Original Article

HEALTHY AGING RESEARCH

OPEN

Effects of aging and recall of common and uncommon first names using the face-name association technique compared with the pure-lists technique over repeated trials

Nicholas M. Almond[a,*], Catriona Morrison[b]

Background: The face-name association technique (FNAT) is commonly used to investigate name recall in nonpathologic aging. This technique is appropriate for studying anomia, but the pure-list technique, in which participants see only names and do not need to form face-name associations, might be more appropriate for studying age-related name recall.
Methods: Experiment 1 recruited 60 adults (30 younger and 30 older adults) to participate in the FNAT recognition task of 30 common and 30 uncommon names. In experiment 2, the same number and demographic of participants attempted to recall 30 common and 30 uncommon names. Both experiments utilized measurements of overall recall across 5 trials and a delayed recognition or recall trial. Measures of encoding (gained access) and consolidation (lost access) were also taken for the 5 initial trials in both experiments. Older participants received 50% extra study and recognition/recall time.
Results: The FNAT experiment revealed an age-related episodic memory deficit for names. However, in cued recall, encoding, consolidation, retention/retrieval, and false alarm tests, older adults were significantly better than younger adults at recalling uncommon names, as opposed to common names. This lends support to the inhibition theory of name recall. Conversely, our second experiment revealed no age effect on any factors of name memory functioning, supporting node structure theory.
Conclusions: The results of our experiments support previous findings that suggest an age-related deficit in name recall, but only in cases of anomia. Therefore, the FNAT methodology may be inappropriate for studying age-related name recall. It is possible that names are stored in the memory differently from nouns. We challenge the belief that older adults are significantly less able to recall names compared with other word types, which has implications for both memory self-efficacy questionnaires and research into eye-witness testimonies.
Keywords: Name recall, Aging, Episodic memory, Face-name association, Pure-list technique, Recall, Encoding, Consolidation, Methodology, Intertrial technique

Introduction

Background

Empirical evidence shows that episodic memory (EM) declines with increasing age[1,2]. Older adults also report greater difficulty in recalling names compared with other word types[3–9]. Substantial evidence also points to an age-related decrease in study participants' ability to recall names when asked to associate a face with a name; this deficit is greater for name recall than it is for semantic information[10–22]. Furthermore, common names are easier to recall than less common names[14,19,23].

Many studies investigating the effects of age and/or name commonality on name recall have used a face-name or face-item association technique. In this technique, participants are shown a face with a name or other semantic information written below it. Later, when presented with the same face, they are asked to recall the written information. This technique may produce enhanced recall deficits in older adults who perform significantly poorer on divided attention[24–27] and associative memory tasks[28–30]. We present 2 studies in which younger and older adults were asked to recall common and uncommon names using either the face-name association technique (FNAT) or by studying pure lists of names[31].

Name recall and aging

In a study by Semenza et al[31], younger (mean age, 22.7 y) and older participants (mean age, 66.5 y) with Alzheimer's disease were given a list of uncommon and common first names. Older adults had a significant deficit in the primacy recall of first names compared with younger adults. The recency effect between younger and older adults for name recall was significantly less than the primacy effect, indicating that name recall has a larger deficit in long-term EM for older adults than for younger adults compared with short-term memory. This effect was significantly

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

[a]Institute of Rheumatic and Musculoskeletal Medicine, University of Leeds, Leeds and [b]Department of Psychology, Bradford University, Bradford, UK

**Corresponding author. Address: Suite 1, McCarthys Business Centre, Education Road, LS7 2AH, UK. Tel: +44-113-2379694. E-mail address: nalmond944@aol.com (N.M. Almond).*

Healthy Aging Research (2017) 6:e4

Received 26 October 2016; Accepted 7 November 2016

Published online 24 March 2017

http://dx.doi.org/10.1097/HXR.0000000000000004

greater for individuals with dementia, indicating that the medial temporal lobe is implicated in name recall to a greater degree than common word recall[32].

The traditional FNAT technique presents younger and older adults with either a picture (of a face[16] or cartoon character[10]) or a video and with a name to be remembered[21]. Crook and West[21] used first names and showed younger and older participants a video of individuals introducing themselves. As in Semenza et al[31], greater name recall deficits were found for longer-term EM compared with younger adults.

Fogler et al[10] used the FNAT with cartoon characters to investigate the relationship between name recall in younger (mean age, 22.73 y) and older (mean age, 73.31 y) adults when additional information was or was not presented at study. The results showed an age-related deficit in name recall when additional information was absent at study. These results indicate that older adults perform better when additional information is presented to enable them to recall the name. This supports the encoding specificity principal proposed by Tulving[33].

The ability to recall first names using FNAT was also used by Tse et al[12]. In this study, middle-aged (mean age, 60.81 y), young-old (mean age, 71.97 y), and old-old (mean age, 81.28 y) participants studied 16 names of unknown faces over 4 trials. Participants received no feedback on their performance between each trial. The results showed that the middle-aged group improved their face-name recall with repeated testing, whereas older adults did not.

Cohen and Faulkner[22] studied the recall of both first names and last names in younger (age, 20–39 y), middle-aged (age, 40–59 y), and older adults (age, 60–80 y). Older participants reported more difficulty in recalling names of friends and acquaintances, indicating a retrieval problem for both first and last names in older adults. A second experiment presented participants with faces along with audio presentations of their first and last names and information about the person, such as their occupation, location, and hobbies. Compared with younger adults, older adults showed a significant deficit in recalling first and last names compared with the person's occupation, location, and hobbies. Furthermore, the age-related deficit was significantly greater for first names over last names.

Most other research has used last name recall when using FNAT. For example, James found that older adults (mean age, 70.2 y) demonstrated a significant impairment in recalling the last names of unfamiliar faces compared with younger participants (mean age, 20.6 y), which was significantly greater than recalling occupations[16]. A 2008 study also used last names, and older participants showed a disproportionate deficit in recalling names compared with occupation[13]. The fact that recognition was used in this study indicates that older adults may have an encoding deficit for names over semantic information compared with younger adults. A similar result was found by Cohen[34], who also showed that older participants reported more tip-of-the-tongue (TOT) occurrences when recalling names as opposed to other personal information, indicating a retrieval deficit[34]. James[35] also found this TOT age-related deficit, but was cautious to state whether older adults had a greater retrieval deficit for names compared with the description of a person (when using the FNAT). This was because there were very few TOTs for the descriptive conditions for younger and older participants and, therefore, the results may have been caused by floor effects.

Rendell et al[15] conducted 2 studies into face-name associations and the ability to recall the occupation of photographs of male faces. Compared with middle-aged participants, older adults showed a significant recall deficit of last names over occupations. The oldest participants (mean age, 73.4 y), compared with young (mean age, 21.3 y) and old participants, for their recognition of famous faces compared with uncommon objects showed a significantly lower recall of names than uncommon objects. However, there was no significant difference between the other 2 groups of participants.

Some studies have questioned whether older adults do show a significant age-related decrement for recalling names compared with semantic information or common nouns. For example, in a review of relevant research into episodic and semantic memory, Maylor[36] concluded that there was no difference in memory of names over semantic information between older and younger adults. Furthermore, Moulin et al[37] concluded that the type of questioning and stress confuses older adults to a greater degree than it does younger adults when investigating eye-witness memory and aging; thus, there is no clear evidence that older adults are significantly impaired at recognizing faces than younger adults. Ramscar et al[38] suggest that methodological issues have a greater impact on assessing cognitive functioning over the lifespan than actual cognitive decline.

Name recall in younger, nonpathologic older adults, and those with pathologic issues

Evidence shows that younger adults use the superior temporal gyrus part of the brain when recalling the faces and names of famous people[39]. Seidenberg et al[32] showed that patients with temporal lobe damage have difficulty recognizing famous people, and Joubert et al[40] showed that patients with prosopagnosia (face blindness) had significant damage to the right temporal lobe. Fine et al[41], in investigating the verbal fluency for names in nondemented patients suffering from Parkinson's disease, found that compared with nonpathologically age-matched controls the nondemented Parkinson's group produced significantly fewer male first names; however, there was no significant difference in the production of common nouns. In line with this research, names appear to be stored in different cognitive networks to common nouns and there is an onus on executive functioning regarding this dissociation.

Neuropsychological evidence suggests that the temporal lobe and the prefrontal cortex is critical for face-name associations. Nonpathologic older adults have shown declines in both of these cognitive functions and atrophy in these cortical regions[42] (see Raz[43] for a comprehensive review). The natural atrophy of the temporal lobe in nonpathologic aging can explain why older adults perform significantly poorer in FNAT tests, but may not show a decrement on the recall of pure lists of names.

Recall of common/uncommon names in younger and older adults

The node structure theory (NST[20,23]; reviewed in greater depth in James and Fogler[14]) predicts that common names will be protected in nonpathologic aging to a greater degree than uncommon names. In brief, the NST produces a model where different nodes (or cognitive representations) are connected to one another. Semantic nodes include information such as occupations or hobbies, whereas phonological nodes represent either sounds of people's names or semantic information about them. The phonological and semantic nodes are connected through the lexical nodes (or cognitive representations), which identify names or other information. The repeated priming (or activation) of the link between the nodes produces stronger connections between them. If there is insufficient priming of the semantic, phonological, or lexical nodes, then associations between nodes will degenerate. Thus, according to this theory, the nodes for common names will be activated more often than those for uncommon names. As older adults encounter more common than uncommon names, the results show a dissociation between the abilities of older and younger adults to recall common/uncommon names[14].

Research shows a relatively high degree of support for the NST; for example, James and Fogler[14] showed that, compared with younger adults, older adults recalled more common last names than uncommon last names. However, there was no dissociation between the old and oldest groups of participants. James also suggested that name commonality of last names benefited older adults to a greater degree than it did younger adults when using name association and comparing last names with occupations[16].

Jones and Rabbitt[19] also investigated the effects of aging on the recall of common and uncommon first and last names. Overall, participants showed a significantly greater ability to recall common names than uncommon names. However, there was no interaction between young-old (aged 60–69 y) and older (aged 70–79 y) adults with regard to first or second name commonality. In a review of the literature, Cohen and Burke[20] concluded that older adults showed a significant recall benefit for more common first and last names versus younger adults. This suggests that older adults who encounter more common names show a recall benefit of these names over uncommon names in comparison with younger adults.

The NST is similar to the inter-item association theory of word frequency and age of acquisition (AoA). According to the inter-item association theory, high-frequency or early-acquired words should have a recall benefit over low-frequency or later-acquired words, respectively[44–48]. This theory is based on connectionist models, which show that words encountered more often (high frequency) or earlier in life (early AoA) show more inter-item associations, with regard to cognitive representations, compared with low-frequency or later-acquired words[49–52]. According to the inter-item association theory, older adults show a significant recall benefit of high frequency and early-acquired words to a greater degree than younger adults. Strong evidence indicates that recall, encoding, and consolidation are significantly greater for older compared with younger adults for words that differ in AoA or word frequency, specifically in EM[44,45]. Thus, a similar result should be found when comparing younger and older adults for the recall, consolidation, and encoding of common and uncommon names when using the same methodological techniques.

Burton and Bruce[53] proposed an alternative theory of the recall of common versus uncommon names based on the inhibition theory (IT) of aging[54,55]. They argue that older adults should have greater difficulty in recalling or recognizing common than uncommon names because they have encountered more common names than younger adults and, therefore, will struggle to select the appropriate common name associated with a previously presented face[53]. Thus, older compared with younger adults should show a face-name association benefit for uncommon names because there is greater difficulty among older adults in selecting the correct common name when shown the to-be-remembered face again.

There is some evidence to support this theory; for example, Stanhope and Cohen[56] showed that when the frequency of first names was manipulated during a face-name association task, older participants did not show the expected recall advantage of common versus uncommon names. Furthermore, when fewer uncommon names were mixed with a higher proportion of common names, older adults demonstrated a significant recall advantage for the uncommon names. Also, in questionnaire studies, older adults reported greater difficulty in recalling names of friends and acquaintances[22], which is contrary to the NST.

Cued and free recall of common/uncommon names in aging: methodological issues

First, older adults show a significant deficit in associative memory[28–30,57–60]; therefore, the FNAT may be replicating an associative memory test. Indeed, older adults show neurological deficits in the frontal lobe and medial temporal lobe region that have been associated with cognitive deficits in executive functioning, metacognition, and associative memory[39,40,42,43,61,62]. Thus, older adults show a greater deficit in forming associative memories than memories for single items in EM[26,63].

The FNAT is similar to a divided attention task, whereby participants must attend to 2 different pieces of information at the same time. Older adults show a greater deficit in cognitive functioning when undertaking a divided attention task compared with younger adults[24–27,63]. Castel and Craik[25] showed that when younger adults attempted to recall either an item or a face under divided attention, their performance matched that of older adults completing the same task under full attention[61]. Older participants show a greater deficit in associative memory when the pairs differ in terms of contextual and perceptual information compared with when just one type of information is used for the paired associations. For example, older participants have greater difficulty in associating a word that has been presented in a specific font (at study) when asked to select it at recall[63]. However, most research suggests that older participants increase their recall when using a cued-recall task than when using a free-recall task. Hence, it would be of interest to compare cued recall of face-name associations with the free recall of names in younger and older adults.

Although the FNAT is ideal for investigating anomia (or agnosia) in aging, it may not be appropriate to investigate the simple recall of names in aging or when comparing the recall of common and uncommon names. In the current era, many conversations are conducted through telephone or email; therefore, one does not always see faces as regularly as one encounters names. In fact, a person may communicate with someone online or over the telephone for years, building up a very strong relationship, but never see the face of the other person. A critical point here is that previous studies[13–15] have argued that the face-name technique is significantly different in the study of name recall related to aging, when in fact the results show an age-related deficit in anomia, not necessarily name recall.

Fogler et al[10] showed that older adults recalled more descriptive face-name associations than younger adults compared with recalling a nondescriptive association (eg, a name). One explanation for this, as demonstrated by Craik and Byrd[30], is that the deeper the levels of processes, the more likely the to-be-remembered information will be encoded. Arguably, this is more effective in older adults than in younger adults because of the encoding and consolidation deficit caused by nonpathologic aging[64]. Furthermore, James[16] showed a significant dis-association between younger and older adults when recalling the last name or occupation of faces. This disassociation can be explained with the NST: older adults will have encountered more last names and occupations compared with younger adults. Therefore, there will be an increase in divided attention among older adults when trying to recall the last name, compared with occupation, than among younger adults. In addition, there was no control on the frequency of last names in the study. Hence, it is possible that the last names were more popular among the younger as opposed to the older participants.

It is questionable as to whether the FNAT should be used when investigating either the aging effect of name recall or the effect of name commonality on recall. Older adults have significantly greater deficit in associative memory than do younger adults. Thus, even though previous research suggests that older adults have a greater recall deficit than younger adults for names over other associative information, such as the occupation of the face presented[16], it is possible that the methodological technique may have produced a greater age difference in name recall than the actual deficit. Cohen and Faulkner[3] argue that using more realistic techniques is important when investigating memory decline in aging; presenting a face and a name is relatively unrealistic because participants do not interact with the person. Other studies[17,18] have shown how environmental support helps older adults recall information; therefore, a more interactive version of the face-name technique might provide more realistic evidence of any name recall deficit in older adults[65].

Second, there are issues regarding the type of name used in previous studies of aging and name commonality recall, and whether the types of faces used in the FNAT were appropriate. It is unclear why most research manipulated last names instead of first names. In the late 20th and early 21st centuries, individuals were increasingly being referred to by their first names. Also, as older adults show a greater recall deficit on first compared with last names[22], it is important to use first names when studying the effects of age on name recall.

A further issue, raised by Valentine and Darling[66], is that famous faces should not be used because character names can be confused with the actors' names. We also argue that younger adults may be more accustomed to current affairs, hence, older adults may be at a disadvantage if famous faces are used. This was acknowledged by Bonin et al[67] who showed that AoA can directly influence recall. Thus, AoA and frequency of encountering first names without doubt has a direct impact on recall in younger and older adults.

The type of face used in face-name association studies also matters. Studies comparing younger and older adults have used faces of people in a wide age range (eg, James et al[13] and James[16] used faces of men ranging in age from 30 to 60 y). Research has shown that older adults can more accurately recognize older faces compared with younger faces; however, there is no difference in the recognition of younger adults when studying younger or older faces[68]. Therefore, one can assume no age bias if older faces are used as a stimulus. Removing this possible confound means that older adults will not be at a disadvantage when attempting to perform a cued-recall test with younger faces.

The emotional expressions of faces have also been shown to be important in either recognition or attentional bias between younger and older participants[69,70]. Griffin[11] argues that it is almost impossible to match faces in a between-subjects experiment; therefore, a within-subjects technique should be used when investigating name commonality. Furthermore, when using the FNAT to investigate cued recall in younger and older participants, neutral-expression faces should be used.

With regard to name recall, it is arguably inappropriate to use the face-name association method; older adults may be disadvantaged compared with younger adults because this technique is similar to a divided attention study or tests of associative memory, at which older adults perform significantly poorer. However, it would be interesting to compare a cued-recall FNAT with a free-recall pure-list technique. To test name recall in relation to aging and name commonality, it may be more appropriate to use a pure-list technique, as used in studies of item, word frequency, and AoA recall[44,45] (eg, in Semenza et al[31]).

Effects of aging on recall, encoding, consolidation, and retrieval/retention in younger and older adults

Younger and older adults show increased recall for items presented over repeated trials (the multi-trial technique[44,45,64,71–73]. The benefit of this technique is that an intertrial method can be used to assess overall recall, gain access (GA), lost access (LA), and long-term retrieval/retention (saving scores). GA is calculated by taking into account the number of new items (in this study, names) that a participant recalls on subsequent trials, whereas LA is calculated by measuring the number of items that participants fail to remember between trial n and trial n + 1. Typically, both GA and LA are calculated as proportions or percentages. Saving scores are measured by comparing the number of items recalled on the final trial with the number of items recalled on the delayed recall trial.

In a hypothetical example, consider 2 participants who both recall 5 out of 15 words on the first and second trials of a memory test. The first participant may recall exactly the same words on the second trial as she/he did on the first trial, and thus would have a GA score of 0% and an LA score of 0%. The second participant may recall 5 new words on his/her second trial and none of the words that she/he recalled on the first trial. For this participant the GA score would be 50% but the LA score would be 100%. These results would suggest that the first participant has an encoding deficit but intact consolidation, whereas the second participant may have an intact encoding system but a deficit in consolidation.

It is assumed that GA represents encoding, LA represents a combination of consolidation and retrieval, and that saving scores represent long-term retrieval/retention. However, this opinion is not shared by all researchers and it is possible that both GA and LA represent a combination of consolidation and encoding, respectively (see Almond and colleagues[45,72] for further discussion). We accept the view that GA corresponds to encoding, LA symbolizes consolidation, and saving scores indicate long-term retrieval/retention.

To our knowledge, no study on the effects of name commonality and aging has ever used an intertrial technique to investigate overall recall, GA, LA, or saving scores in a multi-trial methodology. In an FNAT-recall study of middle-aged and older adults over 4 trials, Tse et al[12] found that when older adults received no feedback on their performance they showed no significant increase in name recall compared with middle-aged adults. They did not, however, calculate GA or LA.

In recent research, evidence suggests that AoA and word frequency have a significantly greater effect on overall recall, GA, and LA of words in older adults compared with younger adults[44,45], over subsequent trials. These results support the inter-item association theory of memory[48,50], in that words that are activated more often will show a greater protection against cognitive decline in nonpathologic aging. Thus, the intertrial approach should show that common names (vs. uncommon names) are recalled, encoded, consolidated, and retrieved/retained significantly better over trials in older adults compared with younger adults, supporting the NST. However, support for the IT would show the opposite.

Aims and hypotheses

The first aim of this study was to compare the name recall of younger and older adults using both the traditional FNAT and a pure-lists recall technique[44,45]. We hypothesized that older adults would show a significant effect of anomia.

Second, we wanted to compare the usage of FNAT with the study of pure lists of common and uncommon names in both younger and older adults. According to the NST, older adults should show a significant benefit in all aspects of EM (ie, recall, GA, LA, and saving scores) for common over uncommon names in both experimental methodologies. However, the IT suggests that older adults show a greater EM performance compared with younger adults for uncommon versus common names.

A further aim of this study was to investigate whether there was a difference between younger and older adults in recall, GA, LA, and/or saving scores when using a multi-trial technique. We hypothesized that different results may be found when using the traditional FNAT compared with when participants are asked to study pure lists of names. Within these aims, we also investigated whether the outcome variables were influenced by name commonality when the 2 different experimental techniques were used.

Overall, we predicted a significant age-related deficit in all aspects of EM when using the FNAT compared with the pure-lists technique. We also predicted that the difference between EM for common versus uncommon names would be greater when using FNAT compared with the pure-lists study-recall method; this is because FNAT utilizes more of older adults' cognitive abilities (compared with that of younger adults).

Experiment 1

The primary aim of experiment 1 was to replicate the findings of previous research showing that older adults have a significant recall deficit in anomia compared with younger adults[10,14,15,22]. A further aim was to investigate the results of previous studies showing that older adults have a recall dissociation between common and uncommon names compared with younger adults[14,16,19]. According to the NST, older adults should show a recall benefit over younger adults for face-name association recall for common versus uncommon names[20,23]. However, Burton and Bruce[53] suggest that older adults should show a recall benefit of uncommon over common names in comparison with their younger counterparts, supporting the IT[54,55]. We felt that it would be interesting to compare false alarms (FAs) for names not recognized on each trial for younger and older adults, and compare whether this was different for common names versus uncommon names.

A further aim of this experiment was to repeat the findings of Tse et al[12], in which older adults were found to show no increase in the learning curve[45] using FNAT over repeated trials. In an extension of Tse's work[12], this study investigated the GA, LA, saving scores, and FAs of younger and older participants when studying names. In addition, the experiment considered the impact of name commonality on all aspects of EM (ie, intertrial recall, GA, LA, saving scores, and FAs), as in previous research[45,46].

Taking into account the methodological issues with previous research using the FNAT, only first names were used as stimuli because they show a greater age-related cued-recall difference compared with last names[22]. Furthermore, as older adults have a recognition bias for older compared with younger faces (compared with younger adults [68]), this experiment used only older faces as stimuli. The faces were computer generated and taken from the study by Firestone et al[68]. Measures were taken to avoid confounding factors, including ensuring that the faces did not resemble famous faces[66], that facial expressions were neutral[69], and that the same faces were used in both experimental lists[11] (except the practice lists).

Methods

Participants

Having provided informed consent, 2 groups of English and Welsh participants were tested: 1 group comprised 30 "younger" adults with a mean age of 23.5 years (SD = 3.92) and the other of 30 "older" adults with a mean age of 72.23 years (SD = 5.28). The younger group had a mean number of years in full-time education of 14.6 (SD = 2.71), which was similar to that of the older adults (14.6, SD = 2.81), with no significant difference between the 2 groups ($t < 1$). All older adults scored >27/30 in the mini mental state examination[74], indicating an absence of cognitive impairment.

Stimuli

The stimuli—that is, first names—were taken from Merry[75], who ranked the top 100 names in England and Wales between 1944 and 1994. Two pure lists of 30 first names were created on the basis of commonality (common vs. uncommon). The common name list consisted of first names ranked in the top 100 in both 1944 and 1994 (eg, Thomas, Catherine). The uncommon name list comprised first names ranked in the top 100 in 1944 but not in 1994 (eg, Nigel, Veronica). Any name ranked outside the top 100 in 1994 was assigned a ranking of 101 because actual rankings for these names were not available (**Table 1**). A third list of 30 common and uncommon names was used as a practice list.

The Wilcoxon rank sum nonparametric test was used to confirm that there was no significant difference between common names selected from 1944 and 1994 ($W = 891.50$) and that there was a significant difference between the common and uncommon names from 1994 ($W_1 = 465$, $Z = -7.112$, $P < 0.001$). There were no significant differences between the number of syllables in each experimental list ($t < 1$). Both experimental lists consisted of 21 male and 9 female names. The lists were presented on one sheet in size 24 Arial font. Above the name was a passport-sized

Table 1

Ranked popularity of proper names taken from Merry[77] used in Study Seven.

Common Names			Uncommon Names		
Name	**1944 Rank**	**1994 Rank**	**Name**	**1944 Rank**	**1994 Rank***
Andrew	45	20	Alan	8	101
Anthony	6	56	Barbara	10	101
Catherine	42	45	Barry	20	101
Charles	38	41	Bernard	37	101
Christopher	16	14	Brian	7	101
David	2	24	Carol	12	101
Edward	29	43	Colin	15	101
Elizabeth	15	25	Dennis	34	101
George	21	17	Derek	27	101
Georgina	84	33	Eric	39	101
Harry	65	6	Evelyn	71	101
Heather	58	76	Frederick	42	101
Helen	45	80	Gordon	44	101
Henry	63	48	Graham	22	101
James	10	2	Ian	23	101
Jennifer	18	42	Julia	70	101
John	1	37	Keith	14	101
Maria	57	86	Malcolm	24	101
Martin	41	87	Norman	43	101
Mary	4	94	Pamela	17	101
Michael	3	11	Pauline	14	101
Nicholas	76	42	Raymond	17	101
Patrick	31	63	Reginald	71	101
Paul	28	66	Ronald	26	101
Peter	4	51	Roy	30	101
Richard	11	49	Shirley	39	101
Robert	5	25	Terence	18	101
Sarah	86	12	Trevor	33	101
Thomas	19	2	Valerie	11	101
William	9	7	Veronica	52	101

*All names ranked as 101 because ranking was only available 1 through 100.

black and white photograph of an older adult, matched for gender. A different set of older faces were used for the practice lists, but the same faces were used for both experimental lists of names. Participants were informed that they were to be tested on their ability to remember the name written under each face. To ensure that participants paid attention to the names, they were first required to rate each name on a scale of 1–7 (1 = do not like this name; 7 = like this name very much)[76].

Design and procedure

A mixed design was used and all participants were exposed to both common and uncommon face-name associations. Participants filled in a general information sheet, and then proceeded to rate the practice list of face-name associations. Younger participants had 60 seconds to rate all 30 names; older adults were given 90 seconds to remove any possible effects of cognition speed[77,78]. This is standard practice in multi-trial memory tests comparing younger and older adults[45,46] and is important when using names as stimuli, as older adults are slower to read such words[21]. Younger participants were asked to spend 2 seconds rating each name on each list presented in the trial; older participants were asked to spend 3 seconds. After rating all 30 face-name associations, participants undertook a standard 5-figure digit span task to clear working memory and avoid the recency effect.

Participants then took a free-recall task in which they were presented with the same faces in a random order and asked to write the name of the face on a line above the photograph.

Participants did not need to recall their pleasantness rating and could recall the names in any order but only had 60/90 seconds (younger/older) to do so. Participants were asked not to guess the names of faces they did not recall; this was important when calculating FAs.

The study, distractor, and free-recall task were repeated 5 times for the intertrial learning of the stimuli. The presentation of common and uncommon face-name associations always followed each other, but were counterbalanced across each participant group and presented in separate test sessions. Furthermore, the order of the face-name associations was random in each study and recall list.

After 5 trials, participants returned 1 week later to complete a delayed recall task of all names encountered in the first intertrial task. Participants repeated the 5 learning trials for the subsequent 30 names. At the beginning of each trial, participants received the same instructions and were not informed that they were being presented with the same names. Participants returned a week later for a second delayed-recall task before being debriefed. See **Figure 1** for a visual representation of the procedure.

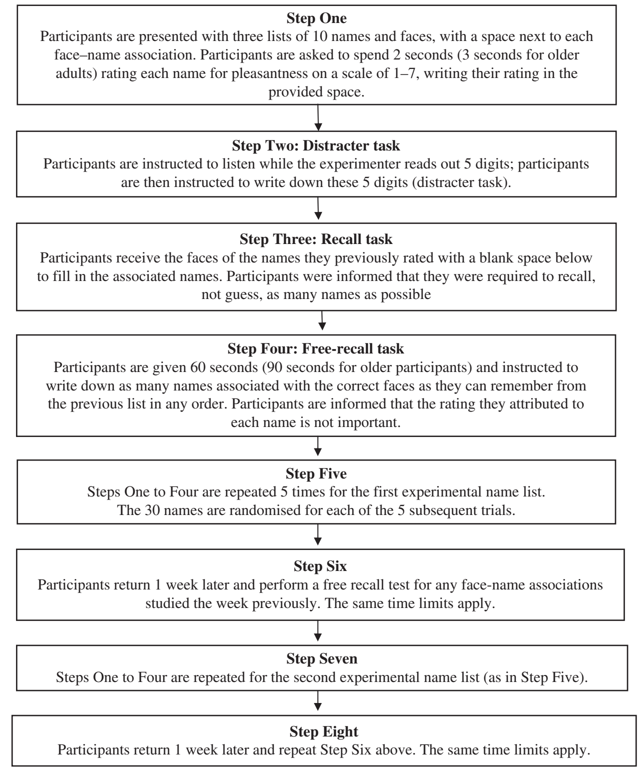

Figure 1. An illustration of the experimental procedure in experiment 1. Note that the experimental name list was counterbalanced for each sample population.

Results

The significant values of the main effect and interactions of experiment 1 can be found in **Table 2**.

Cued Recall

A 2 × 5 × 2 (age group × trial × name commonality) mixed analysis of variance (ANOVA) test was used to analyze the impact of age, number of trials, and name commonality on overall cued recall. **Figure 2** illustrates how cued recall of face-name associations increased across the 5 immediate recall trials. Marginal means show that cued recall for the whole sample population significantly increased by 46.92% from trial 1 to trial 5. Common names showed a significantly higher cued recall (24.23%) than uncommon names overall. Across the 5 trials, younger adults recognized 31.32% more faces than older adults, which was significant.

There was no significant interaction between trial and age group, or between name commonality and trial. However, cued recall showed a significant 2-way interaction between age group and name commonality in which the marginal means show that older adults recalled 0.97% more common than uncommon names compared with younger participants. Furthermore, there was a significant 3-way interaction between all 3 factors on cued recall. This is critical and, as **Figure 2** illustrates, there is a difference in the cued recall of face-name associations between younger and older adults. Specifically, across the 5 trials younger adults showed an increase in cued recall of 75.78% for uncommon names compared with 79.30% increase for common names. In contrast, older adults showed a 142.99% increase in cued recall of uncommon names compared with only a 77.55% increase in cued recall of common names. The results show that the increased cued recall across the 5 trials for common names was relatively similar for younger and older participants, whereas the cued recall of uncommon names was greater for older compared with younger participants; that is, older adults had a steeper learning curve for uncommon versus common names,

Table 2

Summary of results for experiment 1.

	Cued Recall	False Alarms (Trials 1–5)	GA (Encoding)	LA (Consolidation)	Saving Scores (Retrieval/Retention)	False Alarms (Saving Scores)
Age group main effect	$F_{1,58}=81.686$, $P<0.001$, $\eta^2=0.59$	$F_{1,58}=52.403$, $P<0.001$, $\eta^2=0.40$	$F_{1,58}=56.003$, $P<0.001$, $\eta^2=0.49$	$F_{1,58}=30.679$, $P<0.001$, $\eta^2=0.35$	$F_{1,58}=54.271$, $P<0.001$, $\eta^2=0.48$	$F_{1,58}=35.294$, $P<0.001$, $\eta^2=0.38$
Name commonality main effect	$F_{1,58}=347.180$, $P<0.001$, $\eta^2=0.86$	$F_{1,58}=38.358$, $P<0.001$, $\eta^2=0.40$	$F_{1,58}=64.764$, $P<0.001$, $\eta^2=0.53$	$F_{1,8}=152.248$, $P<0.001$, $\eta^2=0.72$	$F_{1,58}=150.132$, $P<0.001$, $\eta^2=0.72$	$F_{1,58}=40.98$, $P<0.001$, $\eta^2=0.41$
Trial main effect	$F_{4,232}=1222.796$, $P<0.001$, $\eta^2=0.96$	$F_{4,232}=21.131$, $P<0.001$, $\eta^2=0.27$	$F_{4,232}=35.207$, $P<0.001$, $\eta^2=0.38$	$F_{3,174}=165.988$, $P<0.001$, $\eta^2=0.74$	$F_{1,58}=2860.126$, $P<0.001$, $\eta^2=0.98$	$F_{1,58}=4.093$, $P<0.05$, $\eta^2=0.07$
Age group × name commonality interaction	$F_{1,58}=4.840$, $P<0.05$, $\eta^2=0.08$	$F_{1,58}=124.189$, $P<0.001$, $\eta^2=0.68$	$F_{1,58}=36.825$, $P<0.001$, $\eta^2=0.38$	$F_{1,58}=12.262$, $P=0.001$, $\eta^2=0.18$	$F_{1,58}=52.667$, $P<0.001$, $\eta^2=0.48$	$F_{1,58}=84.929$, $P<0.001$, $\eta^2=0.59$
Age group × trial interaction	$F_{4,232}=1.949$, NS	$F<1$, NS	$F_{4,232}=3.116$, $P<0.05$, $\eta^2=0.05$	$F=2.217$, NS	$F_{1,58}=14.620$, $P<0.001$, $\eta^2=0.20$	$F=2.431$
Name commonality × trial interaction	$F<1$, NS	$F_{4,232}=6.594$, $P<0.001$, $\eta^2=0.10$	$F=1.23$, NS	$F_{3,174}=3.954$, $P<0.01$, $\eta^2=0.05$	$F_{1,58}=5.205$, $P<0.05$, $\eta^2=0.08$	$F_{1,58}=4.755$, $P<0.05$, $\eta^2=0.08$
Age group × name commonality × trial interaction	$F_{4,232}=32.822$, $P<0.001$, $\eta^2=0.36$	$F_{4,323}=7.760$, $P<0.001$, $\eta^2=0.12$	$F_{4,232}=32.182$, $P<0.001$, $\eta^2=0.36$	$F_{3,174}=6.440$, $P<0.001$, $\eta^2=0.10$	$F<1$, NS	$F_{1,58}=24.292$, $P<0.001$, $\eta^2=0.30$

whereas younger adults had a similar learning curve for each name commonality (**Fig. 2**).

False alarms

FAs were calculated as the number of incorrectly recalled names on the remaining available names. No participants recalled all 30 names; therefore, ceiling effects can be eliminated. The analysis was identical to the cued-recall outcome measurements with the exception that the FA outcome measure was used.

As shown in **Figure 3**, there was a significant decline in FA over the 5 trials for the whole sample population; marginal means showed that FAs decreased by 25.42% from the first to the fifth trial for the whole sample population. There was a significant main effect of age group on FA. As shown in **Figure 3**, for both stimulus characteristics older participants showed a greater number of FAs; the marginal means showed that the older adults had 45.83% more FAs than the younger sample. There was also a significant main effect of name commonality and FAs for the whole sample population in that there was a 31.96% higher FA rate over the 5 initial trials for the whole sample population.

No significant interaction was found between the factors of age group and trial on FA. However, the marginal means showed that, for younger adults, FAs were 55.22% higher for uncommon compared with common names, but for older adults FAs were 139.22% higher for common compared with uncommon names, which was significant. There was also a significant 2-way interaction between name commonality and trial; the marginal means show that, for common names, FAs decreased by 12.77%, but for uncommon names FAs decreased by 74.81% over the 5 initial trials for the whole sample population.

Finally, there was a significant 3-way interaction on FAs for all 3 factors. Comparing FAs for younger adults on trials 1–5 for uncommon and common names, the mean FA of uncommon names showed a decrease of 42.70%, and for common names the same sample population showed a decrease of 88.86%. However, for the sample population of older adults, FAs of uncommon names decreased by 122.13% between trial 1 and trial 5, but for common names there was an increase of 2.84%.

Gained access

In line with previous research[45,46], for the first trial, GA was calculated as LA that could not account for cued recall on trial 1 (see Tulving and Arbuckle[79] for justification). Hence, a $2\times5\times2$ (age group × trial × stimulus characteristic) mixed ANOVA test was used to investigate this dependent variable.

As depicted in **Figure 4** for the whole sample population, GA increased significantly by 31.00% from trial 1 to trial 5. A significant main effect of name commonality was found in that common names showed a 23.22% higher GA than uncommon names. Finally, a significant effect of age groups on GA was found in which older adults had a 42.81% lower GA than did younger adults.

No significant 2-way interaction was found between name commonality and trial, but there was a significant interaction between age group and name commonality on GA, showing that older participants had a 6.41% higher GA score for common over uncommon names, whereas younger adults had a 36.72% higher GA score. A significant 2-way interaction was found between trial and age group. Surprisingly, older adults showed a

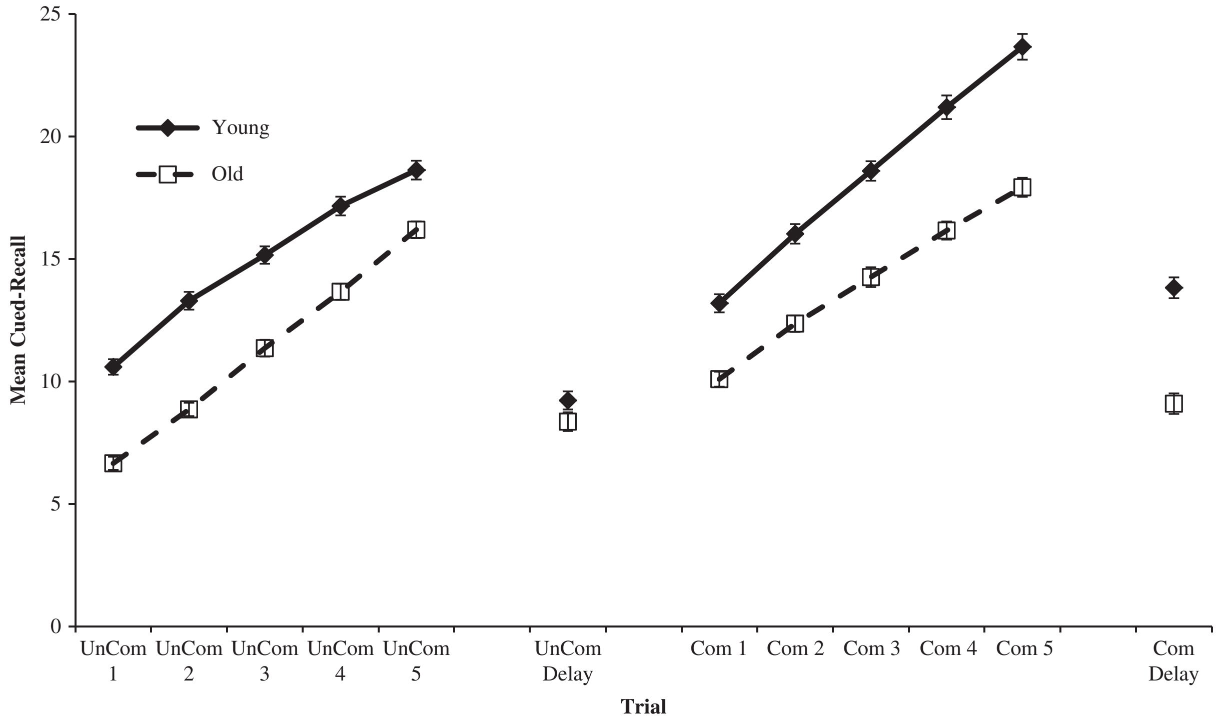

Figure 2. Mean cued recall of younger and older adults studying uncommon (uncom) and common (com) lists across 5 immediate trials and 1 week later (delayed recall) when using the face-name association technique.

higher GA from trial 1 to trial 5 compared with younger adults (31.54% and 30.62%, respectively). However, it must be noted that the effect size and percentage differences are relatively small.

Finally, there was a significant 3-way interaction between all 3 factors on GA. Over the 5 trials, younger adults showed a GA increase of 43.88% for common names compared with a 14.11% increase for uncommon names; however, older adults showed a decrease in GA of 8.24% and an increase of 91.81%. These results suggest that younger adults have an encoding benefit over trial for common versus uncommon names, whereas older adults show an encoding benefit of uncommon compared with common names.

Lost access

LA was not calculated for the final trial (this was analyzed with saving scores—see below; see Almond and colleagues[45,46,64] for justification). Therefore, a 2×4×2 (age group×trial×stimulus characteristic: ie, name commonality) mixed ANOVA test was used to examine the intertrial LA of younger and older adults studying common versus uncommon names in the FNAT. It is important to note that a higher LA score represents a lower consolidation score.

As shown in **Figure 5**, LA significantly decreased over the 4 initial trials. The marginal means show that there was a decrease of 82.69% in LA for the whole sample population. The marginal means showed that older adults had a significant 25.69% higher LA across the 4 trials compared with younger adults. Furthermore, for the whole sample population, LA was significantly higher (34.98%) for uncommon than for common names.

There was no significant interaction for LA between the factors of trial and age group. The marginal means show significantly that younger adults have an overall LA difference of 27.35% between common and uncommon names (lower for common names), whereas older participants had an overall LA difference that was 41.42% lower for uncommon compared with common names. There was also a significant interaction on LA of name commonality and trial; the marginal means show that uncommon names had a decrease in LA of 54.96% over the 4 trials, compared with a decrease of 131.45% for common names.

Critically, for LA there was a significant 3-way interaction between all 3 factors; **Figure 5** illustrates the difference in LA between younger and older adults when studying common versus uncommon face-name associations. Specifically, the marginal means show that younger adults had a decrease in LA of 122.84% compared with 81.74% for common over uncommon names across the first 4 trials; however, for older participants, the decrease across trials for uncommon names was 37.39% compared with 148.28% for common names. These results suggest that consolidation of common versus uncommon names was greater in younger adults, whereas consolidation of uncommon compared with common names was greater for older adults.

Saving scores

As in previous research[45], saving scores were calculated by comparing the recall on the final trial with delayed cued recall. Therefore, a 2×2×2 (age group×trial×stimulus characteristic, ie, name commonality) mixed ANOVA test was used. **Figure 2** shows the difference between the face-name association recall for

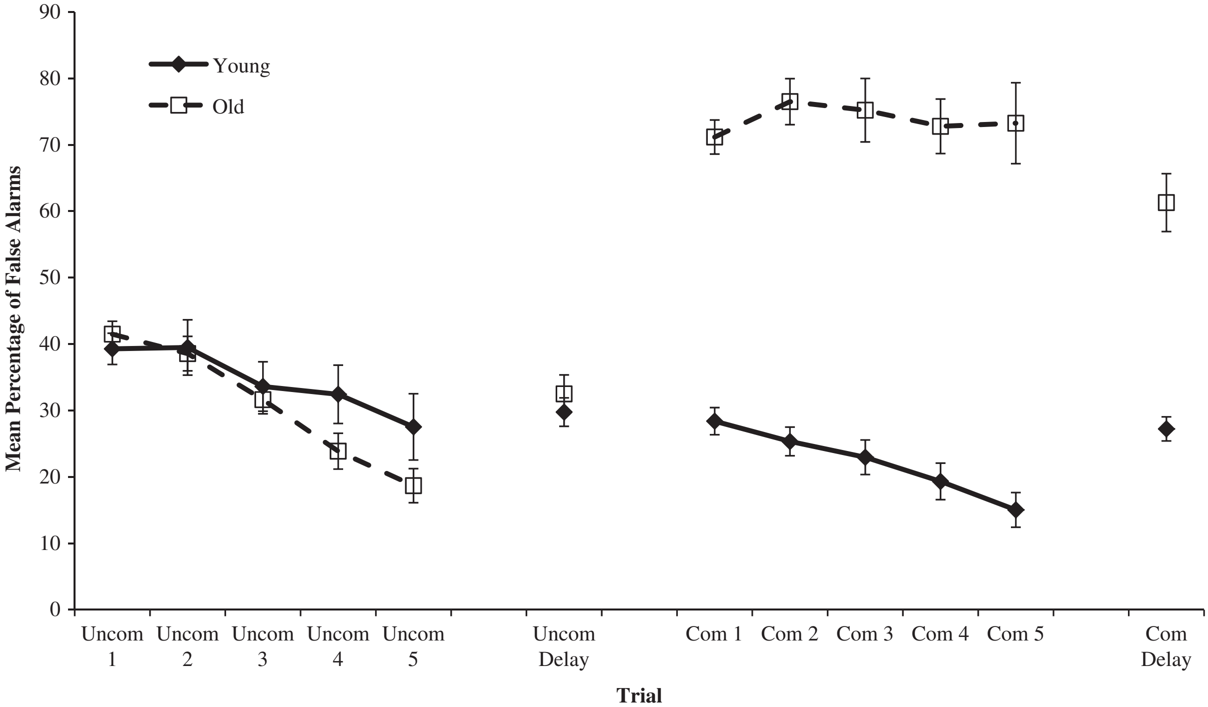

Figure 3. Mean percentage of false alarms for younger and older adults studying uncommon (uncom) and common (com) lists across 5 immediate trials and 1 week later (delayed recall) when using the face-name association technique.

trial 5 and the delayed cued recall for younger and older adults studying common and uncommon names.

The marginal means show that the cued recall of face-name associations was 88.57% higher for trial 5 compared with the delayed cued-recall test for the whole sample population, which was significant. Younger adults showed a significant 26.68% higher mean cued recall (across trial 5 and the delayed cued-recall test) than did older adults. There was also a significant main effect of name commonality; the whole sample population showed a 23.08% higher mean cued recall (across trial 5 and

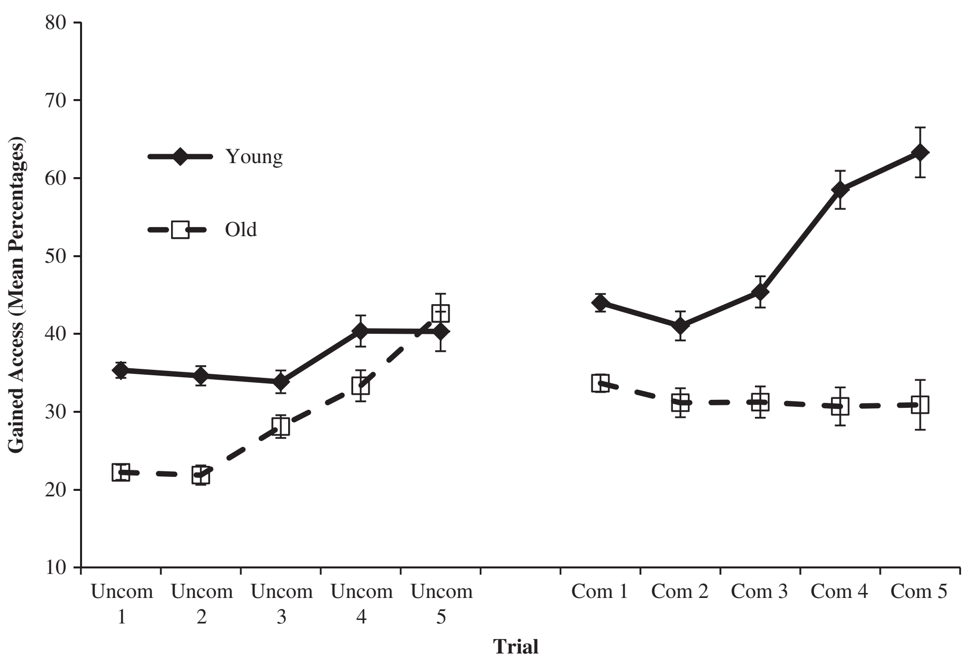

Figure 4. Mean gained access of younger and older adults studying uncommon (uncom) and common (com) names across 5 immediate trials when using the face-name association technique.

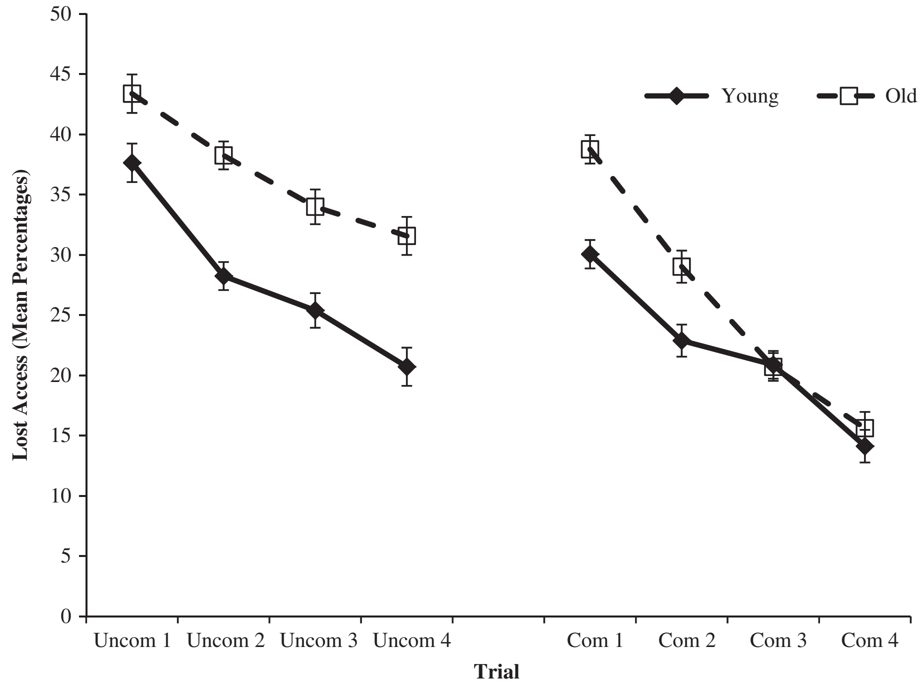

Figure 5. Mean lost access of younger and older adults studying uncommon (uncom) and common (com) names across 4 immediate trials when using the face-name association technique.

the delayed cued-recall test) for common versus uncommon names.

Younger adults failed to retrieve/retain 83.39% of the names that they recognized on trial 5 compared with the delayed cued-recall task, but in older adults this figure was 95.43%, which was significant. The significant reduction in cued recall between trial 5 and the delayed cued-recall task for the whole population was 81.39% for common names, compared with 95.43% for uncommon names. Finally, there was a significant 2-way interaction of saving scores between the factors of name commonality and age group. The marginal means show that the mean cued recall of common versus uncommon names (for trial 5 and the delayed cued recall) for younger participants was 34.57% compared with 10.05% for older participants. This indicates that older adults show increased retrieval/retention of common versus uncommon names in comparison with younger adults. There was no significant 3-way interaction on saving scores between the 3 factors.

FAs on saving scores

It was possible to calculate FAs for the delayed cued-recall test; therefore, the same analysis was used as for saving scores but the outcome measure was FAs on saving scores. As expected, the mean FAs were significant, 86.58% higher for older compared with younger participants. There was a significant main effect of trial on overall FAs; FAs were 12.12% higher on the delayed cued-recall task than on trial 5. There was also a significant main effect of name commonality on overall FAs. Overall, FAs were 63.03% higher for common compared with uncommon names for the whole sample population.

The marginal means showed a significant result in that younger adults had 11.94% more FAs for uncommon over common names; conversely, older adults showed 162.94% more FAs for common over uncommon names overall. The marginal means show that for uncommon names the FAs were 34.74% higher on the delayed cued-recall task compared with those on the final trial, which was significant. However, for the common names there was negligible difference in FAs, in that they were 0.27% higher for the delayed cued-recall task. There was no significant 2-way interaction of FAs for saving scores between the factors of trial and age group.

The marginal means show that FAs for younger adults for uncommon names were 8.11% higher on the delayed cued-recall task than on trial 5, and the FAs for common names were 81.12% higher on the delayed cued recall compared with trial 5. The results for older adults for uncommon names were in the same direction: 87.74% higher on the delayed cued-recall task compared with trial 5. However, for common names, older adults showed a 16.31% higher number of FAs on trial 5 compared with that on the delayed cued-recall task (this was significant and is demonstrated in **Fig. 3**).

Discussion

Effect of age, name commonality, and face-name association trial on recall

Results show that older adults have a cued-recall deficit for names when associating them with faces; this was true in the case of the first trial and overall 5 trials, supporting previous results[10,12,13,20]. Results confirm that there is an age-related deficit when attempting to make face-name associations for unknown faces. The potential confounds of age and emotional expression of the to-be-remembered face did not appear to affect the face-name recall[41,66,68].

Using an intertrial technique allowed us to replicate the results of Tse et al[12], with repeated testing of name recognition using a FNAT for the cued recall of first names. Tse et al[12] showed that older participants showed no significant cued-recall benefit compared with middle-aged participants for name recall across trials when they did not receive feedback on their intertrial performance. This was not the case in experiment 1, where there was no significant dissociation between name cued recall across trials between younger and older participants. Participants did not receive any feedback on their performance between trials; therefore, when comparing younger with older participants, rather than middle-aged with older participants (as in Tse et al[12]), one would expect a greater cued-recall benefit across trials of younger over older adults in the current study because the age difference is greater (ie, a significantly steeper learning curve for younger versus older participants).

With regard to name commonality, there is strong support that common versus uncommon names are recalled significantly better for the whole sample population[10]. This supports the NST[14,19,20,23], in that connections between more common names aid their recall compared with less common names. However, there was a significant dissociation between the recall of common versus uncommon names for younger and older adults, and this was also significant when including trials in the analysis. Contrary to the NST, younger adults showed a recall benefit over the 5 initial recall trials for common versus uncommon names; however, older adults showed an enhanced learning curve of uncommon compared with common names. This does not support the NST[14], but supports the IT[53].

FAs were calculated for the 5 initial trials and for saving scores. As expected, older adults showed more FAs overall than their younger counterparts, indicating that older adults are less able to recognize face-name associations than younger adults. There was also the expected name commonality effect on FAs over the entire study; however, there was no significant interaction between the 2 sample populations over the 5 initial trials, questioning the results of Tse et al[12]. The results show that younger and older adults did not differ in the number of FAs they made for their overall FNAT. The significant 2-way interaction between age and name commonality was a critical finding, as was the 3-way interaction between age, name commonality, and the first 5 trials. These results show that older adults have a lower FA for uncommon names over common names compared with younger participants. This provides overwhelming support for the IT of name recall[54].

Even though both younger and older adults show an overall recall benefit of common versus uncommon names, the results show support for the IT of name recall when using face-name associations[54]. This is based on the traditional IT of aging proposed by Zacks and Hasher[54]. Older adults showed a steeper learning curve for uncommon versus common names in experiment 1; however, this was the direct opposite to younger adults' results. The FA results supported this, whereby older adults showed a significantly lower FA for uncommon versus common names compared with younger adults.

Overall, the results confirm that anomia for unknown faces is significantly greater in older adults for recall, compared with younger adults, especially on the first trial. Furthermore, there is support from the whole sample population for the NST, in that common names are recalled more than uncommon names. However, the results do not support the findings of Tse et al[12], whereby there was no significant dissociation between the recall of names over trials between age groups. Furthermore, there is a lack of evidence for the NST when comparing younger and older subjects: older subjects show a recall benefit over trials of uncommon versus common names when the opposite is the case for younger participants. The recall results of experiment 1 suggest that the FNAT is inappropriate for investigating age-related deficits in name recall and the effects of name commonality on aging.

Effect of age, name commonality, and face-name association trial on gained access

Table 2 shows a summary of results for the effect of age, name commonality, and trial on GA (encoding). As in previous research, older adults show a significantly lower level of encoding across trials compared with younger adults. To our knowledge, no study has used the FNAT to investigate encoding in either younger or older adults, and has certainly not taken name commonality into account. In line with previous research[45,46], the results show that older adults demonstrate a significantly lower encoding level compared with younger adults; this was the case overall, for GA, and when the factor of trial was taken into account.

For the whole sample population, there was a significant main effect of GA on name commonality, such as common names showed a higher GA score than uncommon names. In support of the NST, this suggests that encoding is superior for more common names. However, over the 5 trials, older adults encoded more uncommon names than common names; the reverse is true for younger adults. Furthermore, taking into account the factor of trial, the increase in encoding for uncommon over common names is greater for older adults, whereas younger adults show the opposite effect. Overall, this supports the IT[53] and suggests that older adults find it easier to acquire uncommon names rather than common names when completing a multi-trial experiment.

Finally, the GA results do not support previous research investigating intertrial learning of words, which differ in AoA or word frequency[46]. Experiment 1 shows that older adults have superior encoding across trial for names, which are supposedly less connected than names showing greater inter-item associations.

In summary, the GA results confirm that older adults show an overall deficit in encoding when studying names using the FNAT. There was also the expected increase in encoding across the 5 trials, and for common versus uncommon names for the whole sample population. However, there was a lack of support for the NST, such that older adults showed significantly greater encoding for uncommon over common names (compared with younger adults) overall, for GA, and when the factor of trial was taken into account. When comparing younger and older participants for anomia, these results support the IT of name recall in aging[53], not the NST.

Effect of age, name commonality, and face-name association trial on lost access

For the whole sample population, there was a significant difference in LA for younger and older adults, supporting previous research[46] in which older adults showed a higher mean LA than younger adults. This was also the case when the factor of trial was taken into account, thus supporting the view that older adults have a greater consolidation deficit compared with younger adults, over the whole study and across trials.

There was also an overall consolidation decrement for uncommon compared with common names. This indicates that more common names showed a greater overall consolidation over the 4 trials than did uncommon names. However, older adults showed a dissociation for the consolidation benefit of uncommon versus common names, whereas younger adults showed the opposite. A critical finding was the dissociation between age group and name commonality when the factor of trial was included in the analysis; specifically, older adults showed a greater consolidation of uncommon over common names across the 4 trials, whereas younger adults showed the reverse. This supports the IT[53]. Overall, the results of LA show support for the NST, but when the factor of age is included there is greater support for the IT[54]. This raises questions about whether the FNAT is appropriate for studying the consolidation of first names in younger and older adults.

Effect of age, name commonality, and face-name association trial on saving scores

Previous research[64] has shown that younger adults retrieve/retain more names than older adults from trial 5 to the delayed recall test. Further, in the study by James[35], it was suggested that older adults have a significant retrieval problem for names compared with other information such as occupation. However, this study tested only name recall. There was also evidence that common names were retained/retrieved to a greater degree than uncommon names for the whole sample population. However, the mean recall showed that older adults had a superior retention/retrieval rate for uncommon names over common names, which was the inverse of younger adults. There was no difference in the retrieval/retention of common and uncommon names for younger and older adults between their final trial and the 1-week-delayed face-name recall test.

Figure 3 shows that the results were contrary to the FAs in the 5 initial trials. Both younger and older adults showed a difference in FAs overall; however, older participants showed significantly fewer FAs for common names compared with their final cued-recall trial and the delayed cued-recall task; this was not mirrored in the younger sample. These results suggest that LA and saving scores measure a different cognitive construct.

Overall, the results fail to support either the NST or the IT. However, in terms of the mean recall of younger and older adults for common versus uncommon names, there is an indication that older adults are better at retaining/retrieving uncommon rather than common names, and this is reversed in the younger adults. Conversely, there is strong evidence that common names are not falsely retrieved/retained by older adults in comparison with uncommon names, as in the case of younger participants. The lack of a 3-way interaction suggests that longer-term retention/retrieval for uncommon over common names is no different between younger and older participants when using the FNAT for cued recall, but that it is different for FAs.

Conclusions

Overall, the research shows support for the NST[20,22] in that common names show superior recall, encoding, consolidation, and retrieval/retention over uncommon names. In further support of the FNAT, when controlling for the age[68] and emotional expressions of the to-be-remembered faces[69], older adults show a deficit across all EM variables for recalling names in association with unknown faces.

However, there was a lack of support for the findings of Tse et al[12] in that younger and older adults showed a difference in face-name association recall when studying the associations without feedback. Furthermore, there was a lack of support for the NST with regard to name recall for younger and older adults studying common versus uncommon names. The intertrial technique provided overwhelming evidence for the IT of name recall between younger and older participants[53]. More convincing evidence was found when FAs were analyzed over the 5 initial trials: older adults demonstrated significantly fewer FAs for uncommon versus common names than did younger adults. Even though younger and older adults showed benefits in all aspects of EM for common versus uncommon names, older adults showed a significant benefit in recall, encoding, and consolidation with fewer FAs across the trials in comparison with younger adults. This was not supported in the multi-trial technique to investigate longer-term retention/retrieval; however, there was no evidence for the NST (apart from when FAs were calculated for saving scores). In conclusion, we argue that the FNAT is only appropriate for studying anomia in nonpathologic aging and not for studying age-related deficits in name recall as done in previous research[13].

Experiment 2

The aim of this study was to compare the FNAT with a standard pure-list recall technique to assess younger and older adults' ability to recall common versus uncommon names, thereby removing the possibility that anomia might confound name recall in nonpathologic aging. We argue that the difficulties older participants have in forming face-name associations are caused by these neurocognitive deficits, and are not different in name recall per se.

Although research based on connectionist models has shown that younger adults show an increase in intertrial recall, GA, and LA (specifically for early-acquired over later-acquired words) compared with older adults[46], we predicted that the difference in name recall would be smaller for all EM measures between younger and older adults compared with the results of experiment 1. We believe that by removing the face-name association requirement, the age-related deficit in name recall, encoding, consolidation, and retrieval/retention over trials would be reduced. However, based on the NST, we predicted that there would still be an effect on name commonality on EM aspects for the whole sample population[13].

Methods

Participants

None of the participants of experiment 1 took part in experiment 2. Participants were divided by age into a younger group [n = 30; mean age, 22.47 y (SD = 4.26)] and an older group (n = 30; mean age, 72.3 y (SD = 6.30)]. The younger group had a mean number of years in full-time education of 14.09 years (SD = 1.86), whereas older adults had a mean of 14.77 years (SD = 4.17); there was no significant difference between the 2 groups ($t < 1$). All older adults scored over 27 of 30 on the MMSE[74]. All participants were native to England or Wales and gave their informed consent.

Stimuli

The stimulus was identical to experiment 1, except participants were not shown the faces to form face-name associations.

Design and procedure

The design and procedure were identical to those of experiment 1, except for 2 aspects; first, the participants were not shown faces to associate with the names, and second, half of the younger and older participants were contacted by telephone to perform the delayed recall task on the second name list. The procedure is outlined in **Figure 6**.

Results

The statistical results of experiment 2 are shown in **Table 3**. As in experiment 1, a 2 × 5 × 2 ANOVA (age group × trial × stimulus characteristics: ie, name commonality) was used to examine the effects of age, trial, and name commonality on overall recall. The results of the 3-way mixed ANOVA are illustrated in **Figure 7**. There was a significant main effect of trial on overall recall.

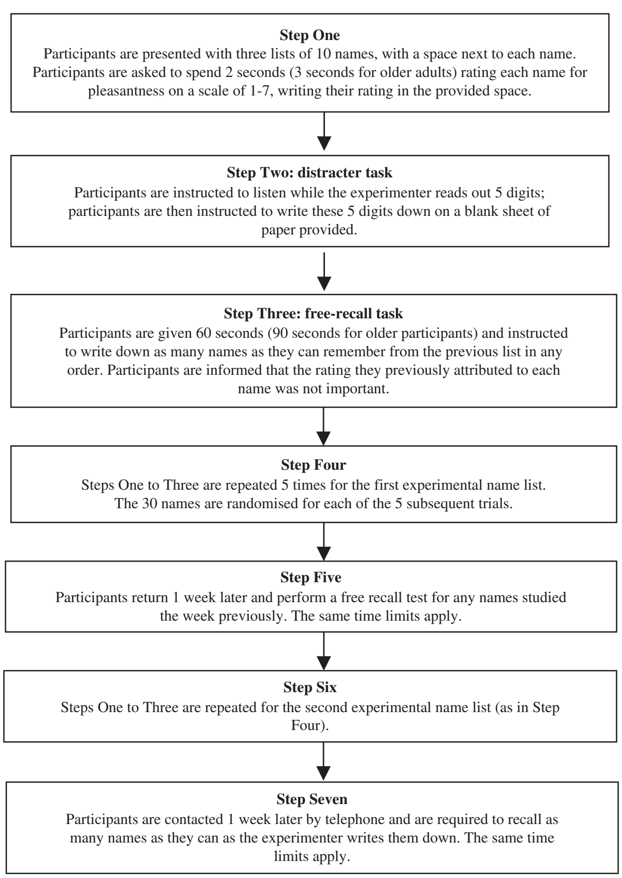

Figure 6. An illustration of the experimental procedure in experiment 2. Note that the experimental name list was counterbalanced for each sample population.

Table 3

Summary of results for experiment 2.

	Recall	GA (Encoding)	LA (Consolidation)	Saving Scores (Retrieval/Retention)
Age group main effect	$F<1$, NS	$F<1$, NS	$F<1$, NS	$F<1$, NS
Name commonality main effect	$F_{1,58}=27.299$, $P<0.001$, $\eta^2=0.32$	$F_{1,58}=19.182$, $P<0.001$, $\eta^2=0.25$	$F_{1,58}=6.751$, $P=0.01$, $\eta^2=0.10$	$F_{1,58}=30.376$, $P<0.001$, $\eta^2=0.34$
Trial main effect	$F_{4,232}=128.901$, $P<0.001$, $\eta^2=0.69$	$F_{4,232}=13.428$, $P<0.001$, $\eta^2=0.19$	$F_{3,174}=8.499$, $P<0.001$, $\eta^2=0.13$	$F_{1,58}=282.308$, $P<0.001$, $\eta^2=0.83$
Age group × name commonality interaction	$F<1$, NS	$F<1$, NS	$F<1$, NS	$F<1$, NS
Age group × trial interaction	$F<1$, NS	$F<1$, NS	$F<1$, NS	$F<1$, NS
Name commonality × trial interaction	$F<1$, NS	$F<1$, NS	$F<1$, NS	$F<1$, NS
Age group × name commonality × trial interaction	$F<1$, NS	$F<1$, NS	$F<1$, NS	$F<1$, NS

NS indicates not significant.

Marginal means show a 50.59% mean increase in name recall for the whole sample population across the 5 initial trials. For overall recall there was also a significant main effect of name commonality; 15.12% more common than uncommon names were recalled by the whole sample population. Critically, however, there was no significant main effect of age group on overall recall. No significant 2-way interaction was found between trial and age group, trial and name commonality, or age group and name commonality. There was no significant 3-way interaction between the 3 recall factors.

Gained access

As in experiment 1, a 2×5×2 ANOVA (age group×trial×stimulus characteristics: ie, name commonality) was used to examine the effects of age, trial, and name commonality on overall GA. The results are shown in **Figure 8**. There was a significant main effect of trial on GA, indicating that GA for the whole sample population increased by 10.78% over the 5 trials. There was also a significant main effect of name commonality on GA. Marginal means show that common names have a 17.80% overall higher GA than uncommon names, indicating increased encoding of common over uncommon names for the whole sample population. However, there was no significant main effect of age group on GA. All 2-way and 3-way interactions were nonsignificant.

Lost access

As in experiment 1, a 2×4×2 (age group×trial×stimulus characteristics: ie, name commonality) mixed ANOVA was used. The results are illustrated in **Figure 9**. There was a significant main effect of trial on LA. Marginal means show that for the whole sample population, name LA decreased by 24.66% over the initial 4 trials, indicating improved consolidation after repeated exposure to the stimulus. There was also a significant main effect of name commonality on LA; marginal means showed a 13.13% higher consolidation for common over uncommon names for the whole sample population irrespective of age group or trial. There was no significant main effect of age group on LA. All 2-way interactions and the 3-way interaction between the main factors were nonsignificant LA.

Saving scores

As in experiment 1, a 2×2×2 (age group×trial×stimulus characteristics: ie, name commonality) ANOVA was used to investigate the impact of the 3 factors on long-term retention/retrieval (saving scores). As expected, there was an overall significant main effect of trial on saving scores; 76.13% more names were recalled on trial 5 compared with the delayed recall trial (**Fig. 8**). There was also a significant main effect of name commonality on saving scores. For the whole sample population, 22.91% more common names were recalled overall. There was no significant main effect of age group on saving scores. All 2-way interactions and the one 3-way interaction were nonsignificant.

Discussion

Effect of age, name commonality, and face-name association recall trial

Our results show that the recall of names increased significantly across the first 5 initial trials for both groups of participants. In contrast to the results of Tse et al[12], we found no evidence that younger and older adults recalled names at a different rate over the 5 initial trials. It is possible that Tse et al[12] did not examine EM; therefore, the ability to recall names might be different in short-term memory compared with that in long-term memory.

There is partial support for the NST[20], in that the whole sample population showed a recall benefit for common over uncommon names. However, contrary to both the NST and the IT[53], there was no difference in the recall of common versus

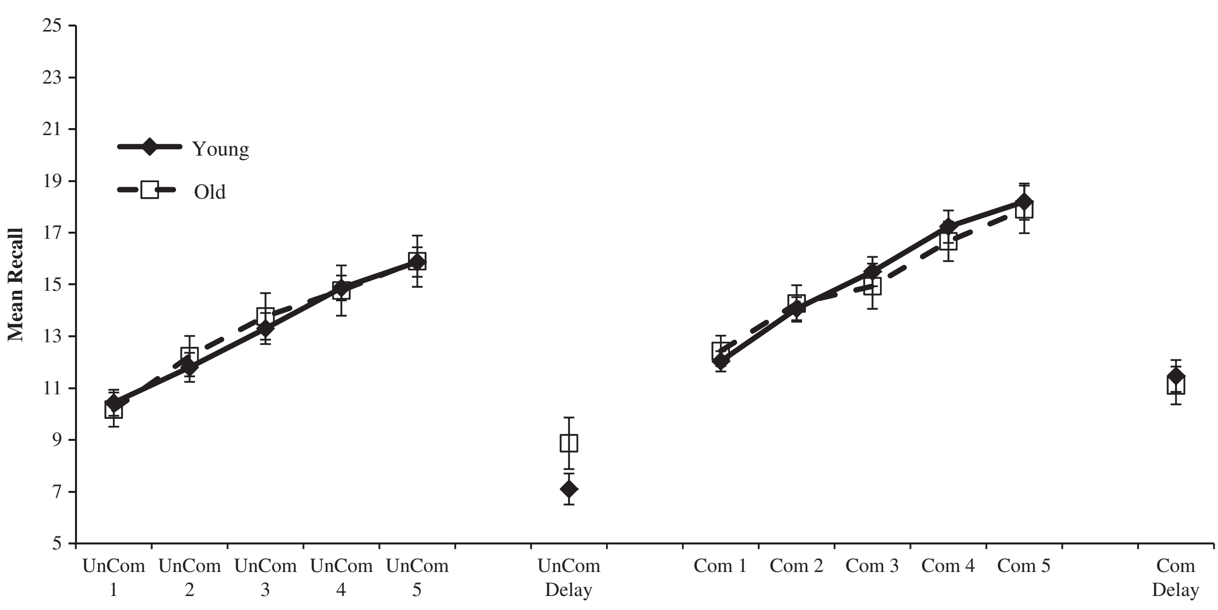

Figure 7. Mean recall of younger and older adults studying uncommon (uncom) and common (com) lists across 5 immediate trials and 1 week later (delayed recall) when using the pure-list study technique.

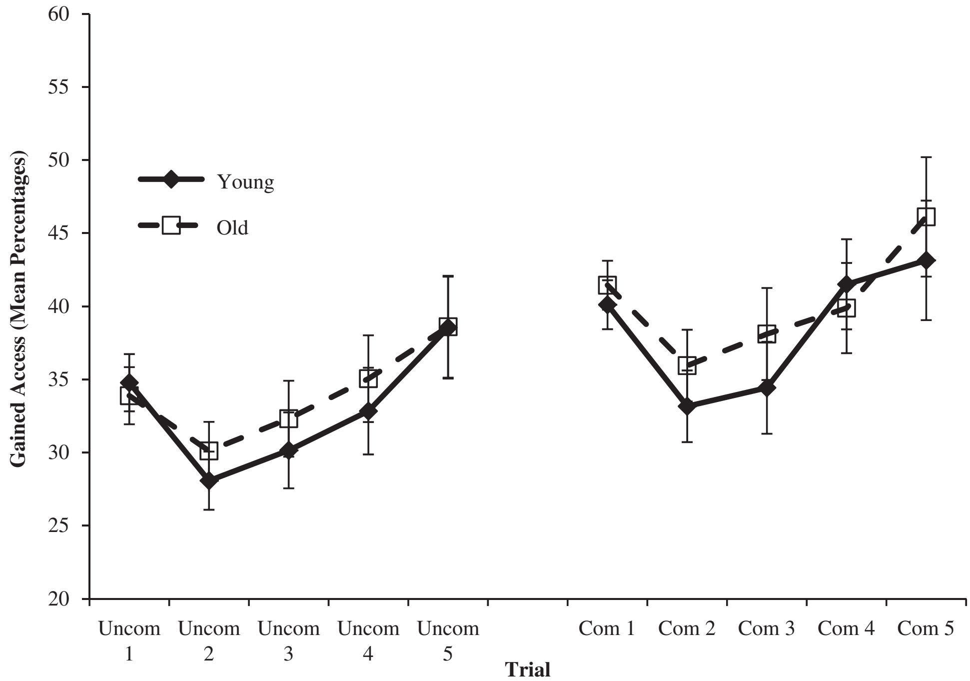

Figure 8. Mean gained access of younger and older adults studying uncommon (uncom) and common (com) names across 5 immediate trials when using the pure-list study method.

uncommon names for the younger or older group, whether for the whole experiment or when the factor of trial was taken into account. More crucially, and contrary to the findings of previous studies[44,45], we found no evidence of an age-related deficit in overall name recall; this was the case when the factors of both trial and name commonality were taken into account.

Furthermore, in both Almond et al[45] and Taylor[46], a significant dissociation was demonstrated between stimulus

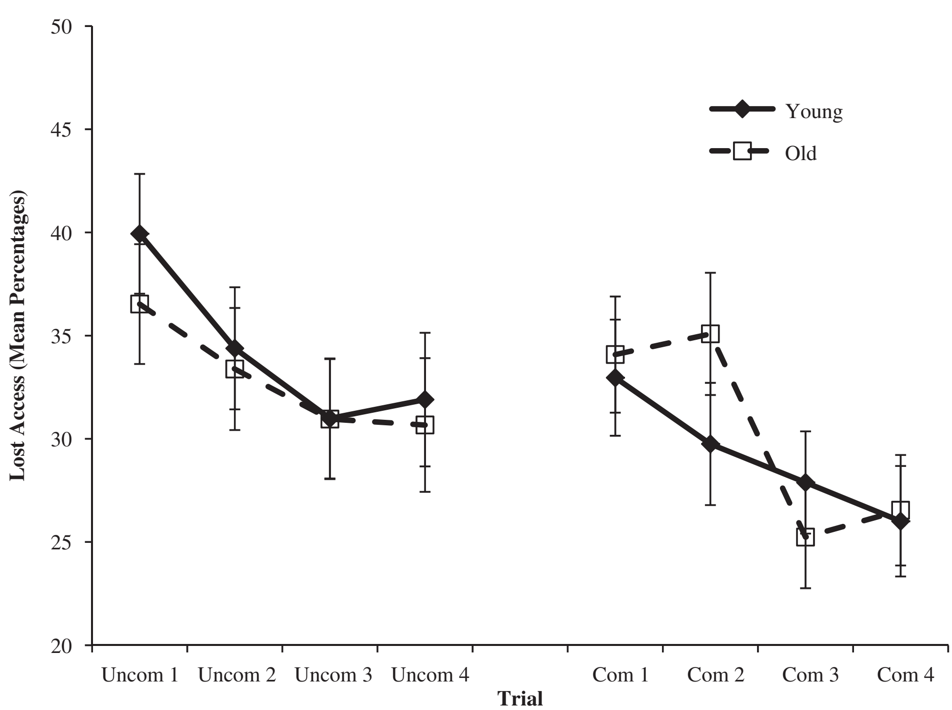

Figure 9. Mean lost access of younger and older adults studying uncommon (uncom) and common (com) names across 4 immediate trials when using the pure-list study method.

characteristics, participants' age, and the number of words recalled across the 5 initial trials. These 2 studies showed that words with weaker inter-item associations (ie, low-frequency words that are later acquired) showed a shallower learning curve in younger compared with older participants than did words with a greater number of inter-item associations (ie, high-frequency and earlier-acquired words). In experiment 2, however, there was no difference in the learning curves for names that differed in terms of commonality for younger and older adults.

Overall, there was no support for the results of Semenza et al[31], which indicated that older adults have a long-term memory deficit for names compared with younger adults when using a pure-list technique of first names. Finally, our results did not show a difference between younger and older adults when studying the same common and uncommon names over 5 trials, as was evident in experiment 1.

Effect of age, name commonality, and pure-list name trial on gained access

The results of experiment 2 showed that for the whole sample population, encoding (GA) significantly increased across the 5 trials. However, there was no significant difference in encoding between younger and older adults. There is clear support that both younger and older adults encode common names significantly better than uncommon names across repeated trials. However, there is no evidence of an age-related decline in name encoding using an intertrial study technique when not using the FNAT.

Overall, the results showed some support for the NST[23] in that common names showed superior encoding over uncommon names for the whole sample population; however, the fact that older adults showed no dissociation in encoding for uncommon over common names does not support the NST. One of our clearest findings was that there was no significant difference in encoding between younger and older adults overall; this was the case when name commonality and number of trials were taken into account, which is incongruent to both the NST[19] and the IT[53] of name recall in aging.

Effect of age, name commonality, and pure-list name trial on lost access

The results support previous research using the intertrial technique, which showed that LA decreased across trials, indicating an increase in consolidation[45]. However, unlike previous studies using the intertrial method, there was no significant main effect of age on LA[45]. In support of the results obtained on recall and GA, older adults do not appear to show a consolidation deficit in names over younger adults. Almond et al[45] showed that older adults display a greater consolidation deficit for stimuli compared with their younger counterparts, which can be regarded as having fewer inter-item associations (ie, later-acquired over earlier-acquired words); however, there is no evidence to show that uncommon names have an increased consolidation deficit than common names for older participants.

Although the NST[14] is to some extent supported by the higher consolidation of common over uncommon names for the whole sample population, older adults do not show a significantly lower consolidation score for uncommon over common names compared with younger adults. There is also no support for the IT[53] in that consolidation for uncommon versus common names was not greater in older compared with younger participants.

Effect of age, name commonality, and pure-list name trial on saving scores

For the entire sample population, the results show that the recall of names on the final trial was significantly better than the recall of names on the delayed recall trial 1 week later. This supports previous research in this area; however, unlike the majority of this research, in our study older adults showed no increased deficit in retrieval/retention on the delayed recall task compared with younger adults[45]. This is contrary to the study of James[35], who suggested that older adults have a significant deficit in name retrieval compared with younger adults. However, James[35] used the FNAT, which may have contributed to these findings.

Our results show enhanced retention/retrieval for common names compared with uncommon names. This supports the NST[23] in that common names appear to be easier to retain or retrieve over a longer period of time than uncommon names. However, we found no significant age-related deficit in saving scores; this does not support the NST or questionnaire research showing that older adults have a long-term memory deficit for retrieving or retaining names[4], nor does our research support that of Semenza et al[31], who found that the recall of first names had a significantly greater effect on long-term memory in older compared with younger adults. There is also no evidence for the IT[53].

Our results do not support previous research manipulating stimulus characteristics in terms of AoA or word frequency to reflect possible inter-item associations. For example, Almond et al[45] found a significant interaction between trial, stimulus characteristics, and participant age for LA, but not saving scores, suggesting that these measure different cognitive EM constructs. In experiment 2, the results show that name commonality did not affect LA and saving scores differently for the 2 outcome variables.

Conclusions

In summary, the results of experiment 2 show that name recall, encoding, and consolidation increase across trials when using the intertrial technique with pure lists of first names. There is some support for the NST in that common names show an overall recall, encoding, consolidation, and retention/retrieval benefit over uncommon names. However, there is no support for the NST or IT of name recall with regard to aging, as there was no dissociation between any of the outcome variables in terms of the learning curves between younger and older participants. Most noteworthy was the lack of evidence of an age-related deficit in name recall, encoding, consolidation, or retention/retrieval overall. This suggests that older adults have no EM decrement for first name recall, as reported in previous research ([31]).

General discussion

On comparing experiments 1 and 2 (**Tables 2**, **3**), we found that experiment 1 showed significant support for an age-related deficit in name recall when using the FNAT, whereas experiment 2 showed no significant effect of nonpathologic aging on name recall. In both experiments a recall benefit was found for the whole sample population for common over uncommon names. The intertrial technique provided insights on the interaction between face-name associations, age, and name commonality. The results of experiment 1 were not mirrored in experiment 2, which suggests that either there is a difference in anomia versus name recall between younger and older adults, or that the methodology used to investigate name recall in aging has produced different results[36,38]. Results obtained using the intertrial technique provided insights into the EM processes accounting for anomia when using the FNAT with younger and older participants.

Difference in anomia versus name recall in younger/older adults: intertrial technique

Traditionally, the age-related effect of name recall has been investigated using the FNAT[14]; however, arguably, this investigates anomia and not specifically name recall in nonpathologic aging. Semenza et al[31] used a pure-list, single-trial technique to investigate first name recall in younger adults, older adults, and subjects with dementia. Experiment 1, which replicated the traditional FNAT, supported evidence to suggest that older adults are deficient in recognizing first names associated with unknown faces over 5 trials. However, experiment 2 tested younger and older participants using a pure-list technique[45,46] across 5 trials using the same names as in experiment 1.

Older participants showed a significant face-name association deficit across the initial 5 trials compared with younger adults in experiment 1; however, there was no significant main effect of age on name recall when the pure-list technique was used in experiment 2. This indicates that older adults show a deficit in anomia but not in name recall, supporting comments by Ramscar et al[38] and Maylor[36], who argue that methodological factors produce the false indication that older adults show a greater deficit, compared with younger adults, for names over other types of words or information.

The result of experiment 2 did not support the findings of Semenza et al[31], who found that older participants had a significantly greater primacy memory (EM) deficit for first names than younger adults. Semenza et al[31] used the serial position effect to conclude that there was a difference between young and older adults in name recall. Conversely, experiment 2 used the intertrial technique with a standard 5-figure digit span to clear out working memory. It is possible that some of the younger adults in Semanza's experiment[31] were able to consolidate and rehearse the names appearing earlier in the list than older adults because there was no difference between study time and recall time[77]. Furthermore, in experiment 2, stimuli were randomly presented over the 5 trials; therefore, participants could not use rote rehearsal to recall the names on each trial (younger adults are more effective at doing this compared with older adults). Furthermore, there was no significant difference in name recall between younger and older adults for saving scores in experiment 2. This contradicts Semenza's[31] results, in which older adults showed a deficit in longer-term memory for names over younger adults. It is likely that the different methodologies used between experiment 2 and Semenza et al[31] are responsible for this.

From the findings of the current study we argue that since older adults have decreased executive functioning, metacognition, and attention span because of neurological changes in the frontal region of the brain[62], they have greater difficulty in associating unknown faces with names. The findings of experiment 1 supported this view: a significant age-related deficit was found for all names using the FNAT, but not in experiment 2. Furthermore, older adults showed a significantly higher percentage of FAs compared with younger adults.

There are 2 aspects to be noted in the methodologies of experiments 1 and 2; first, the same names were used as stimuli for both experiments, and the timing for study and recall was identical (as was the size and type of the font). Second, although different sample populations were used, there was no significant difference between the ages or number of years in education between the 2 younger and 2 older sample populations. Furthermore, there was no difference between the number of years in education between younger and older adults, which has been shown to affect older adults' ability to form memory associations[80].

Another reason why the FNAT should be used to study only anomia and not name recall in aging is that older adults show a significant decline in associative memory compared with younger adults[28]. In addition, there is a significant decline in memory functioning when older adults undertake a divided attention task compared with younger participants[24]. The FNAT requires participants to form associative memories—it is arguably a divided attention task, as the participants need to pay attention to the face and the name, rather than just the name, when studying pure lists of names or words[31,46]. Even in the current study, when older participants received more study and recall time, there was a significant main effect of age on overall recall. To clarify, even though previous studies into the NST have reported a greater recall deficit for names compared with other words (such as occupations) for older adults over younger adults, there is still a significant age decline for the associative memory task[13]. Therefore, as names are less common than nouns[50], age-related face-name associations are likely to be greater for names than for more frequently encountered words.

Using the intertrial method allowed us to partially replicate the results of Tse et al[31], whereby we could investigate the difference in the learning curves for the recall of face-name associations between younger and older adults when the participants received no feedback between each study recall trial. As in Tse et al[31], no feedback on performance was provided in experiments 1 or 2; thus, one would expect that comparing an even younger sample population would produce a greater difference between the learning curves of younger and older adults, and specifically when a greater number of names were used (hence avoiding any possible ceiling effects for younger participants).

Second, the intertrial technique was used and face-name associations were presented on 1 piece of paper and not individually on a computer screen[31]; hence, older participants could form more inter-item associations between the uncommon names, compared with common names, than younger adults. Furthermore, as the uncommon and common names were matched for commonality in 1944 and 1994, younger participants were likely to know more of the common names than the uncommon names compared with older adults. Likewise, older adults demonstrated a deficit in associative memory ability[28]; therefore, the decreased number of uncommon names stored in EM may have made the recall task for uncommon versus common names easier for older adults compared with younger adults. Finally, in experiments 1 and 2, older adults received 50% extra study and recall time than younger adults. This is important because older adults have significantly slower reading latency for names[21]; therefore, it is standard procedure to increase the study and recall time for older adults when using an intertrial technique[77].

Previous studies have suggested that younger and older participants respond differently to faces with different emotional expressions[69], ages[68], and celebrity status[66]. Hence, experiment 1 used computer-generated faces of older adults with neutral expressions. Furthermore, the same faces were used for both word lists to eliminate any possible confounds of AoA or face familiarity[67]. The results show that, even when the same faces were used and the procedure was counterbalanced, older adults were still significantly poorer at forming face-name associations for all names across trials compared with younger adults, but not when pure lists of names were used (experiment 2).

In summary, experiment 1 supports previous research suggesting an age-related deficit in recall for names; however, experiment 2 supports the idea that the FNAT is inappropriate for studying name recall in nonpathologic aging but is appropriate for studying anomia across the lifespan. Overall, there is support for the findings of Ramscar et al[38], who argued that the apparent name recall deficit in older versus younger adults may be caused by the methodology and a decrement in anomia in older adults, rather than cognitive deficit in name recall.

Effects of aging and name commonality on recall and false alarms using the intertrial technique

NST[10] predicts that the whole sample population will show an overall recall benefit for common over uncommon names; this was the case in both experiments 1 and 2. However, when the factor of trial was considered in the analysis of experiment 1, there was strong support for the IT of name recall in aging[53]. Specifically, younger adults recalled significantly more common than uncommon names, whereas older adults did the opposite (**Fig. 2**). This result was not replicated in experiment 2.

Analyses of FAs over the 5 trials in experiment 1 (**Fig. 3**) provide support for the IT. The key finding was that there was a dissociation in FAs between the 2 age groups over trials: older adults displayed fewer FAs for uncommon versus common names, whereas the opposite was found in younger adults. However, this pattern was reversed in the saving scores results. Hence, the FA results suggest an age difference in immediate and longer-term EM, specifically when using the FNAT, and thus supporting the NST.

The results of experiment 2 suggest that, even though there was a recall benefit for the whole sample population in terms of name commonality, older participants showed no increase in difficulty for learning either common or uncommon names. This supports the view that the FNAT is inappropriate for studying differences in recall for names that differ in commonality between younger and older participants[36,38].

In conclusion, the results of experiment 1 show support for the IT when the factor of trial was taken into account (for recall). However, experiment 1 also supported the NST to some extent, when taking into account overall recall (for the whole sample population) and with regard to the results from saving scores and FAs (**Table 2**). Experiment 2 provided a degree of support for the NST for overall recall of the entire sample population. However, there was a significant lack of support for both the NST and the IT as there was no significant dissociation for recall between younger and older adults when recalling names using an intertrial technique (**Table 3**). The critical finding is that there was no age difference in recall for names in experiment 2 between younger and older adults; there was also no dissociation in experiment 1 for recall and this raises the question as to whether the FNAT is appropriate for studying the effects of nonpathologic aging on name recall.

Effects of age, name commonality, and trial on constructs of episodic memory using the intertrial technique

The intertrial technique investigated the effects of stimulus characteristics and age on EM constructs (specifically, GA, LA, and saving scores). To our knowledge, this is the first study to use this technique to investigate the impact of name commonality on these constructs and to investigate the impact of age when comparing FNAT with the pure list using a multi-trial technique.

Experiment 1 supported the results of Light[63] in that older adults showed a significant encoding deficit for associative memory compared with younger adults. However, there were also significant main effects on consolidation, long-term retention/retrieval, and FAs. There is support for the NST in both experiment 1 and experiment 2; however, when trials were included in the analysis, only experiment 1 showed an increase in encoding, consolidation, and retention/retrieval for common over uncommon names across trials for the whole sample population. Experiment 2 did not show that repeated testing of common over uncommon names increased the three constructs at a different rate of EM for younger and older adults. This suggests that the encoding and consolidation of common names can be enhanced using the FNAT but not with the pure-list technique, showing a difference in measuring name recall for different EM constructs when using 2 different methodologies. Specifically, anomia seems to benefit the encoding and consolidation EM constructs, while using a pure-list technique fails to demonstrate that common names show a disproportionate increase in any aspect of EM between younger and older adults for common over uncommon names.

In line with connectionist models[49,50], the results of Almond et al[45], in particular, showed that older (compared with younger) adults have a significantly shallower learning curve for GA and saving scores for words that should have fewer inter-item associations. The results also suggested that consolidation for words with fewer inter-item associations is significantly lower across trials for older compared with younger adults. These results were also partially supportive of the findings of Almond et al[45] who showed that the learning curve for high-frequency over low-frequency words was significantly steeper in older compared with younger adults when assessing encoding.

These findings are important for the current study as the NST[10] predicts that more common names have more cognitive associations, not only with other common names but also with cognitive representations about people with that specific name. The cognitive association between uncommon names should be significantly less because individuals encounter more people with common names across their lifespan. Therefore, using connectionist theories and models of aging, it was assumed that older adults would show a benefit in all EM constructs when using the intertrial technique to a greater degree than younger adults.

The results from experiment 1 did not support this hypothesis and showed that the learning curve for GA was significantly steeper for uncommon than for common names for older participants, and was significantly steeper for common versus uncommon names for younger adults. This indicated that, across the 5 trials, older adults showed an encoding benefit for uncommon over common names. Furthermore, older participants had a shallower LA (an inverse measure of consolidation) curve for uncommon compared with common names (the reverse of the younger adults), suggesting that older adults consolidate uncommon names at a greater rate than do younger adults. In addition, FAs were proportionally lower for uncommon names for older participants, which was also contrary to that found in younger adults. This does not support NST or connectionist models, but does support the IT. Results were not replicated in experiment 2, thus providing no support for NST, connectionist models, or IT.

In conclusion, our results showed that when using the FNAT there is a significant main effect of age on name recall for all constructs of EM, contrary to the results of experiment 2 when pure lists of names were used. The results of experiment 1 also indicate that older adults encode and consolidate uncommon names to a greater degree across trials compared with common names; however, younger adults showed the exact opposite. With the FNAT, older participants show a significant deficit in all memory constructs but have improved recall, encoding, consolidation, and retention/retrieval of names, which is not evident in experiment 2 when the factor of trial is taken into account. Supporting Ramscar et al[38], the FNAT for assessing name recall and, arguably, factors associated with the to-be-remembered names is inappropriate when studying the effect of age on constructs of EM functioning for names.

Implications and future research

Experiment 1 supports the idea of an age-related deficit in anomia for all EM constructs. Research has shown an increase in prosopagnosia in participants with damaged temporal lobes or temporal lobe epilepsy[32,40]. Furthermore, Yagishita et al[39] showed that younger adults have increased cued-recall activation when recalling famous face-name associations in the temporal lobe. Fine et al[41] also suggest that the frontal lobe is important in verbal fluency for names compared with other words. Overall, this research suggests that older adults may show a deficit in anomia because of the neuronal atrophy of the frontal and temporal lobes[43,61,62]. Hence, future research should investigate the difference in face-name association and pure-list recall of names using the intertrial technique in younger, healthy older adults and individuals with temporal lobe or frontal lobe dementia (eg, Alzheimer's disease and Korsakoff's syndrome).

However, experiment 2 showed no significant effects of EM on name recall between younger and older adults. This is contrary to previous research[46], in which older adults were deficient in all EM constructs for nouns. The results of experiment 2 suggest that names are stored differently from other linguistic items such as proper nouns. Future research must investigate whether the age-related deficit for name recall is indeed an actual age-related deficit and not just the effects of the methodology used; Ramscar et al[38] argue that the accepted age-related decrement in name recall is due to the methodology used rather than an actual artifact of nonpathologic aging, which is supported by the results of experiment 2.

The findings of experiment 2, which show no age-related deficit in name recall when the FNAT is not used, have 2 major implications. First, the majority of memory self-efficacy questionnaires[5,6] ask older adults about their ability to recall names. Arguably these questions are inappropriate, because—as this study has shown—although older participants show a deficit in anomia, this is not the case with name recall. Thus, questionnaires investigating memory self-efficacy should focus on anomia rather than on name recall per se. Previous studies[4,7] have assumed that older adults show a decline in name recall compared with younger adults, which is not necessarily the case.

Second, there is an assumption that older adults are less reliable as eyewitnesses of criminal investigations than younger adults. Although this may be the case when the witness sees the assailant's face in a line-up and is required to recall the name, it may not be true when the assailant's face is not present but a name is mentioned. According to Moulin et al[37], there is a lack of evidence to suggest that older adults are weaker eyewitnesses than younger adults, but the type of questioning might increase older adults' confusion during cross-examination.

Ramscar et al[38] and Odegard et al[65] argue that the traditional FNAT is inappropriate for studying age-related name recall and thus, arguably, the effects of name commonality in nonpathologic aging, because there is no interaction between the to-be-remembered name-face associations at study. Therefore, they suggest that future research should have a more interactive method whereby participants interact with the individual to-be-remembered faces and names. As well as being more ecologically valid, this would allow the intertrial technique to be used to investigate the different EM constructs in anomia for younger and older participants. Overall, the results do not show that emotion expression or the age of the to-be-remembered face has an impact on anomia in face-name association recall. However, it is clear that personal familiarity of the to-be-remembered names can have an effect on the different EM constructs. This requires further investigation.

Conclusions

Experiment 1 supported the results of previous research in that older participants showed a general deficit in recalling face-name associations compared with younger adults. In contrast, experiment 2 showed no age-related shortfalls in name recall when using a pure-list technique where faces were not required to be associated with first names. Thus, the FNAT may not be appropriate for studying the effect of name recall in nonpathologic aging.

Both experiments showed a deficit in all EM constructs over the whole sample for uncommon over common names. This supports the NST, in that more common names were recalled, encoded, consolidated, and retained/retrieved for the whole sample in both experiments. However, experiment 1 strongly supported the IT of name recall, wherein the learning curve for recall, encoding, consolidation, retention/retrieval, and FAs was significantly steeper for older adults when studying uncommon versus common names; in fact, younger adults showed the opposite effects for all EM constructs.

Experiment 2 showed no age-related deficits for name recall for any of the EM constructs when the factors of name commonality or trial were included in the analysis. A critical finding was that common names were recalled, encoded, consolidated, and retained/retrieved better than uncommon names for the entire sample population. However, there were no dissociations for the 4 EM constructs between age and name commonality and/or trial.

In conclusion, the results suggest that the FNAT is only appropriate for investigating anomia in aging for names overall, and names that differ in commonality. Compared with previous work[44,45], the results suggest that name storage is different from noun storage in terms of cognitive representations in nonpathologic decline in aging. In support of Ramscar et al[38], further research is needed into why there is not a greater deficit for name recall compared with the recall of nouns or other psycholinguistic items in nonpathologic aging. Furthermore, memory self-efficacy questionnaires should focus on anomia rather than on name recall. The findings of experiment 2 support the argument that older adults are not inferior at eye-witness testimony compared with younger adults[37].

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Acknowledgments

The authors are grateful to the older adult volunteers who participated in this research. The authors also thank research assistants Joseph Alderdice, Elizabeth Kim Murphy, Yvonne Kiera Bartlett, Serena Hannah, Shona Cleland, Rachel Carey, Emily Inston, Paige Roberts, Lorna Murphy, Thomas Almond, Micheal Anning, Nathaniel Rowland, Ruth Bradford, Matthew Taylor, Thomas Crosskey, Laura Vance, Freddy Jones, and Sarah Mooney as well as Dr Christopher J.A. Moulin for research advice on experiment 2.

Supported in part by a scholarship from the Harold Hyman Wingate Foundation and the Snowdon Awards Scheme.

References

[1] Kramer JH, Yaffe K, Lengenfelder J, *et al*. Age and gender interactions on verbal memory performance. J Int Neuropsychol Soc 2003;9:97–102.
[2] Balota DA, Dolan PO, Duchek JM. Memory Changes in Healthy Older Adults. New York: Oxford University Press; 2000.
[3] Cohen G, Faulkner D. Memory in old age: "good in parts". New Scientist 1984;11:49–51.
[4] Hawley KS, Cherry KE, Su LJ, *et al*. Knowledge of memory aging in adulthood. Int J Aging Hum Dev 2006;63:317–4.
[5] Jackson EM, Cherry KE, Smitherman EA, *et al*. Knowledge of memory aging and Alzheimer's disease in college students and mental health professionals. Aging Ment Health 2008;12:258–66.
[6] Langlois AS, Belleville S. Subjective cognitive complaint in healthy older adults: identification of major domains and relation to objective performance. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2014;21: 257–82.
[7] Reese CM, Cherry KE. Practical memory concerns in adulthood. Int J Aging Hum Dev 2004;59:235–53.
[8] Sunderland A, Watts K, Baddeley AD, *et al*. Subjective memory assessment and test performance in elderly adults. J Gerontol 1986;41:376–84.
[9] Troyer AK, Rich JB. Psychometric properties of a new metamemory questionnaire for older adults. J Gerontol B Psychol Sci Soc Sci 2002;57: P19–27.
[10] Fogler KA, James LE, Crandall EA. How name descriptiveness impacts proper name learning in young and older adults. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2010;17:505–18.
[11] Griffin ZM. Retrieving personal names, referring expressions, and terms of address. Psychol Learn Motiv 2010;53:345–87.
[12] Tse CS, Balota DA, Roediger HL III. The benefits and costs of repeated testing on the learning of face-name pairs in healthy older adults. Psychol Aging 2010;25:833–45.
[13] James LE, Fogler KA, Tauber SK. Recognition memory measures yield disproportionate effects of aging on learning face-name associations. Psychol Aging 2008;23:657–4.
[14] James LE, Fogler KA. Meeting Mr Davis vs Mr Davin: effects of name frequency on learning proper names in young and older adults. Memory 2007;15:366–74.
[15] Rendell PG, Castel AD, Craik FI. Memory for proper names in old age: a disproportionate impairment? Q J Exp Psychol A 2005;58:54–71.
[16] James LE. Meeting Mr. Farmer versus meeting a farmer: specific effects of aging on learning proper names. Psychol Aging 2004;19:515–22.
[17] Mather M, Johnson MK. Affective review and schema reliance in memory in older and younger adults. Am J Psychol 2003;116:169–89.
[18] Mitchell KJ, Johnson MK, Mather M. Source monitoring and suggestibility to misinformation: adult age-related differences. Appl Cogn Psych 2003;17:107–9.
[19] Jones SJ, Rabbitt PM. Effects of age on the ability to remember common and rare proper names. Q J Exp Psychol A 1994;47:1001–4.
[20] Cohen G, Burke DM. Memory for proper names: a review. Memory 1993;1:249–63.
[21] Crook TH, West RL. Name recall performance across the adult life-span. Br J Psychol 1990;81(pt 3):335–49.
[22] Cohen G, Faulkner D. Memory for proper names: age differences in retrieval. Brit J Dev Psychol 1986;4:187–97.
[23] MacKay DG. The Organization of Perception and Action: A Theory for Language and Other Cognitive Skills. New York: Springer-Verlag; 1987.
[24] Jacoby LL, Shimizu Y, Daniels KA, *et al*. Modes of cognitive control in recognition and source memory: depth of retrieval. Psychon Bull Rev 2005;12:852–7.
[25] Castel AD, Craik FI. The effects of aging and divided attention on memory for item and associative information. Psychol Aging 2003;18:873–5.
[26] Naveh-Benjamin M, Craik FI, Gavrilescu D, *et al*. Asymmetry between encoding and retrieval processes: evidence from a divided attention paradigm and a calibration analysis. Mem Cognit 2000;28:965–76.
[27] Naveh-Benjamin M, Craik FI, Guez J, *et al*. Effects of divided attention on encoding and retrieval processes in human memory: further support for an asymmetry. J Exp Psychol Learn Mem Cogn 1998;24:1091–4.
[28] Anderson ND, Craik FI, Naveh-Benjamin M. The attentional demands of encoding and retrieval in younger and older adults: 1. Evidence from divided attention costs. Psychol Aging 1998;13:405–23.
[29] Craik FI, Govoni R, Naveh-Benjamin M, *et al*. The effects of divided attention on encoding and retrieval processes in human memory. J Exp Psychol Gen 1996;125:159–80.
[30] Craik FI, Byrd M. Aging and Cognitive Deficits: The Role of Attentional Resources. New York: Plenus Press; 1982.
[31] Semenza C, Nichelle F, Gamboz N. The primacy effect in the recall of lists of common and proper names: a study on young, elderly, and Alzheimer disease subjects. Brain Lang 1996;5:45–7.
[32] Seidenberg M, Griffith R, Sabsevitz D, *et al*. Recognition and identification of famous faces in patients with unilateral temporal lobe epilepsy. Neuropsychologia 2002;40:446–56.
[33] Tulving E. Elements of Episodic Memory. New York, NY: Oxford University Press; 1983.
[34] Cohen G. Why is it difficult to put names to faces? Br J Psychol 1990;81: 287–97.
[35] James LE. Specific effects of aging on proper name retrieval: now you see them, now you don't. J Gerontol B Psychol Sci Soc Sci 2006;61:P180–3.
[36] Maylor EA. Proper name retrieval in old age: converging evidence against disproportionate impairment. Aging Neuropsychol Cogn 1997;4:211–6.
[37] Moulin CJ, Thompson RJ, Wright DB, *et al*. Eyewitness Memory in Older Adults. Mahwah, NJ: Lawrence Erlbaum Associates; 2006.
[38] Ramscar M, Hendrix P, Shaoul C, *et al*. The myth of cognitive decline: non-linear dynamics of lifelong learning. Top Cogn Sci 2014;6:5–42.
[39] Yagishita S, Watanabe T, Asari T, *et al*. Role of left superior temporal gyrus during name recall process: an event-related fMRI study. Neuroimage 2008;41:1142–53.
[40] Joubert S, Felician O, Barbeau E, *et al*. Impaired configurational processing in a case of progressive prosopagnosia associated with predominant right temporal lobe atrophy. Brain 2003;126(pt 11):2537–50.
[41] Fine EM, Delis DC, Paul BM, *et al*. Reduced verbal fluency for proper names in nondemented patients with Parkinson's disease: a quantitative and qualitative analysis. J Clin Exp Neuropsychol 2011;33:226–33.

[42] Souchay C, Isingrini M. Age related differences in metacognitive control: role of executive functioning. Brain Cogn 2004;56:89–99.

[43] Raz N. Aging of the Brain and its Impact on Cognitive Performance: Integration of Structural and Functional Findings. Mahwah, NJ: Lawrence Erlbaum Associates; 2000.

[44] Almond NM, Morrison CM. Episodic inter-trial learning of younger and older participants: effects of age of acquisition. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2014;21:606–32.

[45] Almond NM, Morrison CM, Moulin CJ. Episodic inter-trial learning of younger and older adults: effects of word frequency. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2013;20:174–94.

[46] Taylor R. Effects of age of acquisition, word frequency, and familiarity on object recognition and naming in dementia. Percept Mot Skills 1998;87: 573–4.

[47] Ward G, Woodward G, Stevens A, *et al.* Using overt rehearsals to explain word frequency effects in free recall. J Exp Psychol Learn Mem Cogn 2003;29:186–210.

[48] Watkins PC, Woodward K, Stone T, *et al.* Gratitude and happiness: development of a measure of gratitude, and relationships with subjective well-being. J Soc Behav Pers 2003;31:431–52.

[49] Elman JL. On the meaning of words and dinosaur bones: lexical knowledge without a lexicon. Cogn Sci 2009;33:547–82.

[50] Li P. Lexical organization and competition in first and second languages: computational and neural mechanisms. Cogn Sci 2009;33:629–4.

[51] Steyvers M, Tenenbaum JB. The large-scale structure of semantic networks: statistical analyses and a model of semantic growth. Cogn Sci 2005;29:41–78.

[52] Ellis AW, Lambon Ralph MA. Age of acquisition effects in adult lexical processing reflect loss of plasticity in maturing systems: insights from connectionist networks. J Exp Psychol Learn Mem Cogn 2000;26:1103–23.

[53] Burton AM, Bruce V. I recognize your face but I can't remember your name: a simple explanation? Br J Psychol 1992;83(pt 1):45–60.

[54] Zacks RT, Hasher L. Directed Ignoring: Inhibitory Regulation of Working Memory. San Diego: Academic Press; 1994.

[55] Hasher L, Zacks RT. Working Memory, Comprehension and Aging: A Review and a New View. New York: Academic Press; 1988.

[56] Stanhope N, Cohen G. Retrieval of proper names: testing the models. Br J Psychol 1993;84:51–65.

[57] Cooper CM, Odegard TN. Attention and the acquisition of new knowledge: their effects on older adults' associative memory deficit. Psychol Aging 2011;26:890–9.

[58] Naveh-Benjamin M, Guez J, Shulman S. Older adults' associative deficit in episodic memory: assessing the role of decline in attentional resources. Psychon Bull Rev 2004;11:1067–73.

[59] Naveh-Benjamin M, Guez J, Kilb A, *et al.* The associative memory deficit of older adults: further support using face-name associations. Psychol Aging 2004;19:541–6.

[60] Chalfonte BL, Johnson MK. Feature memory and binding in young and older adults. Mem Cognit 1996;24:403–16.

[61] Hara Y, Naveh-Benjamin M. The role of reduced working memory storage and processing resources in the associative memory deficit of older adults: simulation studies with younger adults. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2014;22:129–54.

[62] Elderkin-Thompson V, Ballmaier M, Hellemann G, *et al.* Executive function and MRI prefrontal volumes among healthy older adults. J Neuropsychol 2010;22:626–37.

[63] Light LL. Memory and aging: four hypotheses in search of data. Annu Rev Psychol 1992;42:333–76.

[64] Dunlosky J, Salthouse TA. A decomposition of age-related differences in multitrial free recall. Aging Neuropsychol Cogn 1996;3:2–14.

[65] Odegard TN, Koen JD, Gama JM. Process demands of rejection mechanisms of recognition memory. J Exp Psychol Learn Mem Cogn 2008;34:1296–304.

[66] Valentine T, Darling S. Competitor effects in naming objects and famous faces. Eur J Cogn Psychol 2006;18:686–707.

[67] Bonin P, Meot A, Mermillod M, *et al.* The effects of age of acquisition and frequency trajectory on object naming: comments on Perez (2007). Q J Exp Psychol (Hove) 2009;62:1132–40.

[68] Firestone A, Turk-Browne NB, Ryan JD. Age-related deficits in face recognition are related to underlying changes in scanning behavior. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2007;14: 594–607.

[69] Wan X, Tian L, Lleras A. Age-related differences in the distractor previewing effect with schematic faces of emotions. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2014;21:386–410.

[70] Tomaszczyk JC, Fernandes MA. Age-related differences in attentional bias for emotional faces. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn 2013;21:544–9.

[71] Davis HP, Small SA, Stern Y, *et al.* Acquisition, recall, and forgetting of verbal information in long-term memory by young, middle-aged, and elderly individuals. Cortex 2003;39(4–5):1063–91.

[72] Woodard JL, Dunlosky JA, Salthouse TA. Task decomposition analysis of inter-trial free recall performance on the Rey Auditory Verbal Learning Test in normal aging and Alzheimer's disease. J Clin Exp Neuropsychol 1999;21:666–76.

[73] Mitrushina M, Satz P, Chervinsky A, *et al.* Performance of four age groups of normal elderly on the Rey Auditory–Verbal Learning Test. J Clin Psychol 1991;47:351–7.

[74] Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98.

[75] Merry E. First Names: the Definitive Guide to Popular Names in England and Wales. London: HMSO; 1995.

[76] Feigenbaum EA, Simon HA. A theory of the serial position effect. Br J Psychol 1962;53:307–20.

[77] Naveh-Benjamin M, Hussain Z, Guez J, *et al.* Adult age differences in episodic memory: further support for an associative-deficit hypothesis. J Exp Psychol Learn Mem Cogn 2003;29:826–37.

[78] Canestrari RE Jr. Paced and self-paced learning in young and elderly adults. J Gerontol 1963;18:165–8.

[79] Tulving E, Arbuckle TY. Sources of intra-trial interference in immediate recall of paired associated. J Verb Learn Verb Behav 1963;1: 321–4.

[80] Zec RF, Burkett NR, Markwell SJ, *et al.* A cross-sectional study of the effects of age, education, and gender on the Boston Naming Test. Clin Neuropsychol 2007;21:587–616.