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Reviews

Own-age bias in face-name associations: Evidence from memory and visual attention in younger and older adults

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ABSTRACT

Successfully learning and remembering people's names is a challenging memory task for adults of all ages, and this already difficult social skill worsens with age, even in normative "healthy" aging. The *own-age bias*, a type of in-group bias, could affect the difficulty of this task across age. Past evidence supports an own-age bias in face processing, wherein individuals preferably attend to and better recognize faces of members of their own age group. However, the own-age bias has not been examined previously in relation to explicit face-name associative encoding and subsequent name retrieval, despite the importance of this social skill. Using behavioral and eye-tracking methodology, this cross-sectional research investigated the own-age bias for name memory (recognition and recall) and visual attention (fixation count, looking time, and normalized pupil size) when learning novel face-name pairs. Younger adult ($n = 90$) and older adult ($n = 84$) participants completed a face-name association task that tested name memory for younger and older female and male faces, while eye-tracking data were recorded. The visual attention variables taken from the eye-tracking data showed significant age-of-face effects at both encoding and retrieval, but no overall own-age bias in attention. Both younger and older participants showed an own-age bias in name recall with better memory for names paired with faces of their own age, as compared to other-aged faces. This cross-over effect for name memory suggests that memory for information with high social and affective relevance to the individual may be relatively spared in aging, despite overall age-related declines in memory performance.

1. Introduction

1.1. The challenge of face-name associations in aging

Please don't be offended when I don't remember your name. I am bad at remembering names – I've never been good at it. Even though learning people's names is a highly valued social skill, such sentiments are rampant. In fact, successfully learning new face-name associations and recalling names is one of the most challenging memory tasks for adults of all ages (e.g., James, 2004; Mather, 2010). And this already difficult skill worsens with age, even in "healthy" aging, likely due to age-related changes in associative memory. Older adults, compared to their younger counterparts, robustly demonstrate a relative weakness for memory for face-name pairs (Herholz et al., 2001; James & Fogler, 2007; Naveh-Benjamin et al., 2009; Troyer, Häfliger, Cadieux, & Craik, 2006). In fact, older adults generally underperform compared to younger adults on most tests of associative memory, which requires binding of two pieces of information, such as a face and a name (e.g., Horn, Kennedy, & Rodrique, 2018; Naveh-Benjamin & Mayr, 2018).

The high value of remembering new face-name pairs, and the potential social disadvantage associated with failure to do so, underscore the importance of understanding factors that contribute to this age-related memory deficit. Proposed mechanisms underlying deficits in older adults' associative memory include age-related changes in neuroanatomy and brain function (Cabeza et al., 2018; Dennis et al., 2008; Monge, Stanley, Geib, Davis, & Cabeza, 2018) and general decline in cognitive capacities, including attentional resources, mental speed, and information processing (Clapp & Gazzaley, 2014; Ghisletta, Rabbitt, Lunn, & Lindenberger, 2012; Lövdén, Ghisletta, & Lindenberger, 2005; Lustig & Jantz, 2015).

In addition, social-cognitive factors, such as beliefs about age-related decline, are involved in memory success and failure (Beaudoin & Desrichard, 2016; Hess, 2014; Strickland-Hughes, West, Smith, & Ebner, 2016). For example, older adults' memory performance is worse in conditions that emphasize negative age stereotypes (Barber, 2017; Brubaker & Naveh-Benjamin, 2018; Lamont, Swift, & Abrams, 2015).

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Motivational factors, such as intention to recall, affect test outcomes in older individuals (Naveh-Benjamin et al., 2009). Also, younger and older adults show better memory for stimuli that are relatively more valued or important (Hennessee, Knowlton, & Castel, 2018; Seigel & Castel, 2018). This evidence highlights the importance of examining social-cognitive factors linked to age-related change in associative name memory, which is the focus of the present research. In particular, using behavioral and eye-tracking methodology in a sample of younger and older adults, the present research tested the impact of an age-related in-group bias on memory and explored its impact on visual attention.

1.2. Bias and factors associated with bias

In-group bias (Brewer, 1979, 2007) might explain why some pairs of faces and names are more easily learned than others and could contribute to the differential difficulty of this task as a function of age. Improved processing for members of the in-group over members of out-groups has been demonstrated in perception, evaluation, and memory (Hackel, Looser, & Van Bavel, 2014; Ziaei, Persson, Bonyadi, Reutens, & Ebner, 2019). This relatively superior processing may be due to perceptual expertise or extensive contact with members of one's own social groups (McGugin, Tanaka, Lebrecht, Tarr, & Gauthier, 2010; Rhodes & Anastasi, 2012; Wiese, Komes, & Schweinberger, 2013). Yet, in-group bias is also evident when perceptual expertise is held constant, and thus social-motivational processes could contribute to these effects (Bernstein, Young, & Hugenberg, 2007; Hugenberg, Wilson, See, & Young, 2013; Van Bavel, Swencionis, O'Connor, & Cunningham, 2012). In-group versus out-group bias has been evidenced for groups based on gender (Lovén, Herlitz, & Rehnman, 2011; Wolff, Kemter, Schweinberger, & Wiese, 2014), race (Meissner & Brigham, 2001; Rhodes, Sitzman, & Rowland, 2013), and even experimentally-assigned group identities (Bernstein et al., 2007; Hugenberg & Corneille, 2009; Van Bavel & Cunningham, 2012). Of relevance to this paper, in-group bias has also been documented for age group, from childhood to late adulthood (Ebner, 2008;Rhodes & Anastasi, 2012 ; Wiese et al., 2013), called an *own-age bias.*

The own-age bias refers to an in-group bias that is contingent on perceptually identifiable age (Rhodes & Anastasi, 2012; Wiese et al., 2013). Past evidence supports an own-age bias in face perception. A common within-group paradigm used to examine the own-age bias in face perception involves the presentation of photographs of different-aged faces in the context of tasks such as age estimation or emotion identification (Ebner, He, & Johnson, 2011; Fölster, Hess, & Weheid, 2014; Voelkle, Ebner, Lindenberger, & Riediger, 2011). In this paradigm, an own-age bias was suggested by better performance (e.g., greater accuracy) for faces of one's own age group, compared to faces of other age groups. An own-age bias has also been demonstrated for memory, in particular for face recognition (e.g., Neumann, End, Luttmann, Schweinberger, & Wiese, 2015). The present study extended this research by examining for the first time whether an own-age bias contributes to associative memory for names paired with faces, as an important everyday social skill.

Own-age effects may be driven by differences in neural processing for different types of faces and may be moderated by facial emotion (Ebner et al., 2013; Wiese, Schweinberger, & Hansen, 2008; Ziaei et al., 2019). For example, own-age effects in ventral medial prefrontal cortex and insula were found for neutral and happy faces, but not for angry faces (Ebner et al., 2013), while age estimation was more accurate for members of one's own-age group than another age group, especially for neutrally expressive and happy faces (Voelkle et al., 2011). Functional connectivity analyses furthermore suggest that, for both younger and older adults, recruitment of brain networks during processing own-age relative to other-age faces overlapped with brain networks involved in empathy and detection of salient information, with variations by facial emotion (Ziaei et al., 2019).

Other factors, in addition to facial emotion, have been shown to contribute to the own-age bias. Own-age bias, particularly in older adults, may be contingent on level of contact with people of one's own age group (Wiese, Komes, & Schweinberger, 2012). Age estimation and face recognition for older individuals might become easier as we age because over time we experience more contact with older individuals and have increased perceptual expertise for old-age relevant features or have enhanced familiarity with processing older (i.e., own-age) faces (Ebner & Johnson, 2009; Wiese et al., 2013). In support of the perceptual expertise account, meta-analytic data suggest that older adults have superior face recognition for older faces, despite having life experience as a member of other age groups and exposure as well as interaction with younger age groups (Rhodes & Anastasi, 2012). Presumably more frequent, meaningful, and self-relevant recent experience with their own-age group drive this effect. In the case of face-name associative memory, enhanced perceptual expertise for processing own-age faces may "free" cognitive resources to allocate to learning names. Other research suggests, however, that the perceptual expertise account of the own-age bias is incomplete, and a comprehensive explanation of the effect needs to consider socio-cognitive factors as well. For example, motivation and social relevance have been shown to contribute to the own-age bias (Harrison & Hole, 2009; He, Ebner, & Johnson, 2011). That is, social categorization, the relevance and importance of being a member of a certain group, could influence interest or motivation and affect information processing (Van Bavel, Xiao, & Hackel, 2013). Also, there is evidence that the own-age bias for face memory is less pronounced in intentional encoding than in incidental encoding paradigms, suggesting a role of motivation on these effects (Rhodes & Anastasi, 2012). The present research utilized an intentional encoding paradigm for testing the own-age bias in face-name associative memory.

1.3. Own-age bias in memory

The extant research on the own-age bias in memory focuses on face recognition (for a review, see Wiese et al., 2013), often using incidental recognition. That is, the recognition test is a "surprise" and does not accommodate deliberate use of encoding strategies. Robust, converging evidence illustrates that individuals across the lifespan better recognize faces of their own-age group compared to faces of other-age groups (Ebner et al., 2013; Neumann et al., 2015; Wiese et al., 2013), and the effect may be more pronounced for younger adults than older adults (Proietti, Macchi Cassia, & Mondloch, 2014). A meta-analysis demonstrated that healthy children, younger adults, and older adults had more accurate hits and superior discriminability for faces of their own age group than faces of other age groups (Rhodes & Anastasi, 2012).

Collectively, the research on the own-age bias for face recognition indicates that age-related memory deficits may be less pronounced when information refers to one's own group. This social-cognitive process may somewhat counteract the "inevitable" decline in memory with increasing age. In addition, older compared to younger adults may rely more on feelings of familiarity in associative memory tasks (Shing, Werkle-Bergner, Li, & Lindenberger, 2008). This age bias in face familiarity could help older adults in face recognition, a task which generally demonstrates age-related deficits (Germine, Duchaine, & Nakayama, 2011).

One past study tested the own-age bias in associative memory using a recognition paradigm. Across three experiments, Rhodes, Castel, and Jacoby (2008) tested younger and older adults' recognition for *associated pairs* of younger or older faces. Younger adults demonstrated an own-age bias with better discrimination and fewer false alarms for pairs of younger faces. However, older adults did not demonstrate an own-age bias, as their recognition scores were comparable for younger and older pairs of faces. These data suggest that the own-age bias might not be as prevalent for older adults as it is for younger ages, or that the difficulty of associative memory for older adults might outweigh memory benefits for recognizing own-age stimuli. Thus, the own-age bias is evidenced in face recognition, but not for older adults in an associative task. To our knowledge the own-age bias has not yet been tested for name retrieval in the context of associative learning of new face-name pairs, despite the importance and frequent occurrence in real life of this social skill.

1.4. Own-age bias in attention

In this study we also explored whether an own-age bias was evidenced in visual attention to own-age and other-age faces in the context of a face-name associative paradigm. While there is some evidence of an own-age bias for attention (Ebner & Johnson, 2009; He et al., 2011), the evidence across past studies is inconsistent and limited. For example, He et al. (2011) instructed participants to view faces naturally, looking at whatever was interesting to them, as if watching television. Overall, participants looked longer at own-age faces than other-age faces. Further, the difference in amount of time spent looking at own-age compared to other-age faces explained some of the face recognition variance between own-age and other-age faces. Other research, however, suggests that the own-age bias may not extend to visual attention. Firestone, Turk-Browne, and Ryan (2007), for example, reported that older adults had better face recognition for own-age than other-age faces. However, their data suggested that older adults visually attended more to other-age than own-age faces and tended to process younger faces more holistically than older faces. Further, Neumann et al. (2015) manipulated attention across three studies to test the contribution of attention to the own-age bias for face recognition. Their research demonstrated no impact of attention on the own-age bias in face recognition across the different manipulations, such as comparing focused- and divided-attention conditions. Thus, while some evidence suggests that the own-age bias might affect attention, this effect is not consistently supported in past research.

Methodological differences may explain the mixed findings in the literature. In some studies, participants were instructed to make specific social judgments, such as age estimation (Voelkle et al., 2011) or emotion identification (Ebner et al., 2011), or participants were instructed to rate the quality of the faces (Firestone et al., 2007) or to passively "view the faces naturally" (He et al., 2011). Less previous work included explicit memory instructions and, to our knowledge, no work on the own-age bias used an associative face-name memory task or required multimodal processing (associating a visually-presented face with an auditorily-presented name) comparable to a real-world social situation. Changes in paradigm, including the extent to which learning is intentional, and the particular stimulus elements which are targets of attention (e.g., emotion vs. age, picture quality vs. interesting details, face vs. name), may contribute to how participants visually attend and cognitively process information (Ebner & Johnson, 2009; Naveh-Benjamin et al., 2009; Rhodes & Anastasi, 2012). Also, differences between younger and older adults' memory performance may be greater in incidental learning paradigms, compared to intentional learning (Naveh-Benjamin et al., 2009). Participants may focus on distinctive features such as the eyes or jaw following instructions to view faces naturally. In contrast, participants may be motivated to sample the faces more thoroughly if told their memory will be tested (Scherf & Scott, 2012), as in the present research, particularly if memory performance is personally meaningful or important to them (i.e., information related to their own-age group). Thus, in the present study, we collected eye-tracking data, as a proxy for visual attention, to further contribute to the literature regarding an own-age bias in visual attention.

2. Present study

Using a face-name association paradigm, the present study's primary aim was to extend the research on the own-age bias for memory to name retrieval. This skill is a highly-relevant social task that declines with increased age. Because no past research has examined the own-age bias for name retrieval, we built our hypotheses from the extant research evidencing an own-age bias for face recognition. We used an intentional retrieval paradigm, with explicit instructions to study the faces and names for a name memory test. Further, using eye-tracking methodology, we investigated the own-age bias in visual attention to further inform the still sparse, and mixed, evidence for an own-age bias in attentional processes.

We hypothesized that younger participants would outperform older participants in name memory (*Hypothesis 1a*). Based on evidence of the own-age bias in face recognition, we hypothesized that both age groups would have better name memory for faces of their own versus the other age group (*Hypothesis 1b*). We did not formulate a specific hypothesis regarding potential age differences in the own-age bias given the lack of previous data on explicit associative memory tasks, and the typical age declines in associative recall.

Regarding attention (see methods for additional details regarding the specific attentional measures), based on previous research (He et al., 2011; Slessor, Laird, Phillips, Bull, & Filippou, 2010), we predicted that both younger and older participants would show own-age effects for our attentional measures: a greater number of fixations (*Hypothesis 2a*), longer looking times (*Hypothesis 2b*), and larger pupil sizes (*Hypothesis 2c*), when viewing own-age compared to other-age faces. Previous research on bias suggests that these visual attentional effects may occur. Again, no hypotheses were made about age differences in this bias, due to inconsistent evidence from previous research as discussed above. However, this relatively exploratory aim of the research provides a unique opportunity to contribute to the still limited understanding of how the own-age bias may operate in visual attention processes in younger and older adults. This test is important given that attention is critical for memory success, and attentional processes typically decline in aging (Lustig & Jantz, 2015). Yet, results of past research on own-age bias for attentional processes do not parallel the findings for memory (e.g., Neumann et al., 2015).

3. Methods

3.1. Participants

This study reports data collected from 90 younger (18–27 years old; $M = 19.22$, $SD = 1.31$ years; 71.1% female) and 84 older (68–81 years; $M = 73.36$ years; $SD = 3.48$; 70.2% female) generally healthy community-dwelling participants. Analyses in G*Power (version 3.1.9.4; Faul, Erdfelder, Lange, & Buchner, 2007) indicated that a sample size of 168 participants would have 80% power (1 - β error probability) to detect a 2 × 2 between-within mixed model interaction with a small-to-medium effect size of Cohen's $f = 0.22$ and $\alpha = 0.05$. Younger participants were recruited from an Introduction to Psychology course and were compensated with course credit. Older participants were recruited from existing university participant pools, word-of-mouth, and advertisements, and were compensated with their choice of memory handouts or a $20 gift card.

All participants were White to control for own-race bias in face processing (Meissner & Brigham, 2001; Wiese & Schweinberger, 2018), given that all face stimuli were of White individuals (see description below in 3.3.1; see also Ebner, Riediger, & Lindenberger, 2010). Participants were native-English speakers to assure familiarity with the selected names (see stimuli description in 3.3.1). Participants had normal or corrected-to-normal vision and hearing adequate to complete a telephone interview. Further, older participants were free from cognitive impairment, using inclusion criterion of scores at or above 31 on the Telephone Interview for Cognitive Status (TICS; Brandt, Spencer, & Folstein, 1988). Table 1 reports descriptive demographic, health/sensory, and cognitive information for the final sample.

In addition to the 174 participants included in final analyses and

Table 1
Means and standard deviations of participant demographics, health, and sensory and cognitive functioning.

Measure	Older participants		Younger participants		Age differences			
	M	*SD*	*M*	*SD*	*df*	*t*	*p*	Cohen's *d*
Demographics								
Years of education	16.44	2.77	12.83	1.23	172	−11.20	< .001	1.68
Health and sensory functioning								
Physical health rating[a]	8.27	1.44	8.58	1.13	172	1.55	.122	0.24
Mental health rating[a]	8.87	1.17	8.62	1.20	172	−1.37	.173	0.21
Visual acuity	0.52	0.11	0.61	0.00	172	7.15	< .001	1.16
Michelson contrast sensitivity	0.74	0.29	0.67	0.16	171	−2.12	.035	0.30
Normal or corrected vision rating[a]	8.86	1.10	9.34	0.77	171	3.49	.001	0.51
Normal or corrected hearing rating[a]	8.04	1.56	8.98	1.05	172	4.71	< .001	0.71
Cognitive functioning								
Category fluency	19.50	4.80	23.17	5.76	172	4.55	< .001	0.56
Baseline working memory	7.26	2.51	8.49	2.76	172	3.06	.003	0.47
Immediate working memory	8.70	2.56	9.11	2.00	172	1.18	.240	0.18

[a] Using a scale from 1 = *poor* to 10 = *excellent.* Visual acuity scores are in the decimal system (the reciprocal value of the size of the gap to 20/20 vision, where 1.0 represents 20/20 vision). Greater Michelson contrast sensitivity scores represent better contrast sensitivity.

described above, 29 participants completed the study but were excluded from all analyses for poor eye-tracking calibration, outlier performance for name recognition (more than three standard deviations below the mean), computer error, or failure to follow instructions.

3.2. Procedure

The study protocol was approved by the University of Florida IRB (#2013-U-0511). Participants were asked to complete a preliminary phone interview (30–45 min) followed by an individual testing session (1.5–2 h). During the phone interview, after verbal informed consent, participants were screened for study eligibility, provided demographic and health information, and completed baseline cognitive assessments. During the onsite session, after written informed consent, participants completed the Face-Name Association (FNA) task, and other measures not relevant to this report (see Strickland-Hughes et al., 2016). Participants' visual acuity and contrast sensitivity (Bach, 1996), as standard performance-based measures used in eye-tracking methodology, were tested prior to the FNA task.

3.3. Face-Name Association (FNA) task

3.3.1. Task overview

The FNA task measured accuracy of immediate name memory for unfamiliar face-name pairs with four blocks of encoding and testing (both name recognition and name recall). Fig. 1 illustrates the task paradigm for each block. Task instructions were intentional – *study the faces in order to remember the names later*. Each block included 12 same gender face-name pairs comprising six younger faces and six older faces with no more than two faces of the same age presented consecutively in the set of 12. Name memory testing immediately followed encoding for each block. Fixation crosses were presented for 2 s, non-jittered, between faces, both in encoding and testing blocks.

During encoding, faces were presented on the computer monitor (12 s each) with auditory presentation of target first names at a 2 s delay (all name stimuli were high frequency according to the United States Social Security Administration, 2011). Audio recordings of age- and gender-matched actors reading the names were standardized for sound levels. During testing, the same faces were presented again for 10s, in a different order, with six blocked trials that tested name recognition and six blocked trials that tested name recall, counterbalanced by face age (younger vs. older) and type of memory task (recognition vs recall). Recognition trials were included so that eye-tracking data could be garnered for a large number of encoding trials (48 total faces), while at the same time not overwhelming participants by requiring recall for all 48 names (for additional stimulus and procedural details, see Strickland-Hughes et al., 2016).

The face stimuli were photographs of neutrally-expressive, younger and older White faces selected from the FACES database (Ebner et al., 2010). This database is a standardized while naturalistic database of faces: The photographs control for clothing (all persons in a grey t-shirt), background, and emotional expression. The high-resolution, color images of faces on a grey background were centered on the monitor and presented at a distance similar to the size of a face at a conversational distance. Stimuli were presented on a 19-in. (48.3 cm) ViewSonic VG932m color monitor from a distance of 50–55 cm.

The FACES database includes norm ratings from 154 young, middle-aged, and older men and women for each face's facial attractiveness and distinctiveness, using scales from 1 to 100 (Ebner et al., 2018). Past research suggests that evaluations of facial attractiveness and facial distinctiveness, as well as their possible relationship to face recognition, varies by age and gender of perceiver, and that these face characteristics do not underlie an own-age bias for face recognition (Lin, Fischer, Johnson, & Ebner, 2019; Lin, Lendry, & Ebner, 2015; Wiese, 2012). However, to control for these face characteristics, we excluded the most and least attractive and the most and least distinctive faces, within each age (younger vs. older) by gender (male vs. female) group, among those faces available from the FACES database. Faces used in the present study were then randomly assigned to blocks of same-gender, younger or older faces for our associative face-name memory task.

3.3.2. Memory outcome measures

Name memory focused on accuracy (i.e., the participant provided the correct name for a face at test) and was operationalized as the total number of correct trials per face age group (younger vs. older faces), with separate scores for *name recall* (theoretical range: 0–12) and for *name recognition* (theoretical range: 0–12). During name recall trials, participants were asked to recall the correct name of the face without an auditory cue. During name recognition trials, participants selected the correct name from two choices, the target name and a distractor name (not previously heard during the task). Name recognition was expected to be at ceiling, so recognition was not a focus of this research. We used lenient scoring for pronunciation (e.g., accepted "On-Drey-Ah" for "Ann-Drey-Ah") and strict scoring for nicknames (e.g., did not accept Mike or Mickey for Michael, nor Chuck or Charlie for Charles).

3.4. Eye-tracking equipment and procedures

An SR Research Ltd. EyeLink 1000 Legacy eye tracker, with temporal resolution of 2000 Hz and a spatial resolution of 0.02°, collected eye-tracking data during encoding and retrieval trials of the FNA task. Participants kept their heads on a mounted chin rest to minimize

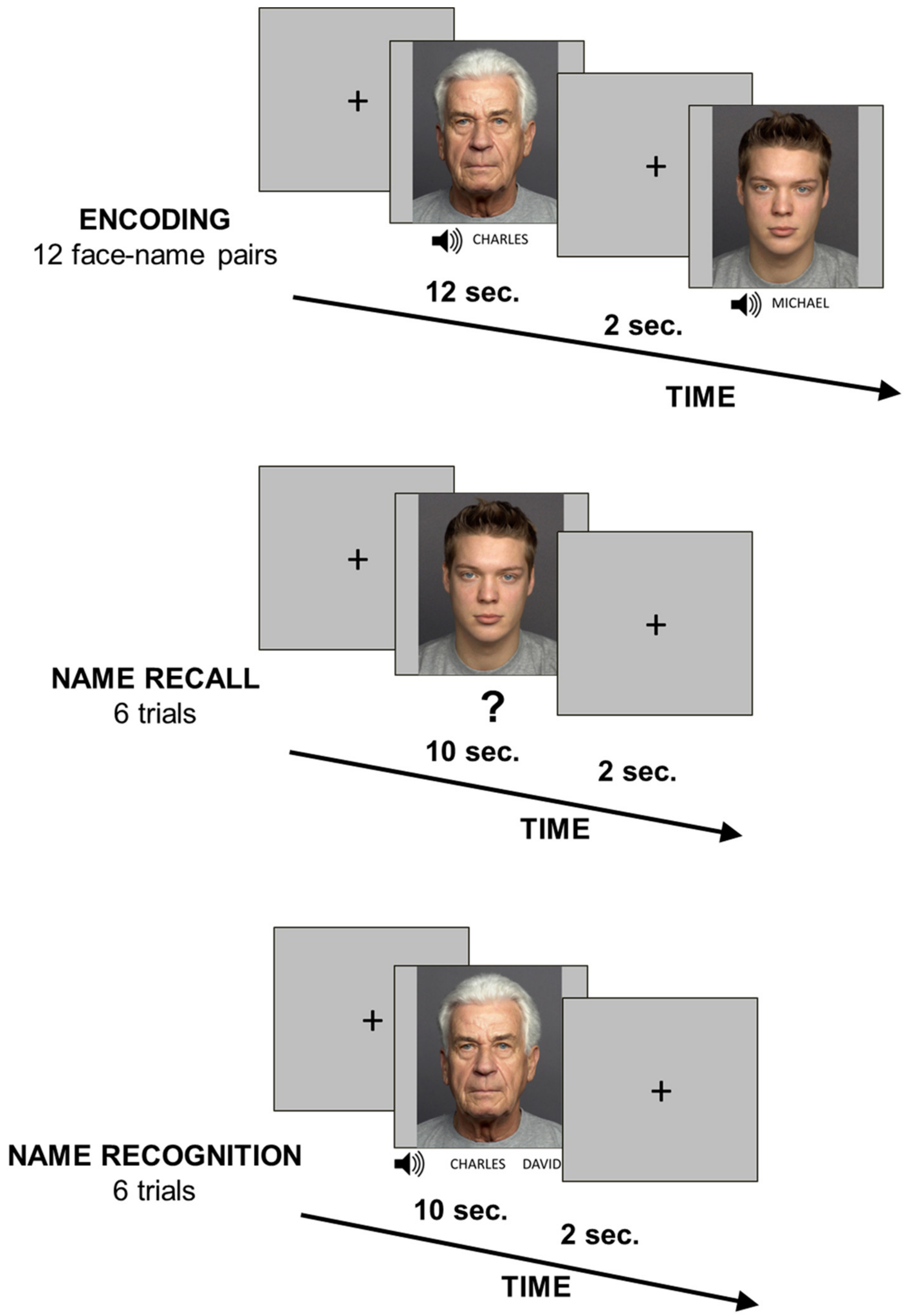

Fig. 1. Example stimuli, trial timing, and trial sequence for a block of the Face-Name Association (FNA) task.

motion or variation in angle of view. A 9-point calibration was conducted at the start of the task, and the system automatically prompted recalibration if the error at any drift correct point (start of each block) was > 5°. Participants' left-eye pupil size, gaze position, and movement were recorded. All testing sessions were administered in the same windowless room, and lighting conditions were constant across all participants.

3.4.1. *Visual attention outcome measures*

Key visual attention variables were calculated separately for encoding and retrieval, using the full encoding or retrieval interval for this first investigation of attentional variables that might be related to an own-age bias in associative memory. Three variables from the eye-tracking data were selected: fixation count, looking time, and normalized pupil size. A higher fixation count and longer looking time can be interpreted to represent more focused attention, and a larger normalized pupil size can be interpreted to represent greater arousal or cognitive effort (Kahneman & Beatty, 1966; Querino et al., 2015; Sirois & Brisson, 2014). *Fixation count* was defined as the average number of fixations per face, with fixations defined as gaze within 1° visual angle of an area for at least 100 ms, which allowed for meaningful separation of these movements from saccades, the fast eye movements occurring between fixations (Isaacowitz, 2006). *Looking time* per face was calculated as the product of fixation count and fixation duration, to yield the total number of seconds looking at a face. Pupil size was originally recorded in arbitrary units, then normalized for each participant to account for individual variability and age-related variation in pupil size. Specifically, *normalized pupil size* was calculated by dividing the difference between average and minimum pupil size by the pupil size range (maximum less minimum pupil size) and multiplying by 100

Table 2
Means and standard deviations for memory performance and visual attention by age group and face age.

	Younger participants				Older participants			
	Own-age faces		Other-age faces		Own-age faces		Other-age faces	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Memory Performance								
Recall[a,b]	6.78	2.53	6.19	2.31	3.86	2.17	2.67	1.99
Recognition	11.82	0.44	11.84	0.42	11.57	0.75	11.58	0.66
Visual Attention								
Encoding								
Fixation count	32.57	5.27	32.72	5.38	33.11	5.42	33.13	5.54
Looking time[a]	9752.12	1045.49	9742.96	1029.05	8768.46	1533.34	8735.24	1316.51
Normalized pupil size[a,c]	59.82	16.03	56.71	15.49	62.09	15.64	64.85	15.31
Recall								
Fixation count[c]	26.28	4.43	26.74	4.47	26.41	4.32	26.31	4.26
Looking time[a,c]	7572.89	946.29	7649.91	807.52	6919.12	1181.82	6868.17	1181.59
Normalized pupil size[b,c]	78.89	17.58	74.42	17.03	80.22	16.63	82.82	16.74

[a] Indicates significant main effect of age.
[b] Indicates significant main effect of face age group.
[c] Indicates significant interaction. Theoretical range for recall and recognition is 0–12. Looking times is presented in milliseconds.

(Piquado, Isaacowiz, & Wingfield, 2010). For normalization, we collected minimum and maximum pupil area values when looking at white and black screens for 15 s each, respectively, prior to the start of the task.

4. Results

Separate 2 participant age (between: younger, older) × 2 face age (within: own, other) repeated measures mixed-model univariate ANOVAs were conducted to test for an own-age bias in name memory and visual attention. Appropriate *F*-test approximations are reported where necessary. We applied a significance criterion of $p < .05$. Table 2 reports means and standard deviations for each dependent variable.

4.1. Own-age bias for name memory

4.1.1. Name recall

We first examined the own-age bias for name recall. Consistent with *Hypothesis 1a*, the main effect of participant age was significant, $F(1,172) = 112.81$, $p < .001$, $\eta_p^2 = 0.396$. Younger participants performed better in name recall than older participants. Additionally, in support of *Hypothesis 1b*, the main effect of face age was significant, $F(1,172) = 30.23$, $p < .001$, $\eta_p^2 = 0.149$. As shown in Fig. 2, both younger and older participants showed better name recall for names paired with own-age faces compared to names paired with other-age faces. The participant age × face age interaction was marginally significant, $F(1,172) = 3.46$, $p = .065$, $\eta_p^2 = 0.020$, and showed a trend for stronger own-age bias in name recall in older than younger participants. Pairwise comparisons indicated better name recall for own-age faces than other-age faces in both younger participants ($M_{diff} = -0.59$, $p = .010$, 95% CI [0.15, 1.03]) and older participants ($M_{diff} = 1.19$, $p < .001$, 95% CI [0.73, 1.65]), but the difference was greater for older participants.

4.1.2. Name recognition

As mentioned earlier, our focus in the present paper was on name recall, but we also included name recognition trials to provide additional eye-tracking data without rendering the task too difficult. As expected, recognition results were at ceiling (98% correct overall; skewness = −1.72; kurtosis = 2.46) and we did not analyze those data further. Means and standard deviations by age group and face age are reported in Table 2.

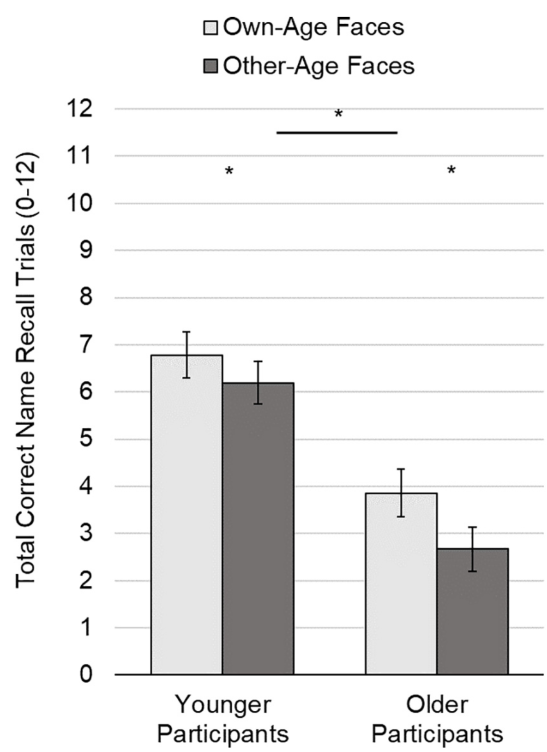

Fig. 2. Name recall by age group and face age
Note. Name recall memory for own- and other-age faces by age group. * With line indicates significant main effect of age group, $p < .05$. * indicates significant difference between own-age and other-age face trials within an age group, $p < .05$. Error bars represent 95% confidence intervals.

4.2. Own-age bias for visual attention

4.2.1. Own-age bias in attention during encoding

We examined an own-age bias for attention during encoding trials separately for fixation count (*Hypothesis 2a*), looking time (*Hypothesis 2b*), and normalized pupil size (*Hypothesis 2c*).

4.2.1.1. Fixation count during encoding. For fixation count, none of the effects were significant. Older participants ($M = 33.12$, $SE = 0.59$) and younger participants ($M = 32.63$, $SE = 0.57$) showed a similar number of fixations, $F(1,172) = 0.35$, $p = .555$, $\eta_p^2 = 0.002$. Number of fixations was also similar when viewing own-age faces (M = 32.82, SD = 5.34) and other-age faces (M = 32.92, SD = 5.45), $F(1,172) = 0.93$, $p = .337$, $\eta_p^2 = 0.005$. The interaction between participant age and face age was not significant, $F(1,172) = 0.52$, $p = .474$, $\eta_p^2 = 0.003$.

4.2.1.2. Looking time during encoding. For looking time, the main effect of participant age was significant, $F(1,172) = 29.39$, $p < .001$, $\eta_p^2 = 0.146$, in that younger participants (M = 9748.53, SE = 127.61) looked longer at faces than older participants (M = 8751.85, SE = 132.09). Looking time was similar when viewing own-age faces (M = 9277.25, SD = 1390.44) as when viewing other-age faces (M = 9256.48, SD = 1277.24), $F(1,172) = 0.25$, $p = .615$, $\eta_p^2 = 0.001$). Further, the participant age × face age interaction, $F(1,172) = 0.082$, $p = .775$, $\eta_p^2 < 0.001$, was not significant. Total looking time during encoding did not differ by face age, and younger participants looked longer than older participants, regardless of face age.

4.2.1.3. Normalized pupil size during encoding. For normalized pupil size, the main effect of participant age was significant, $F(1,172) = 4.85$, $p = .029$, $\eta_p^2 = 0.027$. Younger participants (M = 58.26, SE = 1.64) had smaller pupils during encoding than older participants (M = 63.47, SE = 1.70). The main effect of face age was not significant, $F(1,172) = 1.05$, $p = .306$, $\eta_p^2 = 0.006$, suggesting no difference in pupil size when viewing own-age faces (M = 60.91, SD = 15.84) versus other-age faces (M = 60.64, SD = 15.89). However, as depicted in Fig. 3A, the participant age × face age interaction was significant, $F(1,172) = 287.23$, $p < .001$, $\eta_p^2 = 0.625$. Younger participants had larger pupils when viewing faces of their own-age group, but older participants had smaller pupils when viewing faces of their own-age group. That is, pupil size was larger during encoding of younger faces than older faces, for both age groups.

4.2.2. Own-age bias in attention during recall

Separate analyses of the three eye-tracking variables during recall – fixation count (*Hypothesis 2a*), looking time (*Hypothesis 2b*), and normalized pupil size (*Hypothesis 2c*) – were conducted to observe whether an own-age bias in attention was present during retrieval.

4.2.2.1. Fixation counts during recall. For fixation counts, there was no significant effect for participant age, $F(1,172) = 0.05$, $p = .819$, $\eta_p^2 < 0.001$. That is, the younger participants (M = 26.51, SE = 0.46) and older participants (M = 26.36, SE = 0.47) did not differ in number of fixations across all faces. However, both age groups showed a trendwise effect for fewer fixations overall for own-age faces (M = 26.34, SD = 4.37) than other-age faces (M = 26.53, SD = 4.36), $F(1,172) = 3.10$, $p = .080$, $\eta_p^2 = 0.018$. The interaction between participant age and face age was significant, $F(1,172) = 7.55$, $p = .007$, $\eta_p^2 = 0.042$: Pairwise comparisons indicated that younger participants had fewer fixations for own-age faces than other-age faces (M_{diff} = − 0.46, $p = .001$, 95% CI [−0.74, −0.18]), but older participants did not differ in fixation counts for other-age and own-age faces (M_{diff} = 0.10, $p = .493$, 95% CI [−0.19, 0.39]).

4.2.2.2. Looking time during recall. Similar to encoding trials, during recall trials younger participants looked longer overall (M = 7611.40, SE = 106.93) than did older participants (M = 6893.65, SE = 110.69), $F(1,172) = 21.75$, $p < .001$, $\eta_p^2 = 0.122$. Looking time was similar for own-age faces (M = 7257.28, SD = 1112.70) and other-age faces (M = 7272.52, SD = 1076.47), $F(1,172) = 0.16$, $p = .686$, $\eta_p^2 = 0.001$. However, the participant age × face age interaction was significant, $F(1,172) = 3.94$, $p = .049$, η_p^2. = 022. Although the difference between looking time at recall was not statistically different for own-age and other-age faces for younger or older participants, the direction of the mean difference varied with age: Whereas younger participants spent *less* time looking at own-age faces compared to other-age faces (M_{diff} = −77.02, $p = .087$, 95% CI [−165.45, 11.40]), older participants spent *more* time looking at own-age faces versus other-age faces (M_{diff} = 50.95, $p = .273$, 95% CI [−40.58, 142.48]).

4.2.2.3. Normalized pupil size during recall. Normalized pupil size during recall did not differ by age group, $F(1,172) = 3.58$, $p = .060$, $\eta_p^2 = 0.020$, although there was a trend for older participants (M = 81.52, SE = 1.85) compared to younger participants (M = 76.65, SE = 1.79) to for larger normalized pupil sizes during recall. Normalized pupil size did differ by face age, $F(1,172) = 16.63$, $p < .001$, $\eta_p^2 = 0.088$. Pupil size was larger when viewing own-age faces (M = 79.53, SD = 17.09) than other-age faces (M = 78.47, SD = 17.36) for both age groups overall. However, this effect was

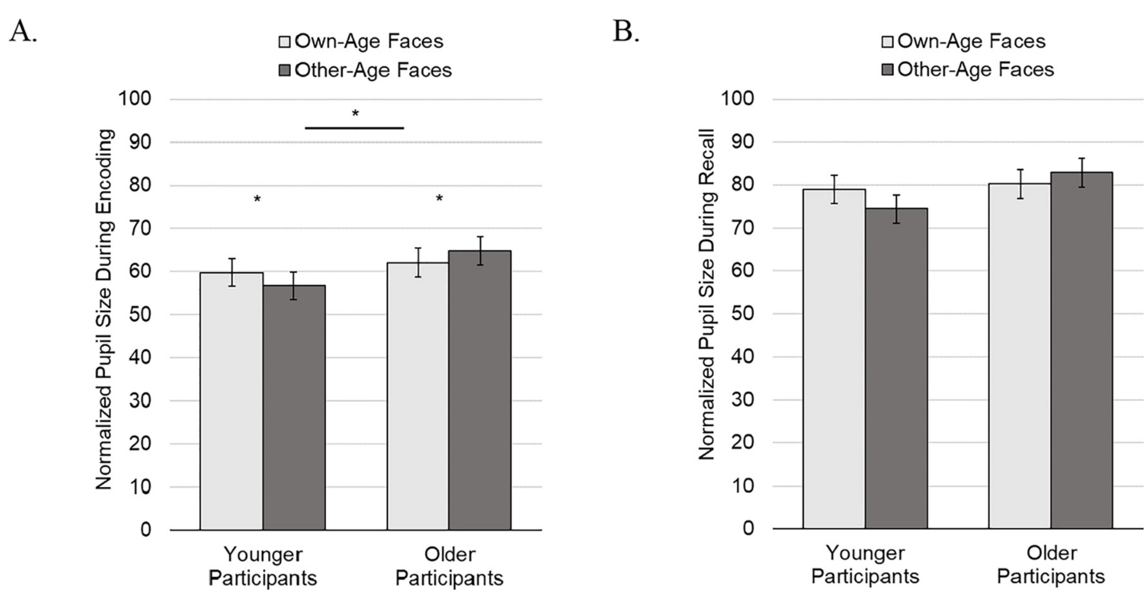

Fig. 3. Normalized pupil size by participant age and face age during encoding and recall

Note. Normalized pupil size (0−100) during A) encoding and B) recall. * With line indicates significant main effect of participant age, p < .05. * Indicates significant difference between face age within a participant age group, p < .05. Error bars represent 95% confidence intervals.

qualified by a significant participant age × face age interaction, $F(1,172) = 235.49$, $p < .001$, $\eta_p^2 = 0.578$. Younger participants had greater pupil size for own-age faces than other-age faces ($M_{diff} = 4.47$, $p < .001$, 95% CI [3.84, 5.10]), while older participants had smaller pupil size for own-age faces than other-age faces ($M_{diff} = -2.59$, $p < .001$, 95% CI [−3.45, −1.94]). This result parallels our findings for normalized pupil size during encoding and suggests larger pupil size in both age groups when recalling names for younger faces.

5. Discussion

In this paper we report novel evidence of an own-age bias in name recall among both younger and older adults, using an associative memory paradigm. As expected, we also found basic age differences in memory and visual attention. With respect to the three visual attention variables taken from eye-tracking data, we found age-of-face effects with some variation across encoding and retrieval, but no evidence for an own-age bias in attention. This work critically extends current knowledge on the own-age bias to name memory and thus offers novel theoretical and empirical insights for social-cognitive and aging research. A summary and discussion of the central results from this study and recommendations for future research to build on these interesting findings are considered below.

5.1. Own-age bias supported for name memory

We report evidence of a complete crossover effect for own-age bias in name memory: Both younger and older participants showed better name memory for own-age faces than other-age faces. Previous research shows an own-age bias in face recognition for younger and older adults, with this effect possibly less pronounced for older adults (Rhodes & Anastasi, 2012; Wiese et al., 2013). Our study is the first to extend the past research to an own-age bias for name memory in an associative face-name task, an ability sensitive to age-related impairment (Hosey, Peynircioğlu, & Rabinovitz, 2009; James et al., 2012). This own-age bias in name recall observed in the present study was significant in both younger and older adults.

The previously-reported own-age bias in face recognition may have contributed to this effect for name memory, as faces needed to be recognized in order for names to be remembered accurately. However, our results are unlikely based solely on face recognition: Name recognition scores were at ceiling for both younger and older participants in our study, and name recognition is typically more challenging than face recognition. Thus, face recognition would likely also have been at ceiling in the present study, making it unlikely that face recognition per se could have accounted for the own-age bias in name recall.

At the same time, explanations for the own-age bias in past recognition research may be relevant here. Researchers examining the own-age effect in face recognition have typically explained the observed results by focusing on (i) experience-based accounts, such as the amount of recent contact with persons of different age groups and perceptual expertise, (ii) socio-cognitive accounts, such as motivation, aging attitudes and other social in-group biases, and (iii) related factors, such as neural correlates or specific characteristics of the facial stimuli. Our study was not designed to test the differential strength of these alternative interpretations. Instead, our study was focused on examining whether the face recognition effect could be extended to name recall, in a face-name association paradigm. Now that we have observed the own-age bias in recall, future studies could compare experience-based and socio-cognitive accounts to better understand how these factors might differentially, or in tandem, contribute to the own-age bias across varying research paradigms.

This intriguing finding for own-age bias in name recall found in the present study contributes to the growing evidence that memory for information with high social and affective relevance to the individual may be relatively spared in aging, despite overall age-related memory decline (e.g., Park & Festini, 2016). Name recall is a socially relevant but difficult task, particularly for older adults (Hosey et al., 2009; James et al., 2012). Evidence of improved memory for information related to one's own-age group, compared to another-age group, in the context of name recall is important to be considered as researchers develop memory intervention programs for highly ecologically relevant tasks like remembering face-name pairs. For example, effects of additional exposure to faces varying in age, and consideration of how best to identify and encode facial features common for different age groups, could inform a more comprehensive and effective approach to training memory for face-name associations.

5.2. Variations in visual attention for young and old faces

This research further tested whether younger and older adults showed an own-age bias in visual attention to faces, using fixation counts, looking time, and normalized pupil size as proxies for attention. These data were collected during encoding and retrieval blocks, using eye-tracking equipment. Overall, the eye-tracking data did not support an own-age bias in attention in our face-name association paradigm. However, we did find that both younger and older participants looked longer at older faces than younger faces during retrieval, but there was no age-of-face effect for looking time at encoding. Also, younger participants showed fewer fixations for own-age faces than other age faces at retrieval, but not at encoding, and this pattern did not hold for older participants. In addition, for both younger and older participants, normalized pupil size was larger for young than old faces, with this effect present at both encoding and retrieval.

The retrieval effect of longer looking at older faces than at younger faces for both age groups could suggest that additional time or effort was needed to recall older faces, by both age groups. Speculatively, for younger participants, perhaps older faces were less familiar (not from their own age group), and for older participants, perhaps older faces motivated them to work harder on during retrieval (possibly due to their greater self-relevance by being of their own-age group). Alternatively, the observed effects may indicate that older faces were seen as more interesting by both age groups, maybe due to their greater variability in distinctive features Ebner et al., 2018; Valentine, 1991; but see Ebner, 2008. These possible (alternative) explanations could be sorted out in future research using think-aloud protocols or neuroimaging during recall, focusing on indications of motivation, effort, or self-relevance. Also, given that the age-of-face effects for visual attention varied somewhat across encoding and retrieval in the present study, future eye-tracking studies that used face-name association tasks would be informative if they systematically varied facial features (see Section 5.3) or examined eye-tracking data across smaller units of time.

The pattern of results for normalized pupil size suggested an overall attention preference for younger over older faces, in younger and older participants alike. The literature discusses whether increased pupil size reflects arousal as well as increased attention or cognitive load (Sirois & Brisson, 2014). Interestingly, older participants in our study, who performed worse and for whom the task may have been more difficult, had larger pupil size overall than younger participants. Larger pupil size when learning and retrieving names for younger compared to older faces may suggest that younger faces are more difficult to learn. However, in the present study, larger pupil size when studying younger faces did not “map” directly onto memory performance, as both younger and older participants had better name memory for members of their own-age group. This finding is consistent with Firestone et al. (2007), wherein visual attention for older faces was lower than that for younger faces, but subsequent face recognition for older adults was superior for older faces.

It is possible that the lack of evidence for an own-age bias in visual attention was related to task difficulty and specific viewing instructions in the present study. Notably, task difficulty disproportionately disadvantages memory performance in older adults, compared to younger adults (Earles, Kersten, Mas, & Miccio, 2004; Luo & Craik, 2008). Furthermore, specific viewing instructions, e.g., intentional versus incidental, may impact task difficulty and individuals' strategic approach and attention to memory tasks (Naveh-Benjamin et al., 2009). Future visual attention research on the own-age bias could benefit from systematic variation of task difficulty and viewing instructions and could monitor participants' motivation and interest level during task pursuit to determine the role of these variables in visual attention. A thorough understanding of the specific conditions under which there is an own-age bias in attention could prove practically relevant for older adults, as attention is related to memory and can be difficult to volitionally control.

5.3. Strengths and limitations

In addition to generating intriguing novel findings, the present study had various methodological strengths compared to previous research. For example, the counterbalanced design of our memory task controlled for any potential confounding effects of group membership, such as gender. Using eye-tracking, we were able to examine multiple variables that have been suggested in research to have meaningful interpretation as a proxy for attention.

Another strength of our approach was to control a number of facial features that can impact recall and attention data. This approach was warranted, we believe, because this was the first study to look at the own-age bias in face-name associative recall. In development of the FNA task (Strickland-Hughes et al., 2016), we excluded faces that were extremely high or low in distinctiveness or attractiveness ratings (in relation to their own age group) as determined in a separate sample (Ebner et al., 2010, 2018). Nevertheless, participants in the present study may have still perceived older faces as more distinctive or less attractive overall than younger faces. At the same time, these variations did not outweigh the own-age bias in memory, which aligns with findings in the own-race bias literature on face recognition (Valentine & Endo, 1992).

Looking at distinctiveness in particular, younger faces may have fewer distinctive features than older faces, given normative age-related changes in facial appearance, such as increased wrinkles with advanced age (Ebner et al., 2018; Valentine, 1991; but see Ebner, 2008). Indeed, older faces were rated as more distinctive than younger faces by younger, middle-aged, and older adults (Ebner et al., 2018), and more distinctive compared to less distinctive faces were more easily remembered (Valentine, 1991). However, other research indicates that facial distinctiveness does not explain the own-group bias (Valentine, 1991; Valentine & Endo, 1992; Wiese, 2012). Further, facial distinctiveness ratings vary according to perceiver characteristics, including age (Ebner et al., 2018).

Similarly, recent evidence suggests that facial attractiveness does not affect memory for older faces as younger faces and does not affect older adults' memory as much as younger adults' memory (Lin et al., 2019; Lin et al., 2015; but wee Wiese et al., 2013). Thus, if our findings for normalized pupil size were driven by facial attractiveness, these effects are unlikely to have affected recall performance. Finally, older faces may be somewhat lighter or brighter than younger faces, due to normative age-related changes to hair and skin, et cetera. However, the stimuli from the FACES database (Ebner et al., 2010) were standardized (e.g., all pictures used the same grey background and t-shirts, and pictures were taken under controlled lighting conditions), and we carefully controlled the lighting in our own testing environment. Any other brightness differences due to facial feature changes with age represent real-world differences that we did not want to eliminate in our naturalistic face stimuli.

Instead of standardizing and controlling multiple facial features, as was done in this study, future research could systematically vary attractiveness, distinctiveness and brightness, or other facial features, to test their impact on both name recall and related attentional variables, such as in Wiese, Altmann, and Schweinberger (2014). Further, more nuanced measures of visual attention, such as area of interest analyses or examination of saccades (Kawakami et al., 2014), might provide insight as to whether younger and older adults more holistically process own-age faces (e.g., Firestone et al., 2007). Testing with inverted faces, or different faces of the same models at encoding and retrieval would be helpful in understanding the extent to which an own-age bias in name memory is driven by perceptual expertise, for example, if holistic processing is used more for own-age faces than other-age faces.

We acknowledge that sample characteristics may limit the generalizability of our findings. The study used specifically only White participants and faces to control for any race effects in memory performance. While this was an important methodological distinction in order to purely evaluate the own-age bias, it poses a limitation in the study's generalizability to other races, and future work is needed to replicate our findings with other racial groups. In addition, the present sample of participants was largely female (approximately 70% in both younger and older age groups). However, the percentage of female participants was comparable for both age groups (i.e., participant gender was not confounded with age). Further, this high percentage of female participants may effectively represent older adults, as females live longer, and older women outnumber older men (Federal Interagency Forum on Aging-Related Statistics, 2012). Also, we did not assess individual participants' levels of exposure or expertise with their own versus other age groups. Previous literature has shown that exposure to a social group can affect perceptual expertise and ability to discriminate (Harrison & Hole, 2009).

5.4. Conclusion

The present study examined name memory and visual attention in the context of a multi-modal face-name associative paradigm. Our findings replicated past research indicating that older adults are at particular disadvantage compared to younger adults in face-name learning. At the same time, the data suggested that socially and emotionally relevant information (e.g., own-age names) may influence name memory for young and old alike. These results show that the impact of own-age bias on learning and memory across adulthood may be more comprehensive than previously found and extend to name recall. With respect to visual attention, there was no evidence for the own-age bias for the highly controlled, though naturalistic, facial stimuli used in the present study. Somewhat mixed age differences across eye tracking variables during encoding and retrieval suggest the value of direct examination of facial features such as distinctiveness or attractiveness, and direct tests for the impact of facial stimulus characteristics in future studies.

Our findings for face-name memory have potential to inform memory interventions to assist older adults with employing strategies to bolster name memory as a crucial social skill in their everyday lives. Pending further investigation of potentially relevant variables, we speculate that the impact of social and motivational factors on memory performance could be targeted to help enhance memory across adulthood. In sum, our findings lend further support to the growing evidence that not all memory declines in aging and that own-age factors could assist older adults in the maintenance or improvement of their memory performance.

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Declaration of competing interest

The authors have no competing interests to report.

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