Research Article

ARE YOU LOOKING AT ME?
Eye Gaze and Person Perception

C. Neil Macrae,[1] Bruce M. Hood,[2] Alan B. Milne,[3] Angela C. Rowe,[2] and Malia F. Mason[1]

[1]Dartmouth College; [2]University of Bristol, Bristol, England; and [3]University of Aberdeen, Aberdeen, Scotland

Abstract—*Previous research has highlighted the pivotal role played by gaze detection and interpretation in the development of social cognition. Extending work of this kind, the present research investigated the effects of eye gaze on basic aspects of the person-perception process, namely, person construal and the extraction of category-related knowledge from semantic memory. It was anticipated that gaze direction would moderate the efficiency of the mental operations through which these social-cognitive products are generated. Specifically, eye gaze was expected to influence both the speed with which targets could be categorized as men and women and the rate at which associated stereotypic material could be accessed from semantic memory. The results of two experiments supported these predictions: Targets with nondeviated (i.e., direct) eye gaze elicited facilitated categorical responses. The implications of these findings for recent treatments of person perception are considered.*

Humans and many other species tend to look at things in their environment that are of immediate interest to them. You might be the recipient of another's gaze, for instance, because you are a potential meal, a mate or simply because you are someone with whom they would like to interact. (Langton, Watt, & Bruce, 2000, pp. 51–52)

Direction of eye gaze is a crucial medium through which humans and other animals can transmit socially relevant information. In some contexts, the mere establishment of eye contact can be interpreted as a sign of hostility or anger (Argyle & Cook, 1976). Indeed, in many primate societies, staring is deemed to be an unambiguously threatening gesture (Hinde & Rowell, 1962). Yet mutual eye contact can also convey positive messages. For example, staring can be taken to be a sign of friendliness, romantic attraction, or general interest (Argyle & Cook, 1976; Kellerman, Lewis, & Laird, 1989; Kleinke, 1986). As von Grünau and Anston (1995) have noted, "whether maintained stare is a sign of dislike or like, it is certainly an indication for a potential social interaction" (p. 1297).

Given the acknowledged informational value of eye gaze, it makes sound evolutionary sense that people should be sensitized to eye gaze in others. As gaze direction signals the appearance and relative importance of objects in the environment (e.g., friends, predators, food), considerable adaptive advantages can be gained from an information processing system that is finely tuned to gaze detection and interpretation (see Baron-Cohen, 1994, 1995; Perrett & Emery, 1994). Luckily for the smooth running of everyday life, the available evidence confirms that people are indeed highly sensitive to gaze direction, an ability that emerges in the very early stages of childhood. Young infants prefer to look at the eyes more than at other regions of the face (Morton & Johnson, 1991) and by the age of 4 months can discriminate staring from averted eyes (Vecera & Johnson, 1995). This fascination with gaze continues into adulthood, particularly with respect to mutual eye contact (Baron-Cohen, 1994, 1995). Although this sensitivity to eye gaze undoubtedly serves a variety of useful functions (e.g., reflexive visual orienting; see Driver et al., 1999; Friesen & Kingstone, 1998; Hood, Willen, & Driver, 1998), one function in particular is of considerable social importance. Understanding the nonverbal language of the eyes facilitates the development of social cognition, notably the cognitive and affective construal processes that guide people's daily interactions with others (see Baron-Cohen, 1994, 1995; Perrett & Emery, 1994).

EYE GAZE AND SOCIAL COGNITION

An intriguing account of the role that eye gaze may play in social cognition has been offered by Baron-Cohen (1995) in his writings on mind reading (i.e., theory of mind). According to Baron-Cohen (1994, 1995), the mind contains a series of specialized modules that have evolved to enable humans to attribute mental states to others (see also Brothers, 1990). One of these modules, the *eye-direction detector* (EDD), deals explicitly with gaze detection and interpretation and plays a critical role in the development of social cognition. In summary, the EDD has three basic functions: It (a) detects the presence of eyes or eyelike stimuli in the environment, (b) computes the direction of gaze (e.g., direct or averted), and (c) attributes the mental state of "seeing" to the gazer. As Baron-Cohen (1995) put it, the "EDD is a mindreading mechanism specific to the visual system; it computes whether there are eyes out there and, if so, whether those eyes are looking at me or looking at not-me" (p. 43). Such a system is believed to occupy a pivotal role in everyday social interaction. Indeed, without the ability to read the language of the eyes, perceivers would find it difficult to adopt the "intentional stance" (Dennett, 1987) when interpreting the actions of others (Baron-Cohen, 1994, 1995).

Whether or not one endorses the view that the mind contains an EDD or some functionally equivalent module (e.g., *direction of attention detector*, DAD; see Perrett & Emery, 1994), it is apparent that a specialized processing system deals with the problem of gaze detection and interpretation. Electrophysiological research has suggested that such a system may be localized in the superior temporal sulcus (STS; see Allison, Puce, & McCarthy, 2000; Haxby, Hoffman, & Gobbini, 2000; Hoffman & Haxby, 2000). A number of early studies identified cells in areas of temporal cortex that were highly receptive to facial stimuli (Bruce, Desimone, & Gross, 1981; Perrett, Rolls, & Cann, 1982). In subsequent research, Perrett and his colleagues located specific cells in the STS that responded selectively to the direction of gaze (Perrett et al., 1985). In particular, whereas some cells were tuned to eye contact, others were tuned to detect averted gaze. As

Address correspondence to Neil Macrae, Department of Psychological and Brain Sciences, Dartmouth College, Moore Hall, Hanover, NH 03755; e-mail: c.n.macrae@dartmouth.edu.

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it turns out, however, these cells appear to be only part of a broader system that is dedicated to the detection of social attention (Perrett & Emery, 1994). In recent research, individual cells in the STS region of the macaque brain have been shown to be responsive to particular conjunctions of eye, head, and body position (Perrett & Emery, 1994), suggesting that the direction of social attention can be signaled by a variety of stimulus cues.

Given, then, the fundamental role that gaze detection and interpretation plays in the development of social cognition (Baron-Cohen, 1994, 1995; Perrett & Emery, 1994), it is surprising that no empirical studies have yet investigated the effects of eye gaze on basic aspects of social-cognitive functioning, such as the pivotal process of person construal (i.e., person categorization). This oversight is puzzling as the categorical inferences that people draw about others are widely acknowledged to be the building blocks of social cognition (Allport, 1954; Brewer, 1988; Bodenhausen & Macrae, 1998; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). Rather than construing people in terms of their unique collections of attributes and proclivities, perceivers typically characterize them instead on the basis of the social groups to which they belong (Allport, 1954; Bargh, 1999). They do so for good reason, however. Not only does categorical thinking simplify the complexities of person perception, but also the products of this process shape the direction and nature of people's social interactions. Specifically, once targets have been categorized in a particular way, associated knowledge structures (e.g., stereotypes) guide people's impressions, evaluations, and recollections of others (Bodenhausen & Macrae, 1998; Brewer, 1988; Fiske & Neuberg, 1990; Macrae & Bodenhausen, 2000). Given this state of affairs, one might expect the efficiency of the person-construal process to be moderated by factors that have obvious biological significance to perceivers, such as the eye gaze of others (Baron-Cohen, 1994, 1995; Perrett & Emery, 1994). That is, in making sense of the persons who populate their social worlds, perceivers may use eye gaze as a cue for computing the relative importance or relevance of the individuals they encounter (e.g., looking at me vs. not looking at me). In turn, this cuing process may moderate the efficiency of the mental operations that furnish perceivers with category-related knowledge about others (Macrae & Bodenhausen, 2000).

EYE GAZE AND PERSON CONSTRUAL

There is good reason to suspect that the efficiency of the person-construal process may be influenced by a target's direction of gaze. Given that eye gaze can signal the potential intentions of friend and foe alike, it is useful to have an information processing system that can deal with this perceptual input in a rapid and effective manner (Baron-Cohen, 1994, 1995; Perrett & Emery, 1994). As Baron-Cohen (1995) has argued, "it makes . . . sense that we should be hypersensitive to when another organism is watching us, since this is about the best early warning system that another organism may be about to attack us, or may be interested in us for some other reason" (p. 98). Of course, in such a situation it is not simply enough to detect the presence of eyes or eyelike stimuli in the environment. To discern the potential intentions or motives of another organism (e.g., friend, enemy, predator, potential mate), it is also necessary to establish the identity of the organism in question and then to access any relevant information that may be stored in memory. After all, it is only after this knowledge has been accessed that appropriate action plans can be generated and implemented. For this reason, we suspect that the efficiency of the person-construal process may be moderated by the direction of eye gaze. As the most relevant stimulus targets are usually those with whom mutual eye contact has been established, we hypothesized that individuals would be categorized most rapidly when they display nondeviated (i.e., direct) eye gaze. Moreover, as a result of this categorization advantage, we expected that generic category-related knowledge (i.e., stereotypic information) would be highly accessible for these persons. We investigated these predictions in the following two experiments.

EXPERIMENT 1: EYE GAZE AND PERSON CATEGORIZATION

Method

Participants and design

Thirty-two undergraduates (14 men, 18 women) participated in the experiment for course credit. The experiment had a single-factor (eye gaze: full face, direct vs. 3/4 face, direct vs. averted vs. closed) repeated measures design.

Procedure and stimulus materials

Upon arrival in the laboratory, each participant was greeted by a female experimenter and seated facing the monitor of an Apple Macintosh iMac microcomputer. The experimenter explained that the study involved a classification task in which participants had to judge the gender of persons depicted in a series of photographs. Each photograph appeared in the center of the screen, and the participant responded by pressing, as quickly and accurately as possible, one of two appropriately labeled keys ("male" or "female"). Throughout the experiment, the participant was instructed to fixate on a small black cross that was located in the center of the screen. It was explained that the photographs would always be located on the fixation cross. On each trial, the fixation cross was blanked out 30 ms before the onset of the stimulus. Each photograph remained on the screen until the participant made a response, and the intertrial interval was 2,000 ms.

In total, 48 black-and-white photographs were presented (i.e., 24 men and 24 women). Across the stimulus set, 12 targets (6 men and 6 women) displayed full-face, direct gaze; 12 targets (6 men and 6 women) displayed 3/4-face, direct gaze; 12 targets (6 men and 6 women) displayed laterally averted gaze (i.e., 6 laterally averted to the right and 6 laterally averted to the left); and 12 targets (6 men and 6 women) had their eyes closed. The 3/4-face, direct condition was included to confirm that any effects observed were not driven by low-level properties of the images (e.g., symmetry, which holds only for direct gaze in full-face views; see George, Driver, & Dolan, 2001). The eyes-closed targets were included as an additional control condition because it is possible that laterally averted gaze may cue covert shifts in visual attention, which in turn may impair categorization performance (Driver et al., 1999; Hood et al., 1998). Presentation of the stimuli was randomized for each participant by computer software. On completion of the task, participants were debriefed, thanked for their participation, and dismissed.

Results and Discussion

The dependent measure of interest in this experiment was the mean time taken by participants to categorize the photographs by gender.

Given the presence of outlying responses in the data set, categorization times that were slower than 3 *SD*s from the mean were excluded from the analysis, as were trials in which participants categorized the targets incorrectly. This resulted in 3.2% of the data being excluded from the statistical analysis. Prior to the statistical analysis, a log transformation was performed on the data. For ease of interpretation, however, the nontransformed treatment means are reported in Table 1. Participants' mean gender-categorization times were submitted to a single-factor (eye gaze: full face, direct vs. 3/4 face, direct vs. averted vs. closed) repeated measures analysis of variance (ANOVA). This revealed an effect of eye gaze on categorization times, $F(3, 93) = 11.47$, $p < .0001$ (see Table 1 for treatment means). Post hoc Tukey tests confirmed that gender-categorization times were faster for targets with direct gaze (both 3/4 face and full face) than for either targets with laterally averted gaze or targets with their eyes closed (all ps $< .01$). No other differences were significant.

As expected, therefore, basic aspects of the person-construal process were moderated by the direction of eye gaze of to-be-categorized targets. Confirming the importance and informational value of mutual eye contact (Baron-Cohen, 1994, 1995; Perrett & Emery, 1994), gender-categorization times were fastest when targets were looking straight ahead. This effect was independent of the orientation of the face (i.e., 3/4 face or full face), thereby confirming that gaze direction was driving the observed effect (see also George et al., 2001).

Of course, identifying social objects is only one aspect of the person-construal process. Equally important is the task of accessing information about the social objects of interest (e.g., what do I know about the person?). After all, once this material has been generated, social interaction can be guided in an appropriate (e.g., purposive) manner (Bargh, 1999; Bodenhausen & Macrae, 1998; Macrae & Bodenhausen, 2000). The results of Experiment 1 suggest a possible route through which perceivers may gain enhanced access to category-related material in memory. Specifically, given the observed differences in gender-categorization times, it is possible that categorical knowledge may also be moderated by a person's direction of gaze. That is, just as category identification is facilitated for targets displaying direct eye gaze, so too associated categorical knowledge may be highly accessible for such targets. If this is indeed the case, then it should be possible to detect such an effect in a semantic priming task (Blair & Banaji, 1996; Macrae, Bodenhausen, & Milne, 1995; Macrae, Bodenhausen, Milne, Thorn, & Castelli, 1997). That is, priming effects should be most pronounced when category-related items follow the presentation of targets who are displaying nondeviated (i.e., direct) eye gaze. We investigated this prediction in our second experiment.

EXPERIMENT 2: EYE GAZE AND KNOWLEDGE ACCESSIBILITY

Method

Participants and design

Eighteen undergraduates (9 men, 9 women) participated in the experiment. The experiment had a 3 (eye gaze: direct vs. averted vs. closed) $\times$ 2 (item type: stereotypic vs. counterstereotypic) repeated measures design.

Procedure and stimulus materials

Participants arrived at the laboratory individually, were greeted by a female experimenter, and were seated facing the monitor of an Apple Macintosh G3 microcomputer. Written instructions explained that the experiment involved an investigation of the speed with which people could categorize letter strings as words. Participants were informed that, on the computer screen, they would see a series of letter strings (e.g., *jeep*, *dlab*). Their task was simply to decide, as quickly and accurately as possible, whether each letter string was a word or a nonword. Responses were made by pressing one of two appropriately labeled keys ("word" or "nonword"). In total, 72 letter strings (36 words and 36 nonwords) were used in the experiment. The target words were selected from those normed by Blair and Banaji (1996) and comprised 18 masculine (e.g., *jeep*, *cigars*, *rebellious*) and 18 feminine (e.g., *flowers*, *lingerie*, *passive*) items. The nonwords were rearranged (but pronounceable) versions of the target items. Participants were told that, prior to the presentation of each letter string, they would briefly see another item appear on the screen. It was emphasized, however, that these items were irrelevant to the task and should be ignored (in reality, of course, these items were the critical priming photographs).

Thirty-six photographs were used as priming stimuli in the experiment: 18 male faces and 18 female faces. Of these priming stimuli, 12 depicted targets (6 men and 6 women) displaying full-face, direct

Table 1. *Gender categorization times and knowledge accessibility as a function of eye gaze*

Measure	Eye gaze: 3/4 face, direct	Full face, direct	Laterally averted	Closed
Experiment 1				
Gender categorization (ms)	534	525	630	611
Experiment 2				
Knowledge accessibility (ms)				
Stereotypic items	—	587	626	621
Counterstereotypic items	—	647	645	650
Nonwords	—	692	690	684

gaze; 12 depicted targets (6 men and 6 women) displaying laterally averted gaze (6 laterally averted to the left and 6 laterally averted to the right); and 12 depicted targets (6 men and 6 women) with their eyes closed. As the two direct-gaze conditions produced comparable effects in Experiment 1, only the full-face, direct targets were used in the second experiment. Each priming stimulus was followed by a stereotypic item, a counterstereotypic item, and a nonword, giving a total of 108 experimental trials. For all trials, the priming stimulus appeared for 150 ms, a blank screen was presented for 100 ms, and then the letter string appeared and remained on the screen until participants made a response (i.e., stimulus onset asynchrony = 250 ms). The intertrial interval was 2,000 ms. The computer recorded the accuracy and latency of each response. On completion of the task, participants were debriefed, thanked for their participation, and dismissed.

Results and Discussion

The dependent measure of interest in this experiment was the mean time taken by participants to classify the category-related letter strings as words. These data were trimmed and normalized using the procedures outlined in Experiment 1. In total, 2.6% of the trials were excluded from the statistical analysis. Prior to the statistical analysis, a log transformation was performed on the data. For ease of interpretation, however, the nontransformed treatment means are reported in Table 1.

Participants' mean lexical decision times were submitted to a 3 (eye gaze: direct vs. averted vs. closed) × 2 (item type: stereotypic vs. counterstereotypic) repeated measures ANOVA. This analysis revealed main effects of eye gaze, $F(2, 34) = 3.26$, $p < .05$, and item type, $F(1, 17) = 7.33$, $p < .02$, on participants' responses. As expected, however, these effects were qualified by an Eye Gaze × Item Type interaction, $F(2, 34) = 3.50$, $p < .04$ (see Table 1 for treatment means). Simple effects analysis confirmed an effect of eye gaze on participants' responses to the stereotypic items, $F(2, 34) = 4.90$, $p < .02$. Lexical decisions were faster when stereotypic items were preceded by targets with direct gaze than when they were preceded by either targets with laterally averted gaze or targets with their eyes closed (both ps $< .05$). In addition, responses were faster to stereotypic than counterstereotypic items when the priming stimuli were targets with direct gaze, $F(1, 17) = 11.40$, $p < .004$. Interestingly, this priming effect (i.e., faster responses to stereotypic than counterstereotypic items) was only marginally significant for targets with laterally averted gaze or targets with their eyes closed.

The time taken by participants to classify letter strings as nonwords was not affected by gaze direction, $F(2, 34) < 1$, n.s. (see Table 1), thereby confirming that direct eye gaze does not prompt a general enhancement in task performance. Instead, the effects of gaze direction were confined to the accessibility of categorical knowledge. This study extends the results of Experiment 1, showing that stereotypic knowledge was most accessible when targets were looking directly ahead. This finding is important as it demonstrates that the task of understanding other persons (i.e., accessing relevant material in semantic memory) is facilitated when mutual eye contact is established between the perceiver and target of interest.

GENERAL DISCUSSION

According to recent writings, the detection and interpretation of eye gaze plays a prominent role in both the development of social cognition and the smooth running of everyday social interaction (Baron-Cohen, 1994, 1995; Perrett & Emery, 1994). Understanding the language of eyes enables perceivers to attribute mental states to others, and hence describe their behavior using a rich variety of mentalistic terms (e.g., intentions, desires, hopes, plans; see Baron-Cohen, 1995; Dennett, 1978). This turns out to be an important ability. As Dennett (1987) has argued, "we use folk psychology all the time, to explain and predict each other's behavior; we attribute beliefs and desires to each other with confidence—and quite unselfconsciously—and spend a substantial portion of our waking lives formulating the world—not excluding ourselves—in these terms" (p. 48). We suspected that people's sensitivity to eye gaze would also prompt the emergence of some important social-cognitive effects pertaining to the efficiency of the person-construal process. Our results corroborated this prediction. The speed with which targets were categorized according to their gender and the rate at which associated knowledge was extracted from semantic memory were shown to be contingent upon the target's direction of gaze. Specifically, person construal was facilitated when targets displayed direct eye gaze. This finding not only is of theoretical significance (Baron-Cohen, 1994, 1995; Perrett & Emery, 1994), but also has important practical implications for the dynamics of everyday social interaction. It is obviously beneficial if perceivers can respond to significant (i.e., relevant, salient) others as quickly and effectively as possible. Through enhancements in the efficiency of the person-construal process when mutual eye contact has been established between perceiver and target, this objective can clearly be attained.

Interestingly, recent neuroimaging research has investigated the neural mechanisms that underlie the detection of eye gaze (Kawashima et al., 1999). It has long been known that the amygdala plays an important role in the processing of emotional stimuli (Adolphs, Tranel, Damasio, & Damasio, 1994). For example, studies have demonstrated activation within the amygdala in response to overt (Adolphs et al., 1994) or masked (Morris, Öhman, & Dolan, 1998) emotionally expressive (i.e., angry) faces and in response to threatening or fear-provoking stimuli (LaBar, Gatenby, Gore, LeDoux, & Phelps, 1998). Similar effects have also been obtained when eye gaze is directed toward a person (Kawashima et al., 1999), suggesting that mutual eye contact induces a strong emotional response. This is perhaps to be expected if shared gaze signals the relevance or importance of another person in the environment (Baron-Cohen, 1995). It is possible, therefore, that the social-cognitive effects demonstrated in the present study may be mediated by differential amygdala activation as perceivers strive to understand the people who populate their social worlds. One task for future research will be to investigate this intriguing possibility.

By emphasizing the functional nature of categorical thinking, researchers have unraveled some of the more perplexing mysteries of the person-perception process (Macrae & Bodenhausen, 2000). As economizing mental devices (Macrae, Milne, & Bodenhausen, 1994), categorical knowledge structures confer order, meaning, and predictability to an otherwise chaotic social world. Notwithstanding the acknowledged benefits that accrue from a category-based conception of others, however, some unresolved issues remain. Notable among these is the question of when exactly perceivers activate categorical knowledge structures in their dealings with others. Is categorical thinking an inevitable aspect of the person-perception process, or is its occurrence regulated by a variety of cognitive and motivational factors (see Bargh, 1999; Macrae & Bodenhausen, 2000)? Rather than attempting to resolve this thorny debate, we considered a closely related issue in the present study: Are there factors that moderate the relative efficiency of person construal, such that targets are processed more rapidly (and effectively) under some circumstances than others? Our results confirmed that this is indeed the case, with eye gaze moderating the efficiency of the construal processes that furnish perceivers with categorical knowledge about others. This finding is theoretically noteworthy as it provides an initial demonstration of the important role that biological factors play in the regulation of social cognition. To gain a complete understanding of the dynamics of person construal, it may therefore be useful to consider the wider evolutionary context in which this process emerged.

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