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Searching for Interference Effects in Learning New Face-Name Associations

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Abstract

In 3 experiments, we attempted to increase interference using experimental manipulations in a face-name learning paradigm. All experiments included young and older adult participants because aging is associated with increases in both susceptibility to interference and difficulty in learning face-name associations. None of the experiments produced interference for either age group: The inclusion of confusable (i.e., ambiguous) names and occupations, having to learn an additional piece of information in association with each face, and requiring participants to guess when uncertain all failed to negatively impact name learning. Interference does not appear to be the critical mechanism underlying the difficulty of learning proper names, and it cannot account for older adults' disproportionate decline in name-learning ability.

Learning a proper name in association with a previously-unknown face is more challenging than learning other biographical information (e.g., an occupation) in association with that same face (e.g., Cohen, 1990; James, 2004; McWeeny, Young, Hay, & Ellis, 1987; Rendell, Castel, & Craik, 2005; Stanhope & Cohen, 1993; Tauber & Rhodes, 2010). One suggested cause for the differential difficulty of memory for proper names holds powerful intuitive appeal: interference or competition from other names (e.g., Schacter, 2001; Schwartz, 2002; Valentine, Brennen, & Bredart, 1996). In three experiments, we tested for a role of interference in the difficulty of learning new face-name associations. The ultimate goal of this research was to increase understanding of the theoretical mechanisms underlying the particular challenges of name learning.

Older adults report specific difficulty with memory for proper names (e.g., Cargin, Collie, Masters, & Maruff, 2008; Cohen & Faulkner, 1984), and experimental studies confirm that older adults suffer disproportionate difficulty compared to young adults when learning names in association with faces (e.g., Baressi, Obler, & Goodglass, 1998; James, 2004; James, Fogler, & Tauber, 2008; but see Rendell et al., 2005). The present research tested interference or competition as a possible mechanism underlying older adults' specific impairment in learning new face-name associations. The inhibitory deficit hypothesis (IDH; Hasher, Lustig, & Zacks, 2007; Hasher & Zacks, 1988) served as the theoretical frame to motivate predictions for this research, because it posits that older adults' reduced ability to suppress or inhibit irrelevant information is a primary factor underlying age differences in cognitive performance.

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Inhibition-based models of memory suggest that non-target information actively suppresses accessibility of target information (e.g., Anderson, 2003; Anderson & Green, 2001; O'Seaghdha & Marin, 2000; Smith & Tindell, 1997; Valentine, Hollis, & Moore, 1999). Under the IDH, aging weakens inhibitory processes across all cognitive systems (e.g., memory, language, attention) such that older adults inappropriately activate irrelevant information, they are less able than young adults to effectively ignore or suppress irrelevant information that is activated, and they are unable to withhold or restrain well-learned responses (Hasher et al., 2007). Inhibition failures are suggested to result in greater interference effects for older than young adults, a prediction supported by many studies employing a wide range of experimental tasks (e.g., Anderson, Reinholz, Kuhl, & Mayr, 2011; Bowles, 1994; Connelly, Hasher, & Zacks, 1991; Hartman & Hasher, 1991; Logan & Balota, 2003; Mund, Bell, & Buchner, 2010; Yang & Hasher, 2007).

As applied to new learning, or forming new associations, the IDH predicts decrements for older adults because they are unable to adequately prevent irrelevant information from entering awareness and this interferes with learning the target information. The competing information can arise from internal (one's own thoughts) or external (stimuli in the environment) sources. In the IDH account of forming new associations with lexical information, competing lexical items disrupt processing of the desired word, with greater disruption for older than young adults. As Zacks and Hasher (1994, p. 259) propose, proper names may be dramatically affected by competition from incorrect but related names or other task-irrelevant associations, and there is evidence that proper name retrieval is sometimes subject to competition and interference effects. For example, the "nominal competitor effect" (Stevenage & Lewis, 2005), indicates that young adults have greater difficulty retrieving names for individuals known by more than one name (e.g., actors who are known by the name of a character they played as well as their own name; e.g., Jennifer Aniston, who was also very well known as "Rachel" from the show "Friends"). This finding has been explained within inhibitory models of memory and proper name retrieval, which often stipulate that items "representing competing pieces of information will generally inhibit each other" (Valentine et al., 1996, p. 182). In terms of new learning, inhibitory deficits should result in decrements for older adults due to competition from inappropriately-activated information. Older adults have been shown to engage in "hyper-binding" (Campbell, Hasher, & Thomas, 2010), in which extraneous information is unintentionally bound to target information during new learning because of older adults' inability to suppress the irrelevant information.

Some previous research has supported the suggestion that interference effects contribute to the difficulty of proper name learning. For example, Weinstein, McDermott, and Szpunar (2011) provided indirect evidence that proactive interference is an important factor in young adults' learning of new face-name pairs. Their participants studied four lists, each containing 12 face-name pairs, and were later shown faces and instructed to recall the associated names. Half the participants were tested immediately after studying each list, and half were tested only after all lists were studied. Participants tested after each list did not experience performance declines across the four lists, indicating a failure to develop the proactive interference that typically builds across trials (e.g., Wickens, Dalezman, & Eggemeier, 1976). Critically, the group tested only at the end performed less well than the frequently-tested group, with fewer correct responses and a greater number of intrusion errors. The implication is that a buildup of proactive interference from previous lists harmed face-name association learning in the group tested only at the end. To the extent that aging reduces the ability to inhibit competing terms, older adults would be expected to suffer even greater proactive interference than young adults, and this could be one reason underlying older adults' increased difficulty in learning new face-name associations.

Tse, Balota, and Roediger (2010) also provided data consistent with the suggestion that interference causes difficulty in a face-name association learning task. They found that young and middle-aged adults benefitted from repeated testing without feedback about their accuracy when learning of face-name pairs. However, older adults only benefitted from repeated testing when feedback was provided. Tse et al. explain this finding as likely due to the interference older adults' experienced from the errors they generated during the testing session, presumably caused by age-related decreases in the ability to inhibit incorrect responses in order to produce the correct associated information.

Other previous research has failed to establish a clear role for interference or competition in the difficulty of learning new names. James and Fogler (2007) tested for interference effects on a name-face association learning task by comparing high- and low-frequency stimulus names. Contrary to the suggestion that confusion would result due to interference from meeting people with common last names (e.g., meeting yet another *Mr. Davis*), high-frequency names were more readily learned than low-frequency names. This benefit of increased frequency was maintained for the oldest group of adults (ages 75–89), indicating that interference failed to harm performance even among the group of people who were the most likely to suffer inhibitory deficits (by virtue of their advanced age) and who were likely to have met the most people with the common names (by virtue of their longer lifetimes and exposure to more people). However, a single experimental result providing evidence contrary to interference effects does not represent a particularly compelling challenge to the notion of interference as a critical determinant of face-name learning ability.

To increase our understanding of the theoretical mechanisms underlying name learning, we conducted a set of studies designed to test the role of interference when learning face-name associations. Each of three experiments included a manipulation designed to increase the potential for interference, so that inasmuch as increased interference is the primary culprit in the difficulty of learning face-name associations, increasing the potential for interference should decrease performance. We included young and older adult participants because the IDH predicts that older adults, under conditions designed to maximize interference, should demonstrate particularly dramatic deficits in learning face-name associations.

Experiment 1: Interference from Adopting Ambiguous Stimuli

Many previous studies in which young and older participants learned information in association with faces have included ambiguous (i.e., homophonic) stimulus words that could serve as either proper names or occupations (e.g., *a baker* vs. *Mr. Baker*). For example, James (2004; also James et al., 2008) used ambiguous stimulus terms, such that for every stimulus person either the name or the occupation was ambiguous, but no stimulus person had both an ambiguous name and an ambiguous occupation or neither an ambiguous name or occupation. Unlike James (2004), Rendell et al. (2005) utilized four types of ambiguity pairings (no ambiguous terms, ambiguous name with non-ambiguous occupation, ambiguous occupation with non-ambiguous name, and both ambiguous terms) and reported that non-ambiguous items were better recalled than ambiguous ones. Further, examination of the means in their Table 1 (p. 59) indicates that older adults performed worse for ambiguous than non-ambiguous names and occupations while young adults (in the full-attention condition) were unaffected by stimulus ambiguity. Rendell et al. did not report results by pairing type, so we cannot assess the potentially-exacerbated difficulty created by having to learn two ambiguous words, one as the person's occupation and one as the name (e.g., "Mr. Barber the dean"). In the present study, we included three levels of stimulus ambiguity: no ambiguous terms, one ambiguous term (either name or occupation), or two ambiguous terms (both the name and occupation) and measured name and occupation recall.

An inhibition-based model of name learning predicts that an increased number of ambiguous items to be learned for a particular stimulus person will create additional interference and increase learning difficulty. The IDH predicts that older adults will be even less able than young adults to suppress the alternative meaning of the ambiguous term, and will therefore suffer more confusion as to whether the presented word was a name or an occupation. Specifically, the IDH predicts differentially-greater impairment for older than young adults in learning new names when they are ambiguous and also paired with occupations that are ambiguous. A smaller age effect is expected when only one term is ambiguous, and an even smaller age effect is predicted when neither term is ambiguous.

Method

Participants—Participants included 28 young (ages 18–24) and 28 older adults (ages 59–83). Young adults' scores on the Shipley (1940) vocabulary test were lower than older adults', $t(54) = 4.29, p < .01$ (see Table 1 for age and vocabulary scores). Older adults' high vocabulary scores indicate that they have intact cognitive function, but older participants were also screened for dementia using the Mini-Mental Status Exam (MMSE; Folstein, Folstein, & McHugh, 1975); only data from non-demented older participants are included in analyses.

Materials—We selected 12 color photographs of unfamiliar male faces (appearing to be 30 – 60 years of age). Each photograph contained a man's head with no distinct clothing and no visible background information. Facial distinctiveness was not a concern because each face was introduced equally often in each experimental condition. Twelve surnames that are also occupations (e.g., weaver/Weaver; cook/Cook) were selected from the U.S. Census Bureau website (1990), with their frequency of occurrence as names in the U.S. between .03% and .12%. Half of these ambiguous items were used as surnames and half as occupations in each of two sets (with items counterbalanced across set). Six unambiguous surnames (which are never occupations, e.g., Wagner; Cox) were selected to match the ambiguous surnames on population frequency of occurrence, syllabic length, and initial phoneme. Six unambiguous occupations (which are never names, e.g., bailiff; coach) were selected to match the ambiguous occupations on Kucera-Francis word frequency (MRC Psycholinguistic Database, 1987) as well as syllabic length and initial phoneme.

Procedure—All participants were tested individually and instructions were presented visually and verbally. Participants were instructed to learn both the name and occupation presented with each face. During an introduction round, each face was shown for 4 s in a fixed random order, and the name and occupation were provided visually and verbally. During testing rounds, faces were presented in various fixed random orders, and participants were to recall the name and the occupation for each face, clearly indicating which item was the name (e.g., by using the title “Mr.”) and which was the occupation (e.g., by using the article “the” before the occupation label). Correct responses were acknowledged, and incorrect responses (when either inaccurate or no information was recalled) were corrected. The experiment ended when participants correctly recalled both the name and occupation of all 12 men in two successive testing rounds, or after 12 testing rounds. The use of multiple testing rounds with feedback has the potential to diminish overall interference across testing rounds, but any reduction in interference due to this aspect of the procedure would be equivalent across conditions and would therefore not impact our manipulation of interest. Ambiguity condition was a repeated measure, so that each participant learned names and occupations in all three conditions of the study (with stimulus face assignment to condition counterbalanced across different sets of materials).

Results and Discussion

Percentage of faces for which information was correctly recalled was computed by dividing the number of names or occupations correctly recalled by the total number of faces presented for each participant. These percentages were analyzed in a 2 (age group: young vs. older) $\times$ 2 (information type: name vs. occupation) $\times$ 3 (amount of ambiguity: no ambiguous items, one ambiguous item, and two ambiguous items) mixed-factorial ANOVA (see means in Table 2). There was a main effect of information type, $F(1, 54) = 393.95$, $\eta_p^2 = .88$, $p < .001$, because more occupations were recalled than names, and a main effect of age, $F(1, 54) = 36.88$, $\eta_p^2 = .41$, $p < .001$, because young adults recalled more than older adults. There was also a main effect of amount of ambiguity, $F(2, 108) = 4.58$, $\eta_p^2 = .08$, $p = .01$, such that more information was recalled with two ambiguous items than with no ambiguous items, $t(55) = 2.57$, $p = .01$. Further, more information was recalled with two ambiguous items than with one ambiguous item, $t(55) = 2.25$, $p = .03$, and the amount of information recalled did not differ between one and no ambiguous items, $t < 1$. No other effects involving ambiguity were significant, all F s < 1 . The interaction between information type and age group was significant, $F(1, 54) = 23.34$, $\eta_p^2 = .30$, $p < .001$. Post hoc comparisons revealed that young adults recalled more names than older adults, $t(54) = 7.16$, $p < .001$, and also more occupations than older adults, $t(54) = 4.09$, $p < .001$, indicating that the magnitude of the age decrement was larger for names than for occupations. In other words, this experiment replicated the James (2004) finding of greater age-related declines in name-face association learning than in occupation-face association learning.

Of primary interest, the competition and interference from using ambiguous terms that was predicted under an inhibitory approach failed to materialize. Indeed, faces that were paired with ambiguous terms for both the name and occupation yielded better name recall than faces paired with a single ambiguous term or faces paired with unambiguous terms for both the name and occupation. This benefit of having two ambiguous terms was obtained for both young and older participants, suggesting that even older adults, who are expected to be more susceptible to interference effects under the IDH, were not negatively impacted by the potential interference generated by having confusable terms to be learned in association with a face.

Experiment 2: Interference from the Amount of Information Presented

Although interference potentially produced by stimulus ambiguity did not harm name-learning performance in Experiment 1, ambiguity is not the only possible source of interference in learning names with faces. In a second experiment, we tested whether interference that exacerbates the difficulty of name learning might arise from the common experimental practice of presenting additional information (e.g., an occupation) during a name-learning task. Stanhope and Cohen (1993) found that young adults have particular difficulty learning names when presented simultaneously with an occupation compared to when presented alone. Specifically, their participants experienced three counterbalanced conditions: learning only a name, learning only an occupation, or learning a name-plus-occupation in association with a face. The name-only condition proved harder than the occupation-only condition, but name learning was differentially difficult when an occupation was simultaneously presented. Terry (1994) found similar results: when the set of to-be-learned stimulus information included some names and some occupations, participants learned occupations better than names, but when name- and occupation-learning were compared in a between-participants design, the difference between name and occupation learning became small and non-significant. These results indicate that the requirement to learn a name-plus-occupation may not only increase task difficulty, but may do so because of interference from the additional to-be-learned item.

No previous experiment has examined the potentially-exacerbated difficulty of name learning for older adults caused by having to learn more than one piece of information (e.g., a name-plus-occupation) compared to learning only one piece of information (e.g., a name-only or occupation-only). The IDH predicts differentially-greater impairment for older than young adults in learning new names when occupations are also being learned, compared to when only one piece of information must be learned.

Method

Participants—Participants included 40 young (ages 18–35) and 37 older adults (ages 61–84). Young adults' scores on the Nelson-Denny vocabulary test (Brown, 1960) were lower than older adults', $t(73) = 8.28, p < .01$ (see Table 1 for mean age and vocabulary scores). Older adults' high vocabulary scores indicate intact cognitive function, but older participants were also screened for dementia using the MMSE (Folstein et al, 1975); only data from non-demented older participants are included in analyses.

Materials—We selected 12 new black and white facial photographs according to the same constraints as Experiment 1. Twelve new surnames and 12 new occupations were also selected using similar criteria as Experiment 1. However, we did not use identical stimuli as Experiment 1 because in this study, no occupations or names were ambiguous (i.e., names could never be occupations, and occupations could never be names).

Procedure—We followed the procedure of Experiment 1, but participants in Experiment 2 were shown printouts of the facial photographs in a binder for 5 s each. Participants were randomly assigned to one of three conditions: a name as the to-be-learned information (name-only condition; 12 young and 11 older adults), an occupation as the to-be-learned information (occupation-only condition; 12 young and 10 older adults), and a name plus occupation as the to-be-learned information (name-plus-occupation condition, within which the order of presentation of the name and occupation was counterbalanced across participants; 16 young and 16 older adults). Participants experienced a fixed-random-order introduction round and a series of fixed-random-order testing rounds to criterion or until 12 trials were completed, as in Experiment 1.

Results and Discussion

Percentage of faces for which information was correctly recalled was computed by dividing the number of names or occupations correctly recalled by the total number of faces presented for each participant. To test whether performance declined when participants were required to learn more than one type of information, separate univariate ANOVAs were conducted for each type of target information (see means in Table 3). For learning names, there was no main effect of amount of information presented, $F(1, 51) = 2.26, \eta_p^2 = .04, p = .14$, because participants showed little decrease in name-learning performance when learning an occupation along with the name compared to learning only the name. There was a main effect of age group, $F(1, 51) = 12.64, \eta_p^2 = .20, p < .01$, because young adults outperformed older adults, but no interaction of age group with amount of information for name recall, $F < 1, \eta_p^2 < .01$.

For learning occupations, there was no main effect of amount of information presented, $F(1, 50) = 2.58, \eta_p^2 = .05, p = .12$, because participants showed little decrease in occupation-learning performance when learning a name along with the occupation compared to learning only the occupation. There was a main effect of age group, $F(1, 50) = 11.61, \eta_p^2 = .19, p < .01$, but no interaction of age group with amount of information for occupation recall, $F < 1, \eta_p^2 < .01$.

These results fail to support predictions of an inhibitory framework, because having a second piece of information to learn in association with a face did not create interference that was differentially greater for older than young participants. While participants in both age groups performed numerically better when learning one than two pieces of information, the difference was never significant. The small-to-medium effect sizes indicate that we may have had low power to statistically detect some possible interference from the second to-be-learned item. However, this potential interference occurred for both young and older adults, in learning both names and occupations, and the non-significant interactions of age group and amount of to-be-learned information had very small effect sizes. Effect size is independent of sample size, and provides a measure of the impact of our manipulation, indicating that a lack of power is not likely responsible for our failure to obtain evidence of dramatic interference for older adults in the name-plus-occupation condition. Rather, the effect size measure suggests that any interference obtained due to this manipulation is of negligible magnitude.

To compare learning only names versus only occupations, the percentage of faces for which information was correctly recalled from the name-only condition and the occupation-only condition were analyzed in a 2 (age group: young vs. older) $\times$ 2 (information type: name vs. occupation) between-subjects univariate ANOVA (see Table 3). There was a main effect of age group, $F(1, 41) = 12.69$, $\eta_p^2 = .24$, $p < .01$, because young adults performed better than older adults overall. There was also a main effect of information type, $F(1, 41) = 29.31$, $\eta_p^2 = .42$, $p < .01$, because learning names was more difficult than learning occupations. The interaction of age group and information type was not, however, significant, $F(1, 41) = 1.00$, $\eta_p^2 = .02$, $p = .32$, suggesting no specific age-deficits in learning proper names in a between-groups manipulation of target information type. This analysis included data from a fairly small number of participants, but the small effect size for the interaction signifies that low power probably does not underlie the failure to obtain a significant interaction, and that even with a larger number of participants, our results would not yield a significant interaction.

To compare learning names and occupations when both types of information were presented with each face, the percentage of faces for which each type of information was correctly recalled from the name-plus-occupation were analyzed in a 2 (age group: young vs. older) $\times$ 2 (information type: name vs. occupation) mixed factorial ANOVA (see Table 3). There was a main effect of age group, $F(1, 30) = 7.42$, $\eta_p^2 = .20$, $p = .01$, such that young adults performed better than older adults overall, and there was also a main effect of information type, $F(1, 30) = 114.47$, $\eta_p^2 = .79$, $p < .01$, because learning names was more difficult than learning occupations. The interaction of age group and information type was not significant, $F < 1$, $\eta_p^2 < .01$, again suggesting no specific age deficit in proper name learning. As with the between-subjects analysis (above), the very small effect size for the interaction signifies that low power probably does not underlie the failure to obtain a significant interaction, and that even with more participants, our results would not yield a significant interaction.

Young adults outperformed older adults in the name-only and occupation-only conditions, as well as in the name-plus-occupation condition, replicating the age difference in learning new associations that has been found in many previous studies (see e.g., MacKay & Burke, 1990; Old & Naveh-Benjamin, 2008, for reviews), including our Experiment 1. Also replicating previous work, greater difficulty with learning proper names than occupations was found across all conditions and for both age groups (e.g., James, 2004; James et al., 2008; McWeeny et al., 1987). Inconsistent with James (2004) and Experiment 1, older adults did not show a significantly greater impairment than young adults for learning names than occupations.

However, our most critical finding is that neither young nor older participants showed an increase in difficulty of learning names or occupations when the two pieces of information were presented simultaneously. In other words, the interference potentially produced by learning an additional piece of information with a given face did not differentially disrupt name learning, contrary to IDH predictions.

Experiment 3: Interference from Guessing Unknown Names

Stimulus ambiguity did not harm name-learning performance in Experiment 1, and increased amount of to-be-learned information did not harm name-learning performance in Experiment 2. Nevertheless, there remain other possible sources of interference in learning names for faces. In a third experiment, we tested whether interference that arises from incorrect guesses that participants generate during the testing rounds contributes to difficulty in learning name-face associations. Anecdotally, participants report that they believe that interference or competition occurs when they make incorrect guesses, and this decreases their name-learning performance. James (2004) reported that older adults provided guesses of incorrect information more often than young adults, whereas young adults more often said “I don’t know” when they did not know the name or occupation to go with a face. While it seems possible that guesses were actively harming older adults’ performance and causing the specific age-related deficit in learning new face-name associations, the age difference in rate of guessing that James identified was similar for names and for occupations. Nevertheless, the speculation that older adults’ poorer performance might be partly due to their propensity to guess rather than say “I don’t know” continues to have intuitive appeal. To test whether guessing incorrect names could generate interference that is the mechanism underlying the exacerbated difficulty of name learning, we manipulated the experimental instructions regarding guessing during a name learning task.

The IDH framework suggests that the interference caused by an incorrect guess will increase with age because the guessed (incorrectly-generated) name will become associated with the face to at least the same extent as the correct (experimenter-provided) name (e.g., Campbell et al., 2010). Therefore, the IDH predicts differentially-greater impairment for older than young adults in learning new names when participants must generate a guess (and are not allowed to say “I don’t know”) compared to when participants are prohibited from guessing (and are required to say “I don’t know” if not completely certain they can provide the correct response).

Method

Participants—Participants included 82 young (ages 18–34) and 82 older adults (ages 60–85). Young adults’ scores on the Shipley (1940) vocabulary test were lower than older adults’, $t(162) = 10.41, p < .001$ (see Table 1 for age and vocabulary scores). Older adults’ high vocabulary scores indicate intact cognitive function, but older participants were also screened for dementia using the MMSE (Folstein et al., 1975); only data from non-demented older participants are included in analyses.

Materials—Materials were similar to Experiments 1 and 2, but included only faces and names (no occupations). We selected a different set of 10 color facial photographs and 10 ambiguous surnames according to the constraints used for Experiments 1 and 2.

Procedure—We followed the basic procedures of Experiments 1 and 2. Participants in Experiment 3 were shown faces via computer for 4 s each during the introduction round, and then were given a series of testing rounds. Participants were randomly assigned to one of two conditions: a guessing required condition, in which they were told that previous research has shown that guessing helps performance on this task, and that they had to guess

a name if uncertain, or a guessing prohibited condition, in which they were told that guessing hurts performance on this task, so they were not to guess names. In this condition, if participants were unsure of the name for a face, they were instructed to say “I don’t know.” Experimenters forced participants to follow instructions by insisting that they generate a guess if they failed to in the guessing required condition, and by reminding them never to guess if they provided incorrect responses in the guessing prohibited condition. In both conditions, participants were informed whether each response was correct and correct information was re-presented. Participants experienced a fixed-random-order introduction round and a series of fixed-random-order testing rounds to criterion or until 12 trials were completed, as in Experiments 1 and 2.

Results and Discussion

Percentage correct was computed as number of names correctly recalled divided by the total number of faces presented for each participant. These percentages were analyzed in a 2 (age group: young vs. older) $\times$ 2 (condition: guessing required vs. guessing prohibited) between subjects ANOVA (see means in Table 4). There was a main effect of age group, $F(1, 160) = 28.10$, $\eta_p^2 = .15$, $p < .001$, because young adults outperformed older adults overall. As in Experiments 1 and 2, and consistent with many previous studies (e.g., James, 2004), older adults had more difficulty than young adults learning names in association with new faces. There was no main effect of guessing condition, $F < 1$, $\eta_p^2 < .01$, and no interaction between age group and condition, $F < 1$, $\eta_p^2 < .01$. The miniscule obtained effect size values suggest that any interference obtained due to our guessing manipulation is of negligible magnitude.

Neither young nor older adults’ performance was harmed by instructions to guess a name when uncertain. Critically, the prediction that verbalizing guesses would harm name learning by generating interference was not supported. Further, the IDH prediction that the interference caused by requiring guesses would be even more disruptive to older than young adults was not supported. Although we cannot be certain that our manipulation of guessing was adequately strong to produce interference, it is not clear that a stronger manipulation would generate different results. Participants did follow instructions and verbalize guesses much more often in the guessing required condition than in the guessing prohibited condition. A stronger manipulation, such as offering incentives for following instructions, would not get at the more crucial concern: We cannot rule out the suggestion that participants were unable to suppress guesses that they did not verbalize, even though the data confirm that participants followed the instructions and rarely verbalized guesses in the guessing prohibited condition. Importantly, we used a between-participants manipulation of guessing condition, and instructions indicated either that guessing had already been found to be helpful to performance (in the guessing required condition) or to harm performance (in the guessing prohibited condition). Thus, participants had no basis on which to intentionally flout the instructions, and appeared to try to follow the rule they were given about guessing.

General Discussion

The findings from these three experiments further our understanding of the theoretical mechanisms that underlie face-name association learning. Our manipulations were carefully designed to increase the potential for interference effects during proper name learning tasks, and we tested older adult participants because they were expected to be highly susceptible to interference. None of our manipulations harmed name learning, and more importantly, none exacerbated age-related deficits in name learning. Our findings suggest that interference is not the primary cause for the difficulty of learning names in association with new faces, and not the primary mechanism underlying the differential difficulty older adults experience in name learning.

While it is clear that interference cannot account for any of our findings, there are several aspects of our results that merit further consideration. In Experiment 1, our results directly contradicted the predictions from an interference-based model. In other words, while we are able to rule out interference from other ambiguous stimuli as a cause of name-learning difficulty, we need to explain why faces presented with two ambiguous items yielded the best recall. One possible explanation is that by virtue of their ambiguity, the frequency of usage for each ambiguous term is higher. Higher-frequency (i.e., more common) names have been shown to be easier to learn in association with new faces than lower-frequency names, with the same benefit of frequency for young and older adults (James & Fogler, 2007). In this experiment, all stimulus names were selected on the basis of having similar frequency according to the U.S. Census website (1990). However, perhaps ambiguous terms inherit at least some of the frequency of their other meaning (e.g., the name *Weaver* is boosted in frequency by uses of the noun *weaver*, whereas the name *Wagner* does not have another source of frequency; see, e.g., Jescheniak, Meyer, & Levelt, 2003, for discussion of this argument). This inherited frequency may have made these terms easier to learn. However, this explanation does not account for why having both an ambiguous name and occupation confers a greater advantage than having either an ambiguous name or occupation. Clearly, additional work is warranted to understand this result.

In Experiment 2, we did not obtain the specific age-related decrement in proper name learning (compared to occupation learning) in either the within-subjects or between-subjects comparisons. This is the only study of which we are aware that has tested for specific age deficits in proper name learning using a between-subjects design (i.e., comparing only name learning with only occupation learning), indicating that replication is necessary. However, our failure to obtain the specific age deficits in face-name learning in the within-participants analysis is surprising, and contradicts results of several previous experiments (e.g., Barresi et al., 1998; James, 2004). The very small effect size suggests that this is not due to a lack of adequate power, and that further study to determine the cause of this result is warranted.

In Experiment 3, it was probably impossible to stop people from guessing or generating plausible answers that they did not verbalize. In other words, perhaps interference was internally generated even if not vocally expressed, so it remains possible that participants made silent guesses in the guessing prohibited condition that increased interference and increased task difficulty, and eliminated any benefit of disallowing guesses. However, under the IDH, older adults would be more prone to generate non-vocalized guesses than young adults, or to suffer greater interference from them, and we obtained the same pattern of results for young and older adults. Nevertheless, this possibility cannot be ruled out and additional research regarding both verbalized and non-verbalized guesses is warranted.

Overall, the present findings cannot be accounted for by interference-based accounts of name learning. However, many of the results from this set of experiments (along with many findings from other studies of name learning and memory) are readily accounted for by models suggesting that the critical factor in name learning is the transmission of excitation within cognitive systems. Specifically, the transmission deficit hypothesis (TDH; MacKay & Burke, 1990) posits that there is an age-related reduction in the spread of priming (excitatory activity) within an interactive-activation network. The TDH explains the difficulty of learning and memory for proper names without postulating interference as a primary mechanism in the difficulty of name learning. The TDH is instantiated within an interactive activation model consisting of nodes that represent meaning (semantic nodes) and nodes that represent sounds (phonological nodes), which are connected to each other through a node corresponding to a word or name (a lexical node). Excitatory priming is transmitted through connections among the nodes, and when a node has accumulated sufficient priming, it becomes activated. Successful activation relies on adequate priming of

relevant nodes, and weakened inter-node connections reduce the likelihood of successful activation. Infrequent or non-recent use of nodes causes their connections to weaken, and so does aging.

Transmission deficits interact with the architecture of the model causing proper names to be more difficult to learn in association with individuals than other types of information (see James, 2004). New learning requires sustained and prolonged activation, and older adults' transmission deficits reduce the likelihood of sufficient priming for node commitment, therefore reducing new learning. When this age-related reduction in priming is coupled with single connections, as when a proper name is to be learned, the age-related deficits are exacerbated. The TDH therefore predicts greater difficulty for older than young adults in all new learning, with a specific impairment for proper name learning in older adulthood, as we found in Experiment 1 (see also Barresi et al., 1998; James, 2004; James et al., 2008). Similarly, the TDH can account for the benefit of ambiguous stimuli (inasmuch as an ambiguous term inherits at least some of the frequency of its homophone), because the increase use of the word's connections keeps them strong and allows ample transmission of excitation among nodes (see James & Fogler, 2007).

However, the THD cannot account for every finding in the present results. For example, the lack of specific age-related deficits in learning proper names in Experiment 2 is problematic for this account. Also, the TDH suggests that the guessing condition in Experiment 3 should generate more correct responses than the non-guessing condition. Specifically, it predicts that guesses would be based on the priming that the correct nodes would have accrued, so that guesses were non-random and likely to be correct responses at least some of the time. However, there was no effect at all of guessing, which does not support this model. It appears that further development of excitation-based models such as the TDH is warranted for increasing our understanding of face-name association learning.

In sum, none of the data from our three experiments indicate that interference is a critical theoretical mechanism underlying the difficulty of learning new face-name associations. We manipulated several variables expected to increase task difficulty by causing interference, none of which impaired participants' performance. Even older adults, who were expected to be more susceptible to interference than young adults, did not experience increased difficulty in learning names to go with faces when confronted with ambiguous stimulus terms, an increased amount of to-be-learned information, or a requirement to guess names when unknown. Thus, interference cannot account for older adults' disproportionate decline in name-learning ability. Theories based on transmission of activation (as opposed to inhibition) throughout the cognitive system appear to more successfully account for the difficulty of name learning in general, as well as older adults' increased problems with name learning.

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References

- Anderson MC. Rethinking interference theory: Executive control and the mechanisms of forgetting. *Journal of Memory and Language*. 2003; 49:415–445.

- Anderson MC, Green C. Suppressing unwanted memories by executive control. *Nature*. 2001; 410:366–369. [PubMed: 11268212]
- Anderson MC, Reinholz J, Kuhl BA, Mayr U. Intentional suppression of unwanted memories grows more difficult as we age. *Psychology and Aging*. 2011; 26:397–405. [PubMed: 21443352]
- Barresi BA, Obler LK, Goodglass H. Dissociation between proper name and common noun learning. *Brain & Cognition*. 1998; 37:21–23.
- Bowles NL. Aging and rate of activation in semantic memory. *Psychology & Aging*. 1994; 9:414–429. [PubMed: 7999326]
- Brown, JI. The Nelson-Denny reading test. Boston: Houghton Mifflin; 1960.
- Campbell KL, Hasher L, Thomas RC. Hyper-binding: A unique age effect. *Psychological Science*. 2010; 21:399–405. [PubMed: 20424077]
- Cargin JW, Collie A, Masters C, Maruff P. The nature of cognitive complaints in healthy older adults with and without objective memory decline. *Journal of Clinical and Experimental Neuropsychology*. 2008; 30:1–13. [PubMed: 18165935]
- Cohen G. Why is it difficult to put names to faces? *British Journal of Psychology*. 1990; 81:287–297.
- Cohen G, Faulkner D. Memory in old age: "Good in parts". *New Scientist*. 1984; 11:49–51.
- Connelly SL, Hasher L, Zacks RT. Age and reading: The impact of distraction. *Psychology & Aging*. 1991; 6:533–541. [PubMed: 1777141]
- Folstein MF, Folstein SE, McHugh PR. Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*. 1975; 12:189–198. [PubMed: 1202204]
- Hartman M, Hasher L. Aging and suppression: Memory for previously relevant information. *Psychology and Aging*. 1991; 6:587–594. [PubMed: 1777147]
- Hasher, L.; Lustig, C.; Zacks, R. Inhibitory mechanisms and the control of attention. In: Conway, AA.; Jarrold, C.; Kane, MJ.; Towse, JN.; Miyake, A.; Conway, AA.; Towse, JN., editors. *Variation in working memory*. New York, NY: Oxford University Press; 2007. p. 227–249.
- Hasher, L.; Zacks, RT. Working memory, comprehension, and aging: A review and a new view. In: Bower, GH., editor. *The psychology of learning and motivation* Vol. 22. San Diego, CA: Academic Press; 1988. p. 193–225.
- James LE. Meeting Mr. Farmer versus meeting a farmer: Specific effects of aging on learning proper names. *Psychology and Aging*. 2004; 19:515–522. [PubMed: 15383001]
- 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; 15:366–374. [PubMed: 17469017]
- James LE, Fogler KA, Tauber SK. Recognition memory measures yield disproportionate effects of aging on learning face-name associations. *Psychology and Aging*. 2008; 23:657–664. [PubMed: 18808254]
- Jescheniak JD, Meyer AS, Levelt WJM. Specific-word frequency is not all that counts in speech production. Some comments on Caramazza et al. (2001) and new experimental data. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 2003; 29:432–438.
- Logan JM, Balota DA. Conscious and unconscious lexical retrieval blocking in younger and older adults. *Psychology and Aging*. 2003; 18:537–550. [PubMed: 14518814]
- MRC Psycholinguistic Database. Kucera-Francis Word Frequency. 1987 Available At: <http://www.psy.uwa.edu.au/mrcdatabase/mrc2.html>.
- MacKay, DG.; Burke, DM. Cognition and aging: A theory of new learning and the use of old connections. In: Hess, TM., editor. *Aging and cognition: Knowledge organization and utilization*. Oxford, England: North-Holland; 1990. p. 213–263.
- McWeeny KH, Young AW, Hay DC, Ellis AW. Putting names to faces. *British Journal of Psychology*. 1987; 78:143–149.
- Mund I, Bell R, Buchner A. Age differences in reading with distraction: Sensory or inhibitory deficits? *Psychology and Aging*. 2010; 25:886–897. [PubMed: 20853960]
- Old SR, Naveh-Benjamin M. Differential effects of age on item and associative measures of memory: A meta-analysis. *Psychology and Aging*. 2008; 23:104–118. [PubMed: 18361660]

- O'Seaghdha PG, Marin JW. Phonological competition and cooperation in form-related priming: Sequential and nonsequential processes in word production. *Journal of Experimental Psychology: Human Perception and Performance*. 2000; 26:57–73. [PubMed: 10696605]
- Rendell PG, Castel AD, Craik FIM. Memory for proper names in old age: A disproportionate impairment? *The Quarterly Journal of Experimental Psychology*. 2005; 58:1–18.
- Schacter, DL. *The seven sins of memory: How the mind forgets and remembers*. Boston, MA, US: Houghton, Mifflin and Company; 2001.
- Schwartz, BL. *Tip-of-the-tongue states: Phenomenology, mechanism and lexical retrieval*. Mahwah, NJ: Erlbaum; 2002.
- Shipley WC. A self-administering scale for measuring intellectual impairment and deterioration. *Journal of Psychology: Interdisciplinary and Applied*. 1940; 9:371–377.
- Smith SM, Tindell DR. Memory blocks in word fragment completion caused by involuntary retrieval of orthographically related primes. *Journal of Experimental Psychology: Learning, Memory, and Cognition*. 1997; 23:355–370.
- Stanhope N, Cohen G. Retrieval of proper names: Testing the models. *British Journal of Psychology*. 1993; 84:51–65.
- Stevenage SV, Lewis HG. By which name should I call thee? The consequences of having multiple names. *Quarterly Journal of Experimental Psychology A*. 2005; 58:1447–1461.
- Tauber SK, Rhodes MG. Metacognitive errors contribute to the difficulty in proper name learning. *Memory*. 2010; 18:351–362. [PubMed: 20408044]
- Terry WS. On the relative difficulty in recalling names and occupations. *American Journal of Psychology*. 1994; 107:85–94.
- Tse C, Balota DA, Roediger HL. The benefits and costs of repeated testing on the learning of face–name pairs in healthy older adults. *Psychology and Aging*. 2010; 25:833–845. [PubMed: 20718541]
- U. S. Census Bureau. name files. 1990. [Data file]. Retrieved from http://www.census.gov/genealogy/names/names_files.html
- Valentine, T.; Brennen, T.; Bredart, S. *The cognitive psychology of proper names: On the importance of being Earnest*. London: Routledge; 1996.
- Valentine, T.; Hollis, J.; Moore, V. Proceedings of the twenty-first annual meeting of the Cognitive Science Society. Mahwah: LEA; 1999. The nominal competitor effect: When one name is better than two; p. 749-754.
- Weinstein Y, McDermott KB, Szpunar KK. Testing protects against proactive interference in face-name learning. *Psychonomic Bulletin and Review*. 2011; 18:518–523. [PubMed: 21465303]
- Wickens DD, Dalezman RE, Eggemeier FT. Multiple encoding of word attributes in memory. *Memory & Cognition*. 1976; 4:307–310.
- Yang L, Hasher L. The enhancing effects of pictorial distraction in older adults. *The Journals of Gerontology: Psychological Sciences and Social Sciences*. 2007; 62B:P230–P233.
- Zacks, RT.; Hasher, L. Directed ignoring: Inhibitory regulation of working memory. In: Dagenbach, D.; Carr, TH., editors. *Inhibitory processes in attention, memory, and language*. San Diego, CA: Academic Press; 1994. p. 241-264.

Table 1

Mean Participant Age and Vocabulary Test Scores for Experiments 1, 2 and 3 (SDs in parentheses)

	Young Adults	Older Adults
Experiment 1	N = 28	N = 28
Age in Years	20.75 (1.88)	71.21 (7.60)
Shipley Vocabulary Test Score (maximum = 40 correct)	28.93 (4.03)	33.57 (4.07)
Experiment 2	N = 40	N = 37
Age in Years	23.10 (4.20)	71.75 (6.85)
Nelson-Denny Vocabulary Test Score (maximum = 25 correct)	13.18 (3.28)	19.56 (3.38)
Experiment 3	N = 82	N = 82
Age in Years	21.63 (3.68)	71.04 (6.80)
Shipley Vocabulary Test Score (maximum = 40 correct)	28.82 (3.62)	34.55 (3.44)

Table 2

Mean percentage of names and occupations recalled by young and older participants in the no-ambiguous item, one-ambiguous item, and two-ambiguous items conditions of Experiment 1 (SD in parentheses).

	Young Adults	Older Adults
No ambiguous items		
Names	55% (12%)	24% (21%)
Occupations	76% (12%)	59% (20%)
One ambiguous item		
Names	56% (14%)	26% (20%)
Occupations	75% (12%)	62% (21%)
Two ambiguous items		
Names	59% (16%)	32% (22%)
Occupations	81% (12%)	65% (23%)

Table 3

Mean percentage of names and occupations recalled by young and older participants in Experiment 2 (SD in parentheses), for the between-participants analysis (top) and for the within-participants analysis (bottom).

	Young Adults	Older Adults
Between-Participants		
Names	67% (14%)	47% (24%)
Occupations	87% (7%)	76% (10%)
Within-Participants		
Names	58% (14%)	41% (23%)
Occupations	83% (7%)	67% (23%)

Table 4

Mean percentage of names recalled by young and older participants under instructions that required or prohibited guessing in Experiment 3 (SD in parentheses).

	Young Adults	Older Adults
Guessing Required	78% (12%)	63% (20%)
Guessing Prohibited	76% (12%)	63% (21%)