This article was downloaded by: [University of Aberdeen]
On: 09 May 2012, At: 01:45
Publisher: Psychology Press
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK

The Quarterly Journal of Experimental Psychology
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/pqje20

Physical Self-Similarity Enhances the Gaze Cueing Effect

Clara J. Hungr [a] & Amelia R. Hunt [a]
[a] School of Psychology, University of Aberdeen, Scotland, UK

Available online: 08 May 2012

To cite this article: Clara J. Hungr & Amelia R. Hunt (2012): Physical Self-Similarity Enhances the Gaze Cueing Effect, The Quarterly Journal of Experimental Psychology, DOI:10.1080/17470218.2012.690769

To link to this article: http://dx.doi.org/10.1080/17470218.2012.690769

Disclaimer: This is a version of an unedited manuscript that has been accepted for publication. As a service to authors and researchers we are providing this version of the accepted manuscript (AM). Copyediting, typesetting, and review of the resulting proof will be undertaken on this manuscript before final publication of the Version of Record (VoR). During production and pre-press, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal relate to this version also.

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: http://www.tandfonline.com/page/terms-and-conditions

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae, and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand, or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

Physical Self-Similarity Enhances the Gaze Cueing Effect

Clara J. Hungr and Amelia R. Hunt

School of Psychology, University of Aberdeen, Scotland, UK

Author Note

Clara J. Hungr is now at the Derner Institute of Advanced Psychological Studies at Adelphi University, Garden City, New York.

Correspondence should be addressed to:

Clara J. Hungr
Derner Institute for Adv Psy Studies, Adelphi University
Hy Weinberg Center, 158 Cambridge Ave.
Garden City, NY, 11530
Tel: 347-407-1378
E-mail: clarahungr@mail.adelphi.edu

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Abstract

Important social information can be gathered from the direction of another person's gaze, such as their intentions and aspects of the environment that are relevant to those intentions. Previous work has examined the effect of gaze on attention through the *gaze cueing effect*: an enhancement of performance in detecting targets that appear where another person is looking. The present study investigated whether the physical self-similarity of a face could increase its impact on attention. Self-similarity was manipulated by morphing participants' faces with those of strangers. The effect of gaze direction on target detection was strongest for faces morphed with the participant's face. The results support previous work suggesting self-similar faces are processed differently from dissimilar faces. The data also demonstrate that a face's similarity to one's own face influences the degree to which that face guides our attention in the environment.

Keywords: gaze-cueing, self recognition, face processing, eye-tracking

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Physical Self-Similarity Enhances the Gaze Cueing Effect

Gaze direction provides a visual signal indicating where a person's interest lies within their environment. The gaze cueing effect (GCE) is typically measured by presenting a face with the eyes diverted to the left or right, followed shortly by a peripheral left or right target. Targets appearing in the gazed-at location tend to be detected faster than those appearing in other locations. This effect has been used to demonstrate that humans rapidly and automatically shift their visual attention in the direction of another's gaze (Friesen & Kingstone, 1998; Kuhn & Kingstone, 2009).

The GCE is observed after brief (100-300ms) viewing times of the cueing face (Driver, Davis, Ricciardelli, Kidd, Maxwell, & Baron-Cohen, 1999), suggesting that the information provided by the face is processed rapidly and involuntarily by the observer. The involvement of higher-level social cognition in the GCE is difficult to imagine given the brief timecourse of the effect. Indeed, several studies have found that certain changes in the social features of a cueing face have no effect on gaze cueing. For instance, increasing the familiarity of a face through repeated exposure to an individual's photo did not change the GCE (Frischen & Tipper, 2004), nor did presenting faces with varying emotional expressions (Bayliss, Frischen, Fenske, & Tipper, 2007; Hietanen & Leppanen, 2003). However, under certain circumstances, the social features of a face have been found to modulate the GCE. For example, individuals with high levels of social anxiety show larger effects of the gaze direction of fearful faces (Fox, Mathews, Calder, & Yiend, 2007). A stronger GCE has also been reported in response to faces manipulated to reflect higher subjective social dominance (Jones, DeBruine, Main, et al. 2009), or masculinity (Jones, Main, DeBruine, Little, & Welling, 2010). Familiar faces also increased the GCE, both for faces within one's social sphere (Deaner, Shepherd, & Platt, 2007, although only

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

amongst female participants) and of cultural celebrities (Frischen & Tipper, 2006; a facilitation found to extend for over three minutes). This latter body of work suggests that the information carried in a cueing face can be influenced by certain socially-relevant facial features.

A person's gaze communicates the location of something that is likely to be of interest to other humans, provided they share common goals and priorities. From this perspective, gaze cueing may involve a process of mentalization, whereby rapid and intuitive inferences of another person's perspective and motives are made based on one's own experience and internalized schemas (Keysers & Gazzola, 2007). This process may be facilitated when the perceived similarity between the self and other is high. Indeed, evidence from neuroimaging studies indicates that similar brain networks are activated during introspection as during perception and judgment of a similar other, but not a dissimilar other (Jenkins, Macrae, & Mitchell, 2008; Mitchell, Banaji, & Macrae, 2005; Mitchell, Macrae, & Banaji, 2006). This has led to the proposal that a similar other's actions can be reflexively linked to one's own experience, triggering a sense of social relation with similar others that differs from dissimilar others. The perceived similarity of a cueing face may likewise influence the degree to which we use their gaze direction to guide our own attention. In a similar vein, information about a person's membership in one's in-group or family has been found to be cued by physical similarity, as well as more general ethno-cultural cues of skin colour and facial structure (DeBruine, 2002; DeBruine, Jones, Little, & Perrett, 2008). Thus, a self-similar face may indicate that individual is family or other in-group relation, whose social communication would hold more relevance to the observer.

Accepted Manuscript

Theories of social learning provide further support for the idea that self-similarity may influence non-verbal social cues such as the GCE. One mechanism of social learning in primates and humans involves imitating family members, with humans in particular found to emulate familial behaviours without much questioning or subjective modification (Tomasello, 1996, 2000). Along with the behavioural evidence of social learning occurring through physical imitation, a rising number of studies has begun linking imitative learning to a region of the pre-frontal cortex referred to as the mirror-neuron system (Rizzolatti & Graighero, 2004). Mirror neurons respond both when the subject performs an action and when the subject observes that action being performed by another individual (e.g. di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992). The system to which these neurons belong, though controversial (e.g. Hickok, 2009), is thought to use our own repertoire of goals and associated actions to simulate the goal of another person's behaviour (Gallese, Keysers, & Rizzolatti, 2004; Van Overwalle, & Baetens, 2009).

As an extension to this body of literature, the current study examines the impact of physical self-similarity on the extent to which we are influenced by another individual's gaze direction. Self-similarity was manipulated by using faces morphed to physically resemble the observer. We predicted that self-similar physical features in another person's face would increase the effect of that person's gaze on attention, or lead to an increased tendency to emulate the other person's behaviour, both of which should lead to enhanced cueing effects for self-similar faces.

Method

Participants

Seven female and five male students from the University of Aberdeen psychology department (mean age = 22.21 yrs, SD = 4.19 yrs) completed the

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

experiment for either course credit or £5 compensation. All participants were Caucasian with normal or corrected-to-normal vision. Data from one participant were excluded due to a high number of eye movement errors.

Stimuli

Photographs of ten "stranger" individuals (5 female, 5 male) were taken looking forward, left, and right (by fixating dots affixed to the walls of the room while keeping the head directed forward). All portraits were photographed under the same conditions, using a Sony α-230 digital SLR camera (10.2 megapixel resolution and 3x optical zoom) in a room with controlled lighting. Using Adobe Photoshop® software, each photograph was cropped into an oval encircling the eyes, nose, and mouth to remove visual cues about hairstyle and clothing.

Each participants' photograph was also taken and cropped as described above (forward, left, right gazing). Participants' photographs were taken in a separate session, usually the day before the gaze-cueing session. For each of the gaze directions, the participant's face was morphed with each of the 10 strangers' faces using Fantamorph software (Abrosoft V.4). Two morphed images were created, one made up of 30% participant and 70% stranger, and one of 50% participant and 50% stranger. This process generated 60 morphed face stimuli out of each participant's photograph (ten strangers by two morphing levels by three gaze directions).

The choice of 30% and 50% was made in order to examine what level of self-recognition is required to observe the hypothesized effects. Conscious self-recognition of a self-morphed face seems to begin with faces made up of around 25% of ones own features (Turk, et al., 2002). Thus, the 30% self faces used in this study may stimulate self-recognition just above this threshold, while the 50% self faces may stimulate more explicit, conscious self-recognition. We chose not to use 100% self-faces in the

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

experiment in order to avoid an overarching self-capture effect (e.g., Bargh & Pietromonaco, 1982) interfering with the cueing effect.

The morphing process decreases the image resolution and smoothes out the original face's skin complexion. To match the smoothed appearance of the self-morphed faces, control faces were created by morphing two stranger photographs together. Five random pairs from the male stranger faces and five from the female stranger faces were selected. These pairs were then morphed to represent approximately 50% of each face, and used as the final stranger control stimuli (referred to as 0% self). Figure 1 shows one example from the set of 0% self, 30% self, and 50% self stimuli used for one participant.

Apparatus

The experiment was displayed on a 17 inch CRT monitor (1024/768px resolution, 85Hz refresh rate) at a viewing distance of 50cm. Participants sat with their head stabilized in a chin and head rest, and their right eye movements were recorded using an Eyelink 1000 (SR Research Ltd, Mississauga, Canada) running Experiment Builder (SR Research Ltd, Mississauga, Canada), and controlled by a Macintosh running Windows XP. Responses were recorded using a hand-held button box.

Procedure

Each trial began with a black dot (0.63°) in the center of the display. Participants fixated the dot and pressed the left thumb-button to initiate the trial. If a stable fixation was detected, a forward-gazing face appeared in the centre of the screen (9.1° by 6.8°). The face was flanked by two black outlined boxes (1.7° by 1.7°) appearing at the level of the face's eyes, at a distance of 12.4° to the left and right of the centre of the display. After 1000ms, the face's eyes shifted randomly to the left or

Downloaded by [University of Aberdeen] at 01:45 09 May 2012
Accepted Manuscript

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

the right. One hundred milliseconds after the gaze shift, a grey target dot (0.60°) appeared in one of the two boxes. The task was to respond as quickly and accurately as possible to the appearance of the target dot. See Figure 2 for an example of a trial sequence.

During one block participants indicated the target location with a left or right button press (manual response), and during another block participants made a left or right eye-movement towards the target (saccadic response). The order of these blocks was counterbalanced. Participants were instructed to maintain fixation on the central face at all times, except during saccadic response trials where a left or right saccade was to be made from the central face only after the target appeared. Saccadic trials were excluded from analysis if a saccade was made away from the central face before the target appeared on screen (defined as a shift beyond the oval circumference of the face). Manual trials were excluded if a saccade was made away from the central face at any point during the trial.

Each block consisted of 480 trials, preceded by a brief calibration sequence and 20 practice trials. Participants were given breaks after every 80 trials. Gaze-cue direction (left, right), target location (congruent with gaze-direction or incongruent), face type (0%, 30%, or 50% self), and the stranger face used during morphing (5 male, 5 female) were randomly intermixed within each block.

After completing the two experimental blocks, participants were asked to look at each of the 30 stimuli presented during the session (ten 0% self, ten 30% self, ten 50% self), and state whether they recognized themselves in the face or not.

Results

Response Time

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

We excluded saccadic responses occurring less than 80 ms or more than 550 ms after target onset (0.08%), and manual responses occurring less than 150 ms or more than 600 ms after target onset (0.02%). Incorrect responses were also excluded from RT analysis.

A three-way within-subjects ANOVA was run with response type (manual vs. saccadic), congruency (congruent vs. incongruent), and proportion of self in the cueing face (0, 30, or 50%) as factors. A significant GCE was found [$F(1, 11) = 145.8$, $p < .001$], with significantly longer RTs on incongruent trials ($M = 265.7$ ms, $SD = 88.7$) than congruent trials ($M = 234.9$ ms, $SD = 85.9$). There was also a main effect of response type [$F(1, 11) = 719.0$, $p < .001$], reflecting significantly longer RTs for manual responses ($M = 333.4$ ms, $SD = 39.0$) than saccadic responses ($M = 167.3$ ms, $SD = 40.1$), and a main effect of face type [$F(2, 11) = 4.7$, $p < .05$], with increasing RT as the proportion of self in the cueing face increased from 0% ($M = 248.7$ ms, $SD = 31.4$), to 30% ($M = 249.5$ ms, $SD = 31.3$), to 50% ($M = 252.8$ ms, $SD = 31.9$). Although small, the RT increase between 0% and 50% self faces was found to be significant [$t(11) = 4.03$, $p < .001$], and that between 30% and 50% to be marginally significant [$t(11) = 2.00$, $p < .1$].

Finally, and most interestingly, an interaction between face type and congruency was observed [$F(2, 22) = 5.9$, $p < .05$]. A t-test on the GCE (incongruent RT – congruent RT) revealed a significantly larger GCE in the 50% self-faces than both the 0% self [$t(11) = 3.34$, $p < .05$], and the 30% self faces [$t(11) = 3.12$, $p < .05$]. No significant GCE difference was observed between the 0% and 30% self faces [$t(11) = 0.77$]. The mean RT for each condition is presented in Figure 3, split by manual and saccadic response type. Because morphing different genders could produce faces that appear androgynous, a follow-up analysis was run examining only

Accepted Manuscript

trials in which participants' faces were morphed with their own gender. The interaction of cueing with self-similarity was replicated in this analysis [$F(2, 22) = 5.78$, $p < .05$], with a larger cueing effect for 30% and 50% self-faces than 0% faces ([$t(11) = 2.19$, $p < .05$] and [$t(11) = 3.68$, $p < .05$] respectively). Another possible concern is that responses were slower to self-similar faces, so a further split-half analysis was run comparing the strength of the GCE between the slower and the faster half of responses. The interaction of GCE with self-similarity was significant only in the faster responses [$F(2, 22) = 4.23$, $p < .05$], and was lost in slower responses [$F(2, 22) <1$]. This rules out slower responses to self-similar faces as an explanation for the interaction effect.

Accuracy

The same ANOVA as was run on RT was also run on error rates. A main effect for response type was revealed [$F(2, 11) = 12.4$, $p < .05$] with more errors on saccadic than manual trials (4.6% vs. 2.4%). A main effect for congruency was found [$F(2, 11) = 12.3$, $p < .05$], with more errors on incongruent trials. Finally, an interaction arose between response type and congruency [$F(2, 11) = 14.7$, $p < .001$], due to a larger effect of congruency for saccadic responses [$t(11) = 3.84$, $p < .001$] than manual responses [$t(11) = 2.84$, $p < .05$]. No significant effect was observed between face type [$F(2, 11)<1$], or interaction effect between congruency and face type [$F(2, 20) <1$]. Table 1 summarizes these results.

Check for Self-Recognition in the Face Stimuli

Participants recognized themselves in none of the ten 0% self controls, and on average in 2.6 out of the ten 30% self faces, and 7.6 out of the ten 50% self faces. Table 2 summarizes individual participants' recognition proportions. There was a significant positive correlation between the proportion of each participants' self-

Downloaded by [University of Aberdeen] at 01:45 09 May 2012
Accepted Manuscript

recognition in the 50% self faces and the size of the cueing effect difference between the 50% and 0% self condition (*Spearman's r* = 0.74, $p < .05$) but not the 30% self (*r* = 0.19). Figure 4 depicts this correlation.

Discussion

The current results demonstrated that the GCE increased with physical self-similarity in the cueing face, supporting the idea presented in the introduction that self-similar faces may be processed differently from other faces, and thus may have different consequences for directing attention. Although the modulation of the GCE with self-similarity was small, especially when compared to the overall main effect of cueing, its impact was significant. This increase in the cueing effect was correlated with the participant's explicit recognition of themselves in the cueing face, suggesting overt self-recognition may be an important factor.

The GCE in error rates was overall larger for saccadic responses than manual responses, demonstrating that a diverted gaze is more likely to trigger an erroneous eye movement than an erroneous key-press. The increased error rate in the saccadic responses may have two possible explanations; that the response mode matches the observed behavior, and that saccades are faster and more reflexive than manual key-press responses. Regardless of why response modalities differ, the important point for the current study is that the interaction of self-similarity with gaze cueing was observed for both manual and saccadic responses alike, suggesting that it is a general consequence of attentional orienting rather than a motor-specific effect. This is a particularly interesting observation because the saccade response directly mimics the behaviour of the face being observed, so might have been expected to be particularly enhanced for faces that are more similar. The fact that self-similarity influenced both response modalities to a similar extent suggests the results are more likely to be

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

related to attentional control than to motor mimicry, and also provides support for the robustness of the effects.

One concern for interpreting the results is the possible transparency of the experimental manipulation. Having photographed participants on the day prior to their running the task may have primed them to look for their own faces, thus mediating the increased self-cueing effect. To some extent this interpretation matches the study's hypothesis, which is that self-similar faces are perceived as more "important" than non-self faces, and consequently have a larger influence on attention. Nonetheless, it is important to discern whether the increase in cueing effects is driven by the visual characteristics of the face itself or by the top-down knowledge that the face has been morphed with one's own. The former interpretation would suggest the effect is a broader reflection of how faces influence our attention outside the laboratory, while the latter interpretation would suggest that the effect is constrained to these experimental conditions. We believe an interpretation based on visual characteristics is more likely, given that each "self" face was blended with ten different strangers at two different levels (30% and 50%). Without explicit labeling, the category of each final stimulus was ambiguous. Despite this variability in the visual characteristics of each individual face, the gaze cue strength subtly increased across the morph levels. It's also important to consider that previous work has failed to find a consistent effect of emotional expression (Bayliss et al, 2007; Hietanen & Leppanen, 2003) and familiarity through repetition (Frischen & Tipper, 2004) on gaze cueing, and both of these are features which could trigger more transparent demand characteristics than our self-morph manipulation.

Another potentially important consideration for the current study's results is self-capture. Previous studies examining the influence of self-recognition on attention

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

have provided evidence that self-stimuli both grab attention (Wood & Cowa, 1995; Bargh et al., 1982) and hold it for longer than non-self stimuli (Devue, Van der Stigchel, Brédart, & Theeuwes, 2009). This was one reason that we decided not to include 100% self-faces in the experiment; to see one's own face, particularly with an averted gaze, is a novel experience which we assumed would capture attention and slow responses to peripheral targets. We were also concerned the very presence of 100% self-faces would cause subjects to prioritize the remaining faces differently. That is, expecting to see your own face on any given trial might change the way you respond to other faces. We therefore used the more subtle manipulation of morphing smaller proportions of the self with a set of stranger faces to avoid self-capture. Nonetheless, responses were slightly but significantly slower overall to self-morphed faces, suggesting some self-capture may have occurred. We obtained an interaction with the cueing effect despite these self-capture effects, but an interesting question is whether and how self-capture and gaze cueing would interact in 100% self-faces.

A final concern is that, although the self-morphed faces are not familiar to the participants in the sense that they had been seen before, they do contain more familiar facial features. This was another reason to avoid 100% self-faces, since they are both self-similar and highly familiar. Past studies have reported stronger cueing effects for personally familiar faces, but only among female participants (Deaner et al., 2007), so it seems unlikely that a subtle familiarity effect in our experiment is driving the interaction with gaze cueing. Nonetheless, familiarity could contribute to our results, and it would be interesting to know whether familiarity and self-similarity increase the GCE through similar mechanisms.

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Follow-up study with 100% self-faces. To begin to address some of the above concerns about demand characteristics, self-capture, and familiarity, we ran a follow-up study using manual button press responses only, in which we directly compared a 100% self-face, a stranger's face, and a familiar other face. The face of one of the experimenters (ARH) was used as the "familiar other" face, and the stranger was one of the stranger faces used in the main experiment, so none of the faces in this experiment were morphed. The spatial and temporal parameters of the experiment were otherwise similar to the gaze-cueing experiment above. The eight participants recruited from the psychology department of the University of Aberdeen were all personally familiar with ARH. A within-subject ANOVA on RT with congruency and face type as factors revealed a significant GCE in response times [$F(1,7) = 34.23$, $p < .01$, congruent M = 304.6ms, incongruent M = 339.3ms], and response times were significantly slower for self faces [M=324.5] than for familiar faces [M=315.5, $t(7) = 3.41$, $p < .05$] and familiar faces were faster than stranger faces [M=322.2, $t(7) = 2.45$, $p < .05$]. However, unlike in the main experiment, no interaction between the strength of the GCE and face type was observed. On the other hand, the same analysis on the error rate data revealed both a gaze-cueing effect [$F(1,7) = 8.22$, $p < .05$] and a significant interaction between face-type and congruency [$F(2,14) = 4.55$, $p < .05$]; with the error rate cueing effect (that is, the difference in the proportion of erroneous responses between congruent and incongruent trials) being larger for self faces than for both familiar faces [$t(7) = 3.48$, $p < .01$)] and for stranger faces [marginally, $t(7) = 1.95$, $p < .1$, see Table 1].

These results confirm that self-faces enhance the GCE. However, that this effect was observed only in the error rates suggests that self-capture (e.g., Devue et al., 2009) may have shifted the effects from RT to errors rates. We also did not

Accepted Manuscript

observe an enhancement of the GCE for personally familiar faces. As mentioned above, in previous work (Deaner et al., 2007), this effect is small and only observed in female participants. Moreover, as suggested above, the presence of the self-face in our experiment, which is both very familiar and self-similar, may have influenced how participants prioritized the other faces in the set. In general, results support our choice of using morphed faces in the original study, and are in line with our interpretation that physical self-similarity drives the interaction with GCE that we observed, rather than self-capture or familiarity.

Conclusions. In showing a modulation of the GCE with self-similarity in the current study, our results are consistent with previous research demonstrating the importance of self-similarity in social cognition. Faces with self-similar physical features are typically identified as familial or in-group (Maloney & Dal Martello, 2006), leading to increased trust (DeBruine, 2002), and cooperative behaviour (Krupp, Debruine, & Barclay, 2008). Making judgments about self-similar others has also been shown to activate a distinct subregion of medial prefrontal cortex relative to making judgments about others that are perceived to be dissimilar (Mitchell et al., 2006). Our results suggest that these two areas of pre-frontal cortex may engage with attentional networks differently. Similarity was manipulated in the above neuroimaging study using sociopolitical attitudes rather than physical self-similarity. Whether perceived shared attitudes could also influence the GCE to a similar extent as physical similarity is an interesting question for future research to explore.

The significant correlation between self-recognition rates and the size of the GCE suggests that self-recognition at a conscious, rather than unconscious, level plays the important mediating role in the enhancement of gaze cueing. However, it is possible that the self-recognition task we used overestimated the amount of overt self-

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

recognition which occurred during the cueing task, in which self-recognition was not an overt goal. Another interesting open question is therefore what role overt versus covert self- recognition may play in the enhancement of GCE.

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

References

Bargh, J. A., & Pietromonaco, P. (1982). Automatic information processing and social perception: The influence of trait information presented outside of conscious awareness on impression. *Journal of Personality and Social Psychology, 43*, 437-449. doi:10.1037//0022-3514.43.3.437

Bayliss, A. P., Frischen, A., Fenske, M. J., & Tipper, S. P. (2007). Affective evaluations of objects are influenced by observed gaze direction and emotional expression. *Cognition, 104*, 644-653. doi:10.1016/j.cognition.2006.07.012

Deaner, R. O., Shepherd, S. V., & Platt, M. L. (2007). Familiarity accentuates gaze cueing in women but not men. *Biology Letters, 3*, 64-67. doi:10.1098/rsbl.2006.0564

DeBruine, L. M. (2002). Facial resemblance enhances trust. *Proceedings of the Royal Society of London. Series B, 269, 1307-1312.* doi:*10.1098/rspb.2002.2034*

DeBruine, L. M., Jones, B. C., Little, A. C., & Perrett, D. I. (2008). Social perception of facial resemblance in humans. *Archives of Sexual Behavior, 37*, 64-77. doi: 10.1007/s10508-007-9266-0

Devue, C., Van der Stigchel, S., Brédart, S., & Theeuwes, J. (2009). You do not find you own face faster; you just look at it longer. *Cognition, 111*, 114-122.

di Pellegrino, G., Fadiga, L., Fogassi, L., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: a neurophysiological study. *Experimental Brain Research, 91*, 176-180.

Driver, J., Davis, G., Ricciardelli, P., Kidd, P., Maxwell, E., & Baron-Cohen, S. (1999). Gaze perception triggers reflexive visuospatial orienting. *Visual Cognition,* 6, 509-540. doi:10.1080/135062899394920

Fox, E., Mathews, A., Calder, A. J., & Yiend, J. (2007). Anxiety and sensitivity to gaze direction in emotionally expressive faces. *Emotion, 7*, 478–486. doi:10.1037/1528-3542.7.3.478

Friesen, C. K., & Kingstone, A. (1998). The eyes have it! Reflexive orienting is triggered by nonpredictive gaze. *Psychonomic Bulletin and Review, 5*, 490-495.

Frischen, A., & Tipper, S. P. (2004). Orienting attention via observed gaze shift evokes longer term inhibitory effects: Implications for social interactions, attention, and memory. *Journal of Experimental Psychology: General, 133*, 516-533. doi:10.1037/0096-3445.133.4.516

Frischen, A., & Tipper, S. P. (2006). Long-term gaze cueing effects: Evidence for retrieval of prior states of attention from memory. *Visual Cognition, 14*, 351-364.

Gallese, V., Keysers, C., & Rizzolatti, G. (2004). A unifying view of the basis of social cognition. *Trends in Cognitive Sciences, 8*, 396-403.

Hickok, G. (2009). Eight problems for the mirror neuron theory of action understanding in monkeys and humans. *Journal of Cognitive Neuroscience*, 21, 1229-1243.

Hietanen, J. K., & Leppanen, J. M. (2003). Does facial expression affect attention orienting by gaze direction cues? *Journal of Experimental Psychology: Human Perception and Performance, 29*, 1228-1243. doi:10.1037/0096-1523.29.6.1228

Jenkins, A. C., Macrae, C. N., & Mitchell, J. P. (2008). Repetition suppression of ventromedial prefrontal activity during judgments of self and others.

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Proceedings of the National Academy of Sciences of the United States of America, 105, 4507-4512. doi:10.1073/pnas.0708785105

Jones, B. C., DeBruine, L. M., Main, J. C., Little, A. C., Welling, L. L. M., Feinberg, D. R., et al. (2009). Facial cues of dominance modulate the short-term gaze-cueing effect in human observers. *Proceedings of the Royal Society of London: Series B, 277*, 617-624. doi:10.1098/rspb.2009.1575

Jones, B. C., Main, J. C., DeBruine, L. M., Little, A. C., & Welling, L. L. (2010). Reading the look of love: Sexually dimorphic cues in opposite-sex faces influence gaze-categorization. *Psychological Science.* doi:10.1177/0956797610370756

Keysers, C., & Gazzola, V. (2007). Integrating simulation and theory of mind: From self to social cognition. *Trends in Cognitive Science, 11*, 194-196. doi:10.1016/j.tics.2007.02.002

Krupp, D. B., Debruine, L. M., & Barclay, P. (2008). A cue of kinship promotes cooperation for the public good. *Evolution and Human Behavior, 29*, 49-55. doi:10.1016/j.evolhumbehav.2007.08.002

Kuhn, G., & Kingstone, A. (2009). Look away! Eyes and arrows engage oculomotor responses automatically. *Attention, Perception & Psychophysics, 71*, 314-327. doi:10.3758/APP.71.2.314

Loftus, G. R., & Masson, M. J. (1994). Using confidence intervals in within-subject designs. *Psychonomic Bulletin and Review, 1*, 476-490.

Maloney, L. T., & Dal Martello, M. F. (2006). Kin recognition and the perceived facial similarity of children. *Journal of Vision, 6*, 1047–1056. doi:10.1167/6.10.4

Mitchell, J. P., Banaji, M. R., & Macrae, C. N. (2005). The link between social cognition and self-referential thought in the medial prefrontal cortex. *Journal of Cognitive Neuroscience, 17*, 1306-1315. doi: 10.1162/0898929055002418

Mitchell, J. P., Macrae, C. N., & Banaji, M. R. (2006). Dissociable medial prefrontal contributions to judgments of similar and dissimilar others. *Neuron, 50*, 655-663. doi:10.1016/j.neuron.2006.03.040

Rizzolatti, G., & Graighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience, 27*, 169-192.

Tomasello, M. (1996). Do apes ape? In J. Galef & C. Heyes (Eds.), *Social learning in animals: The roots of culture* (pp. 319-346). New York: Academic Press.

Tomasello, M. (2000) Culture and cognitive development. *Current Directions in Psychological Science, 9*, 37-40.

Turk, D. J., Heatherton, T. F., Kelley, W. M., Funnell, M. G., Gazzaniga, M. S., & Macrae, C. N. (2002). Mike or me? Self-recognition in a split-brain patient. *Nature Neuroscience, 5*, 841-842. doi:10.1038/nn907

Van Overwalle, F., & Baetens, K. (2009). Understanding Others' Actions and Goals by Mirror and Mentalizing Systems: A Meta-analysis. *NeuroImage, 48*, 564-584.

Wood, N., & Cowan, N. (1995). The cocktail party phenomenon revisited: How frequent are attention shifts to one's name in an irrelevant auditory channel? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 255-260.

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Figure 1. Example of the three face types used as gaze cueing stimuli, seen in contrast with the participant's original, unmorphed 'self' photograph. The control stimulus (A) was created by morphing two randomly selected stranger faces. Self-morph stimuli (B) and (C) were created by morphing the participant's original photograph (D) with each of the 10 stranger faces. Permission was given by persons in this figure to have their picture displayed in a research publication.

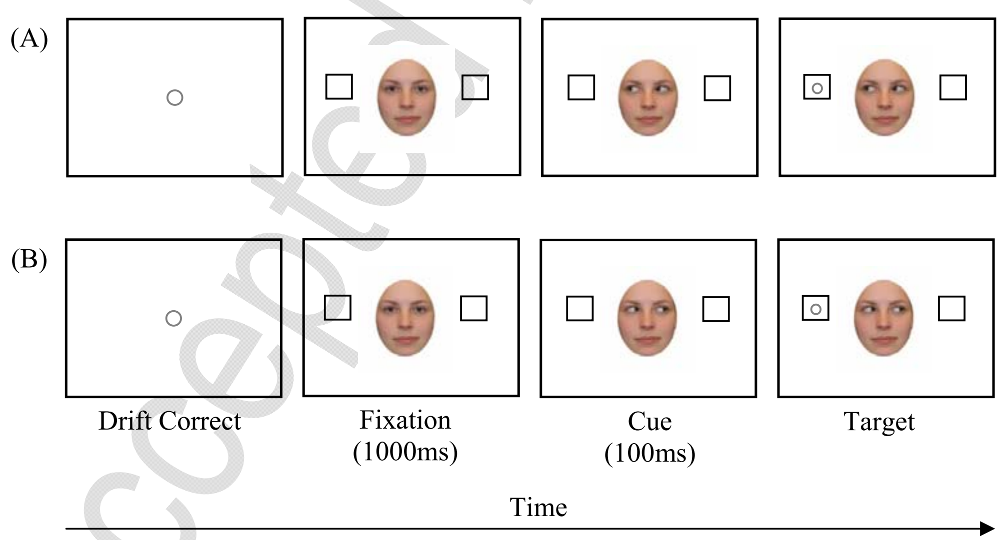

Figure 2. Example layout of a (A) congruent, and (B) incongruent trial used in the current experiment. The cue face shown is one of this study's 10 control stimuli (0% self).

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

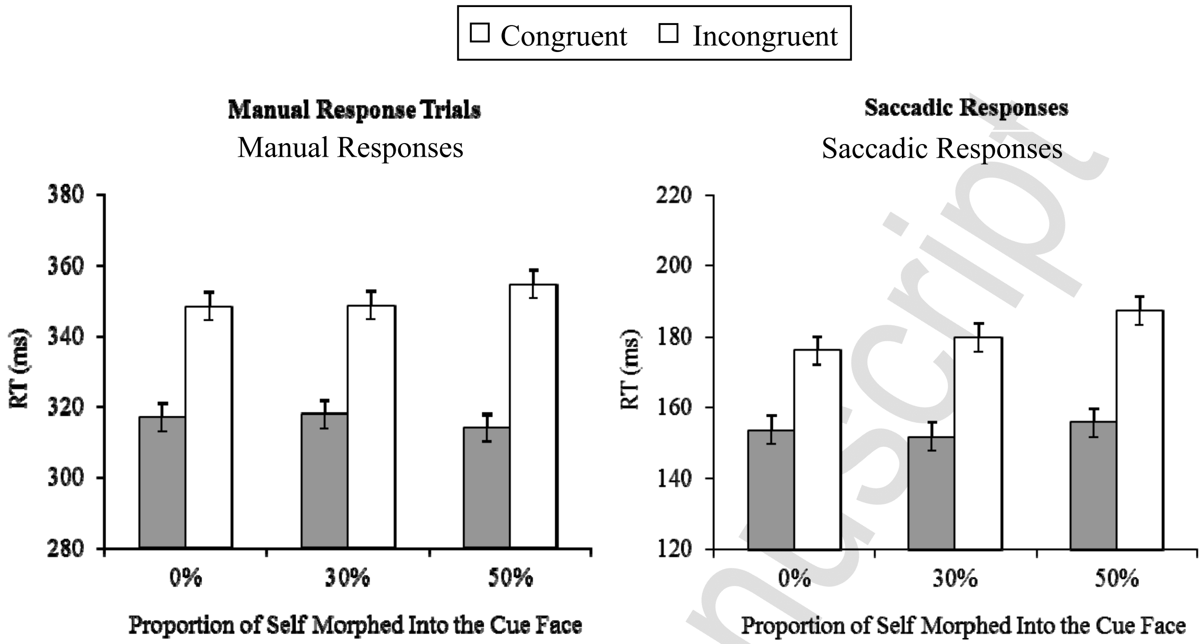

Figure 3. Plot of reaction time means for both manual and saccadic response modes. The results across both response modes show a significant interaction of congruency with face type, with cueing effects increasing across the proportion of self morphed into the face. Error bars were calculated to reflect the 95% confidence intervals within each subject (Loftus & Masson, 1994).

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

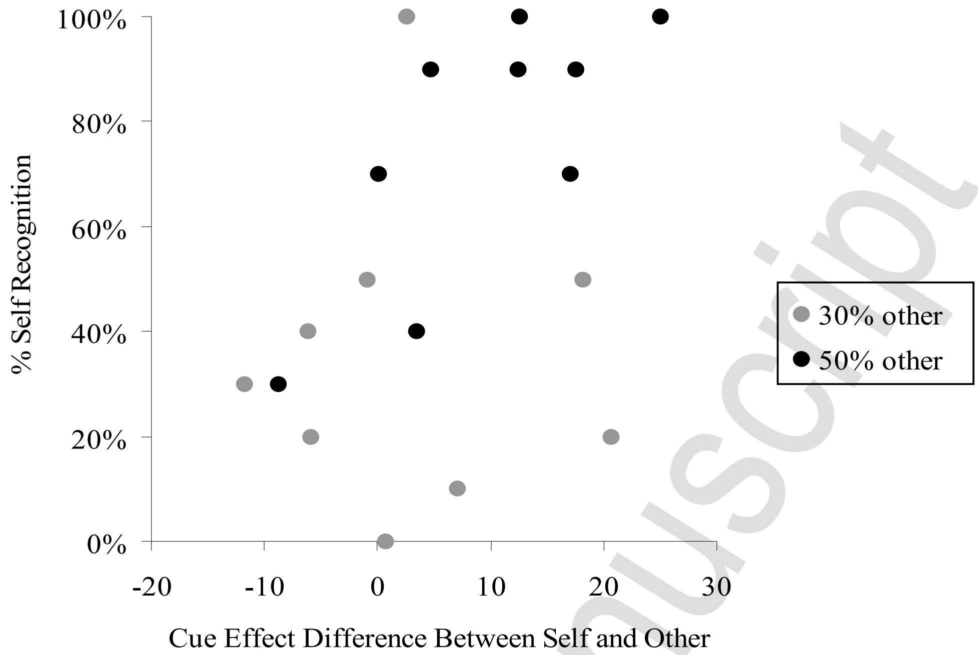

Figure 4. Plot of interaction between proportion of 30 and 50% self-face stimuli recognized in self-recognition task and the difference in GCE between self and other faces cues. Proportion of self-recognition of 50% self faces was significantly correlated to an increase in GCE difference between self and other.

Table 1

Average proportion (%) of erroneous responses made in each condition

	Saccadic responses		
Trial Type	0 % self face	30 % self face	50 % self face
Congruent	0.4 %	0.5 %	0.4 %
Incongruent	9.1 %	8.8 %	8.4 %
	Manual responses		
	0 % self face	30 % self face	50 % self face
Congruent	0.5 %	0.1 %	0.4 %
Incongruent	4.2 %	3.8 %	5.5 %
	Manual responses: Follow-up experiment		
	Stranger	Familiar	100 % self face
Congruent	0.9 %	1.5 %	1.0 %
Incongruent	5.8 %	4.5 %	7.3 %

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript

Table 2

Proportion (%) of the ten 30% self and ten 50% self faces that each participant recognized themselves in after running in the experiment.

Participant	Self-recognition of 30 % self faces	Self-recognition of 50 % self faces
1	50 %	100 %
2	10 %	40 %
3	50 %	90 %
4	20 %	70 %
5	30 %	30 %
6	40 %	90 %
7	0 %	90 %
8	20 %	70 %
9	10 %	100 %
Group mean	26 %	76 %

Note. Self-recognition data was not collected from three participants due to time-constraints in their experimental session.

Downloaded by [University of Aberdeen] at 01:45 09 May 2012

Accepted Manuscript