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GENERALIZATION OF MERE EXPOSURE TO FACES VIEWED FROM DIFFERENT HORIZONTAL ANGLES

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Evolutionary accounts of the centrality of social interaction for our species might anticipate more efficient affective processing for faces. The current study assessed whether mere exposure to upright faces resulted in greater generalization of liking than mere exposure to inverted faces, as might be predicted by special–process views of face perception. We presented upright and inverted photographs of faces taken from three different horizontal angles (full front–view, 45-degree, and full-profile), then asked participants to rate their liking for front–view photographs of the same faces. For inverted faces, but not upright faces, there was a significant linear trend for liking to decrease as presentation angle increased (from front–view through 45-degree to full-profile). Thus, upright front–view faces that had previously been presented in full– or semi–profile were liked at equivalent levels to upright front–view faces that had previously been presented in front–view. These findings suggest that mere exposure for upright faces presented at any angle may easily generalize to other views of the face, but that generalization is less efficient for perceptually matched inverted faces. These findings are consistent with evolutionary arguments for enhanced affective discrimination.

Are faces special? More specifically, do we process faces differently from other kinds of visual stimuli? Furthermore, are our affective reactions to faces influenced by these processing differences? For example, does the apparent facility for face rec-

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ognition shown by humans mean that liking for previously seen faces readily generalizes beyond the particular stimulus configuration presented on their initial occurrence? If so, then the mere exposure paradigm (Zajonc, 1968) may be used to provide an indirect confirmation of the special–process account of face–processing as well as telling us more about the adaptive benefits of affective discrimination.

Mere exposure involves repeatedly presenting particular stimulus objects to participants and recording their emerging preferences for those objects. For liking to be affected, all that is necessary is that the stimulus should be accessible to the individual's sensory receptors, with no type of active response or reinforcement required. The effect has been demonstrated across cultures, species (e.g.,Harrison & Fiscaro, 1974), even prenatally (Rajecki, 1974), and in diverse stimulus domains. It has also been obtained when the presented stimuli are apparently inaccessible to participants' awareness (Kunst–Wilson & Zajonc, 1980). Thus, the benign experience of repetition can, in and of itself, enhance positive affect.

Although many mere exposure studies have focused on the use of nonsocial stimuli such as polygons or line drawings (e.g., Stang & O'Connell, 1974), the effect has also been recorded when the stimuli are people, presented either live or in photographs (e.g., Harrison, 1969). Further, increased positive responses have been found to generalize to new (unseen) stimuli that are related in some way to the exposed items. For example, in artificial grammar learning studies with nonsocial stimuli (e.g., letter strings), liking increases for all grammatical items, and not just the particular ones that were seen in training (Gordon & Holyoak, 1983).

A study by Rhodes, Halberstadt, and Brajkovich (2001) explored the generalization of mere exposure using photographs of faces as stimuli. They demonstrated that increased positive affect associated with seen photographs of faces did indeed generalize to their (unseen) averaged composite or prototype (as well as increasing liking ratings of the faces themselves, as might be expected). However, the question remains of whether mere exposure operates differently for faces and non–face stimuli. Shepard (1980) has argued that stimulus generalization has very similar properties across a wide range of stimulus classes. However, faces may be a unique stimulus class, given people's enhanced facial recognition skills.

Our contention is that generalization of exposure effects should be particularly strong 'within' faces (e.g., across different horizontal viewing angles of the same face) for good evolutionary reasons. More specifically, positive affect (and associated feelings of "safety") should readily become attached to the underlying face (since it is attached to the same person) rather than to the particular way in which the stimulus is presented. Previous research using complex non–face stimuli has shown that an affective generalization gradient is produced with increasing distortion from the original, "standard" stimulus (Gordon & Holyoak, 1983). Our prediction is that this gradient should be less steep for face than for control stimuli.

The control stimuli chosen for this study were the same faces presented upside down. Clearly, these stimuli are matched to the experimental stimuli along dimensions of size and complexity. Despite their similarities to normally presented faces, inverted faces should produce the same effects and results as nonsocial, object stimuli. Indeed, research has shown that face recognition is disproportionately affected by inversion when compared with nonsocial, object inversion, a phenomenon known as the face inversion effect (Yin, 1969). In addition, imaging techniques (e.g., Haxby et al., 1999) have shown that turning faces upside down slightly but significantly decreases the response of face–selective brain regions and increases activity of other areas selective for non–face objects. This suggestion of a double dissociation between face and object recognition, and the possibility of a special face module, is supported by patient data (e.g., Farah, 1991).

In summary, our aim is to investigate whether exposure to photographs of upright faces taken from different angles increases liking for front–view photographs of the same faces. Our prediction is that the generalization gradient from full–profile through 45–degree to front–view faces will be less steep when the stimuli are upright rather than inverted.

METHOD

DESIGN

Two independent variables were manipulated in a fully within–subjects design. Vertical orientation was manipulated by presenting each participant with 12 different facial photographs the right way up (upright) and another 12 upside down (inverted). Each set of 12 pictures was further divided into three subsets of four pictures according to the second independent variable of horizontal viewing angle (front–view, 45–degree, and full–profile). Facial stimuli were counterbalanced so that different faces appeared at different horizontal angles and in different vertical orientations for different participants. The main dependent variable was subsequent liking for front–view photographs of the various faces that had been presented during the exposure phase. Liking was chosen as the dependent measure because it is the most commonly used measure in mere exposure studies and because it tends to yield the strongest exposure effects (Bornstein, 1989).

PARTICIPANTS

Twenty–seven female and three male Caucasian undergraduate psychology students from Oxford University participated for a chance to win one of three prizes of gift vouchers. The uneven ratio of male to female participants was mainly due to the greater number of female than male students enrolled in the psychology course. Participants' ages ranged from 18 to 21 years old.

MATERIALS

Twenty–four full sets (i.e., both upright and inverted for all viewing angles) of black and white photographs of Caucasian faces, half female and half male, displaying neutral expressions, were used in the study. All faces were taken from the PICS Web–based database (http://pics.psych.stir.ac.uk) set up by the Psychology Department at Stirling University, UK, and were of approximately equivalent attractiveness according to the information provided on this database.

From the 24 full sets, the 12 faces of each sex were randomly divided into three sets of four faces, with membership of the different sets determining which view of the face would be seen in the exposure phase. Participants were randomly separated into six groups, with each group's exposure phase consisting of the 24 faces appearing in the different conditions. Each face was represented (five times, as there were five participants in each group) in every viewing condition across the whole set of participants, thereby controlling for any possible effects relating to specific faces.

Because any differences in liking of upright versus inverted faces may depend on the inherent relative attractiveness of these two kinds of stimuli rather than the effects of exposure, the direct effect of vertical orientation on liking was assessed separately by exposing each participant to two more sets of four photographs. The first set consisted of inverted versions of those photographs already seen in the upright and front–view set (e.g., faces 1–4 for participants in Group 1). The second set consisted of upright versions of those photographs already seen in the inverted and front–view set (e.g., faces 13–16 for participants in Group 1). Analysis of the difference between liking ratings of each set and their corresponding upright equivalents allows us to assess any effect on liking produced purely by inversion of the photographs.

All of the images used in the study measured approximately 320 × 420 pixels and were shown at 72 dots per inch on a black background, having been altered using Photo House (Corel Corporation, 1997) software. They were presented on a 16–inch LCD color monitor controlled by an Intel Pentium 4 computer running the SuperLab Pro (Cedrus, 1999) software program.

PROCEDURE

Before the experiment began, participants were briefed on the computer screen that the study aimed to explore the processing and recognition of upright and inverted faces. The procedure itself included an initial exposure phase, in which subjects were simply asked to view a set of stimuli that they would be asked to make judgments about later, followed by a rating phase, in which they were asked to rate how much they liked a second set of stimuli. This new set of stimuli included some photographs that they had already seen, and some that they had only seen from other horizontal viewing angles or vertical orientations.

1. Exposure Phase. Participants were shown the 24 faces in the conditions explained above, with each photograph stimulus in this exposed set shown four times (four exposures is within the optimal range for generating the standard mere exposure effect according to Bornstein, 1989). Therefore, a total of 96 photographs were presented in an order randomized by the computer for each participant. Each of the 96 photographs was presented for one second (in line with Bornstein's (1989) recommendation in order to produce stronger effects), after which the screen went blank (black) for 500 milliseconds. The instructions for the exposure phase told subjects only that they should study each face and that they would be asked to make some judgments about the faces at a later stage of the experiment.

2. Rating Phase. In the rating phase that immediately followed, participants were shown front–view photographs of the 24 faces that they had seen in the exposure phase, along with the eight photographs included to assess the effect of inversion (as explained above). These 32 stimuli were presented in an order randomized by the computer. Participants were instructed at the start of this phase to rate their liking of the photographs. Further, they were asked to make quick responses and told that their reaction times would be measured. This second instruction and measurement served two related purposes:

(1) It would (it was hoped) ensure that participants tried to respond as quickly as possible, and so would not spend time studying the photographs and possibly mentally rotating them. If inverted faces had been mentally rotated to the upright position before rating, then this would defeat the object of the inversion condition.

(2) Measuring response times allowed assessment of whether participants took longer to rate inverted faces, as would be required if they did indeed rotate them mentally.

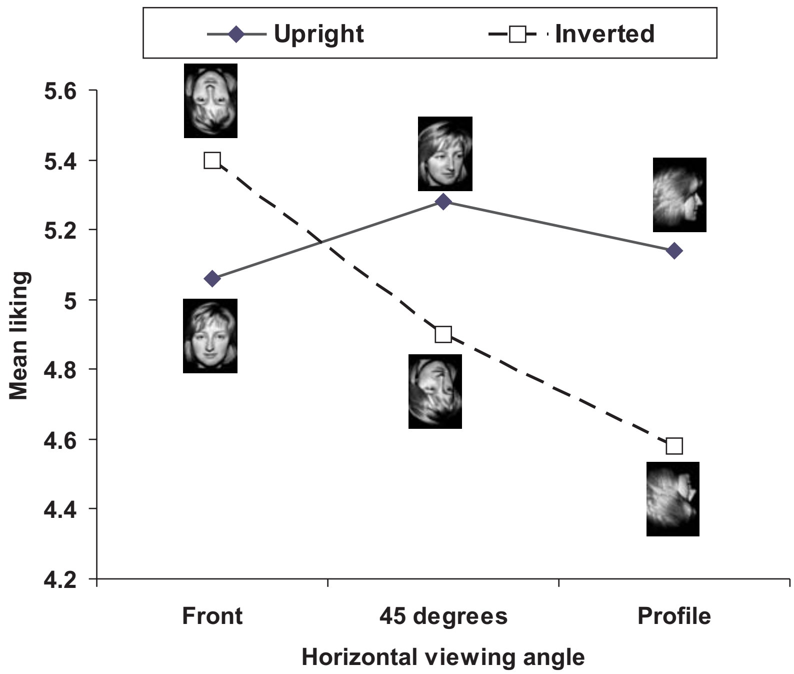

FIGURE 1. Mean liking scores as a function of vertical orientation and horizontal viewing angle.

Each image remained on the screen until the participant responded by judging on a ten–point scale their liking of the photograph (1 = dislike very much, 10 = like very much). Participants' responses were made using the ten numbered keys on the keyboard, with the 0 key (appropriately labeled) used to indicate a rating of 10.

RESULTS

Data were analysed using a 2×3 analysis of variance with vertical orientation (upright vs. inverted) and horizontal viewing angle (front, 45-degree, and full–profile) as within subjects independent variables. There was a significant main effect of horizontal viewing angle, $F(2,58) = 3.27$, $p < .05$, showing that liking for faces was relatively weaker as the difference in angle between the face shown during the exposure phase and the face shown during the rating phase increased. However, this effect was moderated by a significant interaction with vertical orientation, $F(2,58) = 4.06$, $p < .025$. Means for all conditions are presented in Figure 1. It appears that the effects of viewing angle on liking ratings show the predicted generalization gradient in the case of inverted faces, but that liking does not decrease as a result of increased viewing angle in the case of upright faces.

Tests of simple main effects confirmed that there was no significant effect of horizontal viewing angle in the upright condition, but that viewing angle had a significant impact on liking of inverted faces [$F(2,58) = 8.07$, $p < .001$]. Further exploration of this effect for inverted faces using within–subjects contrasts demonstrated a significant linear trend [$F(1,29) = 9.68$, $p < .01$] supporting a consistent generalization gradient as the difference in angles between presentation and rating increases. The difference in the effect of viewing angle between inverted and upright faces supports the main hypothesis that the two types of stimuli are processed differently.

To assess whether a greater liking for upright than inverted faces contributed to these reported effects, we also compared ratings of two sets of additional faces that were not included in the main design. All of these faces had originally been presented in front–view, but half were in the upright and half in the inverted vertical orientation. The vertical orientation of half of each of these sets was preserved, but the others were presented in the alternative vertical orientation. We found that inversion did not have a significant impact on either of these sets of faces, effectively ruling out its role in explaining any of the theoretically more interesting effects reported above.

A 2×3 repeated measures ANOVA was also conducted on reaction time data in order to check for any evidence of mental rotation. Neither the main effects nor the interaction effect were significant. The absence of significant differences in reaction times between upright and inverted faces suggests that participants did not mentally rotate inverted faces prior to making judgments of liking, and hence did not treat them merely as upright faces after rotating them.

DISCUSSION

The results of this study show that variation in horizontal viewing angle during exposure affected liking of inverted, but not upright, faces. For inverted faces, the generalization of liking decreased in a linear fashion as the angle between the face presented during the exposure phase and the face presented for rating decreased, but there was no corresponding decrease in generalization for upright faces.

In effect, we obtained what appears to be perfect generalization in the upright condition even from faces originally presented in full profile. This enhanced generalization may be a consequence of the special way in which facial stimuli are processed and discriminated. In particular, an internal representation of the underlying facial object may be rapidly generated in response to exposure to facial stimuli, and exposure–based affect may quickly become associated with this representation rather than the specific stimulus configuration. Subsequent presentation of the same face from different viewing angles may then activate this representation along with the associated exposure–based affect. Such a process makes evolutionary sense among animals for whom communication and interaction feature so heavily.

In contrast, a different pattern of results was evident for inverted faces. Here, a linear deterioration in generalization effects was found with increased rotation away from the front–view. This affective generalization gradient follows the predictions made earlier, and is consistent with other studies using non–face stimuli (e.g., Gordon & Holyoak, 1983). The implication is that inverted faces are treated simply as complex visual patterns rather than stimuli with special social significance.

The fact that we obtained no generalization gradient at all for upright faces clearly raises issues for future studies. Part of the reason for this finding may be that the alternative views presented correspond to possible facial stimuli that are genuinely confronted in everyday life. Other types of real–world distortion may also be associated with similar effects. For example, we might also predict enhanced affective generalization for faces differing in visual resolution, mimicking the effects of increased viewing distance, or for faces presented in shadow as would be seen under different familiar lighting conditions. Further, affect may generalize readily across different facial expressions, or across faces whose appearance is altered in ways that are consistent with the effects of natural processes such as aging or illness. By contrast, distortions of facial stimuli that do match familiar changes of configuration (e.g., those produced by morphing) may yield less powerful generalization.

It would also be useful to explore the minimal conditions for generalization of exposure effects to upright faces by comparing lower and higher levels of exposure. If generalization of liking is perfect after four exposures of a profiled, upright face, then how many exposures are necessary for this level of generalization to occur? If a low–exposure condition yielded a weaker generalization effect, then this would provide further support for the present interpretation of underlying processes.

Future studies also need to focus upon the differing processes that appear to be invoked by upright and inverted faces. Although we have argued that enhanced face–specific processing may have adaptive benefits for social animals such as humans, it is also possible that this system develops with experience after birth, and that increased experience with other types of stimuli may also lead to similar effects (e.g., Diamond & Carey, 1986; Gauthier & Tarr, 1997). Therefore, it may be useful to explore whether experts with other stimuli also have areas in which they show stronger generalization.

Finally, there remains the question of whether similar effects to those reported here would be obtained if Caucasian participants were shown pictures of non–Caucasian faces. Several studies have demonstrated enhanced memory for (e.g., O'Toole, Deffenbacher, Valentin, & Abdi, 1994; Yarmey & Jones, 1983), or discrimination of (e.g., Walker & Tanaka, 2003), own–race faces compared with other–race faces. Does this mean that generalization of exposure–induced affect would be inferior for the latter? Again, if face–processing reflects experience–based expertise within this stimulus domain, rather than a biologically provided processing mechanism, the prediction would be that other–race faces would not carry the same generalization advantage. However, specific training with the relevant stimuli may alleviate the other–race disadvantage (cf. Gauthier & Tarr, 1997). Predictions from an evolutionary perspective are less clear–cut.

In summary, the present study contributes to the growing body of research indicating that processing of normally presented facial stimuli brings certain distinctive consequences. These consequences not only relate to perceptual and memory processes but also to affective discrimination and response, as demonstrated here.

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