency-based search mechanism for overt and covert shifts of visual attention. Vision Research, 40(10-12), 1489-1506.

Langlois, J.H., Roggman, L.A. (1990). Attractive faces are only average. *Psychological Science, 1(2)* pg. 115-121.

Maner, J.K., Kenrick, D.T., Becker, D.V., Delton, A.W., Hofer, B., Wilbur, C.J., Neuberg, S.L. (2003). Sexually selective cognition: Beauty captures the mind of the beholder. *Journal of Personality and Social Psychology, 85(6)* pg. 1107-1120.

Maner, J.K., Gailliot, M.T., Rouby, D.A, Miller, S.L. (2007). Can't take my eyes off you: Attentional adhesion to mates and rivals. *Journal of Personality and Social Psychology, 93(3)* pg. 389-401

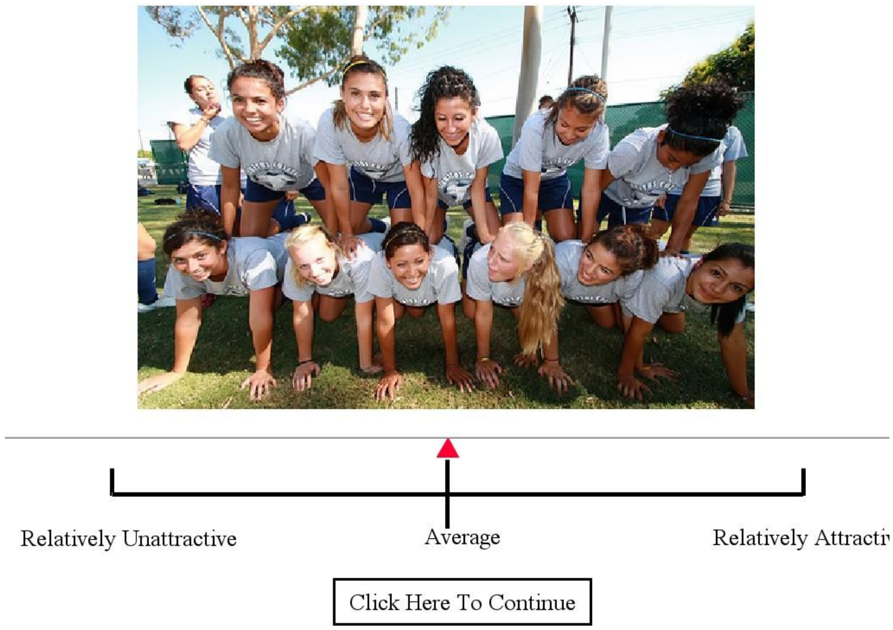
Van Osch, Y., Blanken, O., Meijs, M.H.J., Van Wolferen, J. (2015). A group's physical attractiveness is greater than the average attractiveness of its members: The group attractiveness effect. *Personality and Social Psychology Bulletin, 41(4)* pg. 559-574.

Walker, D., Vul, E. (2013). Hierarchical encoding makes individuals in a group seem more attractive*. Psychological Science* pg. 1-6.

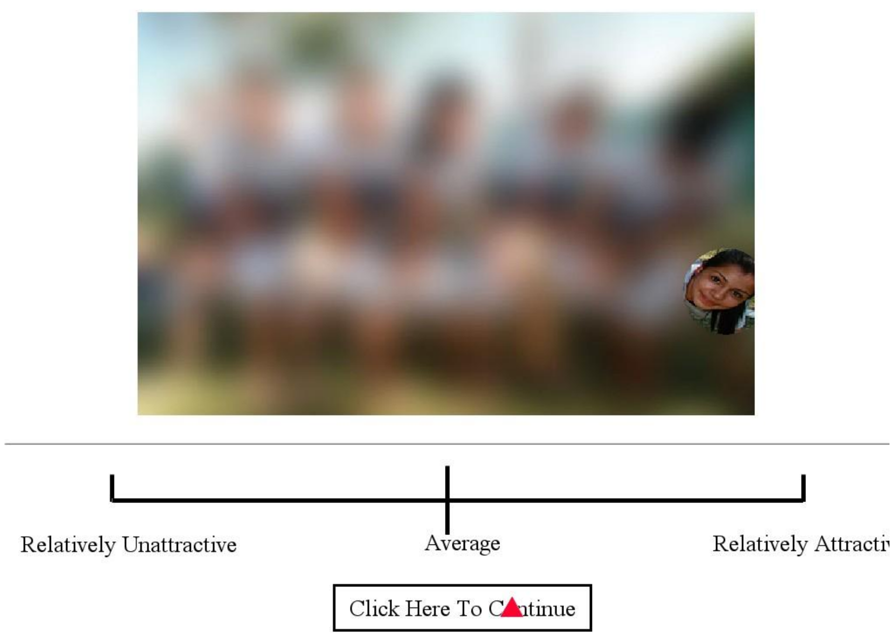
Appendix A

Viewing condition examples

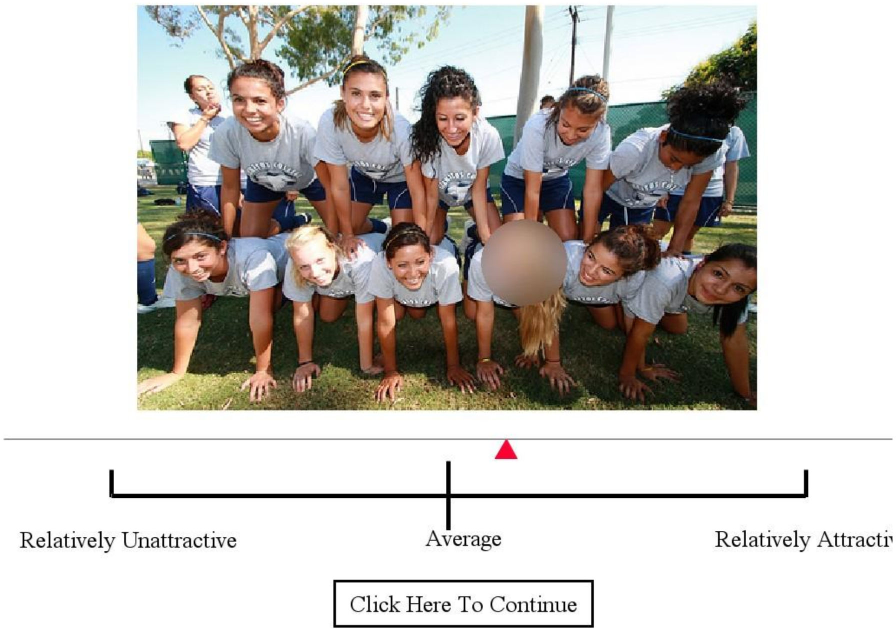
Regular view group rate



Window view group rate



Mask view group rate



Fixed view individual rate

Appendix B

Materials from this study

F4_Formal

F4_Prom

F4_Sorority

F5_College

F5_Prom

F5_Toga

F6_Bridesmaids

F6_Couch

F6_Prom

F6_Prom2

F8_Bridesmaids

F9_Pink

F9_Sorority

F11_Prom

F11_Soccer

F15_Sorority

Appendix C

Graphical representation of results

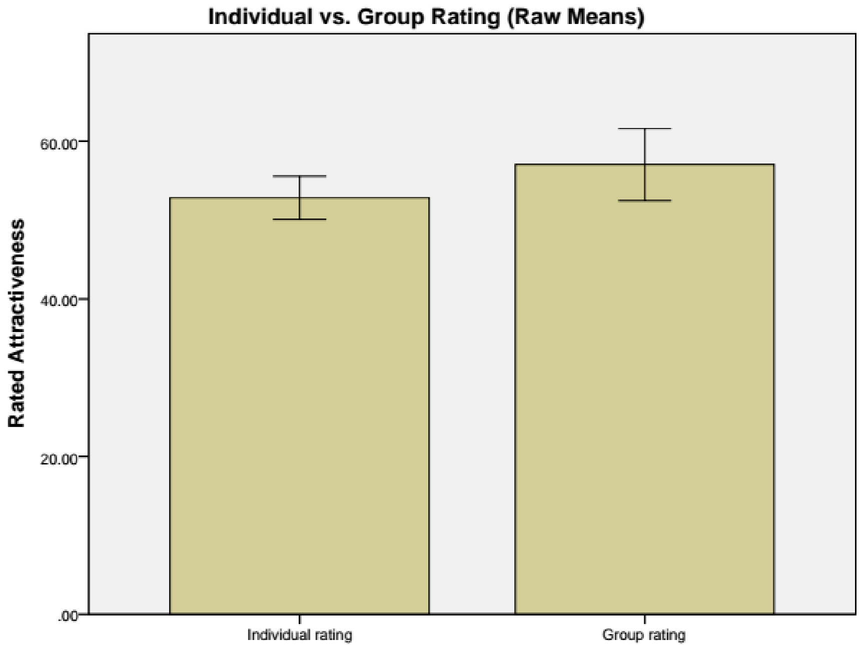


Figure C1

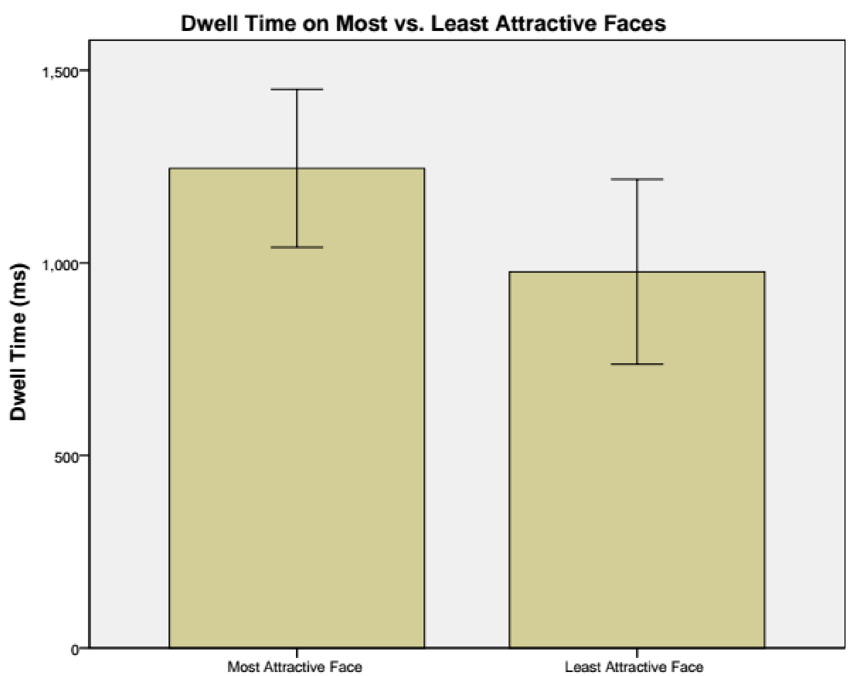
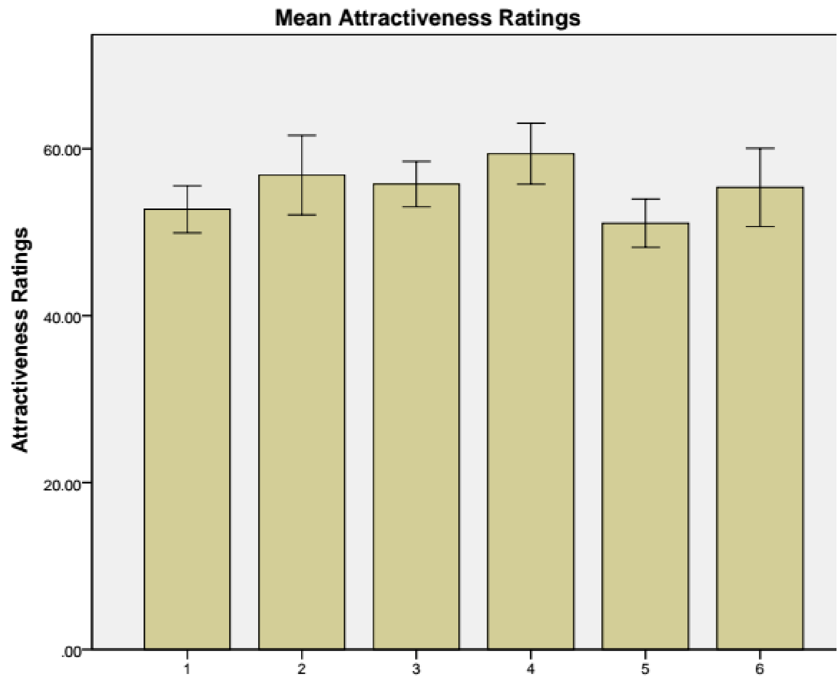


Figure C2



Key
1 = Regular view individual rate
2 = Regular view group rate
3 = Window view group rate
4 = Window view group rate
5 = Mask view individual rate
6 = Mask view group rate

Figure C3

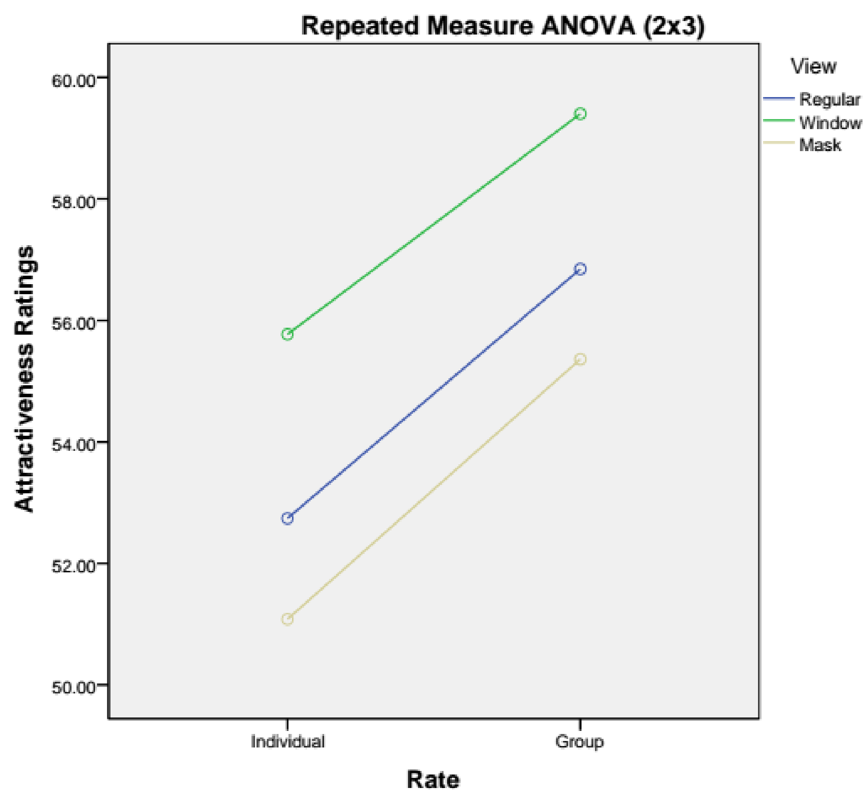


Figure C4

Appendix D

Most attractive individuals by picture

Item	1	2	3	4	5	6	7	8	9	10	11	Item Avg		Most attractive
Formal_4	47.21	56.67	38.62	66.03								54.10	<	66.03
Prom_4	45.14	47.42	59.14	44.42								49.98	<	59.14
Sorority_4	50.30	59.57	59.73	64.19								60.49	<	64.19
College_5	31.62	52.77	55.33	51.81	48.51							51.38	<	55.33
Prom_5	59.48	50.85	61.88	50.00	50.14							56.60	<	61.88
Toga_5	54.00	45.80	67.23	34.80	48.53							49.97	<	67.23
Bridesmaids_6	36.18	51.14	42.74	51.03	36.62	45.00						48.13	<	51.14
Couch_6	52.85	58.70	51.50	68.30	61.80	35.80						56.14	<	68.30
Prom_6	75.45	64.90	70.28	65.28	58.90	56.71						70.29	<	75.45
Prom2_6	33.38	39.90	44.95	43.57	46.95	48.76						42.01	<	48.76
Bridesmaids_8	31.61	51.03	45.26	44.28	58.60	37.46	43.76	59.52				48.45	<	59.52
Pink_9	48.92	38.92	68.80	42.26	59.19	57.92	54.38	53.80	56.61			55.87	<	68.80
Sorority_9	59.48	42.55	53.48	44.81	50.29	64.85	48.37	48.59	52.66			54.53	<	64.85
Prom_11	57.75	55.50	58.37	53.16	49.87	52.37	54.91	57.20	37.54	42.45	57.75	54.98	<	57.75
Soccer_11	62.37	69.51	50.44	54.555	45.88	55.44	52.33	58.20	48.66	58.55	58.48	58.7	<	69.51

Table D1. Highlighted boxes represent that most attractive individual within each picture

Appendix E

Attentional adhesion: Maner et al. 2003 first examined this effect with a dot probe task and found that participants took longer to pull their attention away from the more attractive opposite-sexed individuals (for heterosexual identifying participants) than the less attractive individuals. Combining attentional adhesion with the group attractiveness effect, I think it would be interesting to recreate the same dot probe task but present individuals with a group of faces instead. By creating variation in the attractiveness of the groups, and variation in the attractiveness of the individuals within the group, it would be possible to gain interesting information about how attentional adhesion presents itself when facial stimuli are presented in a group setting.

Manipulating first fixation: In my study, drift checks before each trial were in the center of the screen, and the general gaze pattern of participants was looking at faces from right to left in the group rating condition. I would be interested in seeing how, if it all, the GA effect changes if I manipulated where these drift checks were, and thus manipulating what face the participant looks at first. For instance, what happens when there is a drift check on the most attractive face? The least attractive face?

Mate-search/mate-guarding in a homosexual population: There has not been any literature exploring how the GA effect manifests itself for homosexual identifying individuals. I think that anything related to attractiveness would be interesting looking at this population because they could simultaneously find someone attractive from a mate-search perspective, as well as from a mate-protection perspective. What would be the effect of priming jealously, like Maner et al. 2007, on the size of the GA effect? What about priming mate search? What is the effect if the participant is in a relationship?