Emotion
2010, Vol. 10, No. 4, 555–562

1528-3542/10/$12.00 DOI: 10.1037/a0019152

Age-Related Changes in the Integration of Gaze Direction and Facial Expressions of Emotion

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Gaze direction influences younger adults' perception of emotional expressions, with direct gaze enhancing the perception of anger and joy, while averted gaze enhances the perception of fear. Age-related declines in emotion recognition and eye-gaze processing have been reported, indicating that there may be age-related changes in the ability to integrate these facial cues. As there is evidence of a positivity bias with age, age-related difficulties integrating these cues may be greatest for negative emotions. The present research investigated age differences in the extent to which gaze direction influenced explicit perception (e.g., anger, fear and joy; Study 1) and social judgments (e.g., of approachability; Study 2) of emotion faces. Gaze direction did not influence the perception of fear in either age group. In both studies, age differences were found in the extent to which gaze direction influenced judgments of angry and joyful faces, with older adults showing less integration of gaze and emotion cues than younger adults. Age differences were greatest when interpreting angry expressions. Implications of these findings for older adults' social functioning are discussed.

Keywords: eye-gaze, emotion, aging, positivity bias, social perception

Aging research has increasingly focused on investigating age-related changes in social cue decoding. In particular age-related declines have been found in the ability to interpret the mental states of others (Slessor, Phillips, & Bull, 2007), and emotion recognition (see Issacowitz et al., 2007 and Ruffman, Henry, Livingstone, & Phillips, 2008, for a review). Recently age-related impairments have also been found in the ability to interpret basic social cues such as eye-gaze perception and gaze following (Slessor, Phillips, & Bull, 2008). However, to date, research has not investigated older adults' ability to integrate different social cues such as emotion and eye-gaze direction. The meaning of facial expressions of emotion can vary depending on whether they are directed toward or away from the perceiver (Adams & Kleck, 2003). For example, if an angry individual is looking directly at the perceiver, this suggests that the perceiver is the target of that anger and thus poses a greater threat than an angry individual with averted gaze. Therefore the ability to combine these facial cues (gaze and emotional expression) may play an important role in conveying the social meaning of emotional facial expressions.

Evidence from studies assessing the emotion perception of younger adults has suggested that direction of eye-gaze (direct vs. averted) has an important influence on the way that emotions are perceived in faces (Adams, Gordon, Baird, Ambady, & Kleck, 2003; Adams & Kleck, 2003, 2005; Conway et al., 2007; Sander, Grandjean, Kaiser, Wehrle, & Scherer, 2007). Adams and Kleck (2003) were the first to investigate the influence of gaze direction on younger adults' emotion perception. They found that participants recognized angry and happy faces more quickly when presented with direct (vs. averted) gaze, whereas fearful and sad faces were more quickly identified when presented with averted (vs. direct) gaze. In a further experiment eye-gaze direction was also found to affect the perceived emotional intensity of faces (Adams & Kleck, 2005; experiment three) with emotion faces coupled with direct gaze being rated as more intensely angry and joyful than those with averted gaze. In contrast averted gaze enhanced the perceived intensity of fear and sadness. Adams and Kleck (2003, 2005) interpreted these results in terms of the shared signal hypothesis. They argued that both emotional expression and eye-gaze direction signal that someone intends to approach or avoid the perceiver, and approach-orientated emotions (e.g., anger and joy) are associated with direct gaze whereas avoidance-orientated emotions (e.g., fear and sadness) tend to be expressed with averted gaze. According to the shared signal hypothesis, when eye-gaze direction corresponds with intent to approach or avoid conveyed by a specific emotion, perception of that emotion is enhanced (Adams & Kleck, 2005).

Subsequently, using dynamic schematic faces, Sander et al. (2007) replicated Adams and Kleck's (2003, 2005) findings with respect to angry and fearful facial expressions. However gaze direction was not found to influence the perception of joyful faces. According to Sander et al. (2007) angry faces with direct gaze are perceived to be more intense as they indicate possible confrontation, whereas fearful faces with averted gaze are more relevant to the perceiver as they signal the presence of danger in the immediate environment. Conway et al. (2007) also found that averted gaze enhanced younger females' perception of fearful expressions but only when their progesterone levels were raised, which arguably increases sensitivity to threat. However, not all studies repli-

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This research was supported by the Carnegie Trust.

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cate the finding of effects of gaze direction on interpreting fearful expressions. For example, Bindemann, Burton, and Langton (2008) found that younger adult's perception of fearful faces was impaired when coupled with averted (vs. direct) gaze.

To date, all studies investigating the emotion perception of older adults have employed emotion faces with direct gaze (i.e., looking straight at the perceiver). The majority of these studies have found evidence of age-related impairments in emotion recognition (see Ruffman et al., 2008 for a review), predominantly when recognizing facial expressions of anger, fear, and sadness. Age-related declines have also been found in the ability to interpret information about eye-gaze direction (Slessor et al., 2008). It is unknown whether there are age differences in interpreting the interaction between gaze and emotion. However, given that older adults have difficulties interpreting facial expressions of emotion and gaze direction they may find successfully integrating these cues more demanding than younger adults. This should result in smaller effects of gaze direction on interpretation of all emotions among older adults as compared to their younger counterparts.

However age-related changes in the ability to integrate expression and gaze might be particularly evident for negative and threatening emotional expressions (e.g., anger and fear), as opposed to positive emotional expressions such as joy. According to the Socioemotional Selectivity Theory (SST) older adults have a positivity bias (Mather & Carstensen, 2005; Carstensen, Mikels, & Mather, 2006). They endeavor to avoid negative information and events, evaluating them more positively and focusing on events that make them feel emotionally satisfied (Carstensen, Fung, & Charles, 2003). This may be reflected in their emotion perception, as older adults are less efficient at attending to and recognizing negative facial expressions of emotion (see Ruffman et al., 2008 for a review). Older adults have also been found to make fewer fixations to the eye region of faces when making emotion recognition judgments, predominantly when viewing certain negative emotions (e.g., fear, anger and sadness; Sullivan, Ruffman, & Hutton, 2007; Wong, Cronin-Golomb, & Neargarder, 2005). This inattention to the eye region of negative facial expressions may reduce efficiency in processing other information from eyes, such as gaze direction. If age differences in positivity bias influence integration between emotion and eye gaze cues, age-related declines in integrating these cues should be greatest for negative emotions.

Study 1

Study 1 investigated whether there were age differences in the extent to which gaze direction affected the perceived intensity of emotion faces. A paired face paradigm was employed in which two emotion faces that differed only in gaze direction (averted vs. direct) were presented to younger and older adults, who had to decide which face was most intensely emotional. Both members of each face pair expressed either a positive (joy) or negative (anger or fear) emotion. These three emotions were included as they have been most frequently used in previous studies (Adams et al., 2003; Adams & Kleck, 2003, 2005; Conway et al., 2007; Sander et al., 2007). In accordance with previous research expressions at two levels of emotional intensity (50% and 100%) were included. We also investigated whether general age differences in sensitivity to gaze cue are found when interpreting all emotional expressions, or instead whether age differences are greater for negative, threatening expressions (anger and fear) compared to positive expressions.

Method

Participants

Two groups of participants were recruited: 43 young adults (35 female) age 18 to 37 years ($M = 20.84$, $SD = 4.43$), the majority being students who completed the study for course credit, and 39 older adults (30 female) aged between 65 to 81 years ($M = 72.56$, $SD = 5.25$), recruited through the local participant panel and reimbursed for their time. All had good command of the English language and were free from past or present neuropsychological disorders. The groups did not differ in their years of education, $t(80) = 1.29$ (young $M = 13.95$, $SD = 2.12$; old $M = 13.23$, $SD = 2.93$). All older adults achieved a score greater than 24, the cut off point recommended by Chayer (2002) on the Mini Mental State Exam (Folstein, Folstein, & McHugh, 1975).

Stimuli and Procedure

Two female and two male identities from the Facial Expressions of Emotions: Stimuli and Test (FEEST; Young, Perrett, Calder, Sprengelmeyer, & Ekman, 2002) were selected. Images of each expressing three emotions (anger, fear, and joy) at two levels of emotional intensity (50% or 100%) were chosen. Face pairs were created using these stimuli (see Figure 1). Within each face pair both images were of the same identity, displaying the same emotional expression at the same level of emotional intensity. The only difference between the face images in each pair was the direction of gaze, as one face had direct gaze whereas the other face had gaze averted either to the left or the right. Gaze direction was manipulated using Adobe Photoshop.

Forty-eight face pairs (16 for each emotion) were presented to participants in a fixed randomized order. Each pair of faces was presented simultaneously side-by-side on a computer screen (each face was approximately 8 cm $\times$ 10 cm). Direction of gaze (right or left) was counterbalanced for each face with averted gaze, as was the location of the image with averted gaze. Prior to the presentation of each face pair participants were asked a question (e.g., which face is more angry?) which indicated the emotion that was to be displayed in the subsequent faces. Participants were told that they would see two photographs of the same person on the screen and had to indicate in which photograph they thought the person looked more emotionally intense. Prior to each block participants received six practice trials. The dependent variable was the percentage of trials in which participants chose the direct gaze face as being more emotionally intense.

Results

The mean percentage with which younger and older adults chose faces with direct gaze as being more emotionally intense for each emotion condition is shown in Table 1. To determine whether there were any significant age differences in the frequency with which direct gaze faces were chosen to be more emotionally intense in each emotion condition a mixed design analysis of variance (ANOVA) was conducted with three levels of emotion

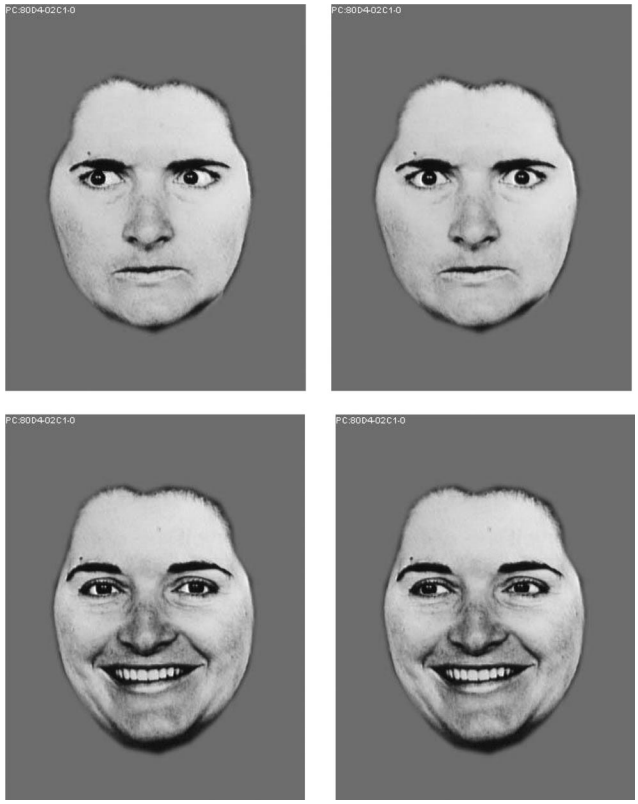

Figure 1. Example stimuli showing angry and joyful expressions at 100% intensity. Reproduced with permission from *Facial Expressions of Emotions: Stimuli and Test* (FEEST;Young et al., 2002).

(anger, fear, and joy) and two levels of intensity (50% and 100%) as within-subjects factors. Age group (young vs. old) was the between subjects factor. This revealed a significant main effect of emotion, $F(2, 160) = 39.53$, $p < .001$, $\eta_p^2 = .33$. Bonferroni pairwise comparisons confirmed that for both groups, the tendency to select direct gaze as most emotional was stronger for joyful faces as compared to angry ($p < .001$) and fearful ($p < .001$) faces. In turn, participants were more likely to choose direct gaze as being most emotionally intense for angry, compared to fearful, faces ($p < .05$). A significant main effect of age group was also revealed, $F(1, 80) = 11.17$, $p < .01$, $\eta_p^2 = .12$, and a significant age group × emotion interaction, $F(2, 160) = 10.74$, $p < .001$, $\eta_p^2 = .12$. No other main effects, two- or three-way interactions were found to be significant (all Fs < 1 except the emotion × intensity × age group interaction, $F(2, 160) = 1.79$, $p = .17$, $\eta_p^2 = .02$). Therefore responses to faces at both levels of emotional intensity (50% and 100%) were combined to give a single direct gaze preference score for each emotion.

To explore the age × emotion interaction in more detail a series of independent samples *t* test were conducted (see final columns in Table 1). For both angry and joyful expressions, younger adults chose faces with direct gaze as being most emotionally intense significantly more often than older adults. No significant age differences were found for responses in the fearful condition. A series of one sample *t* tests were then conducted to examine whether the frequency with which both age groups chose emotion faces with direct gaze as being more intense was significantly different from chance. These revealed that younger adults chose angry and joyful faces with direct gaze more often than chance (see Table 1). Older adults also chose joyful faces with direct gaze more often than chance, but gaze direction did not affect which face older adults chose as more intensely angry. Direction of gaze did not influence younger or older adults' decision about which face was more fearful.

Discussion

In the present study, consistent with previous research (Adams & Kleck, 2003, 2005) younger adults perceived both joyful and angry facial expressions to be more intense when combined with direct, compared to averted, gaze. In contrast, older adults did not show any differentiation between direct and averted gaze when judging the intensity of angry expressions. This suggests a substantial age-related difference in integrating eye gaze and emotion cues when interpreting facial expressions and is consistent with previous research indicating that older adults look less to the eye-region of negative emotion faces (Sullivan et al., 2007; Wong et al., 2005). In relation to joyful faces, both younger and older adults indicated that those with direct gaze were more intensely emotional than those with averted gaze. However older adults did not show such a strong tendency as young to favor direct gaze faces as displaying more joy than those with averted gaze. These findings indicate that older adults tended to be less influenced by gaze when interpreting facial expressions.

Contrary to previous research (e.g., Adams & Kleck, 2003, 2005) gaze direction had no effect on the perceived intensity of fearful faces in younger adults and no age differences were found for the perception of the intensity of fear. Recent studies have also failed to replicate the findings of Adams and Kleck (2003) that fear perception is generally enhanced when combined with averted gaze (Bindemann et al., 2008; Conway et al., 2007).

Study 2

Study 1 revealed age differences in the extent to which gaze direction affected the perceived emotional intensity of angry and joyful faces. However in everyday social interactions individuals do not explicitly and consciously make decisions about the intensity of emotional facial expression. Therefore it is important to

Table 1
Means and SD of the Percentage of Times Participants Chose Faces With Direct Gaze as Being More Emotionally Intense for Each Emotion Condition, and Summary of Independent Sample t-Tests Comparing the Means of Younger and Older Adults

	Younger		Older			
	M	*SD*	*M*	*SD*	*t*	*p*
Anger	73.98**	23.46	50.80	23.04	4.51	<.001
Joy	78.48**	14.77	67.95**	14.91	3.21	<.01
Fear	55.81	27.19	54.80	17.99	.20	=.85

Note. Means with a ** ($p < .01$) are significantly different from chance (50%).

investigate whether there are also age-related changes in the ability to integrate these cues when participants are not required to make explicit judgments about the emotional expression of the target, but are instead asked to make judgments that are more relevant to everyday social functioning. Here we asked whether gaze direction influences how people engage with others displaying different facial expressions.

Previously Jones, DeBruine, Little, Conway, and Feinberg (2006) found that younger adults' preferences for attractive (vs. unattractive) smiling faces was greatest when these were directed toward participants (e.g., coupled with direct gaze) rather than away from them. Gaze direction did not influence attractiveness preferences for neutral faces. According to Jones et al. (2006) integrating emotional expression and gaze direction allowed younger adults to detect those who were most attractive and likely to engage in social interaction, which is beneficial when choosing individuals to form relationships with. However, previous research has not investigated whether subtle cues to gaze direction and emotional expression interact to influence *perceiver's* judgments of how likely they would be to approach and interact with others. Efficient integration of emotion and gaze cues should result in a greater likelihood of interacting with a happy person when they have direct gaze (rather than averted), as that person would be most likely to socially engage with the perceiver. In contrast, it should be better to interact with an angry person with averted gaze (as opposed to direct), because when averted an angry gaze is less threatening, and any rage is less likely to be directed at the perceiver.

Study 2 investigated the following research aims. *First, did gaze direction and emotional expression interact to influence likelihood of social interaction?* Participants were asked to make both forced choice and rating judgments about how likely they would be to interact with people displaying different gaze directions (e.g., direct vs. averted) and emotional expressions. Only angry and joyful expressions were included in Study 2.

Second, were there any age differences in the way in which gaze direction and emotional expression influenced social interaction judgments? Given the findings from Study 1 it could be predicted that older adults would also have problems integrating gaze direction and emotional expression, particularly in relation to anger, when making social judgments of approachability.

Method

Participants

The same group of younger and older adults who participated in Study 1 also took part in Study 2. However in the ratings task the responses of one younger and two older females were removed due to problems using the rating scales. Both Study 1 and Study 2 were completed in the same testing session. The tasks for these studies were presented approximately 40 minutes apart with participants completing a number of unrelated measures between the different tasks. All participants completed the tasks for Study 2 first so that the explicit emotion perception measure could not influence approachability judgments.

Stimuli and Procedure

Forced choice task. The same angry and joyful face pairs were used as in Study 1. These face pairs were presented in a random order. Participants were told that they would be presented with a series of trials in which they would see two photographs of the same person on the screen but the photographs had been taken at different times (e.g., with the one on the left being taken on Monday at 10 a.m. and the one on the right Tuesday at 10 a.m.). They were instructed to decide at which time they would rather ask that person for a favor. This task was chosen as it measures preferences for social approach behavior. The location of the images with direct and averted gaze was counterbalanced for each emotion condition. The dependent variable was the percentage of trials in which participants chose to approach the direct gaze face.

Ratings task. The same joyful and angry faces were used in this task as in Study 1. However in the ratings task, each face was presented individually in the center of the screen. Presentation was in a random order and each face remained on screen until participants made their response. Each image was presented once in the sequence with direct gaze and once with averted gaze (either to the left or the right). Direction of gaze aversion was counterbalanced across images. Participants were told that faces would be presented individually in the center of the screen and asked to rate how likely they would be to ask this person for directions if they were lost. This task also measures preference for social approach behavior, however a different question was selected to avoid repetition. Responses were made on a scale of 1 to 8 with 1 being "not very likely" and 8 classified as "very likely." They were asked to respond by pressing the appropriate numbered key (1–8) at the top of the keyboard. There were 32 trials in total.

Results

Forced Choice Decisions

The mean percentage of times that younger and older adults chose to ask people for a favor when these images were coupled with direct gaze can be seen in Table 2, for both joyful and angry faces. To ascertain whether there were significant age differences in the number of times participants chose images with direct gaze for each emotion condition a mixed design ANOVA was con-

Table 2
Means and SDs of the Percentage of Times Participants Chose to Ask a Person for a Favor When They Were Presented With Direct Gaze, Broken Down by Emotion Condition and Age Group, and Summary of Independent Sample t-Tests Comparing the Means of Younger and Older Adults

	Younger		Older			
	M	*SD*	*M*	*SD*	*t*	*p*
Anger, 100%	35.47*	35.24	63.78*	26.41	4.08	<.001
Anger, 50%	49.71	33.13	66.35*	27.83	2.45	<.05
Joy, 100%	87.50**	16.86	76.60**	24.19	2.39	<.05
Joy, 50%	89.83**	15.49	75.32**	23.21	3.35	<.01

Note. Means with a * ($p < .01$) and ** ($p < .001$) are significantly different from chance (50%).

ducted with two within subjects factors; emotion (joy and anger) and intensity (50% and 100%). Age group (young vs. old) was the between subjects factor. This analysis revealed that there was a main effect of emotion, $F(1, 80) = 64.39$, $p < .001$, $\eta_p^2 = .45$, as the propensity to choose the face with direct gaze was greater in the joyful than angry condition. There was also a main effect of intensity, $F(1, 80) = 7.53$, $p < .01$, $\eta_p^2 = .09$, with the propensity to choose the face with direct gaze being greater in the 50% emotional intensity condition. All two-way interactions were also found to be significant: emotion × age group, $F(1, 80) = 24.55$, $p < .001$, $\eta_p^2 = .24$, intensity × age group, $F(1, 80) = 5.52$, $p < .05$, $\eta_p^2 = .07$, emotion × intensity, $F(1, 80) = 5.41$, $p < .05$, $\eta_p^2 = .06$. However no significant main effect of age, $F(1, 80) = 1.56$, $p = .22$, $\eta_p^2 = .02$, or age × emotion × intensity interaction, $F(1, 80) = 1.42$, $p = .24$, $\eta_p^2 = .02$, was revealed.

To ascertain whether the frequency with which participants would ask a person for a favor when they had direct gaze significantly differed from chance, one sample *t* tests were conducted, separately for each age group and emotion. As there was a significant interaction between age and intensity for each emotion condition responses to faces at 100% and 50% emotional intensity were analyzed separately (see asterisks in Table 2). Younger adults preferred to ask a joyful person for a favor when the image had direct gaze, and this held at both levels of intensity. This pattern was also apparent for older adults. The results for angry faces were influenced by the intensity of the expression. For the 100% angry expressions, younger adults rated themselves as significantly more likely to approach the face with averted gaze compared to direct gaze. There was no effect of gaze direction on younger adults' choices for the 50% angry faces. In marked contrast, older adults were significantly more likely to choose to ask the person for a favor when the face had direct gaze for both intensities of anger.

To further investigate where age effects were occurring in the significant age × emotion interaction a series of independent samples *t* tests were then carried out directly comparing young and old on each condition (see final columns in Table 2). Older adults were significantly more likely than younger adults to choose to approach angry faces with direct gaze, and this held for both levels of emotional intensity. However, in the joyful condition older participants chose faces with direct gaze significantly less often than young, for both levels of intensity. To summarize, older adults were most likely to choose to ask an angry individual with direct (rather than averted) gaze for a favor whereas younger participants elected to ask a favor of an angry individual with averted gaze (at least in the most intense emotional condition). With joyful faces, both age groups were most likely to choose to ask a joyful individual for a favor when displaying direct (vs. averted gaze), however this effect was stronger in younger adults.

Ratings Task

First, mean ratings of the likelihood that each participant would ask angry and joyful individuals for directions when these faces were coupled with direct and averted gaze were calculated separately for each emotion condition (anger, joy) and each level of emotional intensity (50% and 100%). Two mixed design ANOVAs were conducted, one for each emotion condition (anger and joy). These analyses contrasted two levels of gaze (direct vs. averted) and two levels of intensity (50% and 100%) as within subject factors and age group (younger vs. older) as the between subjects factor.

For anger a significant main effect of intensity was found $F(1, 77) = 201.58$, $p < .001$, $\eta_p^2 = .72$, with greater likelihood of asking for directions in the 50% intensity condition. There was also a significant main effect of age group, $F(1, 77) = 15.14$, $p < .001$, $\eta_p^2 = .16$, with older adults more likely to ask for directions overall, an intensity × age interaction, $F(1, 77) = 6.05$, $p < .05$, $\eta_p^2 = .07$, as older adults' greater likelihood of asking for directions was most prominent in the 50% intensity condition. There was no main effect of gaze direction, $F(1, 77) < 1$, but there was a significant age group × gaze interaction, $F(1, 77) = 4.72$, $p < .05$, $\eta_p^2 = .06$. There was no intensity × gaze, $F(1, 77) = 1.62$, $p = .21$, $\eta_p^2 = .02$, or intensity × gaze × age group, $F(1, 77) = 1.20$, $p = .28$, $\eta_p^2 = .02$, interaction.

To further explore the significant age × gaze interaction for anger, paired samples *t* tests were conducted to investigate the effect of gaze direction on the ratings of how likely younger and older participants would be to ask angry individuals for directions. As the ANOVA revealed no age × gaze × intensity interaction, level of emotion intensity was collapsed (see Table 3). Younger adults' ratings indicated that they were less likely to ask for directions when angry faces had direct gaze) as compared to averted gaze, $t(41) = 2.51$, $p < .05$, $d = .40$. Gaze direction did not significantly influence older adults' ratings of angry faces, $t(36) = 0.83$, $p = .41$. These findings suggest that younger adults were more likely to ask an angry individual for directions when that person had averted gaze, whereas older adults did not differentiate angry faces with direct and averted gaze.

An ANOVA analyzing responses for joyful expressions revealed a significant effect of intensity, $F(1, 77) = 31.38$, $p < .001$, $\eta_p^2 = .29$, with participants more likely to ask for directions in the 100% emotional intensity condition. There was also a main effect of gaze, $F(1, 77) = 20.64$, $p < .001$, $\eta_p^2 = .21$, as both age groups were more likely to ask for directions when the joyful faces had direct gaze. There was no main effect of age, $F(1, 77) < 1$, but a significant age × gaze interaction, $F(1, 77) = 4.58$, $p < .05$, $\eta_p^2 = .06$, was found (further explored below). None of the remaining two- and three-way interactions reached significance: intensity × age group, $F(1, 77) < 1$, intensity × gaze, $F(1, 77) = 3.36$, $p = .07$, $\eta_p^2 = .04$, intensity × gaze × age group, $F(1, 77) < 1$.

Again, as there was no age × gaze × intensity interaction responses to joyful faces at both levels of emotional intensity were

Table 3
Mean Ratings and SDs for How Likely Younger and Older Adults Were to Ask an Individual for Directions, Broken Down by Emotion Condition (Anger, Joy) and Direction of Gaze (Direct, Averted)

	Younger		Older	
	M	*SD*	*M*	*SD*
Anger, direct	2.61	.61	3.60	1.35
Anger, averted	2.76	.66	3.53	1.34
Joy, direct	6.86	.87	6.76	.98
Joy, averted	6.56	.97	6.66	1.06

Note. Higher ratings suggest that participants would be more likely to ask the individuals for directions (1 = minimum; 8 = maximum).

collapsed (see Table 3). Paired samples t tests revealed that younger adults were more likely to ask those with joyful expressions for directions when they were presented with direct (as opposed to averted) gaze, $t(41) = 4.52$, $p < .001$, $d = .70$, in direct contrast to the findings for angry faces. Older participants had a nonsignificant trend to rate joyful faces with direct gaze more highly than those with averted gaze, $t(36) = 1.83$, $p = .08$. Therefore both age groups tended to be most likely to ask a joyful individual for directions when these individuals were looking at them (i.e., coupled with direct gaze). However this effect was stronger in younger adults.

Discussion

The present study investigated whether gaze direction influenced younger and older adults' judgments of the approachability of angry and joyful faces when the emotional content of the face was not explicitly referred to. In the forced choice decision task, both age groups preferred to ask a joyful person for a favor when that person was looking at them. However, when making this decision, older adults differentiated between joyful faces with direct (vs. averted) gaze to a lesser extent than younger participants.

Also in line with predictions, and in contrast to the joyful condition, younger adults were more likely to ask an intensely angry person (e.g., in the 100% emotional condition) for a favor when that person was looking away from them. However in the 50% intensity condition they did not differentiate between angry faces with direct and averted gaze. It is possible that participants may be less concerned about approaching an angry person who is looking at them when that individual does not appear to be intensely angry. In direct contrast to the preferences of younger participants, older adults were found to be more likely to ask an angry person for a favor when that person was looking directly at them. Taken together these findings suggest that older adults may be less adept at integrating different social cues.

In line with the forced choice task, older adults also did not integrate gaze and emotion cues in the same way as young when making approachability ratings. Younger adults were significantly more likely to ask a joyful person for directions when the emotion was directed toward them, while older participants' did not significantly differentiate in terms of gaze direction. In contrast to the joyful condition, younger adults were more likely to ask for directions from an angry face coupled with averted gaze, as opposed to direct gaze faces. Again, older adults did not differentiate between angry faces that were looking toward or away from them, indicating that they were failing to integrate gaze and emotion cues. An additional finding from the ratings data was that overall older adults gave angry faces a higher approachability rating compared to younger adults. Therefore it seems that older adults did not appreciate, to the same extent as younger adults, the danger they may be placing themselves in when approaching an angry person in the social environment. There were no age differences in overall approachability ratings of joyful faces.

These findings suggest that there are age differences in the ability to integrate gaze direction and emotional expression even when participants are not required to make explicit judgments of the emotion present in the face. However, although emotion was not explicitly referred to, participants in the current study were still required to make conscious, explicit social judgments about the stimuli. Future research should investigate age differences in the gaze and emotion interaction using a paradigm in which participants are not required to make these explicit judgments of the faces. For example, when completing a visual search task similar to the one employed by Mather and Knight (2006), it would be interesting to assess whether younger and older adults would be quicker at detecting angry and joyful faces from a visual array when the face images are looking toward rather than away from them.

General Discussion

Taken together the results of Studies 1 and 2 suggest that there are age differences in the extent to which gaze direction influences the perception of angry and joyful facial expressions when making both explicit emotion judgments (Study 1) and also social judgments of approachability (Study 2). Consistent with previous findings of age impairments in emotion recognition (see Ruffman et al., 2008 for a review) and eye-gaze processing (Slessor et al., 2008) both of the present studies found that older adults have problems integrating these two different social cues. For example, both age groups were more likely to find joyful faces with direct (vs. averted) gaze more emotionally intense and approachable. Nevertheless, older adults differentiated between images with direct and averted gaze to a lesser extent than younger participants when making both decisions.

In both studies the most pronounced age differences were found for the integration of gaze direction and angry facial expressions. Direct gaze enhanced younger adults' perception of anger in faces and, in turn they were less likely to approach and interact with an intensely angry person when the expression of anger was directed toward them. Older participants only discriminated between angry faces with direct and averted gaze when they were forced to choose when they would rather ask someone for a favor. In direct contrast to the responses of younger participants, older adults were more likely to ask another individual for a favor when the anger was directed toward them (i.e., under conditions of direct gaze). This finding suggests that when making this social judgment, older adults attend to only one cue (gaze direction) and ignore facial cues to anger. Therefore, unlike younger participants, older adults do not seem to meaningfully integrate eye gaze direction and expressions of anger. It has been argued that amygdala activation underlies the ability to integrate gaze direction and angry facial expressions (Adams & Kleck, 2003). The amygdala has been found to subject to shrinkage with age (Mu, Xie, Wen, Weng, & Shuyun, 1999) and there is evidence of an age-related reduction in the activation of this region when viewing negative emotion faces (Iidaka et al., 2002). Therefore these neural changes may be associated with the age differences found in the ability to integrate these facial cues.

Consistent with the SST (Carstensen et al., 2003), the finding of substantial age differences in integrating gaze and angry facial expressions might also reflect the operation of emotion regulation strategies in older adults, which reduce attention to negatively valenced or socially threatening information such as a direct angry gaze. Alternatively it might reflect particular difficulties that older adults have in interpreting threatening information from faces (Ruffman, Sullivan, & Edge, 2006). Future research including

postexperiment interviews would provide interesting insights into why older and younger adults differ in the integration of gaze and emotion, particularly in their preference for asking angry individuals with direct gaze for a favor. Conducting additional eye-tracking studies would also reveal precisely which features of the face younger and older adults attend to when making these decisions.

In addition to age-related changes in gaze perception research has suggested that there are also gender differences in gaze processing (Bayliss, di Pellegrino, & Tipper, 2005). Due to the limited number of male participants, effective group comparisons could not be made in the current study. However analysis of only female participants' responses revealed similar results to those found for the whole sample, suggesting that gender did not influence age differences in the interaction between gaze and emotion. Studies assessing a greater number of male participants would be required to support this claim.

One limitation of the present research may be that, due to the overt manipulation of gaze in the forced choice decision tasks, participants were developing a conscious biased pattern of responding to gaze direction. This seems unlikely however as the findings in Study 2 of the forced choice tasks were similar to the ratings task, which involved a more subtle manipulation. In addition, inspection of the frequency data for the forced choice tasks suggests that participants were not entirely consistent in their preference for direct/averted gaze in each emotion condition.

Although not assessed in the current research age differences in the ability to integrate gaze direction and emotional expression may have negative implications for older adults' social functioning. For example, the findings from Study 2 suggest that older adults may have problems identifying which individuals in the social environment are most likely to respond positively to their own social efforts. In addition they might find it more difficult to decide when it is most appropriate to attempt to engage and interact with others in the social environment. Aging studies have found an age-related increase in socially inappropriate behavior (e.g., making socially inappropriate comments and engaging in extended speech; Henry, von Hippel, & Baynes, 2009). Problems integrating different facial cues may contribute to age-related increases in socially inappropriate engagement with others.

In sum, age-related changes were found in the integration of different facial cues (i.e., facial expression and gaze direction) when making explicit emotional intensity decisions and social judgments of target individuals displaying angry and joyful expressions. Older adults tended to integrate eye gaze with emotional information to a lesser extent than younger participants, particularly when making emotion and social approach decisions about angry faces. These age differences could have negative implications for older adults' interpersonal relationships.

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Received April 30, 2009
Revision received November 17, 2009
Accepted December 8, 2009 ■