Stable middle-aged face recognition: No moderation of the own-age bias across contexts

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Title: STABLE MIDDLE AGED FACE RECOGNITION: NO MODERATION OF THE OWN-AGE BIAS ACROSS CONTEXTS

Short title: *NO MODERATION OF THE OWN-AGE BIAS ACROSS CONTEXTS*

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Abstract:

The own-age bias (OAB) has been proposed to be caused by perceptual-expertise and/or social cognitive mechanisms. Investigations into the role of social-cognition have, however, yielded mixed results. One reason for this might be the tendency for research to focus on the OAB in young adults, between young and older adult faces where other-age individuation experience is low. To explore whether social-cognitive manipulations may be successful when observers have sufficient other-age individuation experience, we examined biases involving middle aged other-age faces and the influence of a context manipulation. Across four experiments, young adult participants were presented with middle aged faces alongside young or older adult faces to remember. We predicted that in contexts where middle aged faces were positioned as other-age faces (alongside young adult faces) recognition performance would be worse than when they were positioned as relative own-age faces (alongside older adult faces). However, the context manipulations did not moderate middle age face recognition. This suggests that past findings that context does not change other-age

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face recognition holds for other-age faces for which observers have higher individuation experience. These findings are consistent with a perceptual-expertise account of the OAB but more investigation of the generality of these results is required.

Keywords:

own-age bias, social-cognition, face recognition, face memory

Data availability statement:

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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The own-age bias (OAB) is the phenomenon wherein identity recognition of unfamiliar faces is better for own-age than other-age faces (see Wiese, Komes, & Schweinberger, 2013, for a review). It has been observed in age groups across the lifespan with the strongest bias observed in young adults where other-age faces are older adults (Rhodes & Anastasi, 2012). Theoretical perspectives have largely suggested that perceptual-expertise and/or social-cognitive mechanisms cause the effect (Wiese, Komes, et al., 2013).

Perceptual-expertise accounts suggest that people tend to have greater expertise in processing own-age than other-age faces and that this is why we observe the OAB (Wiese, Komes, et al., 2013). The social-cognitive accounts, in contrast, posit that the OAB occurs because of differential judgements made about own- and other-age faces which bias encoding to capture information useful for individuating or categorising a face (Wiese, Komes, et al., 2013). An integrative account, the categorisation-individuation model (CIM), has also been proposed, where perceptual-expertise and social-cognition are said to jointly produce own-group biases such as the OAB through motivational, category activation and individuation experience factors (Hugenberg et al., 2010).

Research examining the effects of perceptual-expertise and social-cognition on the OAB has found evidence in support of each. In support of perceptual-expertise accounts, other-age contact has been observed to negatively correlate with OAB magnitude (Ebner & Johnson, 2009; He, Ebner, & Johnson, 2011) and people with high levels of other-age contact (e.g., trainee teachers, preschool teachers, geriatric nurses, nursing home assistants) have been observed to be less biased than the general population (Harrison & Hole, 2009; Macchi Cassia, Picozzi, Kuefner, & Casati, 2009; Wiese, Wolff, Steffens, & Schweinberger, 2013; Proietti, Pisacane, & Macchi Cassia, 2013). The literature that has examined social-cognition, on the other hand is less clear. Manipulations such as the use of emotional expressions (e.g., Cronin, Craig, & Lipp, 2019), instructions to individuate (e.g., Craig & Thorne, 2019), and tasks that require individuation (e.g., Proietti, Laurence, Matthews, Zhou, & Mondloch, 2018) have yielded mixed results. It appears that in some circumstances social-cognitive manipulations may moderate the OAB, however, it is unclear under what conditions these manipulations will be successful.

Research investigating the OAB has been biased towards exploring the OAB between young and older adult faces. This has particularly been the case when it comes to exploring social-cognition. However, considering the CIM, individuation experience is said to contribute to the OAB and the tendency for young adults to have little contact with older adults might be constraining the size of social-cognitive effects. If a certain level of individuation experience is required to facilitate an influence of social cognition, then examining the OAB between young and older adults may reduce or eliminate the possible influence of social-cognitive effects.

Research from the ORB field supports the idea that individuation experience is important to consider when using social-cognition manipulations. Young and Hugenberg (2012) explored the interaction between perceptual-expertise and social-cognition in their study of the ORB and found evidence of individuation experience facilitating social-cognitive manipulations. The authors manipulated motivation by instructing participants to individuate other-race faces and found that while the ORB was present in a control condition, it was eliminated in the instruction group. Importantly, they also found that in the instruction group, the size of the ORB correlated with interracial experience such that participants with higher experience with other-race people had smaller ORBs. They suggested that the motivation manipulation was facilitated by individuation experience, such that when participants had more interracial experience they were able to individuate the other-race faces and be less biased. In a subsequent experiment, however, Young and Hugenberg manipulated motivation using angry expressions and found that angry other-race faces were remembered better than their neutral counterparts, but that the ORB did not correlate with interracial experience. They concluded from this, that strong prompts of social-cognition, such as emotional expressions, may overcome the ORB on their own but that weaker prompts, such as instructions, interact with perceptual-expertise to moderate the ORB.

Comparing Young and Hugenberg's (2012) findings to similar studies in the OAB field we find support only for a strong manipulation of social-cognition. When examining the role of emotional expressions (angry, happy and sad expressions), Cronin et al. (2019) found that this strong prompt of social-cognition reduced the OAB between young own-age and older adult other-age faces relative to neutral expressions and that the OAB did not correlate with inter-group contact. In contrast, when Craig and Thorne (2019) employed Young and Hugenberg's instruction manipulation in a study examining the OAB between young own-age and older adult other-age faces, the weak social-cognitive manipulation did not moderate the OAB. Given that strong but not weak social-cognitive manipulations were successful in reducing the OAB it may be that young adults tend to have insufficient experience with older adults and this prevents some social-cognitive effects from being observed.

In contrast to the OAB between young and older adults, the OAB between young and middle aged adults has received limited attention. Few studies have examined middle aged participants or included middle aged faces as other-age stimuli (Anastasi & Rhodes, 2005, 2006; Fulton & Bartlett, 1991; Randall, Tabernik, Aguilera, Anastasi, & Valk, 2012; Wolff, Wiese, & Schweinberger, 2012; Wright & Stroud, 2002). The outcomes of these studies have been mixed, finding the OAB approximately half of the time. From a perceptual-expertise viewpoint this might be because young adults are likely to have more contact with middle aged adults than they do with older adults. They tend to have more expertise in encoding individuating information from these faces and better overall recognition that sometimes prevents the OAB. From a social-cognitive perspective, young adult and middle aged faces may sometimes be perceived as belonging to one in-group and hence receive similar styles of encoding that prevent the OAB from emerging (Anastasi & Rhodes, 2006).

Both young adults' high level of contact with middle aged faces and the potential malleability of middle aged face categorisation provide an opportunity to explore the influence of social-cognition in a way that may overcome issues with past research. By exploring the OAB between young adult and middle aged faces in young adult observers, we are able to overcome the potential limiting effect of low other-age contact on recognition performance improvement. Young adult participants will have more inter-age experience with middle aged faces that can facilitate social-cognitive manipulations. Additionally, the flexibility of in-group/out-group categorisation for middle aged faces offers a potentially stronger social-cognitive manipulation to explore. As such, by exploring the OAB between young and middle aged faces, we will have a stronger test of the social-cognitive account and the CIM.

The aim of this series of experiments was to explore the role of social-cognition in the OAB and to explore if contextual manipulations of perceived in-group similarity change recognition performance for middle aged faces. To do so, Experiments 1 and 2 explored recognition performance for middle aged faces in contexts where these faces were presented alongside own-age faces of young adults (middle aged faces as the other-age faces), or alongside more dissimilar other-age faces of older adults (middle aged faces as the relative own-age faces). In Experiment 1a and 1b, participants were asked to remember middle aged faces along with either young adult (Experiment 1a) or older adult (Experiment 1b) faces. In Experiment 2, we replicated Experiments 1a and 1b in a single experimental design and added a third condition examining recognition for young and older adult faces. Finally Experiment 3 examined the effect of context under different encoding conditions wherein out-group categorisation saliency was emphasised.

We predicted that if social-cognitive processes contribute to the OAB, recognition performance for middle aged faces would differ depending on whether they were the relative own-age group or relative other-age group. When middle aged faces were the relative own-age faces we expected them to be recognised better than when they were the relative other-age faces. When out-group saliency was enhanced in Experiment 3, we expected to see poorer recognition of middle aged faces, compared to performance in the other experiments. In all experimental conditions we predicted that the relative own-age faces would be recognised more accurately than the relative other-age faces, demonstrating a relative OAB. However, if the OAB is driven by perceptual-expertise mechanisms only, we still expected a relative OAB (as we expected reported contact to increase with in-group similarity) but no changes in recognition performance of middle aged faces across conditions.

Experiment 1

Method

Experiment 1 consisted of two experiments reported here as Experiment 1a and Experiment 1b. They were conducted consecutively rather than concurrently and as such they are reported as separate experiments rather than separate conditions. The procedure for Experiments 1a and 1b was identical with the exception that Experiment 1a included middle aged and young adult face stimuli, while Experiment 1b included middle aged and older adult face stimuli.

Participants. Participants were recruited from Amazon Mechanical Turk and compensated USD2.90 for their time. Demographic inclusion criteria were to be aged between 18 and 31 and Caucasian, and served to highlight in-group membership with the young adult face stimuli. Ethical approval was obtained from an Australian University.

Experiment 1a. Ninety participants' data were analysed (41 male, 48 female, 1 other; M_{age}=26.79, SD_{age}=2.78, range=19-30). Four other participants were excluded prior to analysis as they did not meet demographic requirements (2 participants) or experienced experimental sequencing or completion errors (2 participants).

Experiment 1b. Ninety-two participants' data were analysed (47 male, 45 female; M_{age}=26.40, SD_{age}=2.80, range=20-31). Six other participants were excluded as they did not meet demographic requirements (3 participants) or experienced experimental sequencing or completion errors (3 participants).

Stimuli. Faces were from the FACES database (Ebner, Riediger, & Lindenberger, 2010). Faces of 48 middle aged (Experiment 1a and 1b), 48 young (Experiment 1a only), and 48 older adults (Experiment 1b only) were used (age categories prescribed by the authors of the database), with two images available for each identity giving a total of 192 images of faces in each experiment. Faces were of male Caucasians displaying neutral expressions, and between the ages of 43 and 55 years (*M*=48.29, *SD*=3.54, middle aged), 20 and 31 years (*M*=24.96, *SD*=3.16, young adult), or 69 and 77 years (*M*=72.00, *SD*=2.04, older adults). Images were in colour and 335 × 419 pixels in size.

Procedure. An old/new recognition task conducted online was used which included an exposure phase, a filler task, and a recognition test. In the exposure phase participants were instructed to remember faces that were presented one at a time on screen and to press the spacebar as quickly as they could when the face disappeared from the screen. In line with previous experiments on the OAB conducted online (Cronin et al., 2019), this secondary reaction time task was designed to ensure participants were looking at the screen. Twenty-four faces were viewed (12 from each age group) in a randomized sequence for 1000 or 1500ms (an equal number of trials for each face age were presented for each duration, and duration was counterbalanced between-participants for face identity). Trials were separated by an inter-stimulus interval of 1500ms following the response. Though this is a shorter presentation time than has been used in some other studies of the OAB (e.g., 3000ms in Craig & Thorne, 2019), this presentation time has been shown to successfully produce an OAB and allow the effects of social-cognition to be observed (e.g., Cronin et al., 2019).

Text reminders to "remember the face" and "press spacebar after it disappears" were presented at the bottom of the screen on each trial. The identities of faces seen in exposure, and new identities seen later in test were counterbalanced between-participants. Following the exposure phase, participants completed an unrelated filler task for approximately five minutes (see Cronin et al., 2019 for details).

In the test phase, participants were presented with 48 faces and tasked with identifying which they had seen before. Half of these faces were the faces seen in exposure, and half were new (12 from each age group). All faces were new images; either because they were new identities, or because they were the second photograph of the identities that had been seen in encoding. Faces were presented one at a time for up to 10 seconds and participants responded with 'seen' or 'not seen' using the 'e' and 'i' keys (response mapping was counterbalanced between-participants). When participants made a 'seen' response, a follow-up remember/know/guess question was presented that probed memory (Gardiner & Richardson-Klavehn, 2000). The question asked if participants "remember the face, think they know it, or are making a guess". Participants were instructed to respond 'remember' if they specifically remembered seeing the face, 'know' if it felt familiar but they could not remember it specifically, and 'guess' if they were guessing.

At the conclusion of the experiment, a questionnaire was completed. Participants reported their age, sex, and race, and completed measures of age group contact and social group identification. The contact measure was sourced from Ebner and Johnson (2009) and asks "*How often do you have personal (i.e., face-to-face) contact with young adults/middle aged adults/older adults (approx. between 18 to 30 years of age/approx. between 40 to 55 years of age/approx. 65 years and older)?*" and "*How often do you have other types of contact (e.g., phone, e-mail, letter) with young adults/middle aged adults/older adults (approx. between 18 to 30 years of age/approx. between 40 to 55 years of age/approx. 65 years and older)?*" Responses were given on a 1-8 scale ("*daily*", "*2–3 times per week*", "*once per week*", "*2–3 times per month*", "*once per month*", "*2–3 times per year*", "*once per year*", "*less often*") and the responses to the two questions were averaged to give one contact score for each age group in line with previous research (Ebner & Johnson, 2009). Social group identification was measured using a single item measure for each group where participants were asked to respond to the statements "*I identify with young adults (18-30 years)*", "*I identify with middle aged adults (40-55 years)*", and "*I identify with older adults (65+ years)*" on a 1-7 Likert scale from "*strongly disagree*" to "*strongly agree*" (Postmes, Haslam, & Jans, 2013; Reysen, Katzarska-Miller, Nesbit, & Pierce, 2013).

Data Analysis. Data were analysed with frequentist statistics and supplemented with Bayesian statistics to aid in interpretation of null effects. Bayesian statistics were conducted with JASP 0.8.5.1 using default non-informative priors (Cauchy prior scale = 0.707) and Bayes Factors were reported. Bayes Factors indicate the strength of evidence for H_1 over H_0 with increasing values above 1 providing stronger support for H_1, while decreasing values below 1 providing stronger support for H_0. We used Jeffery's (1961) conventions to guide our interpretation of Bayes Factors in which values above 3 or below 0.33 provide evidence for H_1 and H_0, respectively. A Bayes Factor of 1 provides no evidence, while values between 1-3 and 0.33-1 provide only anecdotal evidence for H_1 and H_0, respectively.

The primary outcome measure for this study is recognition performance as measured by sensitivity (*d'*). To calculate *d'* the difference between z-transformed hit and false alarm rates is taken. Hit rates represent the proportion of the time that previously seen faces were correctly identified as 'seen'. False alarm rates represent the proportion of the time that previously unseen faces were incorrectly identified as 'seen'. Positive scores indicate better recognition. Log-linear adjustments were applied to hit and false alarm calculations in line with recommendations by Snodgrass and Corwin (1988) prior to calculating *d'* wherein 0.5 was added to the raw counts of hits and of false alarms, and 1 was added to the number of trials with previously seen faces and the number of trials with new faces. Where hit and false alarm rates are reported these are the unadjusted rates.

Response bias (*C*) was calculated as an index of participants' propensity to respond 'seen' compared to 'not seen'. This is calculated by taking the negative average of the z-transformed hit and false alarm rates. Positive scores indicate a conservative bias with more inclination to respond 'not seen' than 'seen', and negative scores indicate a liberal bias with more inclination to respond 'seen' than 'not seen'. Zero indicates no response bias.

Remember/know/guess scores were calculated to represent the proportion of time each response (remember/know/guess) was made in each face age condition (young, middle aged, older adult). Scores for each face age condition were compared for each response type. Across the three experiments of this study, and 24 tests, only one significant difference was found. It did not add meaningfully to our interpretation of results and so is not reported in the main analyses. The remember/know/guess analyses can be found in the supplement.

Results

Experiment 1a. Analysis of responses to age group contact and social group identification measures confirmed that participants had more contact ($t(88)=4.19$, $p<.001$,

d_{av}=0.55, BF_{10}=282.25) with young (*M*=1.80, *SD*=1.02) than middle aged adults (*M*=2.51, *SD*=1.54) and higher identification ($t(89)$=9.25, p<.001, d_{av}=1.56, BF_{10}=6.05×10^{11}) with young (*M*=5.98, *SD*=1.37) than middle aged adults (*M*=3.47, *SD*=1.85). Neither reported contact, nor social group identification correlated with *d'* for either face age (all r^2<.015, all p>.256).

Analysis of the *d'* data using a paired samples *t*-test showed that there was no difference in performance between young and middle aged faces ($t(89)$=0.61, p=.544, d_{av}=0.08, BF_{10}=0.14; see Figure 1). Examination of response bias, however, suggests that responses were more conservative to young than middle aged faces ($t(89)$=2.98, p=.004, d_{av}=0.38, BF_{10}=7.25; see Table 1). Participants made more false alarms ($t(89)$=2.67, p=.009, d_{av}=0.33, BF_{10}=3.46) and trended towards making more hits ($t(89)$=1.78, p=.079, d_{av}=0.22, BF_{10}=0.50) to middle aged faces compared to young faces.

Experiment 1b. Participants had more contact ($t(91)$=7.72, p<.001, d_{av}=0.88, BF_{10}=6.04×10^{8}) with middle aged (*M*=2.19, *SD*=1.28) than older adults (*M*=3.50, *SD*=1.71) and higher identification ($t(91)$=7.51, p<.001, d_{av}=0.63, BF_{10}=2.31×10^{8}) with middle aged (*M*=3.33, *SD*=1.62) than older adults (*M*=2.38, *SD*=1.39). Neither reported contact nor social group identification correlated with *d'* for either face age (all r^2<.013, all p>.281).

Paired samples *t*-tests revealed that there was no difference in *d'* between middle aged and older adult faces ($t(91)$=1.35, p=.180, d_{av}=0.16, BF_{10}=0.27; see Figure 2). However, participants were more conservative when making responses to middle aged compared to older adult faces ($t(91)$=4.28, p<.001, d_{av}=0.54, BF_{10}=381.03) which resulted in fewer hits ($t(91)$=3.09, p=.003, d_{av}=0.36, BF_{10}=9.28) and fewer false alarms ($t(91)$=4.85, p<.001, d_{av}=0.57, BF_{10}=3093.44) for middle aged compared to older adult faces (see Table 2).

Combined Analysis

Recognition of middle aged faces was compared between Experiments 1a and 1b using an independent samples *t*-test. There was no difference in *d'* ($t(180)=0.63$, $p=.527$, $d_s=0.09$, $BF_{10}=0.19$). An analysis comparing response bias, however, found that when middle aged faces were the relative own-age group (Experiment 1b) responding was more conservative than when they were the relative other-age group (Experiment 1a; $t(180)=3.06$, $p=.003$, $d_s=0.45$, $BF_{10}=11.61$). Additional examination of hits and false alarm rates showed that both are higher in Experiment 1a than 1b, though the Bayesian analyses only support the finding for false alarms (hits: $t(171.91)=2.11$, $p=.036$, $d_s=0.31$[1], $BF_{10}=1.25$; false alarms: $t(180)=2.94$, $p=.004$, $d_s=0.44$, $BF_{10}=8.57$).

Discussion

The *d'* results of Experiment 1a and 1b suggest that recognition performance for middle aged faces does not depend on whether the accompanying stimuli make these faces the relative own-age group or other-age group. This is consistent with a perceptual-expertise account of the OAB. Response bias analyses in contrast suggest that patterns of response to middle aged faces might be influenced by the age of the other faces encountered in the task. This is such that while participants can discriminate the 'seen' and 'not seen' faces equally well, their scores are being produced by a different pattern of responding. This might indicate that a face's similarity to the age in-group is influencing participants' decision making at test. However, as both hit and false alarm rates were higher in Experiment 1a than 1b, it is unclear how responding differed. It is possible that responses differed only as a function of the particular participants we sampled. To explore these findings further, Experiment 2 aimed to

[1] Levene's test indicated variances were not equal for this comparison ($F(1,180)=7.87$, $p=.006$) so degrees of freedom were adjusted from 180 to 171.91.

replicate Experiment 1a and 1b in a single experiment with random assignment to condition and including a third condition with young and older adult faces to allow comparison between young adult faces and between older adult faces across conditions.

Experiment 2

Method

Participants. Data from 272 participants were analysed (n_{YO}=93, n_{YM}=90, n_{MO}=89; 113 male, 159 female; M_{age}=26.0, SD_{age}=2.93, range=18-31), with an additional 31 excluded as they did not meet demographic requirements (10 participants) or experienced experimental sequencing or completion errors (21 participants).

Stimuli. All stimuli included in Experiment 1a and 1b were used. This was such that there were faces of young, middle aged and older adults.

Procedure. The procedure was the same as in Experiment 1a and 1b with the exception that participants were randomly allocated to one of three groups, with the groups differing in which two face ages they saw. Group YO saw young and older adult faces, Group YM saw young and middle aged faces, and Group MO saw middle aged and older adult faces. Age group contact and social group identification questions were asked for all three age groups.

Results

The groups did not differ on age or any of the contact or social identification measures (all F<2.0, all p>.138, all BF_{10}<1.00). Participants had significantly more contact and higher identification with young adults (contact: M=1.56, SD=0.96; identification: M=6.43, SD=0.96) than middle aged adults (contact: M=2.05, SD=1.14; identification: M=3.64, SD=1.72), and with middle aged than older adults (contact: M=3.72, SD=1.78;

identification: M=2.41, SD=1.52; all t>7.09 all p<.001, all BF_{10}>5.7×10^8). No correlations were found between reported contact and identification, and d' for each face age (all r^2<.006, all p>.340).

Within task comparisons were conducted with paired samples t-tests to assess if there was an OAB (or relative OAB) in d' for each group. Results showed that while there was a bias in Group YO (t(92)=3.43, p=.001, d_{av}=0.38, BF_{10}=25.12) and Group MO (t(88)=2.82, p=.006, d_{av}=0.34, BF_{10}=4.71), there was no bias in Group YM (t(89)=1.06, p=.292, d_{av}=0.13, BF_{10}=0.20). When analysing response bias, all groups showed more conservative responding to relative own-age faces compared to relative other-age faces (Group YO: t(92)=3.81, p<.001, d_{av}=0.41, BF_{10}=79.24; Group YM: t(89)=2.74, p=.008, d_{av}=0.32, BF_{10}=3.82; Group MO: t(88)=4.75, p<.001, d_{av}=0.45, BF_{10}=2015.96).

Independent samples t-tests comparing d' across conditions showed that for young faces (t(181)=0.01, p=.989, d_s<.001, BF_{10}=0.16, see Figure 3), middle aged faces (t(177)=1.08, p=.284, d_s=0.16, BF_{10}=0.28) and older adult faces (t(180)=0.53, p=.595, d_s=0.08, BF_{10}=0.18), recognition performance did not differ. Analyses of response bias in the same manner showed a similar pattern of results to the d' data (see Table 3). Response bias did not differ across condition for young (t(181)=1.00, p=.319, d_s=0.15, BF_{10}=0.26), older adult (t(180)=0.43, p=.670, d_s=0.06, BF_{10}=0.18), or middle aged faces (t(177)=1.35, p=.179, d_s=0.20, BF_{10}=0.38). However, in the case of the middle aged face comparisons, the Bayesian statistics provided only anecdotal evidence for the null. Hit and false alarm rate comparisons also produced no differences across conditions (all t<0.80, all p>.427, all BF_{10}<0.22) with the exception that in the case of middle aged faces, there was a trend to more false alarms when they were the relative other-age compared to relative own-age group (t(177)=1.74, p=.084, d_s=0.26, BF_{10}=0.64).

Discussion

The results of Experiment 2 replicate the finding of Experiments 1a and 1b that *d'* performance for middle aged faces does not change depending on the age of the accompanying stimuli. However, the finding that response bias differs was not replicated, with no difference in response bias found for middle aged faces, though the Bayesian statistics did not provide evidence beyond anecdotal in favour of the null finding. Additionally, unlike in Experiment 1b, a relative OAB was found in the middle-old group.

The current finding that sensitivity does not differ between conditions may reflect perceptual-expertise mechanisms underlying the OAB, with no involvement from social-cognition. However, it is also possible that our manipulation of context was not sufficient. Our manipulation aimed to induce own-age categorisation for middle aged faces by presenting them alongside older adult faces. We expected that this would produce better performance for middle aged faces compared to when they were presented alongside young adult own-age faces as they would now be the age group most similar to the participants' age in-group. However, because we did not find an OAB between young and middle aged face recognition to begin with, it is not surprising that we do not find an improvement in middle aged face recognition when they were positioned as the relative own-age faces. Categorisation of middle aged faces as own-age may happen spontaneously when they are seen alongside young adult faces and as such, our comparison of middle aged faces across conditions may not be appropriate for detecting an influence of social categorization. To further explore the influence of context, Experiment 3 used an age categorisation task during encoding to see if performance for middle aged faces could be reduced by inducing stronger social categorisation for these faces in a task using young adult and middle aged faces.

Experiment 3

Method

Participants. Data from 85 participants were analysed (38 male, 47 female; M_{age}=26.00, SD_{age}=3.02, range=19-31) with 10 additional participants excluded as they did not meet demographic requirements (6 participants) or experienced experimental sequencing or completion errors (4 participants).

Stimuli. As per Experiment 1a.

Procedure. As per Experiment 1a, only that during encoding, instead of pressing the spacebar as soon as faces disappeared from the screen, participants were tasked with categorising each face as 'young' or 'old' using the 'e' and 'i' keys (response-mapping counterbalanced between-participants). They were instructed to do so as quickly and as accurately as they could. Response time was recorded and faces remained on screen for the predetermined exposure duration (1500ms or 1000ms) before the experiment proceeded to the next trial.

Data Analysis. As per Experiment 1a with the addition of reaction time and categorisation data analysis. Reaction times (RT) for young and middle aged faces were computed for each participant as the average reaction time for trials of that face age. Response times <100ms, +/-3 *SD* from the sample mean, or trials that timed-out were removed. Cases with fewer than 9 valid trials were removed from the RT analysis. Accuracy in categorisation was also computed with correct responses being the categorisation of young stimuli as 'young' and middle aged stimuli as 'old'.

Results

Participants reported higher social identification with young (M=6.14, SD=1.18) than middle aged adults (M=3.36, SD=1.66; $t(84)$=10.72, p<.001, d_{av}=2.00, BF_{10}=2.77×10^{14}). They reported equal amounts of contact, however, with young (M=1.95, SD=1.26) and middle aged adults, though Bayesian analysis provided only anecdotal evidence to support this null effect (M=2.18, SD=1.11; $t(83)$=1.53, p=.130, d_{av}=0.19, BF_{10}=0.37). Correlation analyses between reported contact and social identification, and *d'* for each age were non-significant (all r^2<.035, all p>.085).

A paired samples *t*-test revealed there was no difference between young and middle aged face sensitivity ($t(84)$=1.04, p=.300, d_{av}=0.11, BF_{10}=0.20; see Figure 4). There was, however, a difference in criterion with a more conservative bias found for young than middle aged faces ($t(84)$=3.29, p=.001, d_{av}=0.28, BF_{10}=16.19; see Table 4). This was such that there were more false alarms to middle aged than young faces ($t(84)$=2.25, p=.027, d_{av}=0.19, BF_{10}=1.25). There was no difference between hit rates for young and middle aged faces ($t(84)$=1.62, p=.110, d_{av}=0.16, BF_{10}=0.42) but hit rates were higher for the faces that participants categorised as old than young ($t(84)$=2.12, p=.037, d_{av}=0.21, BF_{10}=0.99). The results from the Bayesian analyses of hit and false alarm rates, however, provided only anecdotal evidence and these results should be interpreted cautiously.

Analysis of categorisation data showed high accuracy in categorising young faces as young (M=.87, SD=.15) and middle aged faces as old (M=.92, SD=.13). Analysis of the reaction time data with a paired samples *t*-test revealed an other-age categorisation advantage such that middle aged faces (M=810.80, SD=221.72) were categorised faster than young adult faces, though Bayesian analyses did not support this (M=843.71, SD=235.76; $t(83)$=2.03, p=.046, d_{av}=0.14, BF_{10}=0.84).

General Discussion

The aim of this study was to explore the influence of social-cognition, specifically categorisation, on the OAB by manipulating context to highlight middle aged other-age faces as relatively more or less similar to the young adult own-age group. We predicted that, if social-cognitive mechanisms are involved in the production of the OAB, then positioning middle aged faces as similar to the own-age group would result in better recognition performance than when positioning them as similar to the other-age group. Across four experiments that positioned middle aged faces as other-age (Experiments 1a, 2, 3) and relative own-age faces (Experiments 1b, 2), recognition performance did not differ in this way. In all cases, performance for middle aged faces was not different when faces were presented as other-age or relative own-age faces. Additional exploration of response bias suggested that differences across conditions may emerge here. However, the findings from the combined analysis of Experiment 1a and 1b, suggesting that response bias differed across conditions, did not replicate in Experiment 2.

In addition to our main finding that recognition of middle aged faces did not differ across conditions we also found no OAB between young adult and middle aged faces. Despite reported contact and social identification being significantly higher to young adult than middle aged people, recognition performance was not different for each face age group. There were, however, differences in response bias that are consistent with an OAB (Rhodes & Anastasi, 2012). This was such that, even though recognition performance did not differ, young adult faces were responded to more conservatively than middle aged faces.

These results are not consistent with a social-cognitive account of the OAB. A social-cognitive account would predict that manipulations of context targeted at changing perceptions of group membership and positioning faces as more similar to the age in-group or out-group should change recognition performance. For the middle aged faces, when positioned as more similar to the out-group, we expected encoding with less emphasis on individuating information, while when positioned as more similar to the in-group we expected encoding with more emphasis on individuating information. We did not, however, find evidence of this process as subsequent recognition performance did not differ for middle aged faces between any of our conditions. There was some evidence of different responding to middle aged faces as a function of context in response bias data. Participants responded to middle aged faces more conservatively in Experiment 1b when they were positioned as relative own-age faces, than Experiment 1a when they were positioned as other-age faces (though this did not confer an advantage to recognition accuracy). This is consistent with the finding that own-age faces are responded to more conservatively than other-age faces (Rhodes & Anastasi, 2012), however, the effect was not replicated in Experiment 2. It is possible that this finding is more reflective of differences in samples than an effect of our manipulation.

It is possible that our manipulation of middle age categorisation was unsuccessful. Social category activation is a fast and spontaneous process suggested to be influenced by contextual factors (Brewer, 1988; Macrae & Bodenhausen, 2000). Our manipulation aimed to change category activation by using different stimulus set compositions and through use of a categorisation task. Such manipulations have been successfully applied in the ORB field where racial group cues have been used to create ORBs in racially ambiguous or mixed race face sets (e.g., MacLin & Malpass, 2001; Pauker et al., 2013). It is possible that in Experiments 1-2, where only stimulus set composition was changed, our participants' category activations were not changed and that middle aged faces were processed the same way regardless of the other faces they were encountered with.

The use of a categorisation task in Experiment 3 allowed us to better infer category activation, however, this manipulation did not change recognition performance. We observed that participants were able to accurately categorise young and middle aged faces as 'young' and 'old', respectively. We also found some support for an other-age categorisation advantage. This suggests that there were differences in category activation between young and middle aged faces. Recognition performance, however, did not reflect this difference with no OAB observed. A difference did emerge when comparing hit rates on the basis of how participants categorised faces. Hit rates were higher for faces categorised as 'old' than for faces categorised as 'young'. This was in contrast to our prediction that performance would be lower for 'old' than 'young' faces. The improvement for other-age faces might instead reflect an overall less conservative response bias, however, we cannot confirm this as only hit rates can be examined this way (as participants only categorised faces in encoding, participants' categorization of the 'new' faces is not known). Additionally, as participants reported similar levels of contact with both young and middle aged faces, and several Bayesian analyses for this experiment provided only anecdotal support, we are limited in how we can interpret these results. There may be an effect of categorisation, however, it is not strong enough to influence overall recognition performance.

One may argue that our results are most parsimoniously explained by a purely perceptual-expertise account as we did not find an effect of our social-cognitive manipulation and perceptual-expertise processes can explain the lack of OAB between young and middle aged faces observed. The amount of middle aged contact our participants had may have been sufficient for such expertise to develop. Though reported contact with middle aged people was significantly less than with young adults in all but one case, and we did not find a significant relationship between recognition performance and reported contact, reported contact was relatively frequent for both young adult and middle aged faces. Participants reported contact with young adults on average as between daily and 2-3 times a week, and with middle aged people on average between 2-3 times per week and once per week. Both of these levels of contact may have been sufficient to produce expertise and to result in similar recognition performance.

Overall, the results of this study suggest that manipulating the context that middle aged faces are encountered in to position them as own- or other-age does not impact the OAB. The current results are consistent with a perceptual-expertise account of the OAB and do not provide support for a social-cognitive account. Our conclusions are, however, limited by the lack of OAB between young adult and middle aged faces in our experiments. Further exploration of social-cognitive manipulations of category activation is required under conditions where an OAB is observed to understand the generality of our findings.

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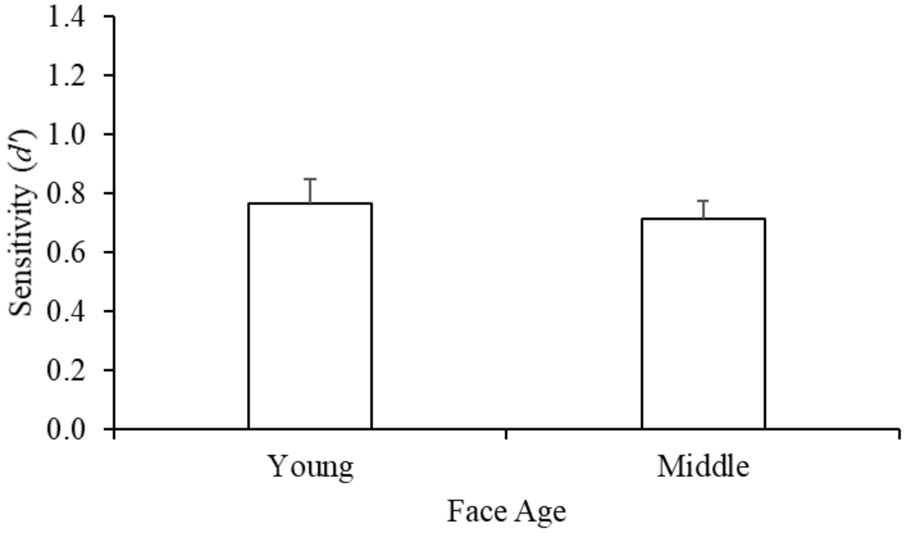

Figure 1. Sensitivity to faces varying in age as measured by *d'* in Experiment 1a. Error bars are 1 standard error of the mean.

Table 1

Mean sensitivity (d'), hit rates, false alarm rates, and response bias (C) to young and middle aged faces in Experiment 1a

	d'	Hits	False Alarms	*C*
Young	0.77(0.78)	.48(.23)	.21(.17)	0.45(0.46)
Middle	0.71(0.58)	.53(.19)	.27(.17)	0.28(0.41)

Note: Standard deviations are reported in brackets.

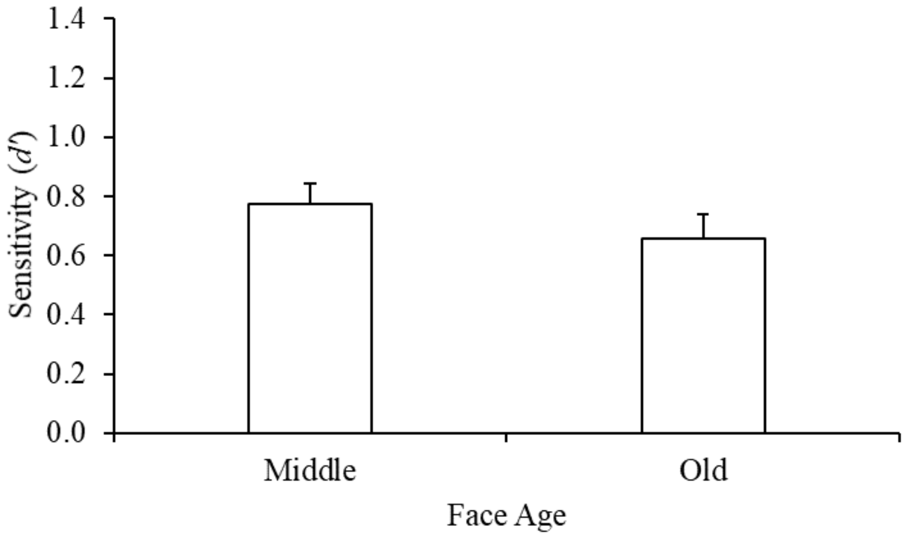

Figure 2. Sensitivity to faces varying in age as measured by *d'* in Experiment 1b. Error bars are 1 standard error of the mean.

Table 2

Mean sensitivity (d'), hit rates, false alarm rates, and response bias (C) to middle aged and older adult faces in Experiment 1b

	d'	Hits	False Alarms	*C*
Middle	0.77(0.68)	.46(.24)	.20(.17)	0.49(0.50)
Old	0.66(0.81)	.55(.23)	.30(.21)	0.22(0.49)

Note: Standard deviations are reported in brackets.

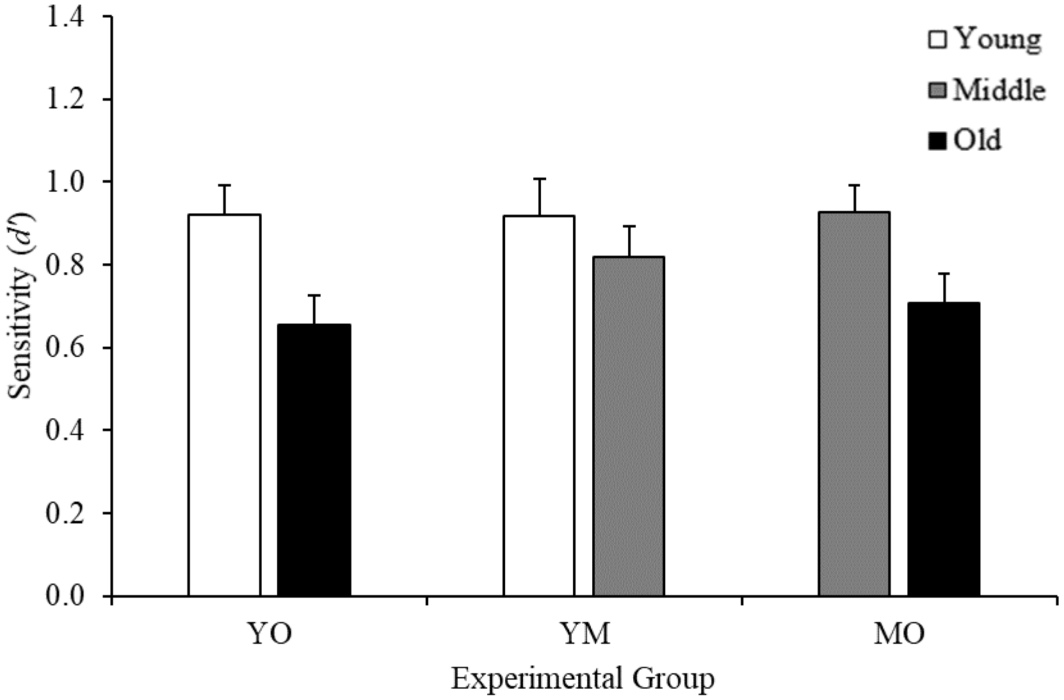

Figure 3. Sensitivity to faces varying in age as measured by *d'* in each experimental group of Experiment 2. Error bars are 1 standard error of the mean.

Table 3

Mean sensitivity (d'), hit rates, false alarm rates, and response bias (C) to young, middle aged and older adult faces in each group in Experiment 2

	d'	Hits	False Alarms	*C*
Young				
Group YO	0.92(0.69)	.53(.22)	.21(.17)	0.34(0.70)
Group YM	0.92(0.83)	.50(.24)	.19(.18)	0.45(0.80)
Middle				
Group YM	0.82(0.69)	.55(.22)	.25(.17)	0.21(0.79)
Group MO	0.93(0.63)	.52(.22)	.21(.19)	0.36(0.79)
Old				
Group YO	0.65(0.69)	.57(.23)	.34(.21)	0.03(0.80)
Group MO	0.71(0.66)	.59(.24)	.34(.23)	-0.02(0.91)

Note: Standard deviations are reported in brackets.

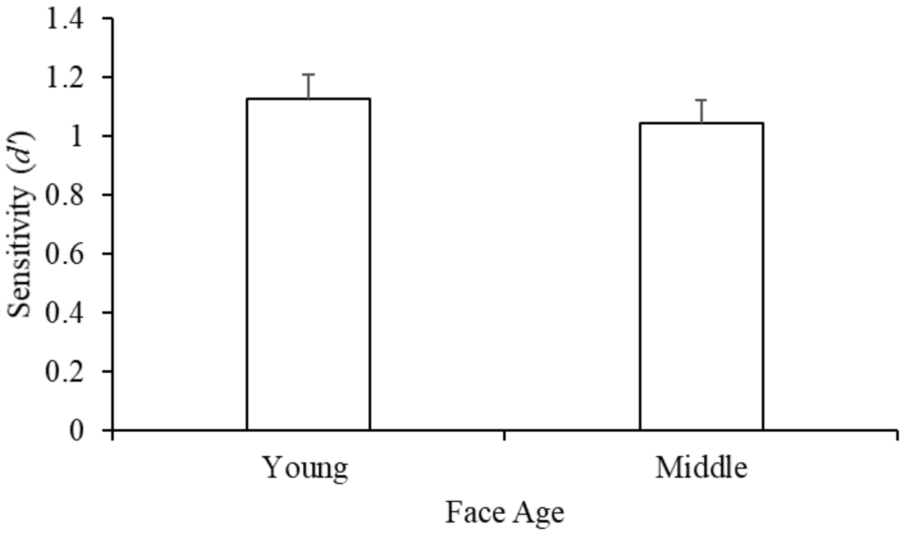

Figure 4. Sensitivity to faces varying in age as measured by *d'* in Experiment 3. Error bars are 1 standard error of the mean.

Table 4

Mean sensitivity (d'), hit rates, false alarm rates, and response bias (C) to stimulus categories in Experiment 3

	d'	Hits	Hits (category)	False Alarms	*C*
Young	1.13(0.76)	.57(.21)	.57(.22)	.19(.20)	0.37(0.51)
Middle	1.05(0.72)	.60(.20)		.22(.17)	0.24(0.42)
Old			.61(.19)		

Note: Standard deviations are reported in brackets. "Hits" compare stimuli based on actual young/middle age categories, "Hits (category)" compare stimuli based on participants' young/old categorisation responses.