Emotional Expressions Reduce the Own-Age Bias

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Abstract

We are better at recognising faces of our own age group compared to faces of other age groups. It has been suggested that this own-age bias (OAB) might occur because of perceptual-expertise and/or social-cognitive mechanisms. While there is evidence to suggest effects of perceptual-expertise, little research has explored the role of social-cognitive factors. To do so, we looked at how the presence of an emotional expression on the face changes the magnitude of the OAB. Across three experiments young adult participants were presented with young and older adult faces to remember. Neutral faces were first presented alone (Experiment 1) to validate the proposed paradigm, and then presented along with angry (Experiment 2), and sad or happy faces (Experiment 3). The presence of an emotional expression improved the recognition of older adult faces, reducing the OAB which was evident for neutral faces. These results support the involvement of social-cognitive factors in the OAB, suggesting that a perceptual-expertise account cannot fully explain this face recognition bias.

Key words: Own-age bias, face recognition, face memory, emotional expression

Faces contain a host of socially useful information that we are adept at extracting and recognising. After even brief exposures to a person's face we have the capacity to later recognise them. However, despite this skill, systematic variation in recognition performance still arises. A number of face recognition biases have been discovered which suggest that the socially relevant information communicated by faces might impact on our capacity to recognise them (Herlitz & Loven, 2013; Meissner & Brigham, 2001; Scott & Fava, 2013; Wiese, Komes, & Schweinberger, 2013). The own-age bias (OAB) is one such phenomenon.

The OAB is the finding that we are better at recognising faces of our own age group relative to faces of other age groups (Wiese et al., 2013). While most studies have demonstrated an OAB for young adult observers (e.g. Anastasi & Rhodes, 2006; Harrison & Hole, 2009; He, Ebner, & Johnson, 2011; Wallis, Lipp & Vanman, 2012), it has also been shown in older adults (e.g. Anastasi & Rhodes, 2005; Perfect & Harris, 2003; Wiese, Komes, & Schweinberger, 2012) and in children (e.g. Anastasi & Rhodes, 2005; Crookes & McKone, 2009; Hills, 2012; Hills & Lewis, 2011), albeit to a weaker extent. There has been much discussion regarding the mechanisms that lead to face recognition biases with accounts drawing on a range of potential drivers including perceptual characteristics, expertise, social factors, motivations, cognitions, stereotypes and more (see Wiese et al., 2013 for a review). These accounts for the OAB have been derived from research on the more extensively investigated own-race bias (ORB). The ORB refers to the observation that own-race faces are recognised better than other-race faces (Meissner & Brigham, 2001). Here, two prominent accounts from the ORB literature will be discussed in reference to the OAB: the perceptual-expertise account and the social-cognitive account.

Perceptual-expertise accounts of the OAB hold that the bias occurs because of our tendency to have greater experience with, and exposure to, in-group than out-group members (Wiese et al., 2013). In the case of age, our social structures tend to result in us spending more time with people of our own age; whether that is at school, at work, or in social situations with our similarly aged friends. As such, the faces that we see the most, and have to recognise most often, are own-age faces. We should therefore, become familiar with the perceptual components of these faces and through practice, become effective at encoding the information that is most useful for differentiating them. On the other hand, we are exposed to other-age faces less frequently and should have less opportunity to build up the expertise needed to be able to effectively encode and recognise them.

The majority of work investigating the underlying mechanism of the OAB has been focussed on the perceptual-expertise account. In this research, it is suggested that increased contact with an age group will increase recognition performance for faces of that age. This has been demonstrated largely in studies showing a correlation between more own-age than other-age contact and a larger OAB (Ebner & Johnson, 2009; He et al., 2011). The evidence is strengthened by studies showing that the OAB is attenuated or eliminated in groups with high other-age contact such as geriatric nurses, trainee teachers and maternity ward nurses (Wiese, Wolff, Steffens & Schweinberger, 2013; Harrison & Hole, 2009; Macchi Cassia, Picozzi, Kuefner, & Casati, 2009). However, there is a lack of experimental studies that manipulate real-life contact. Until such evidence is gathered it is difficult to discern how much of the result is due to differences in contact, and how much may be attributable to other factors, such as differences in motivation or liking of other-age groups, that may correlate with increased contact and reduced recognition bias.

An alternate group of accounts of the OAB that has received less attention but may also explain some of the effects noted above are the social-cognitive accounts. While often proposed as potential mechanisms for the OAB, they have not been well investigated. Again, as with perceptual-expertise, most support for the influence of social-cognitive factors on face recognition is found in the context of the ORB (Meissner & Brigham, 2001). Broadly, the social-cognitive accounts suggest that our social evaluations of, and cognitions about the faces we see can bias us to perceive and encode them in different ways, and affect how well we can later recognise them. For instance, in-group and out-group evaluations might result in us paying more attention to the individual person, or to the group that person belongs to. In such a case, we should expect to be better at encoding in-group faces as more attention is paid to in-group faces' individuating characteristics, but worse at encoding out-group faces as less attention is paid to them and processing is more focused on group membership information which does not facilitate later recognition (Levin, 2000).

One avenue for investigating the influence of social-cognitive factors in the ORB literature has been to present faces with emotional expressions. Emotions convey socially relevant information that may combine with group membership to indicate whether it is important to remember a face, or may bias impressions of the person whose face is being looked at. In the ORB literature, research has largely looked at the effects of angry expressions. Ackerman et al. (2006) proposed a functional account whereby we only allocate cognitive resources to remembering faces that appear relevant and important to remember. As anger communicates threat, this should highlight the importance of devoting resources to better encode and remember otherwise poorly remembered out-group faces which will in turn, reduce the ORB. Ackerman et al. (2006) found support for this functional account, with a reduction in the ORB observed for angry Caucasian and African American faces in a sample of Caucasian observers.

This anger effect has since been replicated by others, although emphasis has been placed on different social-cognitive mechanisms. Krumhuber and Manstead (2011) replicated the anger findings and extended them to fearful expressions. They suggested that negative intergroup relations are primed when negative expressions are viewed and that the resulting intergroup antagonism facilitates the processing of out-group faces with negative expressions, reducing the recognition bias. Young and Hugenberg (2012) also replicated the ORB reduction for angry faces and demonstrated that a reduction can be produced through other means, such as instruction. When participants with higher levels of other-race contact were instructed to individuate faces their ORB was reduced. They argued that their findings support the Categorisation-Individuation Model proposed by Hugenberg, Young, Bernstein, and Sacco (2010) which proposes that both perceptual-expertise and social-cognitive factors contribute to recognition biases. The model suggests that expertise improves recognition but that social-cognitive factors can improve it even further by motivating us to maximise our individuation of faces.

The reliability of the finding that anger facilitates other-race face recognition has, however, been the subject of recent scrutiny. Gwinn, Barden, and Judd (2015) reviewed past studies and pointed to a lack of variability in stimulus sets used. This was such that studies which found that anger reduced the ORB used the same stimulus materials. Additionally, these face sets were not complete in their counterbalancing of poser and expression, i.e. some posers always displayed the same expression. When Gwinn et al. (2015) had the stimuli rated for distinctiveness they also discovered that the angry African American faces were rated as more distinctive than the neutral African American faces, and that this difference was much larger than the difference between Caucasian angry and neutral faces. Testing the effect again, Gwinn et al. (2015) developed a new and improved set of stimuli and recruited both Caucasian and African American participants. Their findings deviated from Ackerman et al.'s (2006), with anger having different effects depending on participant race. In both cases, recognition performance was reduced for angry African American faces. This in turn reduced the ORB for African American participants, but exacerbated it for Caucasians. Gwinn et al. (2015) proposed a stereotype congruency account to explain their findings suggesting that expressions that are consistent with a racial group stereotype result in more categorical face processing while those that are inconsistent result in more individualistic face processing. As a result, stereotype consistent faces should be recognised worse than stereotype inconsistent faces.

There seems to be evidence that emotional expressions influence the magnitude of the ORB in some way. Whether emotional expressions also have the capacity to change the size of the OAB is unclear. Ebner and Johnson (2009) looked at differences in emotion categorisation and identity recognition in young and older adult participants. Their stimuli were neutral, angry, and happy young and older adult faces. The emotion categorisation task also served as an incidental learning phase which was later followed by a surprise recognition task. However, no OAB was produced in the small sample (32 young and 24 older adults) and results were reported collapsed across participant age. This study aims to revisit the question of whether or not emotion can moderate the OAB.

The aim of this series of experiments is to determine whether emotional expressions change the magnitude of the OAB in young adult participants. We chose to use a young adult sample for this study given that they produce the most robust, reliable OAB (Rhodes & Anastasi, 2012). Participants were presented with young and older adult male faces and asked to remember them for a later recognition test. Faces were presented with either neutral or emotional expressions and the size of the OAB was compared and results evaluated in light of the predictions made by the functional and stereotype congruency accounts. While there are other social-cognitive accounts applicable to this research question, these two were chosen for explicit evaluation given their competing predictions for the first emotion of interest, anger.

In Experiment 1 only neutral faces were presented in order to confirm that the proposed paradigm produced the OAB. In Experiment 2, neutral and angry faces were presented as this emotion has been suggested to be most relevant by the ORB literature. We predict that angry expressions will reduce the OAB. Both the functional account and stereotype congruency account make this prediction, although for different reasons. In the case of the functional account, we expect anger to increase older adult recognition by increasing the importance of remembering these now potentially threatening out-group faces. In the case of the stereotype congruency account, we expect anger to worsen young adult recognition due to the stereotypic associations between young men and anger (Montepare & Dobish, 2013). In Experiment 3 neutral and sad or happy faces were presented to further extend the findings and evaluate differences between the functional and stereotype congruency accounts. For these emotions, the predictions regarding how the OAB magnitude will change vary between accounts. Based on the functional account we expect happy expressions to reduce the OAB by providing an affiliative signal, making out-group older adult faces more socially relevant and improving their recognition. For sad expressions we do not expect the OAB to change as sad expressions do not communicate any risk or reward for the observer that would warrant more resources being devoted to the encoding of out-group faces. For a stereotype congruency account we expect sad expressions to exacerbate the OAB as sadness is stereotypically congruent with older adults and should reduce performance for these faces (Montepare & Dobish, 2013). For happy expressions we predict no moderation. While there is some suggestion that young adults may expect high arousal positive emotions to decline over the lifespan, there is no strong stereotypic association with either age as both age groups are still considered to experience the emotion often (Montepare & Dobish, 2013).

Experiment 1

The series of experiments presented in this paper were completed online using Amazon Mechanical Turk which varies from previous OAB studies which generally have participants complete studies in the laboratory. Conducting studies online means that some control over experimental setting, device used, and participant supervision is lost. As such, the paradigm developed for this study was first tested with neutral faces to ensure that the OAB was observed in this setting. The paradigm is largely comparable to those of other face recognition studies with the main point of difference being the addition of a reaction time task to the encoding phase where participants are initially exposed to the faces they will later be asked to recognise. While this phase of the experiment takes just over a minute to complete, there is the potential that an online participant might not attend to the faces on screen like a supervised lab participant would. As such, during encoding, participants were instructed to respond when each face disappeared from the screen.

Method

Participants. Prior to recruitment a power analysis was conducted using G*Power to determine sample size (Faul, Erdfelder, Lang, & Buchner, 2007). We estimated the sample size required to find the Face Emotion × Face Age interaction which would allow us to fully explore the effect of emotional expression on the OAB. Given the lack of relevant literature in the OAB field, we took a conservative estimate of the comparable Face Emotion × Face Race interaction (η_P^2 = .11; Gwinn et al., 2015). The analysis indicated 68 participants would be required to achieve an 80% chance of detecting an effect of this size. We oversampled to account for potential data loss, recruiting 96 participants. While this first experiment does not include emotional expressions, we chose to sample a similar number of participants to confirm the OAB would be observed with the sample size to be used in subsequent experiments. Ethics approval was obtained from the Curtin University human research ethics committee.

The analysed sample consisted of 64 Amazon Mechanical Turk workers who participated in exchange for USD2.80 (38 males, 26 females, M_{age}=25.91, SD_{age}=2.94, range=19-30). Thirty-one additional participants were removed prior to analyses as they did not meet demographic requirements (Caucasian adults 31 years old or younger; 30 participants) or they experienced program sequencing errors during the experiment (1 participant). The race and age demographic requirements chosen reflect the characteristics of faces in the young adult stimulus set and serve to highlight in-group membership of these faces.

Stimuli. The face stimuli used in this experiment were sourced from the FACES database (Ebner, Riediger, & Lindenberger, 2010). Images of 24 young adult and 24 older adult male posers were chosen displaying neutral expressions. Young adult faces were aged between 19 and 31 years old and older adult faces were aged between 69 and 80 years old. Stimuli were limited to male faces so as to not introduce another social cue (sex) that might indicate in-group or out-group membership. The database provides two versions of each expression, an A and a B version, both of which were used in the experiment. Images were colour and 335 × 419 pixels in size.

Procedure. Participants completed a recognition memory task that consisted of an encoding phase, filler task, and a recognition test. Learning was intentional in the encoding phase, with participants instructed to pay attention to the faces as they would be asked to remember them later. This intentional learning paradigm is consistent with many other OAB studies (Rhodes & Anastasi, 2012) and also had the added benefit of increasing the likelihood that the online sample would attend to the faces throughout encoding. To further facilitate this, participants were also tasked with pressing the spacebar as quickly as they could when faces disappeared from the screen. Text reminders to “remember the face” and “press spacebar after it disappears” were presented at the bottom of the screen during each trial. Twenty-four images (12 young, 12 older adult) were displayed one at a time for 1000 or 1500ms with a 1500ms inter-stimulus interval (half of the faces were presented for 1000 and half for 1500ms, with an equal number of young and older adult faces presented for each duration; presentation duration for each poser was counterbalanced between-participants). Presentation time was varied so that the reaction time task was less predictable.

After the encoding phase participants completed eight word puzzles. This filler task took approximately five minutes and was designed to remove the encoded faces from working memory so that long-term face recognition could be assessed in the test phase. The puzzles consisted of a grid of nine letters with the centre letter bolded. Participants were asked to generate the longest word they could using the nine letters that included the centre letter in the 30 seconds allotted for each puzzle.

Next, participants completed the recognition test where all of the faces from posers they had seen in encoding were presented again, intermixed with an unseen set of 24 faces (12 young, 12 older adult). All of the faces presented were new images (i.e. if participants saw version A in the encoding phase they would see version B in the test phase). Images were presented one at a time for up to 10s and participants were instructed to respond “Seen” or “Not Seen” to each face using the ‘e’ and ‘i’ keys, with response mapping counterbalanced across participants. If they responded ‘Seen’ they were prompted with an additional remember/know/guess question asking if they “remember the face, think they know it, or are making a guess”. This question probed if participants’ memory came from recollection (remember), familiarity (know) or guessing processes (Gardiner & Richardson-Klavehn, 2000). To conclude, demographics were collected (age, sex and race) along with a measure of group contact that measured how often participants had contact with young and older adults. The measure included two questions for each age group: “*How often do you have personal (i.e., face-to-face) contact with young adults/older adults (approx. between 18 to 30 years of age/approx. 65 years of age and older)?*” and “*How often do you have other types of contact (e.g., phone, e-mail, letter) with young adults/older adults (approx. between 18 to 30 years of* *age/approx. 65 years of age and older)?*". Responses were taken on a 1-8 scale from *"daily"* to *"less than once a year"* (Ebner & Johnson, 2009).

Data Analysis. To assess differences in recognition memory the signal detection measure of sensitivity (*d'*) was compared between conditions. To calculate *d'* the difference between the z-transformed hit rates and false alarm rates is taken, with positive scores indicating more accurate recognition. To deal with extreme hit and false alarm rates where z-transformations yielded infinite scores (0 and 1), the loglinear adjustment approach was taken (Hautus, 1995). In this approach, before hit and false alarm rates are calculated, 0.5 is added to each of the raw hit and false alarm counts, and 1 is added to the number of signal trials and the number of noise trials.

Results for the remember/know/guess data and the group contact data are not reported in the main analyses for this study. However, further detail on these can be found in the Supplementary Analyses where differences among the proportion of remember, know and guess responses for young and older adult faces, and differences in group contact and correlations between group contact and OAB magnitude were examined. Group contact did not correlate with OAB magnitude and there were no significant results of interest that would change the interpretations of our main analyses.

Results

A paired samples t-test of the *d'* scores confirmed that the paradigm produces an OAB (see Figure 1). Participants had higher sensitivity to young than older adult faces ($t(63) = 4.14$, $p<.001$, $d_{av}=0.64$).

------------- Figure 1 -------------

Experiment 2

Experiment 1 confirmed that the paradigm produces the OAB. The second experiment looked at how angry expressions affect the OAB. If, like in the case of the ORB, social-cognitive factors play a role in the OAB, we expect to see this bias reduce when expressions are angry. For results to be consistent with the functional account, we expect the reduction to occur because of improved older adult recognition. For results to be consistent with the stereotype congruency account, we expect the reduction to occur because of worsened young adult recognition.

Method

Participants. The analysed sample consisted of 72 Amazon Mechanical Turk workers (47 males, 24 females, 1 other; M_{age}=26.00, SD_{age}=0.51, range=19-30) who received USD2.80 for participating. An additional 28 participants were excluded prior to analyses as they did not meet demographic requirements (23 participants) or they experienced program sequencing errors during the experiment (5 participants).

Stimuli, procedure, and data analysis. The experiment proceeded as per Experiment 1 with the following differences. The stimulus set was expanded to include the angry expressions for each of the posers from Experiment 1. The same overall number of stimuli were used in the experiment, but half of the young and older adult faces were presented with angry expressions (counterbalanced between-participants). A single item measure of social identification was added that asked participants to respond to the statements *"I identify with older adults (65years+)"* and *"I identify with young adults (18-30years)"* on a 1-7 Likert scale from *"strongly disagree"* to *"strongly agree"* (Postmes, Haslam, & Jans, 2013; Reysen, Katzarska- Miller, Nesbit, & Pierce, 2013).

Detail on additional analyses conducted on the remember/know/guess, group contact, and the group identification data can be found in the Supplementary Analyses. Group contact did not correlate with OAB magnitude, and there were no significant results that would change the interpretations of our main analyses.

Results

The *d'* scores were subjected to a 2 (Face Age: young, old) × 2 (Face Emotion: neutral, angry) repeated measures ANOVA (see Figure 2, left panel). Results show that there was an overall OAB ($F(1, 71) = 10.15$, $p=.002$, $\eta_P^2 = .125$). Neither the main effect of Face Emotion ($F(1, 71) = 0.32$, $p=.574$, $\eta_P^2 = .004$) nor the Face Age × Face Emotion interaction reached significance ($F(1, 71) = 2.14$, $p=.148$, $\eta_P^2 = .027$). In order to directly test our predictions, planned analyses were conducted. We investigated the presence of the OAB for neutral and angry faces separately. The analyses confirmed that while the OAB was present for neutral faces ($F(1, 71) = 10.16$, $p=.002$, $\eta_P^2 = .125$), it was not present when the faces were angry ($F(1, 71) = 0.79$, $p=.378$, $\eta_P^2 = .011$).

------------- Figure 2 -------------

Discussion

These results provide some support for the notion that anger can attenuate the OAB and that social-cognitive factors influence it. However, the lack of a significant Face Age × Face Emotion interaction means that we are unable to evaluate the predictions of the specific social-cognitive accounts. Figure 2 (left panel) seems to suggest that the largest change in recognition is a reduction for young adult faces when angry compared to neutral. However, without statistical support, the OAB reduction could be driven by improved older adult recognition or a combination of both. Experiment 3 used sad and happy expressions to further explore the functional and stereotype congruency accounts.

Experiment 3

To further explore the effect of emotional expression on the OAB and which social-cognitive account may explain this moderation, sad and happy expressions were examined. As in Experiment 2, the size of the OAB was examined when faces were neutral, and when emotional (sad or happy). For the results to be consistent with a functional account, we expect that sad expressions will not moderate the OAB, but happy expressions will reduce it through improved recognition of older adults. This is because sad expressions do not signal risk or potential reward that might make a face more relevant, but happy expressions are signals of affiliation which may give them functional relevance. For the results to be consistent with a stereotype congruency account, we expect that sad expressions will exacerbate the OAB by reduced recognition of older adult faces and that happy expressions will not influence the OAB. Sadness is stereotypic of older adults (Montepare & Dobish, 2013) which should prompt more categorisation of these faces, reducing recognition performance, while happiness is not strongly stereotypic of either age group.

Method

Participants. Participants were 180 Amazon Mechanical Turk workers (100 male, 79 female, 1 other; M_{age}=26.22, SD_{age}=7.43, range=18-31; n_{sad}=94, n_{happy}=86) who received USD2.80 for participating. An additional 14 participants were excluded prior to analyses as they did not meet demographic requirements (11 participants) or they experienced program sequencing errors during the experiment (3 participants).

Stimuli, procedure, and data analysis. Experiment 3 proceeded as per Experiment 2 with the following exceptions. Participants were randomly allocated to the sad or happy condition in which they either saw neutral and sad faces, or neutral and happy faces. Participants saw the same total number of faces, and the same number of neutral and emotional faces as in Experiment 2, only in the current experiment the angry faces were replaced with either sad or happy faces (manipulated between-participants).

Detail on additional analyses conducted on the remember/know/guess, group contact, and the group identification data can be found in the Supplementary Analyses. Group contact did not correlate with OAB magnitude. Some significant differences emerged in the remember/know/guess data but these were inconsistent with findings of Experiment 1 and 2 and did not shed any additional light on our findings. There were no other significant findings that would change the interpretation of our main analyses.

Results

The *d'* scores were subjected to a 2 (Face Age: young, old) × 2 (Face Emotion: neutral, emotional) × 2 (Emotion Type: sad, happy) mixed ANOVA, with Face Age and Face Emotion varied within-participants, and Emotion Type varied between-participants (see Figure 2, right panel). As in Experiment 2, there was an overall OAB ($F(1, 178) = 16.02$, $p<.001$, $\eta_P^2 = .083$), and a trend towards a significant Face Age × Face Emotion interaction emerged ($F(1, 178) = 2.98$, $p=.086$, $\eta_P^2 = .016$). There was no main effect of Face Emotion ($F(1, 178) = 1.39$, $p=.240$, $\eta_P^2 = .008$), or Emotion Type ($F(1, 178) = 2.27$, $p=.134$, $\eta_P^2 = .013$). The remaining effects were non-significant ($F<1$).

To directly test our predictions, planned comparisons were conducted to determine if the OAB was present when the faces were neutral, sad, or happy. The OAB was present for neutral faces in both groups – when these faces were presented alongside sad faces ($F(1, 178) = 13.75$, $p<.001$, $\eta_P^2 = .072$), and alongside happy faces ($F(1, 178) = 6.24$, $p=.013$, $\eta_P^2 = .034$). The OAB was not present, when faces were sad ($F(1, 178) = 1.11$, $p=.293$, $\eta_P^2 = .006$) or when they were happy ($F(1, 178) = 0.92$, $p=.340$, $\eta_P^2 = .005$).

Discussion

As in Experiment 2, these findings demonstrate an influence of emotional expressions on the OAB and suggest that social-cognitive mechanisms are involved in the bias. Additionally, they suggest emotional expressions in general, regardless of the specific expression, are able to reduce and eliminate the OAB. However, the results cannot provide support for any specific social-cognitive mechanism involved. Without a significant Face Age × Face Emotion interaction, we cannot explore whether reduction of the OAB occurred due to poorer recognition of young faces or improved recognition of older adult faces, or some combination of both. In turn this means we cannot evaluate if these results fit a functional or stereotype congruency account, or if neither is suitable to account for the data.

The results from Experiments 2 and 3 show similar trends (see Figure 2). To confirm this impression, we conducted a more powerful combined analysis to explore how emotional expression moderates the bias, and which social-cognitive mechanism may be driving the attenuation of the OAB.

Combined Analysis

A combined analysis of Experiments 2 and 3 was conducted, such that Experiment 2 was incorporated into the Experiment 3 design, with anger as the third level of the factor Emotion Type.

Results

The *d'* scores were subjected to a 2 (Face Age: young, old) × 2 (Face Emotion: neutral, emotional) × 3 (Emotion Type: sad, happy, angry) mixed ANOVA, with Face Age and Face Emotion varied within-participants, and Emotion Type varied between-participants. Overall, the OAB emerged ($F(1, 249) = 26.51$, $p<.001$, $\eta_p^2 = .096$). The Face Age × Face

Emotion interaction also reached significance ($F(1, 249) = 5.35$, $p=.021$, $\eta_p^2 = .021$). Follow-up comparisons demonstrated that the OAB was present for neutral faces ($F(1, 249) = 30.00$, $p<.001$, $\eta_p^2 = .108$), but not for emotional faces ($F(1, 249) = 2.77$, $p=.097$, $\eta_p^2 = .011$). The difference was driven by increased sensitivity for older adult emotional faces, relative to neutral faces ($F(1, 249) = 4.36$, $p=.038$, $\eta_p^2 = .017$), with no differences in sensitivity seen between young neutral and emotional faces ($F(1, 249) = 1.83$, $p=.178$, $\eta_p^2 = .007$). There was no main effect of Face Emotion ($F(1, 249) = 0.34$, $p=.563$, $\eta_p^2 = .001$). There was a main effect of Emotion Type ($F(2, 249) = 5.64$, $p=.004$, $\eta_p^2 = .043$). Pairwise comparisons conducted with independent samples t-tests revealed that sensitivity was overall lower for participants in the angry, compared to the happy ($t(156) = 3.34$, $p=.001$, $d_s = 0.53$) and sad emotion type groups ($t(164) = 2.14$, $p=.033$, $d_s = 0.34$). However, sensitivity did not differ significantly between the happy and sad emotion type groups ($t(178) = 1.32$, $p=.186$, $d_s = 0.20$). All other effects were non-significant ($F<1$).

General Discussion

The aim of this study was to determine if emotional expression moderates the OAB and the results suggest that it does. The OAB was evident for neutral young and older adult faces, but was eliminated when expressions were angry (Experiment 2), sad or happy (Experiment 3). A combined analysis indicated that this bias reduction was attributable to improved recognition of older adult faces when emotional. These findings are consistent with the ORB literature in which emotion has also been demonstrated to moderate the bias (Ackerman et al., 2006; Krumhuber & Manstead, 2011; Young & Hugenberg, 2012), and suggests that the OAB is also in part driven by social-cognitive processes. However, the effect of emotion on the OAB appears to be quite small and neither the functional account nor the social-congruency account can fully explain the pattern of results.

We predicted that given the functional account, angry and happy faces would improve older adult face recognition, while sad faces would not change it (Ackerman et al., 2006). Both angry and happy faces convey information that makes them more relevant to the observer; anger communicates potential threat and danger, while happiness conveys affiliative intent and opportunity for social connection. This should have prompted better encoding and recognition of these emotional faces, especially the poorly remembered older adult faces, and reduced the OAB. These predictions are supported by the data. Our findings for sad faces however, are not consistent with this account. There is no personal risk or reward evoked by sad expressions making these faces less relevant and less important to remember. The presence of sadness was not predicted to moderate the OAB, however sadness also attenuated the OAB in a manner consistent with the other expressions.

Based on the stereotype congruency account we predicted stereotype congruency to impede recognition, with reductions in sensitivity for angry young and sad older adult faces, and no changes seen for happy faces (Gwinn et al., 2015). Anger is more stereotypical of young adults (Montepare & Dobish, 2013) and the congruence of the angry-young face pairing was predicted to facilitate categorical processing of these faces, worsening recognition of young adult faces and reducing the OAB. A reduction in recognition was also predicted for sad older adult faces given the stereotypical associations of sad older adults (Montepare & Dobish, 2013), having the effect of increasing the magnitude of the OAB. Again, our findings only partially align with these predictions. Anger was found to reduce the OAB, but it could not be determined if that was due to reduced recognition of young angry faces. However, neither of the predictions for sad nor happy expressions were supported with both emotions producing OAB reductions. It is possible that our participants did not subscribe to the stereotypes reported in the literature and that we have based our interpretation of the results on. Future research should include measures of stereotype beliefs to further clarify findings.

Looking to other accounts proposed in the literature, Krumhuber and Manstead's (2011) intergroup antagonism account also cannot reconcile these findings. In this account, negative expressions are predicted to improve the recognition of negatively evaluated out-group faces. Our data do show improvements in older adult face recognition when emotional, however the emotional expressions that improved recognition encompass both negative and positive expressions, the latter of which is inconsistent with this account.

Hugenberg et al.'s (2010) Categorisation-Individuation Model may be able to explain our findings. This model incorporates perceptual-expertise and social-cognitive factors, suggesting that the ORB is produced by both. Through contact and experience we improve our individuation of particular groups of faces. However, the full potential of experience is not realised unless we are motivated to individuate as well. In our case, emotional expressions may motivate people to individuate faces more. Emotional expressions communicate important social information about the experiences and current state of the person displaying them. Compared to faces with neutral expressions, emotional expressions may increase our perception of a person as an individual rather than a group member and change our focus from processing categorical to individuating information. In the current study emotional expressions improved recognition for older adult faces but not for young faces. This may be because participants are already sufficiently motivated to individuate own-age faces and as such, the presence of an emotional expression only confers an additional advantage to other-age faces.

Alternatively, emotional expressions may engage more attention and thus improve encoding of face identity. In addition to the OAB in face recognition, age related biases have also been shown in the allocation of attention to faces. People look longer at own-age relative to other-age faces (He et al., 2011) and are more distracted by own-age faces when they are task irrelevant (Ebner & Johnson, 2010). Time spent looking at own-age compared to other age faces has also been shown to predict the magnitude of the OAB (He et al., 2011). Emotional expressions likewise attract attention, with more attention given to emotional relative to neutral facial expressions (Yiend, 2010). It may be that the presence of emotional expressions on other-age older adult faces engaged attention more, and that this enhanced engagement of attention improved face encoding. The same improvement in face recognition may be absent for young adult faces as attention is already sufficiently engaged by own-age faces regardless of emotional expression.

It is possible that stimulus-level perceptual factors also contributed to our results. Emotional expressions change the nature of the face, scrunching and stretching features, and introducing colour changes. These sorts of changes could make faces more distinctive. If emotional expressions increase the distinctiveness of older adult faces more than they do for young faces, this could explain the recognition improvement for older adult emotional faces. However, in this case we would still expect to see at least some improvement for young adult recognition as performance for these faces is not yet at ceiling (*d'* scores were on average less than 1.0, while near perfect performance of 99% hits and 1% false alarms would give a *d'* of 4.65), but we do not. To control for stimulus effects future research should investigate different own- and other-age groups. This would allow the influence of stimulus qualities, like distinctiveness, to be separated from the effects of own- and other-age group membership. If the effects are driven by age group membership, the improvements noted for emotional other-age faces in the present study should hold regardless of how old the own-age and other-age faces are.

Overall, our study confirmed that the OAB is moderated by emotional expressions and suggests that it cannot be entirely explained by perceptual-expertise factors, but is likely the result of a combination of perceptual-expertise and social-cognitive factors. The current research is silent as to what these social-cognitive factors are, but suggests that they are uniform across emotional expressions. This finding is inconsistent with social-cognitive accounts implicated in the ORB that predict improvements and/or decrements that differ across expressions, due to their functionality as social signals or their stereotypicality. This may suggest that there are differences in the underlying mechanisms of the ORB and OAB. It also highlights the utility of including more than one expression in research that addresses their effect on psychological processes.

For an aging population the current results are good news as they suggest that there are ways that young adults can mitigate the effects of the OAB on their recognition of older adults. Rather than just increasing the amount of contact young adults have with older adults, making those interactions more emotionally expressive might also help to improve memory. In order to fully explore and understand the specific social-cognitive factors that help produce this outcome, future research should expand on the current experiments by examining more varied emotions as well as whether the findings generalise to other (age) in-groups and out-groups.

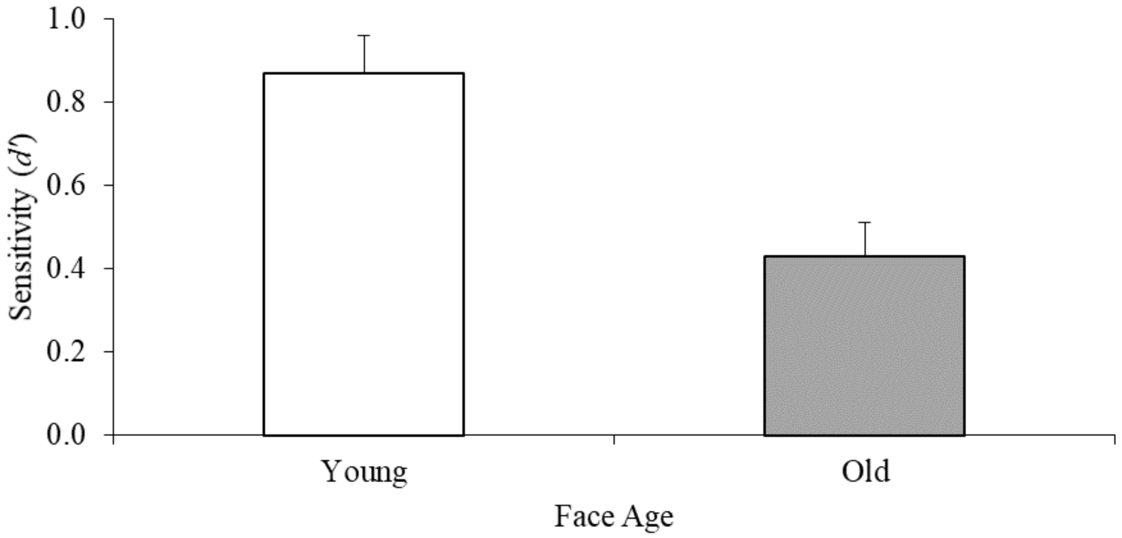

Figure 1. Sensitivity to young and older adult faces as measured by *d'* in Experiment 1. Error bars are 1 standard error of the mean.

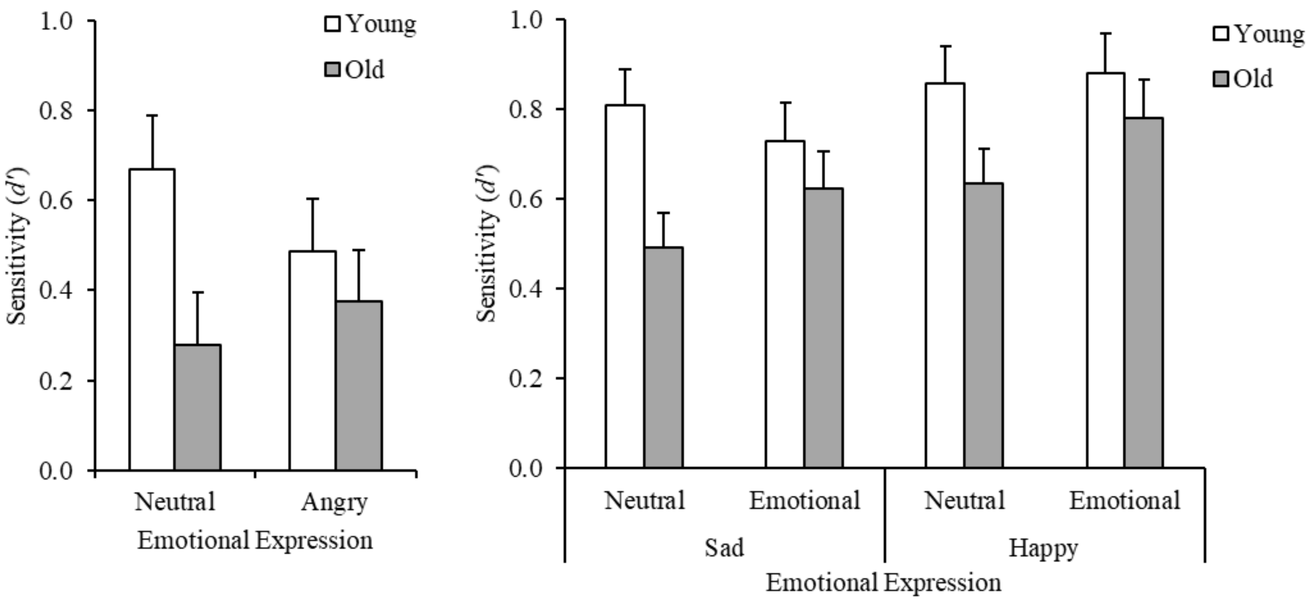

Figure 2. Sensitivity to faces varying in age and emotional expression as measured by *d'* in Experiment 2 (left) and Experiment 3 (right). Error bars are 1 standard error of the mean.

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