Age-Related Differences in Gaze Following: Does the Age of the Face Matter?

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Previous research revealed age differences in following the gaze of others. To date, however, investigations have concentrated on only young faces as target stimuli. The present study explored whether varying the age of target stimuli moderated gaze following in younger and older adults. Overall, older participants showed less evidence of gaze following, but this was qualified by the age of the face viewed. Younger participants showed an own-age bias, following the gaze cues of stimuli depicting those in their own age range to a greater extent than stimuli depicting older adults. However, a similar own-age effect was not found for older participants. These findings suggest that age differences in gaze following may be driven by younger participants having an advantage for processing the gaze cues from the faces of younger adults, highlighting the importance of varying the age of the target stimuli when assessing age differences in some aspects of social perception.

Key Words: Aging—Gaze following—Own-age bias—Social cognition.

GAZE following refers to the ability to detect where someone else is looking in the social environment and also attend to that same stimulus. This is the main way of establishing joint attention with others (Driver et al., 1999). Gaze following allows the rapid detection of socially relevant information in the environment and is thus important for guiding social interactions and communication (Langton, Watt, & Bruce, 2000). At approximately 6 months of age, infants begin to develop the ability to follow the gaze of others, orienting their attention to objects at which others are looking (Morales, Mundy, & Rojas, 1998). Demonstrating the importance of this ability, it has been found that children with superior gaze-following ability have larger vocabularies and better communication skills (Charman, 2003; Morales et al.).

Research using gaze-cueing paradigms has found that younger adults successfully follow the gaze of others, showing a reliable gaze-congruity effect (i.e., responding more quickly to targets that are predicted by gaze direction compared with those that are incongruent with gaze cues; Driver et al., 1999). Several factors can influence younger adults' gaze processing ability, including, under certain conditions, the identity of the individual cueing participants. For example, gaze-congruity effects were stronger for young female participants who were familiar with the individuals cueing them (i.e., they worked in the same department) than those who were not (Deaner, Shepherd, & Platt, 2007).

Slessor, Phillips, and Bull (2008) investigated adult age-related differences in the ability to follow the gaze of others, finding evidence that older adults showed less of an advantage for congruent gaze trials than younger adults. This means that older adults were less likely than their younger counterparts to follow gaze cues and thus engage in joint attention with others. Given the findings that difficulties in

establishing joint attention may be associated with interpersonal difficulties such as poor social communication and interaction skills (Charman, 2003; Mundy, Sigman, & Kasari, 1990; Sigman & Ruskin, 1999; Stone & Yoder, 2001), it is important to further investigate age differences in gaze following as this may contribute to findings of socially inappropriate behavior in old age (e.g., making inappropriate comments and engaging in extended speech; Henry, von Hippel, & Baynes, 2009). However, similar to most other studies of social cognition in old age, Slessor and colleagues used only young faces as stimuli. To date, research has not investigated whether the age of face stimuli influences gaze-cueing effects in younger and older adults.

Evidence suggests that the age of a face may be an important factor in determining older and younger adults' processing of some types of facial information. For example, studies of recognition memory have often found interactions between the age of the participant and age of the face stimuli employed (Anastasi & Rhodes 2005, 2006; Fulton & Bartlett, 1991; Lamont, Stewart-Williams, & Podd, 2005; Perfect & Harris, 2003; Wright & Stroud, 2002). However, the exact nature of this effect is debated. Some studies have found that both age groups are better at recognizing individuals of their own age (Anastasi & Rhodes 2005; Backman, 1991; Perfect & Moon, 2005; Wright & Stroud), whereas others have found that only younger (Bartlett & Leslie, 1986; Fulton & Bartlett; Mason, 1986; Wiese, Schweinberger, & Hansen, 2008) or only older (Anastasi & Rhodes, 2006; Lamont et al.) adults show this own-age effect. These findings suggest that younger and older adults may be more likely to attend to, process, and remember the faces and facial features of those of their own age than those from another age group. Therefore, it is argued that older participants may be at a disadvantage when completing tasks in which stimuli of only younger adults are used.

Recently Ebner and Johnson (2009) assessed age-related differences in the ability to recognize angry, happy, and neutral expressions of emotion when varying the age of the stimuli. Both younger and older participants were better at recognizing angry and neutral expressions when displayed by younger (vs. older) actors; this may reflect changing physiognomy with age, making it more difficult to process some aspects of facial features. Facial features change throughout the aging process (Bruce & Young, 1998). Of particular importance to gaze processing, wrinkling around the corners of the eyes increases with age, whereas the eyelids and tissue surrounding the eyes drop, resulting in the eyes appearing smaller. Such changes could influence age-related differences in gaze processing. For example, if individuals are better at or are more motivated toward encoding and processing faces of their own age group, such changes may influence the extent to which younger and older adults follow gaze cues of those of different ages.

Following on from the findings of Slessor and colleagues (2008), the current study assessed the possible role of own-age effects in adult age differences in processing social cues (e.g., gaze) from faces. In the present study, we investigated whether age differences in gaze following were influenced by the age of the face presented. Using a similar task to that reported by Slessor and colleagues, younger and older adults completed a task in which the gaze of a face cue was either congruent or incongruent with the position of a target to which they subsequently responded. Consistent with the majority of previous research, gaze following was indicated by a longer time to respond to incongruent compared with congruent gaze (see Frischen, Bayliss, & Tipper, 2007 for a review). The major aim of this study was to manipulate the age of the face used as the gaze-following cue and to investigate whether the age of the face influenced the strength of the gaze-congruity effect in younger and older adults. Given the findings from the face recognition memory literature suggesting that the age of the face stimulus may influence how younger and older participants' attend to, encode, or remember faces (Anastasi & Rhodes 2005, 2006; Fulton & Bartlett, 1991; Lamont et al., 2005; Perfect & Harris, 2003; Wright & Stroud, 2002), it is predicted that there will be evidence of an own-age bias in gaze following. More specifically, it is hypothesized that younger and older participants will show a stronger gaze-congruity effect when following the gaze of those of their own age.

METHOD

Participants

Two groups of participants were recruited: 30 young adults (23 women) ranging in age from 17 to 41 years ($M = 20.09$, $SD = 5.60$), the majority being first year psychology students from the University of Aberdeen who completed the study for course credit, and 29 older adults (21 women)

ranging in age from 65 to 81 years ($M = 73.59$, $SD = 4.70$), who were compensated £10 for their time and travel expenses. Older participants were recruited through the local participant panel, which has been developed at the University of Aberdeen by recruiting individuals from local community groups and by word of mouth. All participants had good command of the English language and reported being free from past or present neuropsychological disorders. Both younger and older participants had normal or corrected to normal vision and those who were required to wear glasses did so. Visual contrast sensitivity was assessed using the Pelli Robson Contrast Sensitivity Test (Pelli, Robson, & Wilkins, 1988), with all participants performing within the normal range. No age differences were found in years of education, $t(57) = 1.56$, $p = .12$ (young $M = 13.43$, $SD = 1.29$ and old $M = 12.53$, $SD = 2.74$). All older adults achieved a score greater than 24, the cutoff point recommended by Chayer (2002), on the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975).

Stimuli and Procedure

Colored photographs (12×9cm) of the faces of 15 younger adults (8 women and 7 men) and 15 older adults (8 women and 7 men) all displaying neutral expressions were used. These images were taken from a face image database created in 2008 at the University of Plymouth. The younger adults photographed were students at the University of Plymouth, aged between 18 and 25 years, whereas the older adults were from local residential homes and were all between the ages of 60 and 88 years. Similar to Slessor and colleagues (2008), gaze direction of these images was manipulated using Adobe Photoshop, creating face images with gaze-averted 16 pixels (0.2° from direct gaze, which was 1.5° from the center of the screen) to the left or right.

The gaze-cueing task was based on a previous study investigating gaze following in younger adults (Bayliss & Tipper, 2006). It consisted of 360 trials in total, with each of the 30 faces being presented 12 times. In 180 trials (90 with young face cues and 90 with older face cues), gaze direction was congruent with the subsequent position of the target. In the remaining 180 trials (90 with young face cues and 90 with older face cues), gaze direction of the face was incongruent with the subsequent target location. These trials were split into six blocks of 60 trials with breaks in between each block. Each trial began with a central fixation cross, which remained on the screen for 600 ms. Participants were asked to focus on the fixation cross and hold their attention in that location until the target appeared, returning their gaze to the fixation cross after making their response. A face with direct gaze then appeared in the center of the screen for 1,500 ms, and following this, the eyes of the face cue immediately averted to either the left or the right. After 500 ms, the target (an asterisk of approximately 1×1cm) appeared to either the left or the right of the face image. The face cue

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Table 1. Mean Reaction Times (ms) and Standard Deviations for Younger and Older Participant's Responses to Congruent and Incongruent Trials Broken Down by Age of Stimulus

| | Younger adult gaze cues | | | | Older adult gaze cues | | | |
| | Congruent | | Incongruent | | Congruent | | Incongruent | |
Age of participant	M	SD	M	SD	M	SD	M	SD
Young	327.55	66.01	347.50	69.81	333.16	65.23	345.16	67.68
Older	533.91	146.27	542.64	152.99	534.26	149.88	547.45	156.59

and target remained on the screen until a response was made.

Participants sat approximately 45 cm from the computer screen and were told to respond to the location of the target as quickly and accurately as possible, indicating their decision with a key press. Cue direction, target position, and face cue occurred equally often and were presented in a random order. However, due to a technical error, three congruent and three incongruent trials had to be removed from the young face cue condition.

Data Reduction.—Frequency of errors in each condition in the gaze-following task was less than 2%. One younger female participant was excluded from subsequent analyses for having error rates of greater than 10% in one condition. As error rates were low, correct reaction times (RTs) to congruent and incongruent trials were the main dependent variables. Median response times for the correct trials in each condition were calculated individually for each participant. Similar to Slessor and colleagues (2008), each person's data were then transformed to reciprocals in order to reduce the influence of outliers and produce a more normal distribution of scores (Howell, 2006). Note that although analyses were carried out on these reciprocal RTs, descriptive statistics of performance (later) are reported in terms of the raw mean RTs.

RESULTS

The descriptive statistics for the performance of both age groups in the gaze-cueing task, by the age of the stimulus cue, can be seen in Table 1. To test for age differences in performance on the gaze-cueing task, a mixed design analysis of variance (ANOVA) was conducted with two within-subjects factors: age of stimulus (young and old) and cue congruity (congruent vs. incongruent). Age of participant (young vs. old) was the between-subjects factor. This analysis revealed a significant main effect of cue congruity, $F(1, 56) = 24.49$, $p < .001$, $\eta_p^2 = .30$. Both younger, $t(28) = 4.32$, $p < .001$, and older participants, $t(28) = 2.43$, $p < .05$, responded significantly faster to congruent (vs. incongruent) trials. A significant main effect of age of participant was also found, $F(1, 56) = 96.05$, $p < .001$, $\eta_p^2 = .63$, with older adults responding more slowly overall. There was also a significant Age of Participant × Cue Congruity inter-

action, $F(1, 56) = 7.891$, $p < .01$, $\eta_p^2 = .12$, with the strength of congruity effect (RT difference between congruent and incongruent trials) being significantly smaller in older adults ($M = 10.96$) compared with the congruity effect shown by younger adults ($M = 15.97$). This was qualified by a significant Age of Participant × Cue Congruity × Age of Stimulus interaction, $F(1, 56) = 7.62$, $p < .01$, $\eta_p^2 = .12$, indicating that age differences in the congruity effect were influenced by the age of the stimulus-cueing participants. This interaction is explored in further detail later. No other main effects and two-way interactions were significant, age of stimulus, $F(1, 56) = 2.11$, $p = .15$, $\eta_p^2 = .04$; Age of Stimulus × Age of Participant, $F(1, 56) = .69$, $p = .41$, $\eta_p^2 = .01$ and Age of Stimulus × Cue Congruity, $F(1, 56) = 2.66$, $p = .11$, $\eta_p^2 = .05$.

To explore the Age of Participant × Cue Congruity × Age of Stimulus interaction in more detail, we looked at own-age effects: that is, whether younger and older adults' cue congruity effects were stronger when following the gaze cues of stimuli depicting those in their own age range. Two repeated measures ANOVAs were conducted, one for each age group, varying cue congruity and age of face as within-subjects factors. For younger participants, this analysis revealed that there was a significant main effect of congruity, $F(1, 28) = 18.64$, $p < .001$, $\eta_p^2 = .40$, but no main effect of age of face, $F(1, 28) = 1.74$, $p = .20$, $\eta_p^2 = .06$. However, a significant interaction between age of face and cue congruity was found, $F(1, 28) = 7.04$, $p < .05$, $\eta_p^2 = .20$, with younger participants showing a stronger cue congruity effect for the gaze of younger ($M = 19.95$) compared with older ($M = 12.00$) adult stimuli.

Analysis of older participant's responses found that there was a significant main effect of cue congruity, $F(1, 28) = 5.93$, $p < .05$, $\eta_p^2 = .18$. However, there was no significant main effect of age of face, $F(1, 28) = .39$, $p = .54$, $\eta_p^2 = .01$, or interaction between age of face and cue congruity, $F(1, 28) = 1.01$, $p = .32$, $\eta_p^2 = .04$. Therefore, the strength of the cue congruity effects found in older adults did not significantly differ dependent on the age of the face stimulus (see Table 1).

DISCUSSION

The present study investigated whether there was an own-age effect in relation to age differences in gaze following.

Consistent with the findings of Slessor and colleagues (2008), the ability to follow the gaze cues of others was influenced by age, with older adults showing less evidence of gaze following. However, the age of the face cue influenced age-related differences in gaze following. Further analysis to investigate the issue of own-age biases in gaze following revealed that the strength of the gaze congruity effects shown by younger participants differed significantly depending on the age of the face stimulus, with a significantly greater congruity effect found when following the gaze cues of individuals in their own age. These results suggest that younger participants show an own-age effect when following the gaze cues of others and are consistent with the findings of an own-age bias in younger adults' recognition memory for faces (Bartlett & Leslie, 1986; Fulton & Bartlett, 1991; Mason, 1986; Wiese et al., 2008). However, the strength of older participants' cue congruity effect was not significantly influenced by the age of the target face, suggesting that they did not demonstrate an own-age bias in gaze following. Taken together, these findings indicate that age differences found in gaze following are influenced by younger participants having an advantage for processing gaze cues presented in younger adult faces. Therefore, the findings of Slessor and colleagues could be attributable to the use of only younger adult stimuli, which benefits the young participants. These results highlight the importance of including both younger and older adult stimuli in order to fully understand the pattern of age effects on gaze-following ability.

There are a number of potential explanations for the finding that younger, but not older, participants show an own-age effect in gaze following. First, younger adults may find it easier to follow the gaze cues of those of a similar age range to themselves as they are more familiar with the faces, and thus facial features, of younger adults due to greater experience of interacting with and encountering people in this age group (Anastasi & Rhodes, 2005). This suggestion is supported by the findings that younger adults rate novel faces of their own age as more familiar than other-age faces (Bartlett & Fulton, 1991) and report having more contact with younger than with older adults (Ebner & Johnson, 2009). It is also consistent with the findings of Deaner and colleagues (2007) that familiarity influenced younger females' gaze-following ability, with those females who were more familiar with the individuals cueing them showing greater gaze congruity effects. However, it has been argued that in comparison with younger participants, who throughout their life have mainly encountered individuals of their own age, older adults may have greater experience of interacting with people of different age ranges. For example, they have encountered younger adults in the past when they themselves were young and also have more recent experience of interacting with other older adults (Wiese et al., 2008). In addition, many older participants have regular contact with a number of people of varying ages (e.g., children, grandchildren,

etc.), whereas younger participants have more limited contact with older adults (Ebner & Johnson). Although amount of contact with same and other age counterparts was not assessed in the current study, all older adults lived independently in the local community, and thus, contact with people of varying age ranges would be less restricted than if they were living in retirement communities. Wiese and colleagues argued that this may weaken the own-age effect for older adults.

Alternatively, the finding of an own-age effect in younger adults' gaze-following behavior could be due to motivational factors. For example, younger adults may choose to process only the gaze cues of those of their own age as these are more salient and relevant to them (Ebner & Johnson, 2009). According to the in-group/out-group model in social cognition, when perceivers first see a face, they make a judgment about whether it belongs to an in-group or an out-group, and this then dictates their processing strategy (Sporer, 2001). Younger adults may view other individuals of their own age as part of their in-group and therefore engage in automatic configural processing of these faces. In contrast, they first categorize stimuli of older adults as being in their out-group and then engage in less detailed processing of these faces. Indeed, it has been found that younger adults strongly associate older adults as being part of their out-group (Chasteen, 2005). However, this effect is weakened in older adults as they are more likely to classify members from both age groups as belonging to their in-group. According to Chasteen, this effect may be attributable to the increased familiarity and contact that older adults have with people of various ages. Future research is required to evaluate these different accounts of the interaction between age of participant and age of stimulus in gaze following. In particular, research should assess the contact that younger and older adults' have with others in varying age groups and investigate whether this is linked to an own-age bias in gaze following.

The current study was limited as the majority of younger and older participants were women. It is unlikely that this would have accounted for the age differences found, as approximately the same proportion of women were recruited in each age group. However, previous findings from the recognition memory literature indicate evidence of an own-gender bias, with participants showing better recognition for faces of those of the same gender as themselves (Wright & Sladden, 2003). Therefore, in addition to further investigating own-age biases in gaze following, it would also be interesting to assess whether younger and older adults show an own-gender effect in relation to gaze cueing.

Given the importance of gaze following for effective social functioning and communication (Langton et al., 2000; Mundy et al., 1990; Sigman & Ruskin, 1999; Stone & Yoder, 2001), the findings that younger adults show an own-age bias in gaze following could have negative consequences for intergenerational interactions. For example, lack of gaze following could mean that older and younger adults are less

able to communicate effectively with each other and may be a contributing factor to poor-quality interactions between people of different generations. Indeed, younger adults report finding it more problematic to interact with older adults compared with communicating with their own peers. They perceive intergenerational interactions more negatively than intragenerational communications, rating interactions with other-age partners as being of a lower quality and less satisfying (Giles, Makoni, & Dailey, 2005; Giles et al., 2003). Consequently, younger adults often report avoiding communication and interactions with older adults (McCann, Ota, Giles, & Caraker, 2003; Ota, Giles, & Somera, 2007). This could contribute to feelings of social isolation and loneliness in old age (Wenger, Davies, Shahtahmasebi, & Scott, 1996). It is important in further studies to directly investigate the implications that age-related differences in following the gaze of younger and older adults have for intergenerational communication.

The results of the present study also highlight the importance of considering the age of the stimulus when assessing age-related differences in social cognition, particularly when processing social cues from faces. Future research should attempt to more closely match age of the stimulus and age of the participant, including stimuli of older as well as younger adults, when assessing age differences in other aspects of social cue decoding, such as gaze detection.

In summary, age differences were found in the ability to follow the gaze cues of others, but these were influenced by the age of the target stimulus. Further analyses revealed that younger, but not older, participants demonstrated an own-age bias in gaze following, showing a stronger gaze-congruity effect for people of their own age. Therefore, age differences found in gaze following may be driven by younger adults having an advantage for following the gaze cues of people of their own-age range. The finding that younger adults have an own-age bias in gaze following may reflect their attempts to avoid communicating with older people and thus contribute to poor-quality intergenerational interactions. These results highlight the importance of systematically varying the age of the stimulus employed when assessing age-related differences in social cognition.

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