Look into my eyes: Gaze direction and person memory

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The current research considered the effects of gaze direction on a fundamental aspect of social cogition: person memory. It was anticipated that a person's direction of gaze (i.e., direct or averted) would impact his or her subsequent memorability, such that recognition would be enhanced for targets previously displaying direct gaze. In Experiment 1, participants were presented with faces displaying either direct or averted gaze in a person-classification (i.e., conceptual) task. Then, in a surprise memory test, they were required to report whether a presented face had been seen before. As expected, a recognition advantage was observed for targets displaying direct gaze during the initial classification task. This finding was replicated and extended in a second experiment in which participants initially reported the spatial location (i.e., perceptual task) of each face. We consider the implications of these findings for basic aspects of social-cognitive functioning and person perception.

Detecting and interpreting gaze-related information is an exquisitely adapted human skill. That people possess such a talent is probably just as well. When gaze direction can signal the potential intentions of conspecifics, it is useful to have an information-processing system that is capable of understanding the non-verbal language of the eyes (Baron-Cohen, 1995). People naturally look at objects in the environment that are of interest or importance (Emery, 2000). Knowing whether you are the recipient of another person's gaze because you are a possible mate, adversary, or interaction partner is critical as it enables one to generate an appropriate behavioural response (e.g., smile, run, or contribute the next conversational utterance). Possessing a system that is finely tuned to gaze monitoring enables you to exploit visual cues, which in turn simplifies navigation through complex social environments.

As the available evidence attests, people are highly adept at using gaze direction as a cue to decoding the intentions of others (i.e., mind-reading, see Baron-Cohen, 1994, 1995). The precursors of this ability appear in early infancy. Almost from birth, infants show a fascination with the eyes over other regions of the face (Morton & Johnson, 1991) and, by the age of 4 months, can discriminate direct from averted gaze (Vecera & Johnson, 1995). By the time they are between the ages of 9 and 18 months, young children begin to read the eyes in terms of goal direction, attending immediately to the eyes when the intentions of an adult actor's goals are ambiguous (Phillips, Baron-Cohen, & Rutter, 1992). Continuing into adulthood, this sensitivity to eye gaze serves a variety of useful functions (e.g., reflexive visual orienting, see Driver, Davis, Ricciadelli, Kidd, Maxwell, & Baron-Cohen, 1999; Friesen & Kingstone, 1998).

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Nowhere is this more apparent than in the arena of social-cognitive functioning. By understanding the language of the eyes, perceivers can infer the mental states of others (Baron-Cohen, 1994, 1995; Emery, 2000).

Supporting people's ability to decode the behavioural intentions of others is a specialised processing system that deals with the problem of gaze detection and interpretation (Allison, Puce, & McCarthy, 2000; Haxby, Hoffman, & Gobbini, 2000). Electrophysiological work has suggested that key aspects of this system are localised in regions of the superior temporal sulcus (STS). Building on early research that identified cells in areas of temporal cortex that were highly receptive to faces (Bruce, Desimone, & Gross, 1981; Perrett, Rolls, & Cann, 1982) Perrett and his colleagues located specific cells in the STS that responded selectively to gaze direction (Perrett et al., 1982). In particular, some cells were tuned to eye contact, whereas others were tuned to averted gaze. It turns out, however, that these cells comprise only part of a broader system that is dedicated to the task of determining the direction of social attention (Perrett & Emery, 1994). Research has demonstrated that individual cells in the STS region of the macaque brain are responsive to particular conjunctions of eye, head, and body position (Perrett, Hietanen, Oram, & Benson, 1992), suggesting that the direction of social attention can be signalled by a variety of stimulus cues (Langton, Watt, & Bruce, 2000). Finally, recent functional neuroimaging work has suggested that, together with the STS (Hoffman & Haxby, 2000), the amygdala also plays an important role in gaze processing (George, Driver, & Dolan, 2001; Kawashima et al., 1999).

Interestingly, while considerable advances have been made in understanding the neural substrates of gaze detection (Haxby et al., 2000; Langton et al., 2000), little is known about the extent to which eye gaze impacts basic behavioural aspects of social-cognitive functioning (but see Campbell, Wallace, & Benson, 1996; Kampe, Frith, Dolan, & Frith, 2001). This empirical lacuna is puzzling, as gaze detection is widely believed to play a pivotal role in the person-perception process (Baron-Cohen, 1994, 1995). In one of the few studies to investigate this issue to date, Macrae, Hood, Milne, Rowe, and Mason (2002) speculated that direction of eye gaze may modulate the efficiency of categorical thinking (see also Campbell et al., 1996), notably the ease with which perceivers can classify others (in terms of sex) and extract associated information from semantic memory (Macrae & Bodenhausen, 2000). As the most relevant stimulus targets are usually those displaying direct gaze (von Grünau & Anston, 1995). Macrae et al. anticipated that individuals would be categorised most rapidly when they displayed direct rather than averted gaze. In addition, generic category-related knowledge was expected to be more accessible for the former than the latter targets. The results of two experiments supported these predictions, thereby demonstrating that gaze direction can influence basic aspects of the person-perception process (see also Campbell et al., 1996).

Acknowledging the importance of gaze detection in social interaction, recent work has characterised eye gaze as an attentional mechanism (Driver et al., 1999; Farroni, Johnson, Brockbank, & Simion, 2000; Friesen & Kingstone, 1998; Hood, Willen, & Driver, 1998). Direct gaze captures the attention of perceivers (Baron-Cohen, 1995; von Grünau & Anston, 1995), and this attentional capture, in turn, increases the efficiency of basic cognitive operations. Given this state of affairs, one might expect gaze direction to affect social-cognitive tasks with attentional components (George et al., 2001), particularly tasks that capture the importance of gaze direction in human social interaction (Langton et al., 2000).

One fundamental problem confronting perceivers in their daily lives is remembering whether or not specific individuals have been encountered in the past (i.e., person memory). As successful social interaction rests on the execution of this ability, it is clearly important to identify factors that may moderate people's ability to recognise others. This is particularly true in task contexts in which perceivers have no explicit goal to remember experiences from the past. Aside from a few settings, perceivers rarely consciously try to encode others in a way that will facilitate person recognition. Rather, through the operation of implicit forces, some individuals simply turn out to be more memorable than others. But what is it that determines whether or not perceivers will recognise a person? Our intuition is that gaze direction may be one important factor that contributes to the memorability of others. As we have already noted, the most relevant social targets are usually those displaying direct gaze. Indeed, the visual system appears to be sensitised to faces displaying this gaze direction (von Grünau & Anston, 1995). Accordingly, it is possible that person recognition may be enhanced for targets displaying direct rather than averted gaze (see George et al., 2001), even when perceivers have no explicit goal to commit these individuals to memory (i.e., incidental encoding). We investigated this possibility in the two experiments reported herein.

EXPERIMENT 1

Method

Participants and design. Participants were 25 undergraduates (20 women and 5 men) from Dartmouth College who completed the experiment in return for course credit. The experiment had a single factor (gaze direction: direct or averted) repeated-measures design.

Procedure and stimulus materials. Participants arrived at the laboratory individually, were greeted by a female experimenter, and told that the study was an investigation of people's ability to classify others. The experimenter asked each participant to imagine a scenario in which he or she worked as a bouncer at a popular nightclub. As bouncer, his or her task was to determine the age of guests and to ID or "card" those who looked under 21 years of age. Participants then observed "guest" faces appear in the centre of the computer screen (Apple Macintosh I-Mac). Their task was simply to make a "card" or "no card" judgement by pressing one of two appropriately labelled keys.

The target stimuli comprised 28 male and 28 female greyscale faces, all conveying neutral facial expressions (see Figure 1). The targets were aged between 18–24 years. Of the 56 faces, 28 (14 male and 14 female) displayed averted gaze (averted left or averted right) and 28 (14 male and 14 female) displayed direct gaze. Gaze direction (direct or averted) was counterbalanced across the faces in the stimulus set. In other words, for any given stimulus, half of the participants made a

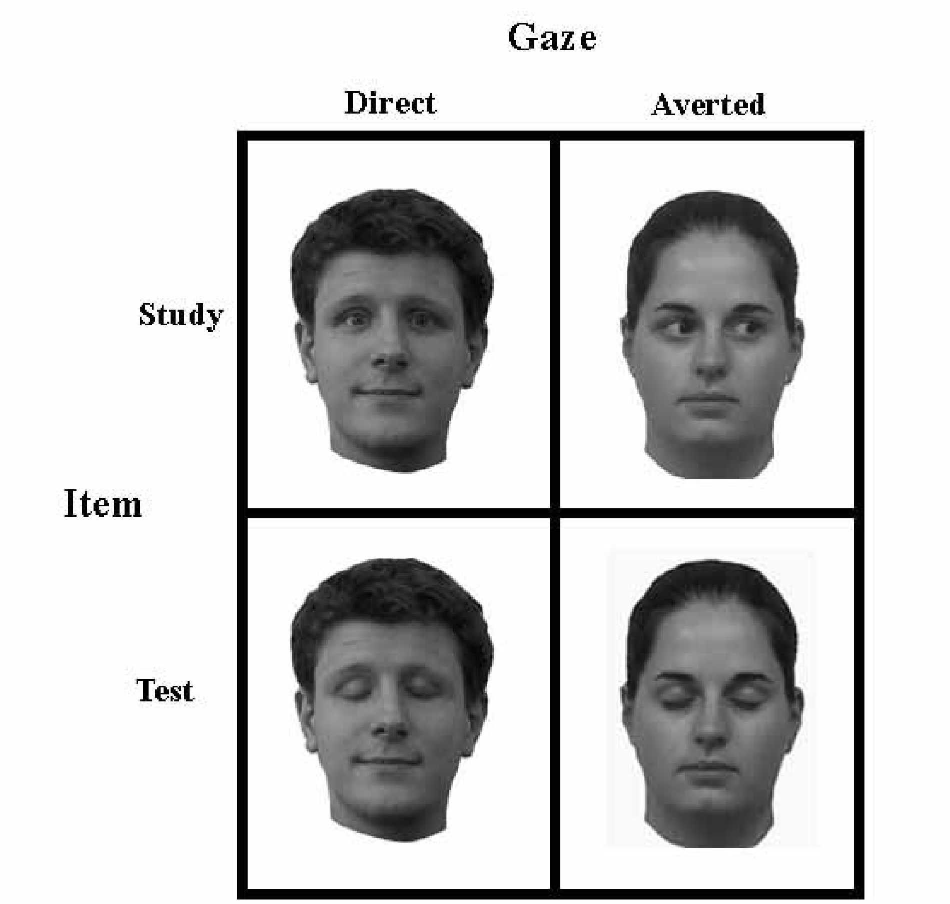

Figure 1. Example stimuli for Experiments 1 and 2.

judgement on the face presented with averted gaze and half made a judgement on the same face presented with direct gaze. This was done to ensure that any memory differences were driven by gaze direction and not by the appearance of distinctive (or non-distinctive) items in one of the gaze conditions. Each face remained on the screen for 2000 ms and the inter-trial interval was 1000 ms. The age-classification task was used to conceal the true nature of the current investigation (i.e., incidental memory for faces). No mention was made by the experimenter of gaze direction or an upcoming memory test.

Following the classification task, participants completed a 5 minute interpolated activity in which they were required to list as many countries of the world as possible on a piece of paper that was provided by the experimenter. This was immediately followed by a surprise recognition test in which 86 faces (56 targets and 30 lures) were presented in the centre of the computer screen. At test, all 86 stimuli were displayed with closed eyes. This was undertaken to ensure that face recognition and not pattern matching was investigated (Bruce, 1982) and to eliminate gaze as a retrieval cue in the recognition task. By means of a key press, participants were required to report whether each face was ‘‘old’’ (i.e., had been seen before in the previous task) or ‘‘new’’ (i.e., had not been seen before). Each face remained on the screen until a response was made. On completion of the task, participants were debriefed, thanked for their assistance, and dismissed.

Results and discussion

Following the completion of the age-classification task, it was expected that participants would show enhanced memory for persons who previously displayed direct rather than averted gaze. Analysis of the recognition scores (i.e., hits) for each gaze configuration supported this prediction. Person recognition was enhanced for targets who, during the prior classification task, displayed direct rather than averted gaze, $t(24) = 2.71$, $p < .01$ (respective *M*s: .68 vs .61; *SD*s: .12 vs .12). Participants were no more likely to recognise a face they decided to ‘‘card’’ than one they believed was of drinking age, $t(24) = 1.05$, *ns*. (*M*s: .66 vs .62; *SD*s: .13 vs .16).

Responses during the age-classification task (i.e., ‘‘card’’ or ‘‘no card’’) were not influenced by gaze direction, $t(24) < 1$, *ns* (Medians: direct = 916 ms; averted = 905 ms: *SD*s 213 ms vs 197 ms). While previous research has shown a processing advantage for targets displaying direct gaze in a sex-categorisation task (Campbell et al., 1996; Macrae et al., 2002), a comparable effect did not emerge when age was the dimension of judgement. It is probable that the difficulty of the classification task eliminated any gaze-related effects on person construal. As the targets were all aged between 18–24 years, estimating age is much more difficult than establishing sex, as evidenced by the elevated response times in the current study (cf. Macrae et al., 2002).

These findings provide preliminary support for the prediction that gaze direction moderates face memory in such a way that faces with direct gaze, relative to averted gaze, are more memorable. What remains to be determined, however, is the extent to which this enhancement generalises to faces encountered in different task contexts. It may be the case that enhanced memory for direct-gaze faces is dependent on the encoding operation that is undertaken on the face. In Experiment 1, the encoding task (i.e., age classification) demanded that participants base their judgements on the internal properties of each face. This leaves open the question of whether processing tasks that do not draw attention to facial features would also prompt effects of the sort observed in Experiment 1. For example, following a low-level stimulus detection task (e.g., where did the face appear on the screen) would participants continue to reveal a recognition advantage for targets displaying direct rather than averted gaze? To establish the generality of effects observed in Study 1, we investigated this issue in our second experiment.

EXPERIMENT 2

Method

Participants and design. Participants were 20 Dartmouth College undergraduates (8 women and 12 men) who completed the experiment in return for course credit. The experiment had a single factor (gaze direction: direct or averted) repeated-measures design.

Procedure and stimulus materials. Experiment 2 was a replication of the previous study but with an important modification. At study, rather than estimating the age of the targets, participants performed a simple spatial detection task. The stimulus materials were as in Experiment 1. Each target stimulus appeared either to the right or left of a fixation cross located in the centre of the screen. The task was to report the location of each stimulus (i.e., left or right), by means of a button press. Each item remained on the screen for 2000 ms and the inter-trial interval was 1000 ms. Gaze direction and screen location were counterbalanced across participants. Following a 5 minute filler task (report countries of the world), participants were given a surprise recognition task. On completion of the task, participants were debriefed, thanked for their assistance, and dismissed.

Results and discussion

We predicted that participants would demonstrate enhanced memory for faces that displayed direct gaze during the stimulus location task. Analysis of the recognition scores (i.e., hits) for each gaze configuration supported this prediction. Person recognition was enhanced for targets who, during the prior perceptual task, displayed direct rather than averted gaze, $t(19) = 2.32$, $p < .03$ (respective *M*s: .500 vs .443; *SD*s .158 vs .129). Analysis of performance on the location task revealed that median response times (ms) did not differ as a function of gaze direction, $t(19) < 1$, *ns* (direct = 425 ms; averted = 424 ms; *SD*s, 111 ms vs 112 ms).

GENERAL DISCUSSION

The results of the present experiments support the prediction that person recognition is enhanced when targets display direct rather than averted gaze (George et al., 2001). Interestingly, this recognition advantage emerges when perceivers have no explicit goal to commit the targets to memory and the effect persists under different incidental encoding conditions (i.e., Expt 1—conceptual; Expt 2—perceptual). These findings are noteworthy as they extend recent investigations into the effects of gaze direction on the efficiency of social-cognitive functioning (Campbell et al., 1996; Macrae et al., 2002). Not only does direct gaze facilitate person construal, but, as demonstrated herein, it also increases the memorability of stimulus targets. But why does this recognition advantage emerge? What is it about direct gaze that enhances the memorability of others?

The demonstration that encoding is optimised under conditions of direct gaze is consistent with a recent model of social attention. According to Baron-Cohen (1995), detecting the presence of eyes and determining where they are looking is one of the primary objectives of the social brain (Brothers, 1990). In the present experiment, direct gaze may therefore have activated mutual gaze detectors, hence triggering elaborate encoding of the associated faces. In turn, this enhanced encoding would have facilitated subsequent recognition performance. Although mutual gaze contact was not established in the present investigation, previous work has demonstrated the attention-grabbing property of direct gaze (von Grünau & Anston, 1995). Given this finding, it is possible that effects of this kind are arousal based (Nichols & Champness, 1971), with attentional mechanisms (triggered via direct gaze) shaping the generation of people's social-cognitive products (e.g., judgements, memories). Direct gaze is known to activate neural circuits that are associated with the task of evaluating the social relevance of stimuli. Recent functional neuroimaging investigations of gaze detection have shown increased levels of activity in the STS and amydala when participants view faces displaying direct gaze (George et al., 2001; Haxby et al., 2000; Kawashima et al., 1999; Langton et al., 2000). One possibility is that the stronger activation that is observed for faces with direct gaze may reflect the elaborate encoding operations that are undertaken on these items because of the social significance of this gaze configuration (Argyle & Cook, 1976; Baron-Cohen, 1995). Echoing this viewpoint, George et al. recently suggested that, "it would be interesting to supplement … MRI findings with behavioral measures of face recognition as a function of gaze direction at initial exposure" (2001, p. 1107). The present experiment comprised just such an investigation and revealed the anticipated effect—person recognition was enhanced when targets displayed direct gaze at encoding.

It is worth noting that an alternative explanation can potentially be offered for the present results. Investigations of visual orienting have demonstrated obligatory shifts of attention when the eyes are laterally averted (Driver et al., 1999; Friesen & Kingstone, 1998). Thus, it is possible that participants in the present experiments were unable to process these faces efficiently as their attention was temporarily directed elsewhere. We think this is unlikely for a number of reasons. First, obligatory shifts in visual attention are typically confined to the first 200 ms of a processing episode (Friesen, Ristic, & Kingstone, in press). In the present paradigm, however, the faces remained on the screen for 2000 ms, thereby giving participants ample time to process the stimuli. Second, performance on the age classification and stimulus location tasks were not influenced by gaze direction, thereby suggesting that covert shifts of attention were unlikely to be driving the effects observed for faces displaying averted eye gaze (see also Macrae et al., 2002).

Understanding the language of eyes is an ability that lies at the heart of human social cognition (Baron-Cohen, 1994, 1995). By discerning the potential behavioural intentions of others, perceivers gain a critical edge in dealing with the intricacies of everyday social interaction (Emery, 2000). Reflecting the importance of gaze cues in social cognition, work is now beginning to chart how gaze direction may influence basic aspects of the person-perception process. Not only has this research documented the effects of eye gaze on person construal and the accessibility of categorical knowledge (Macrae et al., 2002), but it has also shown that gaze direction influences people's evaluations of others. Kampe et al. (2001), for example, recently reported that estimates of attractiveness are moderated by a person's direction of gaze. In an imaging study, direct gaze was shown to modulate the effect of attractive faces on the ventral striatum, a brain region linked with the prediction of reward. Thus, making eye contact would appear to enhance the appeal of an attractive face, via the rewards associated with establishing a connection with a desirable person. Building on work of this kind, one task for future research will be to clarify exactly how, why, and when gaze direction impacts on social-cognitive functioning and its related behavioural products. At least where person recognition is concerned however, the implications of the present findings are unambiguous. If someone is looking in your direction, you are likely to remember them.

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REFERENCES

Allison, T., Puce, A., & McCarthy, G. (2000). Social perception from visual cues: Role of the STS region. *Trends in Cognitive Science*, *4*, 267–278.

Argyle, M., & Cook, M. (1976). *Gaze and mutual gaze*. Cambridge: Cambridge University Press.

Baron-Cohen, S. (1994). How to build a baby that reads minds: Cognitive mechanisms in mindreading. *Cahiers de Psychologie Cognitive*, *13*, 513–552.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Cambridge, MA: MIT Press.

Brothers, L. (1990). The social brain: A project for integrating primate behavior and neurophysiology in a new domain. *Concepts in Neuroscience*, *1*, 27–51.

Bruce, C., Desimone, R., & Gross, C. (1981). Visual properties of neurons in a polysensory area in superior temporal sulcus of the macaque. *Journal of Neurophysiology*, *46*, 369–384.

Bruce, V. (1982). Changing faces: visual and non-visual coding processes in face recognition. *British Journal of Psychology*, *73*, 105–116.

Campbell, R., Wallace, S., & Benson, P. J. (1996). Real men don't look down: Direction of gaze affects sex decisions on faces. *Visual Cognition*, *3*, 393–412.

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

Emery, N. J. (2000). The eyes have it: The neuroethology, function and evolution of social gaze. *Neuroscience and Biobehavioral Reviews*, *24*, 581–604.

Farroni, T., Johnson, M. H., Brockbank, M., & Simon, F. (2000). Infants' use of gaze direction to cue attention: The importance of perceived motion. *Visual Cognition*, *7*, 705–718.

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

Friesen, C. H., Ristic, J., & Kingstone, A. (in press). Reflexive and volitional orienting to directional cues: Separable attentional effects unique to biologically relevant gaze stimuli. *Journal of Experimental Psychology: Human Perception and Performance*.

George, N., Driver, J., & Dolan, R. J. (2001). Seen gaze-direction modulates fusiform activity and its coupling with other brain areas during face processing. *NeuroImage*, *13*, 1102–1112.

Haxby, J. V., Hoffman, E. A., & Gobbini, M. I. (2000). The distributed human neural system for face perception. *Trends in Cognitive Science*, *4*, 223–233.

Hoffman, E. A., & Haxby, J. V. (2000). Distinct representations of eye gaze and identity in the distributed human neural system for face processing. *Nature Neuroscience*, *3*, 80–84.

Hood, B. M., Willen, J. D., & Driver, J. (1998). Adult's eyes trigger shifts of visual attention in human infants. *Psychological Science*, *9*, 131–134.

Kampe, K. K. W., Frith, C. D., Dolan, R. J., & Frith, U. (2001). Reward value of attractiveness and gaze. *Nature*, *413*, 589.

Kawashima, R., Sugiura, M., Kato, T., Nakamura, A., Hatano, K., Ito, K. et al. (1999). The human amygdala plays an important role in gaze monitoring: A PET study. *Brain*, *122*, 779–783.

Langton, S. R. H., Watt, R. J., & Bruce, V. (2000). Do the eyes have it? Cues to the direction of social attention. *Trends in Cognitive Sciences*, *4*, 50–59.

Macrae, C. N., & Bodenhausen, G. V. (2000). Social cognition: Thinking categorically about others. *Annual Review of Psychology*, *51*, 93–120.

Macrae, C. N., Hood, B. M., Milne, A. B., Rowe, A. C., & Mason, M. F. (2002). Are you looking at me? Eye gaze and person perception. *Psychological Science*, *13*, 460–464.

Morton, J., & Johnson, M. (1991). CONSPEC and CONLEARN: A two-process theory of infant face recognition. *Psychological Review*, *98*, 164–181.

Nichols, K., & Champness, B. (1971). Eye gaze and the GSR. *Journal of Experimental Social Psychology*, *7*, 623–626.

Perrett, D. I., & Emery, N. J. (1994). Understanding the intentions of others from visual signals: Neuropsychological evidence. *Cahiers de Psychologie Cognitive*, *13*, 683–694.

Perrett, D. I., Hietanen, J. K., Oram, M. W., & Benson, P. J. (1992). Organization and functions of cells responsive to faces in temporal cortex. *Philosophical Transactions of the Royal Society of London: Biological Science*, *335*, 23–30.

Perrett, D. I., Rolls, E., & Cann, W. (1982). Visual neurones responsive to faces in the monkey temporal cortex. *Experimental Brain Research*, *47*, 329–342.

Phillips, W., Baron-Cohen, S. & Rutter, M. (1992). The role of eye contact in goal detection: Evidence from infants and children with autism or mental handicap. *Development and Psychopathology*, *4*, 375–383.

Vecera, S., & Johnson, M. (1995). Gaze detection and the cortical processing of faces: Evidence from infants and adults. *Visual Cognition*, *2*, 59–87.

von Grünau, M., & Anston, C. (1995). The detection of gaze direction: A stare-in-the-crowd effect. *Perception*, *24*, 1297–1313.