AGE DIFFERENCES IN MEMORY FOR NAMES:

THE EFFECT OF PRE-LEARNED SEMANTIC ASSOCIATIONS

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation entitled

AGE DIFFERENCES IN MEMORY FOR NAMES:
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AGE DIFFERENCES IN MEMORY FOR NAMES:

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ABSTRACT

The present experiments investigated whether participants could use basic semantic information about a person (i.e., a "mediator"), such as an occupation, to help link that person's name to his or her face. In each of three experiments, older and younger adults pre-learned associations between semantic information about fictional people (character information or occupations) and names. They then attempted to learn links between faces and either the names or semantic information that had been pre-learned. In the "unmediated" condition, participants learned only one piece of information (either the name or the semantic information) about each face, whereas in the "mediated" condition, they learned both the to-be-tested information as well as the "mediator" (i.e., both the name and the other semantic information). Experiment 1 showed that, at a simple level, both age groups could use character information ("good" or "bad") to help remember people's names, given their faces, when instructed to do so. In Experiment 2, knowing the occupation associated with a name helped both age groups to later remember the name associated with a given face, when they were instructed to use this mediation technique. Experiment 3 showed that this effect occurred, although to a lesser degree, even when participants were not explicitly told to use the mediation technique. Overall, the present experiments show that both younger and older

participants can use semantic information about a person (i.e., a "mediator"), such as an

occupation, to improve their memory for names given the presentation of a face.

INTRODUCTION

Importance of Memory for People's Names

In many societies, a name is an important part of who we are. Choosing a child's name is often a difficult decision for parents, who have a plethora of books and websites to consult. Various lines of research support the idea of a name's importance. Ellis and Beechley (1954), for example, believe that "peculiar" first names are linked to emotional disturbance in boys, and Erwin and Calev (1984) found that undergraduates gave higher grades to essays supposedly written by children with attractive names than to those written by children with unattractive names.

If a name is highly important, then it follows that the ability to remember a person's name also plays a significant role in one's life. A quick internet search for "remembering people's names" provides more that 92 million hits, suggesting that the *forgetting* of people's names is a common and troublesome occurrence. Indeed, both younger and older adults report that they have difficulty remembering people's names (e.g., Reese & Cherry, 2004). This can lead to social embarrassment, and in extreme cases, can severely impact one's quality of life. B.F. Skinner (1983) believes that forgetting is "most conspicuous" when it comes to memory for names, and writes that "the failure to produce a name at the right moment…can be especially punishing" (p. 240). Memory for names is not a new topic; even decades before the cognitive revolution, a paper investigating memory for names and faces was published (Clarke, 1934).

Looking at the extensiveness of work devoted to the topic of memory for people's names provides many indications of the importance of this issue in the field of cognitive

psychology. One such indication lies in the multitude of studies investigating possible methods by which memory for proper names may be improved (e.g. Groninger, 2000; Morris, Jones, & Hampson, 1978; Neuschatz, Preston, Toglia, & Neuschatz, 2005). The importance of memory for names is further suggested by the extensive work conducted to create a "large-scale database" of proper names (Conley, Burgess, & Hage, 1999). Finally, a special edition of the journal *Memory* was devoted to the topic of memory for proper names (Cohen & Burke, 1993). Thus, the field of cognitive psychology is deeply interested in how we remember people's names.

The present dissertation will take a novel approach to this problem, exploring whether the relatively easy-to-remember link between a face and semantic information may facilitate the creation and usage of a link between a name and a face.

Difficulty of Memory for People's Names

Various lines of research, including questionnaire studies, indicate that remembering people's names is quite difficult. For example, Higbee (2001) asked his students at a memory workshop, ranging from 13 to 81 years of age, to write down questions they had about their memories and found that 41% of these questions involved memory for people's names. The next most common topic, studying and schoolwork, weighed in at only 15%. Similar conclusions were made after Reese and Cherry (2004) asked 152 adults between 20 and 83 years of age to list five things they found difficult to recall. Of the total number of responses, 8% of young, 15% of middle-aged, and 21% of older adults' responses involved memory for names. Thus, while older adults seem to be especially concerned about their memory for people's names, a topic discussed in the following section, even younger adults recognize that names are difficult to recall.

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Numerous experimental studies support the findings of the questionnaire data. For example, James (2004) asked both older and younger adults to learn faces together with names and occupations (e.g., a face might be presented with the sentence, "This man is Mr. Sutton, he is a weaver"). She found that, regardless of age, significantly more errors were made in name recall than in recall of occupations, and that this was especially true for older adults. Stanhope and Cohen (1993) found similar results, whether the names and occupations used were common or uncommon in frequency of occurrence.

People's names have also been shown to be more difficult to recall than names of places and hobbies. Cohen and Faulkner's (1986) participants listened to short biographies of fictional people, each including the person's name, the name of a place associated with that person, an occupation, and a hobby. (For example, "In *Glasgow* a *policeman* by the name of *James Gibson* has recently won a prize for *ballroom dancing*.") At test, participants were asked to fill in one piece of missing information from each person's biography. Results showed that the people's names were recalled much less frequently (28% of trials for first names and 26% for last names) than occupations or hobbies (55% and 59%, respectively), and perhaps surprisingly, much less often than place names (56%).

There is evidence that names are not just more difficult to remember than occupations, but also take more time to remember. Young, Ellis, and Flude (1988), for example, conducted two experiments using eight famous people as stimuli. Half of the people were named Michael (e.g., Michael Caine), and half were named David (e.g., David Steel). Among each name group, half of the people were politicians and half were non-politicians. In Experiment 1, participants saw pairs of faces and said "same" or

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"different" as to whether the two people shown shared either an occupation or a name. In

Experiment 2, participants saw the faces one-at-a-time and orally stated the occupation or

name as quickly as possible. In both experiments, responses to occupations were

significantly faster than responses to names. Thus, a substantial amount of evidence

indicates that people's names are differentially difficult to remember.

Age Differences in Memory for Names

Young adults have a greater difficulty retrieving people's names than other

information about those individuals, but this effect is even stronger in older adults. In

fact, when asked to list the five areas of memory they most wanted to improve, a group of

29 older adults listed memory for names 24 times (Reese, Cherry, & Norris, 1999).

Likewise, a questionnaire study by Leirer, Morrow, Sheikh, and Pariante (1990) found

that nearly half of older adult respondents reported that memory for people's names was

the memory skill they would most like to improve, ranking it higher than memory for

appointments, paying bills, and taking medication.

As these desires to improve memory for names might suggest, older adults tend to

believe that they have problems in this area. When asked to provide self-ratings of their

memory abilities, older adults rated themselves more poorly than did younger and

middle-aged adults in terms of memory for both proper names and object names, but age

differences were largest in the former case (Cohen & Faulkner, 1984, October).

Furthermore, using a questionnaire, Cohen and Faulkner (1986) found that whereas

young adults reported just 2 memory blocks per week, 58% of which were for names of

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friends and acquaintances, older adults reported 4 memory blocks per week, of which

77% involved blocks for friends' and acquaintances' names.

More importantly, experimental work confirms older adults' suspicions that their

decline in memory for names has been larger than that for other forms of information.

For example, Maylor and Valentine (1992) conducted a study similar to that of Young et

al. (1988) noted above, except that middle-aged and older adults were now included as

participants. Specifically, the participants viewed eight famous faces, half named

Michael and half named David, with half of each name group being politicians and half

being TV personalities. When shown a face, participants produced either that person's

name or occupation as quickly and accurately as possible. Both age groups were slower

and less accurate in the name task than in the occupation task, and older adults were

slower overall. Furthermore, age differences between the middle-aged and older adults

were somewhat larger on the name than the occupation task in terms of both response

times (100 ms age difference for occupations and 190 ms age difference for names) and

accuracy (with the older group making an average of 1.6 more errors than the middle-

aged group for the occupations and 3.8 more errors on the names).

Using a more conventional methodology, Lori James and colleagues have shown

a differentially larger name than occupation memory deficit of older adults using both

recall (James, 2004) and recognition (James, Fogler, & Tauber, 2008) measures. Barresi,

Obler, and Goodglass (1998) reached similar conclusions, and also found that repetition

of the study list led to greater improvement in the name than occupation recall in young

adults, but had the opposite effect in older adults.

Although most studies test only a few age groups, there are some indications that memory for names begins to decline before old age. For example, Crook and West (1990) conducted a large-scale study involving over 1200 participants between the ages of 18 and 90. Participants were "introduced" to 4, 6, or 14 people on video tape, with each person stating his or her name. Cued-recall tests revealed a decline in name memory each decade, except for between the ages of 40 and 60. Thus, the decline may start as early as the 20s and accumulate over time, creating the most noticeable problems in old age.

Older adults' naming difficulties seem to relate to an increase in tip-of-the-tongue (TOT) states. Evrard (2002) presented young, middle-aged, and older adults with pictures of common objects and of "very famous faces". Participants were asked to name each picture as quickly as possible. In line with other data, all participants were slower to name people than to name objects, and this difference was greater for older than for younger adults. In addition, Evrard determined each participant's tip-of-the-tongue state by asking questions about unnamed pictures (e.g., "What's its first letter, its number of syllables?"). All participants produced more TOTs to faces than to objects, and again, this difference increased with age. In fact, older adults produced TOTs to common nouns (i.e., object names) on only 0.9% of trials, but on 18.3% of proper name trials. On the other hand, young adults produced 1.8% and 8.9% TOTs to the common nouns and proper names, respectively.

One problem which may exacerbate older adults' naming difficulties is that names are necessarily linked to people. It has been proposed and experimentally supported that older adults have a deficit in the binding of information to its context

(Chalfonte & Johnson, 1996; Mitchell, Johnson, Raye, Mather, & D'Esposito, 2000).

This idea was extended by Naveh-Benjamin (2000), who proposed in the associative

deficit hypothesis that older adults have difficulty creating and retrieving links between

single pieces of information, and that this deficit leads to a general decline in episodic

memory. In regard to name-face memory, Naveh-Benjamin, Guez, Kilb, and Reedy

(2004) found no age-related deficit in name recognition, only a small age deficit in face

recognition, and a quite large deficit in recognizing a name given a face or vice-versa.

While this idea partially explains older adults' deficit in linking a face to other

information, further theories are necessary to distinguish between names and other forms

of semantic information.

Possible Explanations for Naming Difficulties

There is thus a great deal of evidence to support the idea that people's names are

particularly difficult to remember. There are many possible explanations for this

phenomenon, each of which will be discussed in the next several sections. First, proper

names tend to be used less frequently in language than are other words. Second, proper

names can be created from an infinite set of possible sounds. Third, we are not able to

attach images or meaning to them as easily as to common nouns, or to replace them with

alternative words. Finally, there is evidence that proper names are stored differently than

are other words.

Low frequency. Perhaps the simplest explanation for our difficulty recalling

people's names is the fact that we do not attempt to recall them as often as we recall

common nouns. For example, you hear the word "architect" more often than the name

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"Charles" (see Conley, et al., 1999). The findings of Carson, Burton, and Bruce (2000) support the claim that low frequency of names is partially, although not fully, responsible for name-retrieval difficulties. These researchers asked participants to decide whether two shown famous faces (either Michael or John and American or British) shared either a name in one condition or a nationality in the other condition. Following this, participants took part in a "name practice phase" in order to increase the frequency of encountering the names in the very recent past. In this phase, each face was shown five times and participants simply named them. The same/different task was then repeated, followed by a second name practice phase and a third same/different task. Participants were slower to say same or different in the name task than the occupation task, but this effect decreased with increased name familiarity. The researchers thus claim that part of our difficulty in retrieving people's names is due to a lack of practice retrieving them.

Plausible Phonology Hypothesis. Another proposed reason why proper names are especially difficult to remember is that these names may be composed from a larger array of sounds than are common nouns. We frequently encounter new surnames, but names of objects are rarely new to us. If we see a word composed of syllables we have not previously encountered, we are likely to guess that the word is a person's name. A similar phenomenon is well-known to crossword-puzzle enthusiasts: An unfamiliar common noun missing only a few letters can usually be guessed or narrowed down drastically, whereas an unfamiliar person's name could be solved in many different ways.

In his Plausible Phonology Hypothesis, Brennen (1993) proposes that the learning of proper names—especially surnames—involves not only associating that name with a given person (a step which must also be conducted when learning, say, that person's

occupation), but an additional step in which learning of the name's phonology must take place. Common nouns, even ones that are newly-encountered, consist of phonologies that have already been learned, and these phonologies often let us know the domain of a given word. For example, we easily know that a word beginning with the prefix "cyber-" certainly relates to computers. People's names rarely contain such clues.

Furthermore, Brennen (1993) notes that TOTs are much more difficult to resolve when attempting to recall a proper noun than a common noun. For example, if you know that someone's job begins with the sound "bay", you are more likely to come up with the word "baker" than if you have the same knowledge about a person's name. The name could be a wide range of possibilities, not limited to Baker (e.g., Bateman, Bailey, Bader). This, according to Brennen, helps to explain the finding that it is easier to recall "baker" when it is presented as a person's occupation than as a person's name (e.g., McWeeny, Young, Hay, & Ellis, 1987). While this hypothesis focuses largely on surnames, it seems reasonable that it also applies to first names. While there are very few occupations beginning with the long-a sound (e.g., air traffic controller), a large number of first names with highly similar beginnings are possible (e.g., Aiden, Avery, Abraham, April). Thus, the difference in range of phonologies between proper names and common nouns is a quite feasible (but likely only partial) explanation for people's difficulties in recalling people's names.

Low imageability and meaninglessness. Another possible factor increasing the difficulty of name retrieval involves imageability. Common nouns are generally much easier to mentally picture than are proper names. For example, when trying to remember that someone is a baker, we can imagine that person with a flour-covered face, holding a

spatula. However, there is no such image for the name Baker. A common mnemonic is to select an imageable word similar to the name (or, the name itself in cases such as Baker) and link it to a prominent facial feature of that person (e.g., picture "Gordon" having a *garden* growing on his large nose), and this mnemonic seems to work, at least in short-term retention (Morris, et al., 1978). However, other information about a person, such as occupation, is more easily imageable than a name (e.g., if Gordon is a baker, it is easier to simply picture him with flour over his nose than to first create a link between Gordon and garden, then picture him with plants on his nose).

Closely related to the difficulty in producing mental images for people's names is the fact that names usually do not convey any meaning. They may provide clues as to one's nationality, and first names usually convey one's gender, but very little else can be known from a name only. There is some good evidence that the meaninglessness of people's names makes them more difficult to remember. Cohen (1990), for example, found that meaningless possessions (e.g., "He has a blick") and occupations (e.g., "He is a ryman") were recalled no better than surnames. Investigating a similar issue, Fogler and James (2007) were able to attribute some of older adults' naming difficulty to names' lack of descriptiveness. Younger and older participants were asked to name commonly-known cartoon characters as quickly as possible. Older adults were found to be impaired when the names were nondescriptive (e.g., Garfield, Charlie Brown) compared to descriptive names (e.g., Snow White, Pink Panther), but young adults performed similarly for descriptive and nondescriptive names.

To test the idea that low imageability and meaninglessness are accountable for the difficulty of proper name retrieval, McWeeny, Young, Hay, and Ellis (1987) conducted

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an inventive study holding these factors constant. This study made use of the fact that some surnames are also occupations. Participants first studied faces along with names and occupations, and were then asked to recall the names and occupations when shown the faces. Half of the names could be used as occupations and half of the occupations could be used as names (e.g., Baker/baker, Cook/cook; ambiguous condition). The other half of names and occupations were unambiguous (e.g., Hyde, Rothwell; architect, grocer; unambiguous condition). Thus, for the ambiguous condition, the same words could serve as either a name or an occupation for a given participant. Results showed that even in this condition, in which meaningfulness and imageability of the words themselves was held constant, occupations were much more likely to be recalled than names. "It is much more difficult to recall that someone's name is *Mr.* Potter than to recall that he is *a* potter" (p. 147). In a similar type of study, Terry (1994) found that nursing students were better able to remember words presented as diseases (e.g., Hodgkin's, Addison's) than those same words presented as names. Thus, the fact that words used as names contain low meaning and are difficult to image cannot be solely accountable for the difficulty in memory for names.

  Lack of alternatives. Another possible reason why people's names are difficult to remember is that there is no way to replace them with an alternate word. For example, if you want to ask someone to turn up the thermostat, but cannot think of the word "thermostat", you can instead use the words "furnace" or "heater". You might then forget the difficulty you had retrieving the initial word, because you had successfully stated your point. However, if you are trying to introduce a friend to someone else and

cannot think of her name, then this would create quite a noticeable problem. Simply introducing her as just "my friend" would seem quite awkward, if not rude.

Brédart (1993) created an interesting methodology to test this idea. He chose as stimuli two sets of pictures showing famous actors. For one set ("faces with one name"), participants were familiar with the actors themselves, but not with the name of a particular character that they had portrayed (e.g., Julia Roberts had played the role of Vivian Ward). The other set ("faces with two names") included actors who were strongly linked with a particular, nameable, character (e.g., Harrison Ford as Indiana Jones). Brédart found that, when asked to retrieve a name for each face, people had many fewer name blocks (i.e., tip-of-the-tongue states) in the "faces with two names" condition than in the "faces with one name" condition. Other support for this idea comes from Izaute, Chambers, and Larochelle (2002), who found that participants' "feeling of knowing" ratings were more accurate in response to proper names than to common words, indicating that proper names are very specific and allow for quite good estimates of whether they have been learned. Thus, being unable to use alternative words when naming people is partially responsible for our difficulties in remembering names.

Dependence on retrieval of non-name information. Although the above ideas may help to explain the difficulty in memory for people's names, they offer little in terms of possible interventions; this is due to the assumption that names are difficult to remember due to something inherent to the names themselves. For intervention purposes, it seems more appropriate to focus on explanations involving factors which may be manipulated in everyday life. One such idea is that people's names may be especially difficult to remember because they are stored in memory separately from other

information about people. For example, Bruce and Young (1986) created a model in which faces are linked directly to most semantic information about a person, but names are directly linked only to the semantic information--not to the face. Additionally, the differential name memory decline that occurs with age may be due to the fact that names do not provide the wealth of knowledge that other information, such as occupations, might (see MacKay & Burke, 1990).   These theoretical frameworks have not been used as the basis for memory improvement, but they provide an excellent opportunity to enhance memory for names. The ultimate goal of the current dissertation is to investigate whether it is possible to overcome the difficulty of name retrieval by combining the storage of a name with the storage of other information about a person.

During the 1980s, many models of face processing were developed. Despite their differences, all of them held that names are special—that they cannot be retrieved until other information about a person, such as an occupation, has been retrieved (see Valentine, Brennen, & Bredart, 1996). There is a great deal of evidence supporting the idea that names cannot be retrieved without also having access to other personal information. In one diary study (Young, Hay, & Ellis, 1985), for example, 22 participants were asked to record the details of the various person recognition difficulties they experienced over an 8-week period. Of 922 reported events, none of them involved memory for a name without knowing the person's identity, but the reverse occurred relatively often. In a different study, Hay, Young, and Ellis (1991) showed participants pictures of both famous and nonfamous faces and asked, "Do you know this face?". If participants gave a positive response, they were then asked to provide the occupation, and then the name, of the person. Out of 2160 responses, there were 240 instances in which

participants provided the correct occupation but no name, and 77 additional cases in which an incorrect name was produced with correct occupation identification. However, participants *never* produced a correct name without also providing a correct occupation, suggesting that retrieval of a name depends on retrieval of other information about a person.

Such effects have also been shown in regard to new learning. Craigie and Hanley (1997) showed participants 18 nonfamous faces, each with a name and occupation, and told them to learn all the information. At test, participants were presented with three large cards, one with all the names, one with all the occupations, and one with all the faces. The experimenter pointed to one stimulus and asked the participant to choose the other two stimuli which had been presented with it at study. Name memory was better when cued with the occupation than with the face, and more faces were remembered when given an occupation than given a name; this is consistent with the idea that only the occupations have direct links to both names and faces. Furthermore, memory for a name given a face was found to be contingent on memory for the occupation. However, when given an occupation, memory for the face was not contingent on memory for the name. (See also Craigie & Hanley, 1993). As mentioned earlier, response times also support the notion that names are retrieved after other information (Johnston & Bruce, 1990; Maylor & Valentine, 1992; Young, et al., 1988).

Hanley and Cowell (1988) were able to find more specific information supporting the distinct stages of face processing put forth by Bruce and Young (1986), who hold that, upon viewing a face, processing begins at the level of "structural encoding", during which facial properties are identified. This information enters the stage of multiple face

recognition units (FRUs), each of which stores the face of one known person. Incoming visual information about a face is compared to existing FRUs in order to recognize a familiar face. If a given face is recognized as familiar, the appropriate FRU is sent on to the next stage of processing, which holds various types of information about the person, in the form of a person identity node (PIN). The only information about a person *not* stored at the PIN level is the person's name. Instead, the name is held in a separate stage and can be retrieved only after the PIN has been accessed.

Hanley and Cowell (1988) presented participants with photographs of famous people and asked whether the person was familiar, then asked for the person's occupation and then for the person's name. After that, subjects were provided with one of three types of cues: another photograph of the person; 4 possible sets of initials and the number of letters in the first and last names, one of which applied to the correct response (to serve as a retrieval cue); or relatively detailed biographical information about the person. Three types of errors could be made initially: lack of familiarity, familiar only (lack of any biographical or name information about the person), or familiar and occupation known, but without the name. Results showed that the effects of retrieval cues varied according to a participant's original state of knowledge. For example, when subjects knew the occupation, the biographical cue was much less likely to lead to name retrieval than when the subjects were only familiar with the face. This suggests that people need a cue which will help them progress to the next stage of retrieval in Bruce and Young's model. When participants already knew the celebrity's occupation, the cue involving initials was the most helpful "because it helped them bridge the gap between contextual information in the person-specific semantic system and the name in the lexical

output system" (p. 548). Carney, Levin, and Stackhouse (1997) reached similar

conclusions when they asked participants to provide the occupation and facial feature

(balding, bearded, glasses, or long hair) for the famous names provided. It was extremely

common for participants to recall the occupation without the facial feature, but the

reverse almost never occurred. Furthermore, being provided with biographical

information about the famous person aided retrieval of the facial characteristic. The

researchers conclude, "These results suggest that there are no direct links between the

representation of a person's name in memory and visual information about their facial

appearance. The link appears to be indirect, and to be mediated by non-visual semantic

information about the person, such as their occupation" (p. 367). This idea provides a

platform for the present dissertation.

The Present Experiments

The ultimate goal of this dissertation is to uncover a method by which both

younger and older adults are better able to encode and retrieve newly-learned people's

names. As discussed previously, occupations are easier to recall than names, and this

difference is larger for older than for younger adults. The idea that names cannot be

recalled directly from faces will be adopted as a possible method by which to improve

memory for names. Specifically, the present investigation will focus on the use of

"mediating" information, i.e., information used to link a face to a name (see Figure 1).

Participants should be able to remember a name given a face if they first remember the

semantic information from the face, and then remember the name given the semantic

information.

Without mediation:
Good face-semantic
information memory and
poor face-name memory.
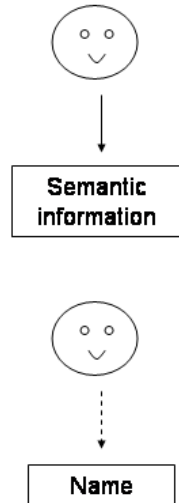
With mediation: Using semantic
information as a mediator should
improve memory for names, given
faces. Because memory for
names is poor without mediation,
using names as a mediator should
not help memory for semantic
information

Semantic
information

Semantic
information ↔ Name
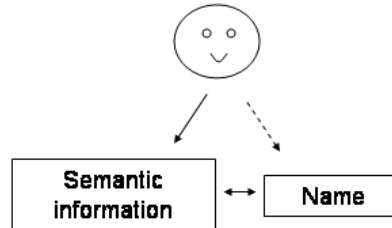
Name

Figure 1. *A depiction of memory for semantic information and for names, given faces, with and without the use of mediating information. Solid lines represent relatively good recall, and dashed lines represent relatively low recall.*

Because, according to Bruce and Young's (1986) model mentioned above, as well as various other information-processing models of face recognition (see, e.g., Valentine, et al., 1996), a naming response comes only after face identification and retrieval of semantic information, studies which ask participants to simply learn the name of a given face may be underestimating people's abilities. Based strictly on the model, to remember the name of a person, participants must create their own "mediating" information—i.e., something to help them link the name to the face. It is possible that older adults are at a special disadvantage in such cases, because they are less likely than young adults to use spontaneous strategies (see, e.g., Naveh-Benjamin, Brav, & Levy, 2007).

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In the following experiments, an attempt will be made to teach participants to use a piece of semantic information (character information in Experiment 1 and occupation in Experiments 2 and 3) as a mediator between the name and face of a given person. Thus, participants should be able to bypass the direct name-face link that is required in most studies of name-face memory, a link which, according to Bruce and Young (1986), does not exist without some type of semantic information intervening. If participants can link a name to a bit of semantic information and a face to that same bit of semantic information, this should create an indirect link between name and face. In effect, the name should now be stored at the level of semantic information.

In each of the following experiments, older and younger adults were presented with faces paired with semantic information, names, or both. In the unmediated condition, only one piece of information (either semantic or name) was presented with a given face. In the mediated condition, both types of information were provided with a face, such that participants had the opportunity to use mediating information; the link between these two pieces of information had already been learned. If memory for a type of information (i.e., names or semantic information) was higher in the mediated than in the unmediated condition, it could be assumed that participants were able to use the link between a name and semantic information to tie the face to the to-be-remembered information.

In both Experiments 1 and 2, participants were given instructions on how to use the mediation strategy. One reason that older adults have differentially poor memories for names could lie in a lack of proper strategies. In fact, older adults have been shown to have no name memory deficit in implicit tasks, but a large deficit in explicit tasks (B. M.

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Brooks, Gardiner, Kaminska, & Beavis, 2001), suggesting that strategy, which is assumed to be used only in explicit tasks, may be involved in the deficit. Furthermore, J.O. Brooks, Friedman, Gibson, and Yesavage (1993) use their findings to suggest that varying degrees of utilization of "spontaneous mnemonic strategies" is a cause of the differentially large effect of age on name memory. In their study, younger and older adults were asked to learn the first and last names presented with faces and were then asked to recall the names given the faces. Unsurprisingly, there were quite large age differences in name recall. What separates this study from the others is that, following test, participants were asked specific questions regarding the strategies that they had used. Older adults reported, more often than young, simply looking at the faces, trying to notice a distinctive feature of the faces, and just listening attentively to the names, none of which were correlated with name recall. Young adults, however, reported more often than older adults the use of a strategy found to be positively related to name recall: giving meaning to the names.

In Experiment 3, participants were no longer instructed to use the mediation strategy. This was intended to investigate whether they would use it spontaneously.

Experiment 1

Because this approach to name-face memory is relatively novel, it is a good idea to begin this line of research using a simple methodology with high power to detect the expected effects. Thus, in Experiment 1, participants studied a series of faces, each with either one of two names or one of two characteristics. At test, each face was re-presented and participants were asked to choose the name or characteristic belonging to that face.

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Additionally, the second half of the experiment tested participants' ability to use mediation, at the simplest level possible. Participants first learned a link between the two names and two characteristics ("pre-learning"). Next, they studied the faces along with the to-be-remembered names or characteristics. Because memory for character information was predicted to be higher than that for names, mediation was predicted to produce an increase in performance on the name list, but not on the characteristic list. With names and character information directly and simply linked, performance on the mediated lists was expected to be similar on the name tests as on the character tests.

The reason character information ("good" and "bad") was chosen is that older adults seem to be quite good at binding this type of information to a face. Rahhal, May, and Hasher (2002) presented younger and older adults with a series of pictures showing people's faces. Each face was presented with a verbal description including that person's name, occupation, and state of residence. Each description was heard in one of two voices; one of those voices (e.g., that of "John") was said to always describe good people, whereas the other voice (e.g., that of "Mary") was said to always describe evil people. When later shown each face, participants in the "character-source test" were asked whether the face shown was that of a "good" or "evil" person, or had not been previously shown. Those in the "voice-source test" were asked whether the person had been described by "John" or "Mary", or had not previously been seen. Results showed that older adults were significantly impaired on the voice-source test, but not on the character-source test. It appears, then, that they are unable to spontaneously use character information as a mediator (e.g., to know that, because a given person is "good", he must

have been described by "Mary"), which, again, is why in the current experiment, they were explicitly instructed to do so.

It was expected, first, that in the unmediated lists, name memory would be worse than memory for characteristics. Second, mediation was predicted to improve memory for names, but not for characteristics. Finally, age differences were expected to be larger on the name lists than on the characteristic lists. It was uncertain whether there would be age differences in the improvement from unmediated to mediated name lists. On one hand, older adults should have had a larger age-related impairment on the name than the characteristic lists, giving them more room to improve. Alternatively, they may also have had more difficulty using the given strategy to help remember the name of each face.

Method

Participants. Twenty-four younger and twenty-four older adults participated in this experiment. The younger adults were college students who received course credit in return for their participation. The older adults were volunteers who lived independently in the community. All older participants were free of any known health problems that could affect their cognitive functioning. The older adults received $15 in return for their participation. Demographic information, for each of the following three experiments, is presented in Table 1. There was a significant difference between the age groups in terms of education level, $t(46)=2.78$, $p=.008$, with older adults having more education than younger adults. There was also a somewhat higher proportion of males in the younger than older age group, $t(46)=1.78$, $p=.082$. However, education was not correlated with

performance on any test for younger or older adults, and sex was not involved in any

significant interactions or a main effect.

Table 1

Demographic Information for Experiments 1-3.

	N	Age	Education	Proportion Male
Experiment 1				
Young	24	19.29 (1.33)	13.00 (1.38)	13:11
Old	24	69.88 (4.24)	14.42 (2.08)	7:17
Experiment 2				
Young	25	18.3 (.56)	12.3 (.62)	8:17
Old	24	70.6 (6.97)	16.0 (2.23)	10:14
Experiment 3				
Young	28	19.2 (1.31)	13.0 (1.02)	12:16
Old	28	68.0 (4.10)	15.3 (2.21)	11:17

Note. For age and education, means are presented with standard deviations in

parentheses.

Design. This experiment involved a 2 (Age: young, old; between subjects) x 2

(Mediation: unmediated, mediated; within subjects) x 2 (Test: name, character; within

subjects) design.

Materials. Headshot photographs of smiling young, middle-aged, and older

adults were used as stimuli. Four sets of faces were prepared; two sets contained 34 male

faces and the other two sets included 34 female faces. (Of these 34, 4 were buffers—two at the beginning and two at the end of the list.) Each face was paired with one of two first names (Anna or Mary for one female list and Karen or Laura for the other female list; Dave or John for one male list and Steven or Robert for the other male list). Two versions of each name-face grouping were used, such that each photograph was paired with each name and each characteristic within that grouping. Furthermore, for the second half of the experiment, each name was associated with "good" for half of the participants and with "bad" for the other half. Photographs were taken from the internet (http://www.veer.com). For each of the four lists, 10 additional faces were used in a practice session. Study items were presented in a random order, with the condition that the same name or characteristic could not appear more than four times consecutively. All participants were tested on four lists, with the first two being unmediated and the last two being mediated. See Appendix A for examples of stimuli from each section of the experiment.

Procedure. For each of the first two lists ("unmediated" lists), one of which tested names and the other of which tested characteristics, participants were told that they would learn the name or character information (depending on which list occurred first for that given participant) which accompanied a particular face. During study, each of the 34 faces appeared for 4 seconds, with a 500 ms pause between presentations; the name or characteristic was shown underneath each face. After the study of each list, a two-minute interpolated task (pencil-and-paper multiplication problems) was done. Participants then completed the appropriate test. In each test, 30 non-buffer faces from the study list were individually presented in a random order. Participants were asked to respond to each by

pressing one of two keys corresponding to one of the two possible names or characteristics, which were presented at the bottom of the screen. (Order of names or characteristics was counterbalanced with response key; e.g., for half of the participants, "good" corresponded with "1" and "bad" with "0", and for the other half, this order was reversed.) Faces remained visible until a response was made. Before each study period began, a brief practice session was conducted.

The last two lists ("mediated" lists) were quite similar to the first two, except that participants were given strategies to help them remember the names and characteristics for each face. Before study of the name list, participants were told that everyone with one of the two names was "good" and everyone with the other name was "bad", and that remembering this information might help them to remember the names. Likewise, before study of the character list, they were told that everyone labeled "good" had one name and that everyone labeled "bad" had the other name, and to use this information to help them. Before each test, participants were reminded that if they could not remember the tested information directly (e.g., a name), they might be able to first think back to the other piece of information (e.g., "good") to help.

Also, before beginning the practice session of each mediated list (name and character), participants took part in a 15-item "pre-learning" session to ensure that they had learned the association between a name and "good" or "bad". Before the name-learning sessions, this pre-learning session showed one of the names on the screen and subjects pressed a key for either "good" or "bad". Conversely, before the characteristic-learning sessions, the training session showed either "good" or "bad", and participants pressed a key corresponding to one of the two names in that section.

Following pre-learning, participants took part in practice phases. While practice

sessions before the first two lists were exactly the same, but shorter, than the actual lists,

those before the last two (i.e., mediated) lists were slightly different, in that participants

were asked to state the mediator aloud during both study and test. For example, during

the study section of the practice name-learning list, subjects saw a face paired with one of

the two names, and said either "good" or "bad" aloud. Also at test, they were instructed

to again say the person's characteristic aloud before pressing a key corresponding to the

person's name. This process was employed to ensure that participants learned and used

both pieces of information, but was not used during the real sessions due to concerns over

the difficulty of speaking aloud while learning.

Results

  Memory accuracy. For each participant, the proportion of correct responses in

each condition was assessed. These results are shown in Figure 2. (See Appendix B for

a table of the exact values.) A 3-way analysis of variance (ANOVA) was conducted on

these data (Age x Test x Mediation). The 3-way interaction was not significant,

$F(1,46)=.135$, $p>.7$. However, the analysis did show a significant interaction between

Mediation and Test, $F(1,46)=4.06$, $p=.05$. A follow-up analysis revealed that the source

of this interaction lies in the increase in name memory with mediation compared to

without mediation, $t(47)=2.34$, $p=.023$, with a very slight decrease in character memory

with mediation, $t(47)=-.51$, $p=.61$. Neither of the other two 2-way interactions was

significant (Test x Age, $F(1,46)=.097$, $p=.76$ and Mediation x Age, $F(1,46)=.38$, $p=.54$).

Although Age was not involved in a significant interaction, a main goal of the present experiment was to determine if older adults might be helped more than younger adults by mediation. Because the effect of mediation was limited to performance on the name tests, results on only the name tests were further assessed. A Mediation x Age ANOVA in the name test did not yield a significant interaction, $F(1,46)=.35$, $p=.56$. However, further analysis revealed that the effect of mediation on name memory was significant only in older adults (Young adults: $t(23)=1.10$, $p=.28$, $M=.67$, $SD=.15$ for unmediated names and $M=.71$, $SD=.17$ for mediated names; older adults: $t(23)=2.39$, $p=.025$, $M=.62$, $SD=.14$ for unmediated names and $M=.70$, $SD=.11$ for mediated names). Thus, there are some indications that mediation aided older adults more than younger adults when attempting to remember people's names, but this differential effect between the age groups did not reach significance.

Also, there was a large main effect of Test, $F(1,46)=29.8$, $p<.001$, indicating that performance in the character lists ($M=.76$, $SD=.12$) was higher than in the name lists ($M=.68$, $SD=.11$). This effect was similar for older and younger adults (see the lack of an Age x Test interaction noted above). Surprisingly, the main effect of Age also failed to reach significance, $F(1,46)=1.43$, $p=.24$, which could be partially due to the type of test used (i.e., a two-choice recognition test). Age did not significantly affect performance in either the unmediated condition, $t(46)=1.45$, $p=.16$ or in the mediated condition, $t(46)=.72$, $p=.47$.

To ensure that participants did not make errors during the key-press (e.g., holding a key down too long during one response, causing a response to the next stimulus), data were re-analyzed excluding all responses made more than 2.5 SD's from the mean

response time of each age group during a given condition. The 3-way ANOVA noted above was repeated on this data set. Outcomes were affected only very slightly and thus will not be reported here. Additionally, incorrect responses during the pre-learning session in the mediated lists were quite rare, so performance on those tests will be omitted from the results section.
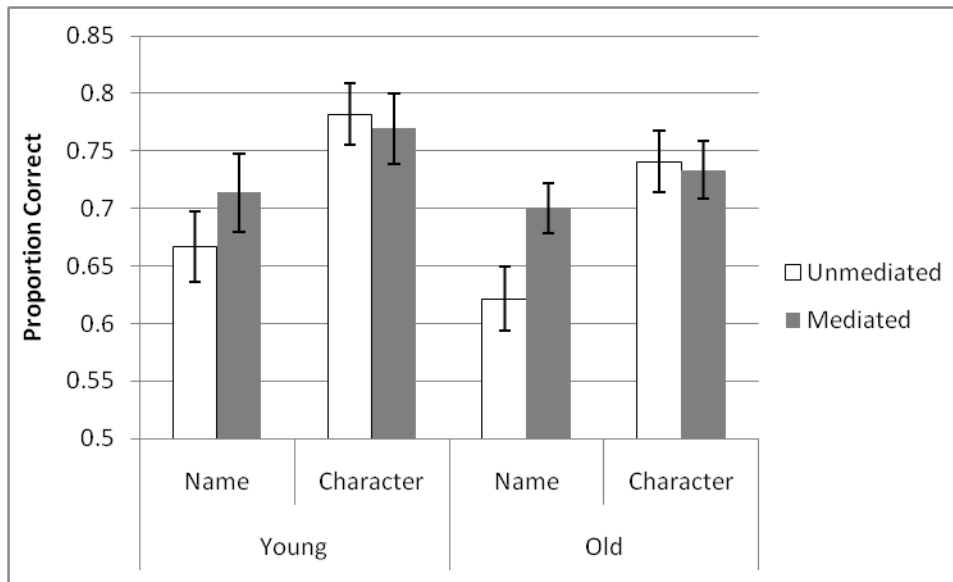
Figure 2. *Average proportion correct for Experiment 1, with standard error bars, as a function of age, test, and mediation. Chance level is 0.5.*

Response times. Average response times (in milliseconds) on each of the tests are shown in Figure 3 (see Appendix B for a table of exact values). An Age x Mediation x Test ANOVA revealed a main effect of Test, $F(1,46)=12.93$, $p=.001$, with faster responses on the character tests ($M=1975$ ms., $SD=636$) than the name tests ($M=2142$, $SD=767$). The main effect of Mediation was marginally significant, $F(1,46)=3.23$, $p=.079$, with faster responses on the mediated lists ($M=2001$, $SD=663$) than the

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unmediated lists (*M*=2117, *SD*=779). Surprisingly, there was no main effect of Age, *F*(1,46)=.25, *p*=.62.

A significant 3-way interaction, *F*(1,46)=4.52, *p*=.039, indicated the need for further analyses. For younger adults, there was a marginally-significant Test x Mediation interaction, *F*(1,23)=3.63, *p*=.069; there was a significant effect of Test in the unmediated condition, *t*(23)=2.65, *p*=.014, with slower RTs in the name list (*M*=2306, *SD*=1111) than in the character list (*M*=1952, *SD*=793), but not in the mediated condition, *t*(23)=1.05, *p*=.31 (*M*=1927 and 1849, *SD*=770 and 614, for name and character lists, respectively). For older adults, there was no Test x Mediation interaction, *F*(1,23)=1.20, *p*=.28 (for unmediated lists: *M*=2125 and 2084, *SD*=740 and 645, for name and character lists, respectively; for mediation lists: *M*=2212 and 2015, *SD*=678 and 651, for name and character lists, respectively).
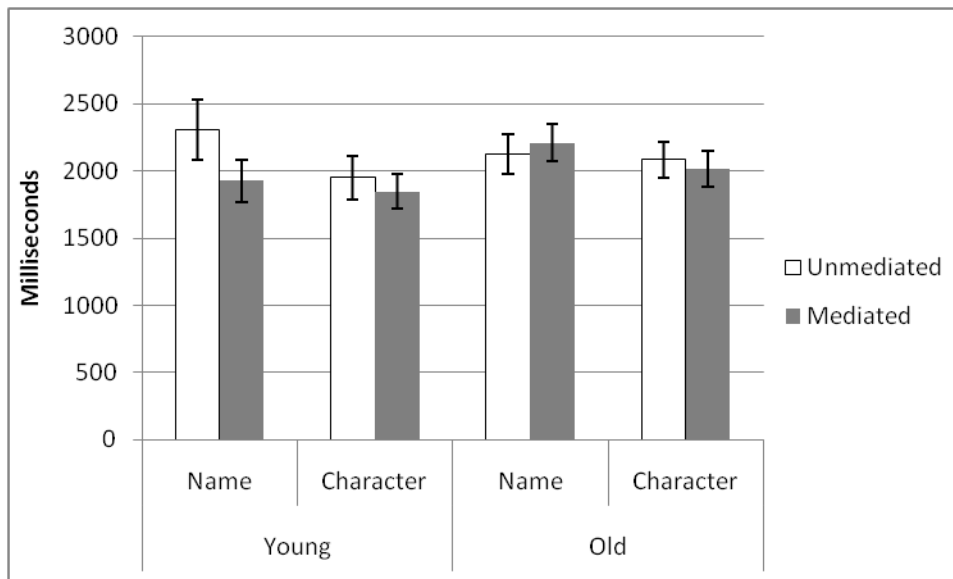
Figure 3. *Average response time (in milliseconds) for Experiment 1, with standard error bars, as a function of age, test, and mediation.*

Estimated percentages correct. In a post-experiment questionnaire, participants were asked to estimate the percentage of responses they believed they had answered correctly for each test. Although it was emphasized that 50% was chance-level performance, many participants produced much lower estimates. It is still feasible, however, to compare estimates among test types, using each participant as his or her own control. Average values are presented in Table 2.

Table 2

Average estimates of percentage correct made by younger and older participants, for each of the four conditions in Experiment 1.

	Unmediated Name	Mediated Name	Unmediated Character	Mediated Character
Young	45.1 (21.7)	56.7 (24.7)	63.1 (20.3)	56.6 (23.9)
Old	48.5 (18.6)	50.8 (19.0)	49.9 (19.1)	54.5 (18.4)

A Test x Mediation x Age ANOVA revealed a significant 3-way interaction, $F(1,43)=6.58$, $p=.014$. There was a strong Test x Mediation interaction in younger adults, $F(1,22)=10.16$, $p=.004$. Young adults estimated that their performance on the name tests increased significantly with mediation, $t(22)=2.63$, $p=.015$, but that their performance on the character lists declined somewhat with mediation, $t(22)=-1.53$, $p=.14$. Older adults, however, did not show a Test x Mediation interaction, $F(1,21)=.031$, $p=.86$. This finding suggests that young adults have a greater understanding of factors which may aid in memory performance. The only significant main effect was that of Test,

$F(1,43)=6.95$, $p=.012$, with higher estimates for the character test ($M=55.4$, $SD=19.2$)

than the name test ($M=50.3$, $SD=19.3$).

Discussion

Experiment 1 showed that, at a very basic level, older and younger adults are able

to use character information to help remember names, but that learning people's names

does not help to know their character information. This finding aligns with the idea that

there is not a direct link between a face and a name, but that other information about a

person must indirectly link the face and name. Another interesting finding in Experiment

1 was that older adults showed a somewhat larger effect of mediation on the name lists

than did younger adults. This may be a result of older adults' quite low performance

(although not significantly lower than that of younger adults) on the unmediated name

list.

Experiment 1 also verified the previous finding that name memory is especially

difficult. Both age groups were better at remembering whether a person was "good" or

"bad" than at remembering a person's name. This was especially true in the unmediated

lists, but was also found in the mediated lists.

It was surprising that overall age differences in memory performance did not quite

reach significance. This is likely due to a convergence of factors aiding older adults'

memories. First, it has been found that older adults are less impaired on recognition tests

than on cued-recall tests (e.g., Craik & McDowd, 1987; Schonfield & Robertson, 1966),

and among recognition tests, they are less disadvantaged on forced-choice than on yes/no

tests (see Bastin & Van der Linden, 2003). This latter finding is perhaps due to their

reliance on familiarity (e.g., Parkin & Walter, 1992), which may be more useful during forced-choice than yes/no tests (e.g., Aggleton & Shaw, 1996; Parkin, Yeomans, & Bindschaedler, 1994). Using a forced-choice recognition test in the present study likely kept age differences to a minimum.

Second, this study used a many-to-one mapping, in which many faces belonged to a single name or characteristic. This type of mapping, as opposed to one-to-one mapping (in which each face is linked with its own name or characteristic, for example), may reduce the negative effects of aging on memory for associations (Old & Naveh-Benjamin, 2008). This may indicate that older adults are especially poor at creating completely new associations, but have less trouble binding a new piece of information (e.g., a face) to something that is already learned (e.g., a name or characteristic). Thus, the forced-choice, many-to-one, nature of the present study may have reduced the usually-significant effects of age.

Response times from Experiment 1 yielded interesting results. While older adults' response times were quite stable across all conditions, young adults took significantly more time to respond in the unmediated name list than in the other lists, even taking slightly longer than the older adults. This finding may be an indication that young adults realized the difficulty of the name responses (as was also indicated in the post-experiment questionnaire data) but that, at least on some trials, they were able to simply remember "good" or "bad" (i.e., the mediator) in the mediated name list. The fact that older adults did not adjust their response rates across conditions adds further evidence to the post-experiment questionnaire finding that they were unable to recognize the changes in difficulty for the different conditions.

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It is surprising that only younger adults were able to detect that names were more difficult to remember than character information, and that mediation helped to remember names. As discussed in the introduction, older adults typically recognize that name memory is difficult (e.g., Cohen & Faulkner, 1984, October; Reese, et al., 1999). It is likely that such an outcome was not found in the present study because older adults' complaints are usually in reference to recall, whereas here, they only had to choose one of two options for each face. The following experiments use cued-recall and also ask participants to estimate their performance on each test, such that the involvement of test type (recall versus recognition) in this surprising finding may be assessed.

There are several limitations of the present experiment, which are remedied in Experiments 2 and 3. First, all participants were necessarily given the unmediated lists before the mediated lists. This does not negate the main finding of this experiment, because mediation was used only on the name lists; if practice effects were fully responsible for the increase in performance with mediation, character performance would also have increased. Still, some scores may have been affected due to fatigue or practice effects; Experiments 2 and 3 use mediation as a within-list factor so as to avoid these potential effects.

A second issue in Experiment 1 is that performance in the mediated name list may have been high simply because participants were completely ignoring name information at test and were responding only to "good" and "bad". This is a legitimate concern, considering that response times were not longer in the mediated than in the unmediated name lists. However, performance still remained lower in the mediated name than the mediated character test, indicating that, at least on some trials, participants were not

remembering only the character information. This issue will be resolved in Experiments 2 and 3 by using a variety of names and occupations.

A final limitation of Experiment 1 relates to ecological validity. In real life, of course, people are not labeled as "good" and "bad", and not everyone has one of just two names. Furthermore, we are not given choices of names from which to choose for a given face. Experiments 2 and 3 will gain ecological validity by using a variety of names and occupations to be paired with faces, as well as by using a cued-recall test.

Despite its limitations, starting off with a simplified design has assured us that both age groups are capable of using their knowledge about a person to help remember that person's name. In Experiments 2 and 3 we assessed whether this strategy would be useful under more realistic conditions.

Experiment 2

As mentioned above, the purpose of Experiment 2 was to determine whether younger and older adults are able to use a mediator to help remember a name in a relatively realistic setting. Thus, each face was now paired with a unique name or occupation, two pieces of information we often gather when meeting someone for the first time. Furthermore, cued-recall was used at test instead of recognition, as an additional step toward ecological validity.

Experiment 2 was divided into two sections: memory for names and memory for occupations. Mediation was a within-list variable, such that the potential practice effects from Experiment 1 were avoided. A pre-learning session was conducted for each list, during which participants studied names (in the name-recall lists) or occupations (in the

occupation-recall list). Half of these stimuli were presented with the appropriate

mediators (e.g., an occupation accompanied some names), and the other half were

presented alone. These conditions constitute the mediated and unmediated categories,

respectively. Following testing of the pre-learning session, participants viewed faces

along with the appropriate pre-learned information. For example, in the name lists,

participants saw faces accompanied by only names in the unmediated condition, and by

names and occupations in the mediated condition. Participants were instructed on how to

use the mediators to help them recall the to-be-remembered information, both before

study and before test. (See Appendix C for schematic representations of the procedure.)

One hypothesis for Experiment 2 was that younger adults would outperform older

adults in recall and that age differences would be larger on the name than the occupation

tests. Furthermore, as in Experiment 1, mediation was expected to help both age groups

in memory for names, but not memory for occupations. Finally, it was uncertain whether

older and younger adults would display different degrees of impact from mediation on

memory for names. While age differences were expected to be larger on the name than

the occupation tests, giving older adults more room for improvement than younger adults,

this effect could be offset by older adults' potential associative deficit (i.e., trouble

remembering the name-occupation links) and by their difficulty in using this strategy.

Method

Participants. Participants were drawn from the same pool as in Experiment 1,

but no individual had also participated in Experiment 1. There were 25 young and 24

older participants. Demographic information is presented in Table 1. Older adults had

significantly more formal education than younger adults, $t(46)=7.86$, $p<.001$, but education did not correlate with performance in any condition for either age group.

Design. This experiment involved three factors, each with 2 levels: Age (young, old; between subjects), Mediation (mediated, unmediated; within lists), and Test (name, occupation; between lists and within subjects).

Materials. A total of 76 faces—half men and half women—were used in this experiment. Half of the photos within each gender depicted "young" adults, appearing to be between 18 and 30 years of age, and the other half depicted "older" adults, appearing to be over the age of 60. A variety of races were included. The faces were divided into lists as follows: 14 were used in each of 4 study-test lists, 2 were used as buffers in each of the 4 lists, and the remaining 12 were divided into groups of 6 for 2 different practice lists. Instead of using smiling faces, as in Experiment 1, the present study included only faces with neutral expressions. Faces were again taken from veer.com.

Additionally, 112 first names—half men's names and half women's names—and 112 occupations were chosen. The names were equated for commonality in 1940 and 1990, years near when the older and younger participants were born. These items (names and occupations) were divided into lists as follows: 21 were used in each of 4 study-test lists (14 were paired with faces during study and the other 7 were distractors presented during the pre-learning session), 10 were used in each of 2 practice lists (6 paired with faces during study, and 4 presented as distractors during the pre-learning phase), and the remaining 8 served as buffers (2 in each of the 4 lists).

Items were organized into four 14-item (plus 2 buffer items) study-test lists, with each list being exclusively male or female. Each face was paired with a name and an

occupation. Four different versions of each list were created such that each name and occupation was paired with both a younger and an older face, and each face-name-occupation triplet served in both the mediated and the unmediated conditions. Sample stimuli are presented in Appendix C.

Procedure. Each participant engaged in four lists: a male name list, a female name list, a male occupation list, and a female occupation list; these were presented in a counterbalanced order, with the two name lists and the two occupation lists always being presented together. A practice list immediately preceded the first name list and the first occupation list.

First, participants were given the following instructions: *This experiment includes two sections: 1) Memory for people's names and 2) Memory for people's occupations. In each section, you will first learn the names and occupations that belong to some (but not all) of the people whose faces you will later see. You will then see the faces, along with either the name or occupation (or both) belonging to each person, and will be asked to remember this information.* Before beginning practice, participants were told that they would learn name-occupation pairs (or occupation-name pairs, in the occupation lists) and would then learn the faces that belonged to each of the names or occupations. They were also given brief instructions, with examples, on the way in which they may be able to use the mediators. Diagrams (see Figures 4 A-D for examples from the name list instructions) were used to show that they could remember the to-be-reported material either directly (e.g., in the name list, they viewed a face with an arrow pointing directly to the name) or indirectly (e.g., in the name list, there was an arrow pointing from the face to the occupation to the name). After participants verified that they understood these

instructions, they began the pre-learning phase (study and test), followed by face study, an interpolated activity, and the cued-recall test. Each phase of the experimental procedure is described in greater detail below.

Pre-learning phase. Before starting the pre-learning section, participants were told that they were about to see either 14 names, 7 of which would be singly presented and 7 of which would be paired with occupations (in the name lists) or 14 occupations, 7 of which would be singly presented and 7 of which would be paired with names (in the occupation lists). They were told to study these for a later test. Next, each name and/or occupation was shown for 4 seconds in a random order. After each item or pair was presented once, the list was shown two more times.

Immediately following study of the pre-learning phase, participants were tested both to determine whether they had learned the individual stimuli (in the unmediated condition) and the name-occupation pairings (in the mediated condition), and to provide them with more chances to learn them. They saw a name (in the name list) or occupation (in the occupation list) on the left side of the screen and were presented with 9 possible options on the right side of the screen, each option corresponding to a digit on the keyboard. The first 7 options were the occupations presented with the names earlier (in the name list) or the names presented with the occupations earlier (in the occupation list). Option 8 was always "shown alone" and option 9 was "not shown". Participants had as long as needed to respond during the pre-learning test. Feedback was provided after each response, and the correct response was presented on the screen until the participant pressed a key to continue with the test. After all items were tested once, each item, except for the distractors, was presented again for testing, to give participants a second

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chance to respond correctly. (A simplified sample of both the pre-learning and study/test

sections of a name list and an occupation list are shown in Appendix C).

Study phase. Following the pre-learning phase, participants studied the faces

belonging to each of the names and/or occupations they had just encountered during the

pre-learning session. They were told that they would be tested over only the names or

occupations, but that they might use the mediator, if available, to help them (e.g., in the

name list, they were told that if they could remember the occupation to which they had

already linked a name, this might help them in the name test). The slides in Figure 4 (A-

D) were shown to each participant after they had been given these basic instructions, to

provide a more visual depiction of the to-be-used strategy.

(A)
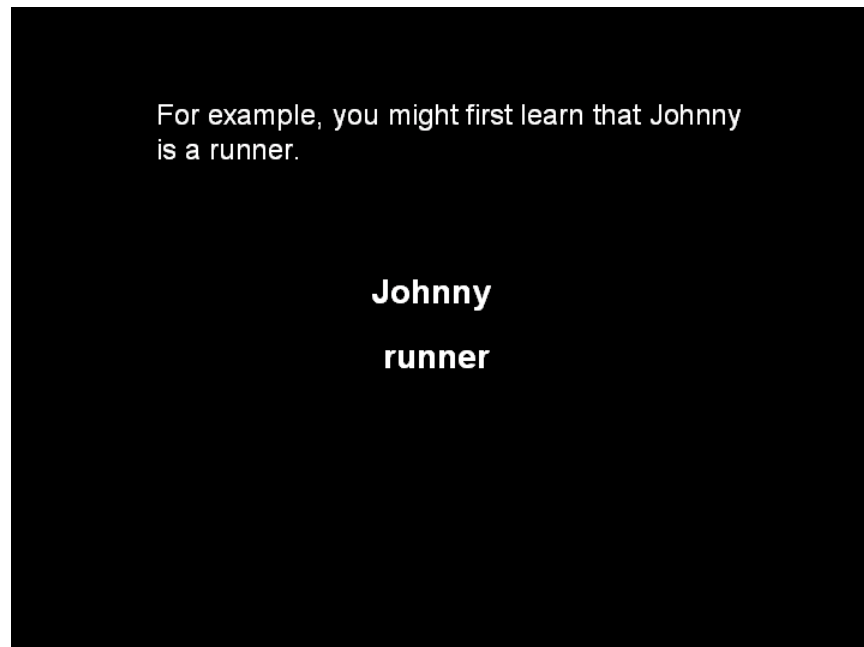
(B)

(C)
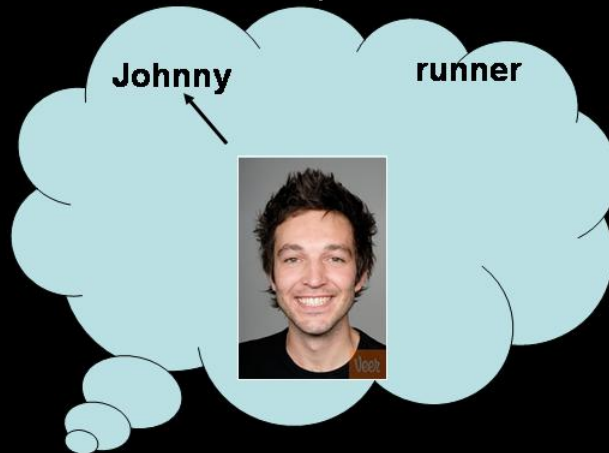
(D)
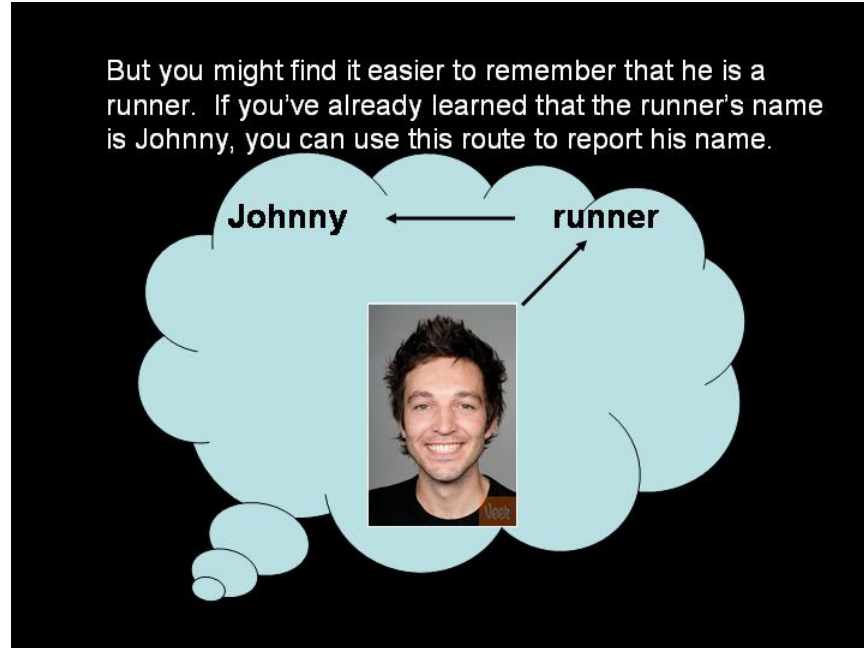
Figures 4 A, B, C, and D. *Instructions given to participants to use mediation in the name lists in Experiment 2.*

Next, participants viewed 16 faces (the 14 belonging to the written profiles from the pre-learning phase and 2 buffers), each paired with the to-be-remembered information. Additionally, the mediating information, if there was any, was presented in parentheses below the to-be-recalled information. Each slide was presented for 5 seconds.

Interpolated task. Between the study and test phases, participants engaged in a simple mathematics task. They typed responses to multiplication problems, up to 12x12, presented on the computer screen. This lasted for 60 seconds (or 20 seconds during practice).

Test phase. At test, participants were instructed to say aloud either the name or occupation (depending on the list) of each face presented. They were reminded that they could use the mediating information, if there was any, to help, although such information was not provided on the screen. They then saw each of the 14 non-buffer faces and had up to 30 seconds to provide a response to each. Guessing was encouraged, but was not required. Upon a spoken response, the experimenter typed the response into the computer and the next face appeared.

Results

Memory performance. For each participant, the proportion of correctly recalled names and occupations in each mediation condition was calculated. The data are shown in Figure 5. (See Appendix D for exact values.) A Test x Mediation x Age ANOVA was conducted, and revealed a main effect of Test, $F(1,47)=16.09$ $p<.001$, with higher performance on the occupation than the name lists (means of .56 and .48, respectively, SDs of .28 and .27). There was also a significant effect of Mediation, $F(1,47)=6.95$, $p=.011$, with higher performance in the mediated than in the unmediated condition (means of .55 and .49, respectively; SDs of .26 and .25). The main effect of Age was also highly significant, $F(1,47)=44.77$, $p<.001$, with young ($M=.68$, $SD=.18$) outperforming older ($M=.35$, $SD=.17$) participants.

As hypothesized, there was also a significant interaction between Test and Age, $F(1,47)=4.94$, $p=.031$, with a greater age-related impairment in the name test, $t(47)=6.68$, than in the occupation test, $t(47)=5.63$ (both $p<.001$). Also important, there was a strong Test x Mediation interaction, $F(1,47)=10.88$, $p=.002$. There was a significant benefit of

mediation on the name tests, $t(48)=4.14$, $p<.001$, but no benefit on the occupation tests, $t(48)=-.10$, *ns*. Finally, the lack of a triple interaction ($p=.92$) suggests that the effect of mediation is similar for younger and older adults. Thus, both age groups appear to be able to use occupations to help them recall names.
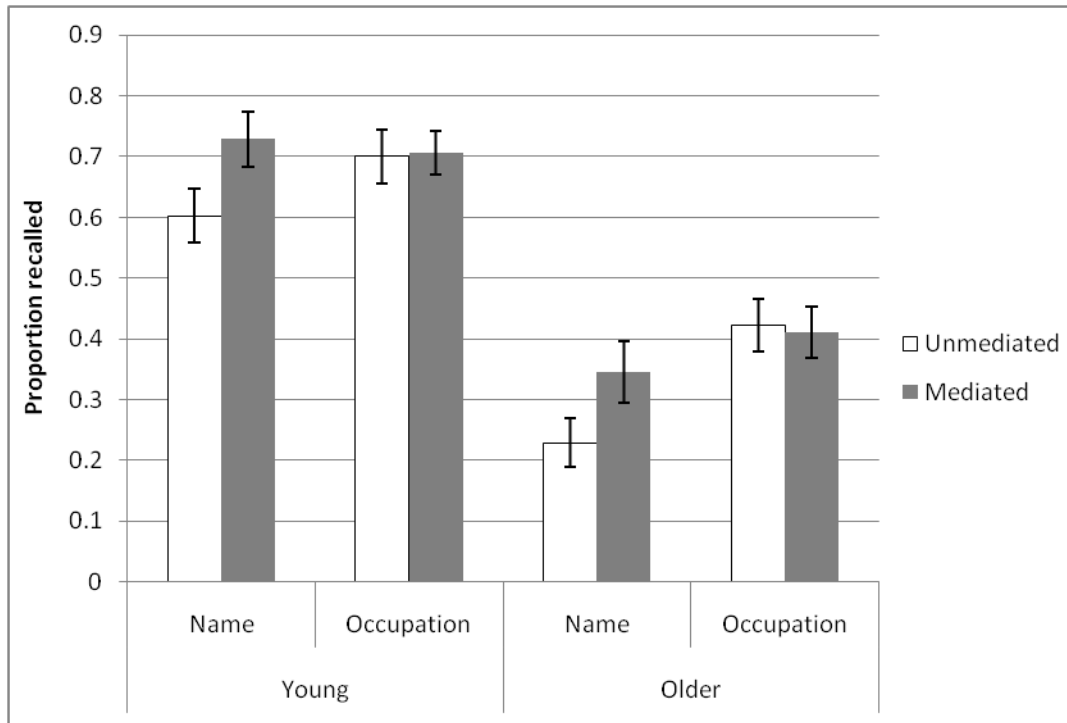
Figure 5. *Proportion of correct cued-recall responses (with standard error bars) from Experiment 2 as a function of age, test, and mediation.*

The above analyses were also conducted using adjusted recall scores (see Appendix D for proportions correct with and without correct pre-learning), in which all names and occupations which had been missed during the second half of the pre-learning test were dropped from the recall scores. (Pre-learning results are presented later in this Results section.) The reasoning behind these adjusted scores was that if a name-

occupation pairing had not been pre-learned, a participant would not have the opportunity to use mediation during the cued-recall test; unmediated items missed during pre-learning were also removed to maintain consistency in scoring. The significant effects noted above were all still significant, except for the Test x Age interaction ($p=.063$), which was only marginally significant. Furthermore, the Test x Mediation effect was even stronger, $F(1,47)=11.71$, $p=.001$.

Results were also re-analyzed using a lenient scoring method, in which exact responses were not necessary. Occupations with similar meanings (e.g., "journalist" or "broadcaster" instead of "newscaster") were accepted, as were occupations related to the correct response (e.g., "singer" instead of "actress"). Because names are not meaningful, these were accepted if the participant's response began with the same letter as the correct response (e.g., "Alan" instead of "Andrew") or if the two names were highly similar in sound (e.g., "Karen" instead of "Sharon"). This scoring method produced only minor changes in performance levels (see Appendix D), without changing the significance of the analyses noted above. Notably, the Test x Mediation effect was again strong, $F(1,47)=15.33$, $p<.001$.

Effects of list number. To assess whether there were any practice or fatigue effects, the analyses above were again conducted on the original (i.e., unadjusted) data set including the additional factor of list number (i.e., the first or second time a participant had done the name or the occupation list). These data are presented in Figures 6 A and B. The 4-way ANOVA (Test x Mediation x Age x List Number) was not significant ($p>.7$). List number had only a minor effect on overall performance, $F(1,47)=2.89$, $p=.096$, with

performance somewhat better on List 2 (*M*=.534, *SD*=.251) than on List 1 (*M*=.501, *SD*=.240)

List Number was involved in several marginally significant effects. There were indications that Mediation interacted with List Number, $F(1,47)=3.60$, $p=.064$. This effect stemmed from a significant effect of mediation in the first list, $t(48)=3.58$, $p=.001$, but not in the second list, $t(48)=.74$, $p>.4$. List Number and Age Group also interacted somewhat, $F(1,47)=3.25$, $p=.078$; age differences were smaller on List 1, $t(47)=5.72$ than on List 2, $t(47)=7.10$, both p's <.001. Finally, there was a marginally significant main effect of List Number, $F(1,47)=2.89$, $p=.096$, with slightly higher overall performance on List 2 (*M*=.53, *SD*=.25) than on List 1 (*M*=.508, *SD*=.24).

Finally, inspection of Figures 6 A and B suggests that young adults benefitted from mediation on the name lists mainly on their first lists whereas, for older adults, this benefit occurred mainly on their second list. However, a List x Mediation x Age ANOVA involving data from only the Name tests was not significant, $F(1,47)=1.678$, $p=.20$.

(A)
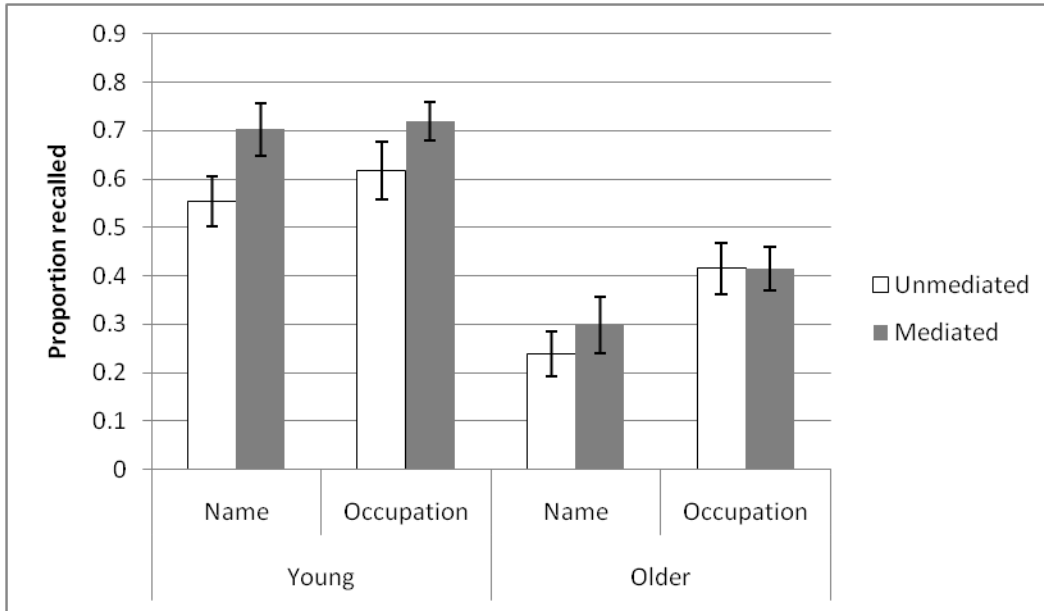
(B)
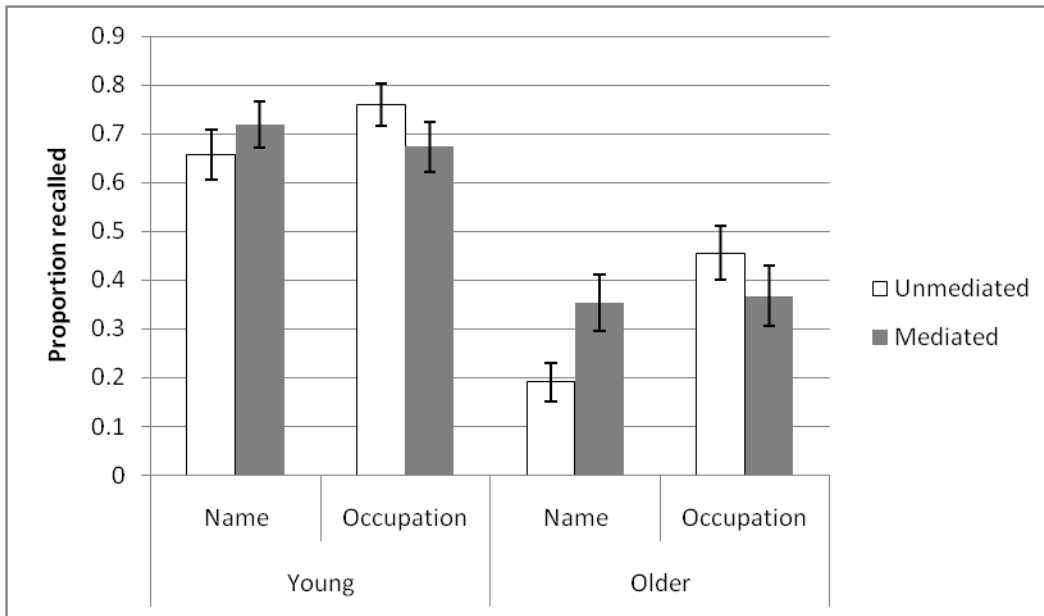
Figures 6 A and B. *Results of Experiment 2 split into separate figures for each participant's first name list and first occupation list (A) and for each participant's second name list and second occupation list (B). Means (with standard error bars) are shown.*

Effects of test order. To determine if the order in which participants received the lists (i.e., name lists or occupation lists first) affected results, proportions of correct recall were separated by Test Order. Results for participants who took part in the name lists before the occupation lists are shown in Figure 7 A, and those who completed the occupation lists before the name lists are shown in Figure 7 B. An Age x Test x Mediation x Test Order ANOVA was conducted on these data. Test Order did not have a significant main effect, $F(1,45)=.88$, $p=.35$, and the 4-way interaction was not significant, $F(1,45)=.62$, $p=.43$. However, there was a significant Test x Mediation x Test Order interaction, $F(1,45)=4.22$, $p=.046$. For participants who took part in the name tests first, there was a large Test x Mediation interaction, $F(1,25)=14.38$, $p=.001$; this interaction was not significant, however, for participants who received the occupation tests first, $F(1,22)=.76$, $p=.39$. In the former group, mediation on the name tests provided a large benefit, $t(25)=5.98$, $p<.001$; the benefit on the occupation lists was negligible, $t(25)=.59$, $p=.56$. Age was not involved in any significant interactions including Test Order, indicating that the effect of Test Order was similar for older and younger adults. Test order was not involved in any other significant interactions.

(A)
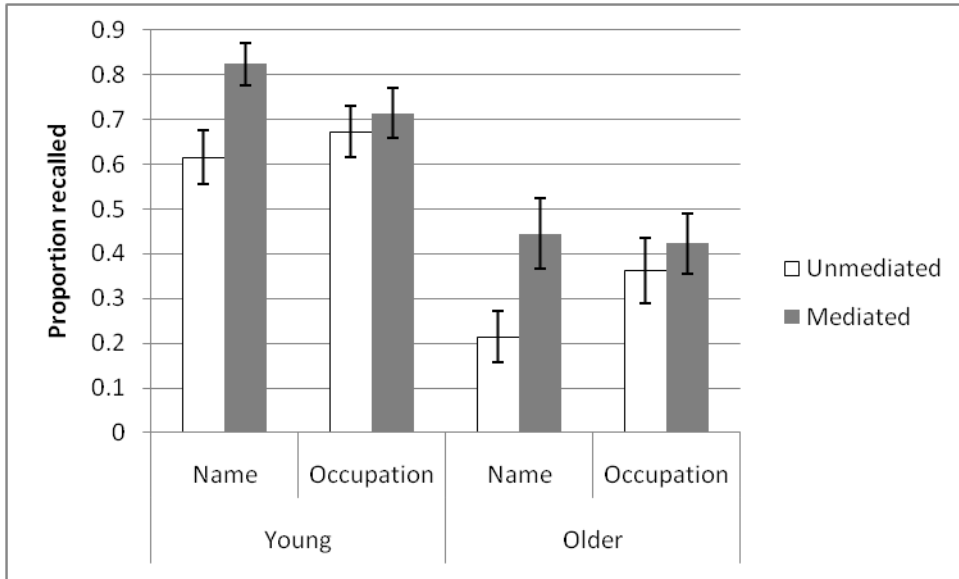
(B)

Figures 7 A and B. *Results from Experiment 2 separated between participants who received the name lists first (A) and those who received the occupation lists first (B). Means (and standard deviation bars) are shown.*

Response times. Response times to *correct* answers were also analyzed in an ANOVA (Test x Mediation x Age; see Appendix D for a table of exact values). Note that response times included the time between initial stimulus onset until the experimenter had finished typing the participants' response. Thus, it may be helpful to plot the data centered at 0, as shown in Figure 8. In this figure, each age group's grand mean response time was subtracted from that age group's mean response time in each of the four conditions; thus, lower bars indicate faster responses. Although the analyses were conducted on raw response times, this figure makes it easier to see differences in each age group's response times among conditions, with the experimenter's typing speed factored out. Three older adults' data sets were dropped from this analysis due to missing values; that is, they failed to get any correct answers in one of the four conditions.

There was a highly significant main effect of Age, $F(1,45)=35.79$, $p<.001$, with younger adults responding faster than older adults ($M=5709$ and 8098, $SD=1023$ and 2114 for younger and older adults, respectively). There was also a significant main effect of Mediation, $F(1,45)=6.58$, $p=.014$, with faster responses in the unmediated ($M=6330$, $SD=2841$) than the mediated ($M=7403$, $SD=1964$) condition. Finally, the interaction between Test and Age group neared significance, $F(1,45)=3.33$, $p=.075$, with older adults being somewhat slower on the name than the occupation test, $t(23)=1.81$, $p=.084$ ($M=8780$ and 7471, $SD=3439$ and 1759 for the name and occupation tests, respectively), but younger adults showing no such difference, $t(24)=-.66$, $p>.5$.
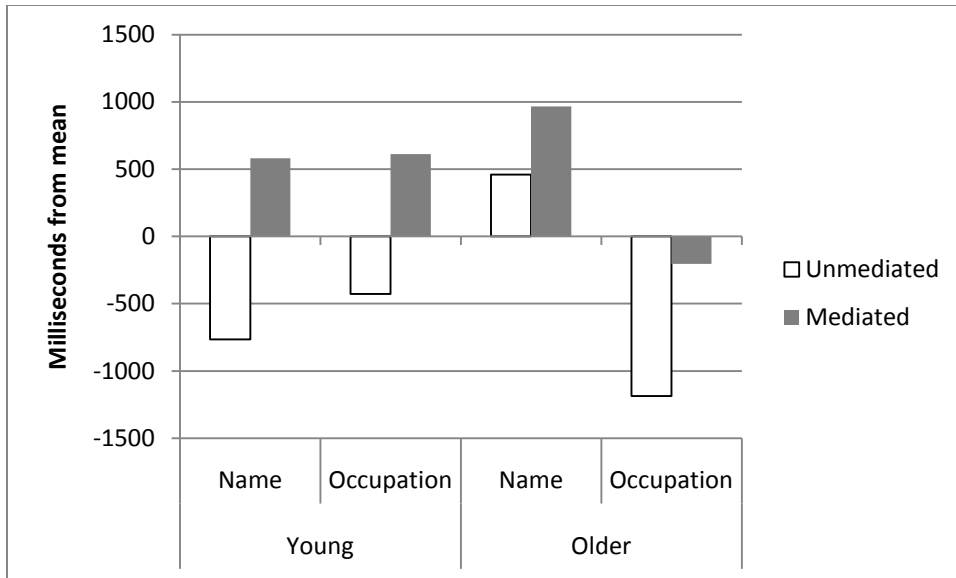
Figure 8. *Difference from each age group's mean RT in the cued-recall portion of Experiment 2, as a function of test and mediation. The lowest values depict the fastest responses.*

Memory errors. Responses made during the cued-recall portion of the experiment were classified into categories according to the type of mistake made, or into correct responses. There were three types of responses most commonly found: 1) *correct response*; 2) *no response*—when a participant said "pass" or failed to make a response before the 30-second response period had passed; 3) *within-list target error*—when the response produced was the name or occupation to be remembered with a different face in the same list. All other types of errors were classified as "other errors", and together accounted for only 5% of responses. "Other errors" included: *within-list distractor error*—the word produced was from the same list, but appeared during the pre-learning test as a distractor; *between-list target error*—the response was a target name or occupation on a previous list; *between-list distractor error*—the response was a distractor

during the pre-learning session of a previous list; *between-list mediator error*—the response was used as a mediator on a previous list. A table of all errors can be found in Appendix D.

Figures 9 A and B represent the number of correct responses and various error types made by each age group in each condition, in the name tests (Figure 9 A) and the occupation tests (Figure 9 B). These figures nicely illustrate the major source of the mediation effect in the name lists (Figure 9 A). Both younger and older adults produced more correct responses on the mediated name lists than on the unmediated name lists. For older adults, this was caused exclusively by a reduction in "no" responses in the mediated lists. For younger adults, the effect stemmed largely from a reduction in within-list target errors in the mediated condition. As illustrated in Figure 9 B, patterns of responses in the occupation tests were quite similar between the mediation conditions, although younger adults clearly outperformed older adults, due to a reduced rate of "no" responses.
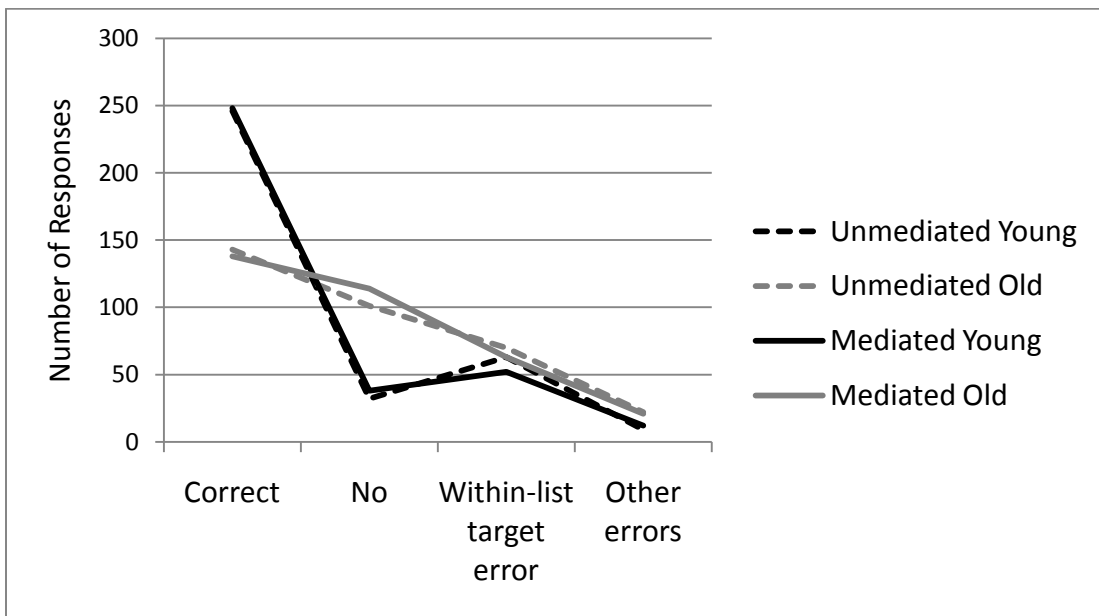
(A)
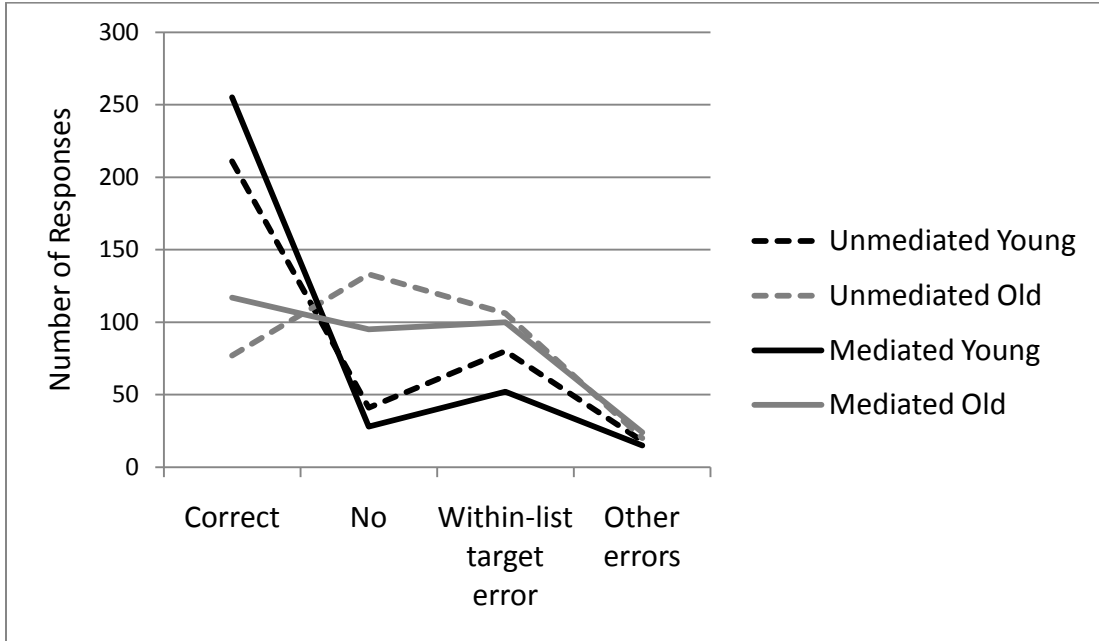
(B)

Figure 9. *The number of responses made in each response category by each age group in each condition of Experiment 2. (A) Responses in the name tests. (B) Responses in the occupation tests.*

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Pre-learning memory performance. Each participant's proportion of correct responses was averaged for each condition and each presentation (first or second) during the test portion of the pre-learning session; these data are presented in Table 3. A 2 (Age) x 2 (Mediation) x 2 (Time; first presentation versus second presentation of a given stimulus) x 2 (Test) ANOVA was conducted using the results of the pre-learning phase of this experiment. There was a main effect of Time, $F(1,47)=22.70$, $p<.001$, with higher performance on the second presentation ($M=.857$, $SD=.14$) compared to the first presenation ($M=.827$, $SD=.13$). The effect of Age was also significant, $F(1,47)=13.75$, $p=.001$, with younger adults ($M=.90$, $SD=.09$) outperforming older adults ($M=.78$, $SD=.14$). There was a main effect of Test, $F(1,47)=4.41$, $p=.041$, with better performance on the occupation lists ($M=.858$, $SD=.135$) than the name lists ($M=.827$, $SD=.145$). Also, there was a main effect of Mediation, $F(1,47)=53.19$, $p<.001$, with better performance on unmediated stimuli ($M=.904$, $SD=085$) compared to mediated stimuli ($M=.780$, $SD=.19$).

The 4-way interaction was not significant, and no 3-way interaction approached significance. However, there were several two-way interactions. The Time x Mediation interaction was significant, $F(1,47)=4.36$, $p=.042$, with performance on mediated stimuli increasing more from the first to the second attempt, $t(48)=4.06$, $p<.001$ than on unmediated stimuli, $t(48)=1.83$, $p=.074$ (see Table 3 for means). The interaction between Mediation and Age was also highly significant, $F(1,47)=8.63$, $p=.005$, with larger age differences in the mediated condition, $t(47)=3.61$, $p=.001$, than in the unmediated condition, $t(47)=3.29$, $p=.002$. Finally, the interaction between Time and Age was

significant, $F(1,47)=6.186$, $p=.016$, with greater improvement from time 1 to time 2 in younger adults, $t(24)=5.04$, $p<.001$ than in older adults, $t(23)=1.64$, $p=.11$.

Table 3.

Proportion of correct responses (with SDs) during the pre-learning phase of Experiment 2, separated by attempt, test, and mediation for younger and older adults.

| | First Attempt | | | |
| | Names | | Occupations | |
	Unmediated	Mediated	Unmediated	Mediated
Young	.922 (.106)	.803 (.179)	.938 (.051)	.857 (.150)
Old	.852 (.105)	.679 (.225)	.871 (.117)	.688 (.221)
	Second Attempt			
	Names		Occupations	
	Unmediated	Mediated	Unmediated	Mediated
Young	.928 (.107)	.880 (.158)	.970 (.046)	.920 (.148)
Old	.854 (.118)	.685 (.212)	.890 (.115)	.717 (.216)

Pre-learning response times. Response times in milliseconds from the pre-learning phase are shown in Table 4. These data were submitted to an Age x Mediation x Time x Test ANOVA. There was a main effect of Time, $F(1,47)=42.00$, $p<.001$, with faster responses at time 2 ($M=3524$, $SD=1702$) than time 1 ($M=3863$, $SD=1653$). There

was also a main effect of Test, $F(1,47)=4.38$, $p=.042$, with faster responses on the occupation lists ($M=3535$, $SD=1722$) than the name lists ($M=3852$, $SD=1772$). The main effect of Mediation was also significant, $F(1,47)=159.6$, $p<.001$, with faster responses to unmediated stimuli (M=3054, SD=1559) than to mediated stimuli ($M=4333$, $SD=1846$). Finally, the main effect of Age was highly significant, $F(1,47)=33.1$, $p<.001$, with younger adults ($M=2654$, $SD=704$) faster than older adults ($M=4776$, $SD=1699$).

The 4-way interaction approached significance, $F(1,47)=3.98$, $p=.052$. Follow-up tests looked at the Test x Mediation x Age interaction within each time. For the first test attempt, this interaction was highly significant, $F(1,47)=6.97$, $p=.011$; this interaction was not significant, however, for the second test attempt, $F(1,47)=.189$, $p=.67$. Additional analyses investigated the source of the 3-way interaction within the first attempt. For young adults, the Test x Mediation interaction for the first attempt was not significant, $F(1,24)=2.27$, $p=.15$. This interaction was significant, however, for older adults, $F(1,23)=4.73$, $p=.04$. Older adults were slower to respond to both names and occupations with mediation than without mediation, but this effect was stronger for the occupation lists, $t(23)=8.14$, $p<.001$, than the name lists, $t(23)=4.39$, $p<.001$.

The 4-way ANOVA had revealed only one other interaction that reached significance, that between Mediation and Age, $F(1,47)=5.60$, $p=.022$. Both age groups took significantly longer in the mediated condition than in the unmediated condition, but this effect was larger in younger adults, $t(24)=11.39$, $p<.001$, than in older adults, $t(23)=8.27$, $p<.001$. In sum, then, both age groups were slower to respond in the mediated than the unmediated condition. There was a differential effect in older adults

for the first attempt, in that they had a larger slowing with mediation in the occupation than in the name lists.

Table 4.

Response times (and SDs), in milliseconds, for the first and second attempts of the pre-learning session in Experiment 2, as a function of age, test, and mediation.

	First Attempt			
	Names		Occupations	
	Unmediated	Mediated	Unmediated	Mediated
Young	2338　(793)	3726 (1590)	2119　(610)	3096　(715)
Old	4440 (1964)	5626 (1785)	3924 (1717)	5812 (2001)

	Second Attempt			
	Names		Occupations	
	Unmediated	Mediated	Unmediated	Mediated
Young	2246 (1357)	3088　(982)	1826　(570)	2793　(827)
Old	3983 (1578)	5533 (2401)	3709 (1901)	5183 (2066)

Effects of stimulus age. The age of the stimulus face was assessed in another ANOVA: Participant Age x Mediation x Test x Stimulus Age. (See Figures 10 A and B.) Stimulus Age was involved in one significant interaction: that with Participant Age, $F(1,47)=25.93$, $p<.001$. Young participants performed better with young stimuli ($M=.73$,

SD=.19) than with old stimuli (*M*=.63, *SD*=.19), *t*(24)=4.26, *p*<.001. Older adults, on the other hand, performed better with old stimuli (*M*=.39, *SD*=.19) than with young stimuli (*M*=.32, *SD*=.17), *t*(23)=-2.94, *p*=.007.

Inspection of Figures 10 A and B suggests that, although there was not a significant 4-way interaction from the above analysis, older and younger participants' own-age effects may have stemmed from specific sources. Additional analyses were conducted to investigate this issue. For older participants, there was a significant Mediation x Test x Stimulus Age interaction, *F*(1,23)=4.86, *p*=.038. For young stimuli, there was not a Mediation x Test interaction, *F*(1,23)=.21, *p*=.65. However, the interaction between Mediation and Test was significant for older stimuli, *F*(1,23)=10.40, *p*=.004. Specifically, older participants were better at remembering older stimulus occupations than their names in the unmediated condition, *t*(23)=3.70, *p*=.001 (*M*=.50 and .25; *SD*=.30 and .24, for the occupation and name tests, respectively), but not in the mediated condition, *t*(23)=.32, *p*=.75 (M=.41 and .39; *SD*=.25 and .30, for occupation and name tests, respectively). Thus, for older participants, better memory for information about older stimuli stemmed largely from relatively high memory for occupations of older adults in the unmediated condition, compared to occupations of younger adults.

A Mediation x Test x Stimulus Age ANOVA was also conducted for younger participants' data. The 3-way interaction was not significant, *F*(1,24)=.008, *p*=.93, and Stimulus Age was not involved in any other significant interactions. For younger participants, then, the own-age effect occurred to a similar degree in each of the conditions.

See Appendix D for other effects of stimulus face characteristics.

(A)
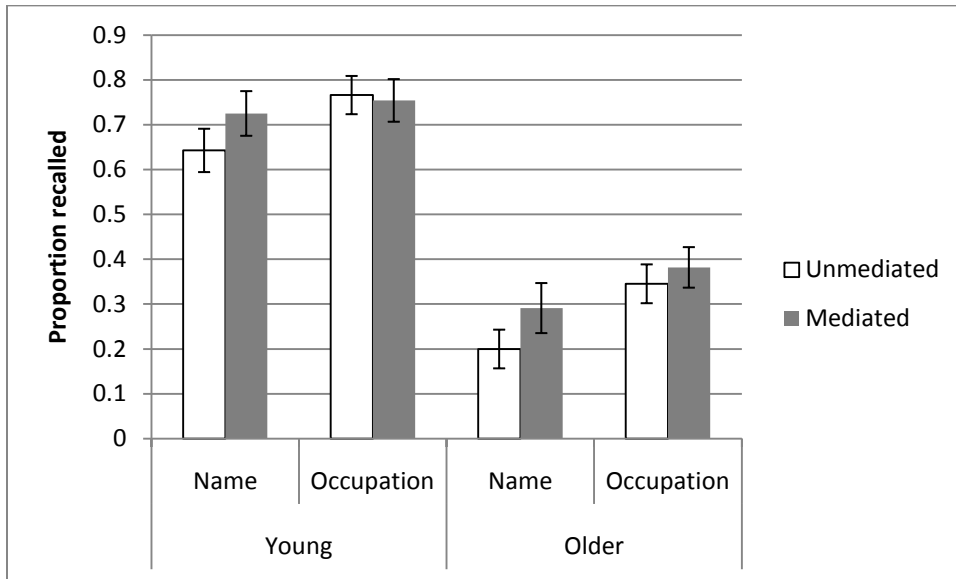
(B)
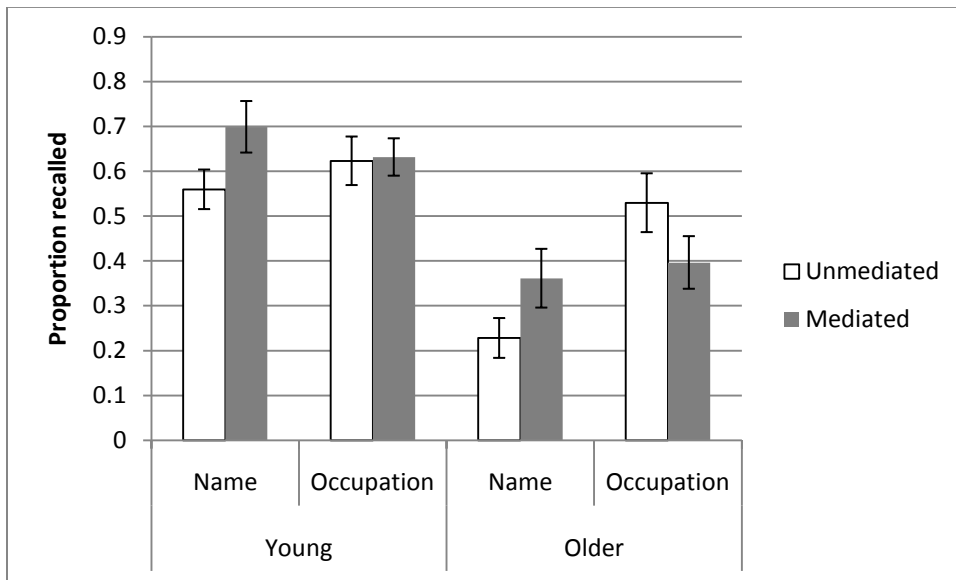
Figures 10. *Means (with SD bars) of correct recall, separated by age of the stimulus face, for young stimuli (A) and older stimuli (B) in Experiment 2.*

Estimated percentages correct. Following completion of the experiment, participants filled out a questionnaire about the study. They were asked to estimate the percentage of names and occupations that they remembered in each of the mediation conditions. Data were provided by 22 young and 16 older adults. These estimates are reported in Table 5. These data were submitted to a Test x Mediation x Age ANOVA. The analysis revealed a significant effect of Age, $F(1,36)=30.93$, $p<.001$, with young adults providing much higher estimates ($M=78.4$, $SD=14.6$) than older adults ($M=48.5$, $SD=18.9$). There was also a main effect of Mediation, $F(1,36)=11.70$, $p=.002$, with higher estimates in the mediated condition ($M=68.2$, $SD=21.6$) than in the unmediated condition ($M=62.58$, $SD=24.35$). The effect of Test was not significant, $F(1,36)=.50$, $p=.48$.

Only one interaction neared significance, and that was the interaction between Age and Mediation, $F(1.36)=2.93$, $p=.095$. Follow-up tests revealed that young adults produced somewhat higher estimates on the mediated stimuli ($M=80.07$, $SD=14.56$) than on the unmediated stimuli ($M=76.77$, $SD=15.66$), $t(21)=1.96$, $p=.063$. This effect was larger for older adults, $t(16)=2.27$, $p=.038$ (mediated condition: $M=52.94$, $SD=19.81$; unmediated condition: $M=44.21$, $SD=21.23$). These results run in contrast to those from Experiment 1, which will be discussed in the following section.

Table 5.

Estimated percentages correct by each age group, for each of the four conditions in

Experiment 2.

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young	77.73 (18.42)	80.59 (14.53)	75.82 (15.55)	79.55 (16.10)
Old	41.56 (24.27)	49.69 (22.76)	44.25 (20.71)	55.94 (22.08)

Discussion

Experiment 2 yielded several interesting results. Most important, the major

finding from Experiment 1 was upheld in a relatively realistic task: both younger and

older adults were better able to name faces whose occupations were also known than to

name faces without occupations presented. There were no age differences in the degree

of benefit that mediation produced, indicating that despite their difficulty pre-learning the

links between names and occupations, older adults were still able to use the links they

had learned to benefit their name memory. Given that the mediation effect was even

stronger following the removal of stimuli that had not been successfully pre-learned, it

may be expected that, given a greater opportunity to learn the associations between

names and occupations, older adults may have shown a larger effect of mediation than

young adults.

The above statements must be taken in stride, as there is one important caveat:

mediation aided memory for names only when participants studied and were tested on the

names *before* they studied and were tested on the occupations. This was an unexpected finding and emphasizes the importance of counterbalancing test order. One possible explanation is that participants for whom mediation did not immediately work—largely those attempting to remember occupations belonging to different faces—dropped the strategy upon finding that other strategies worked better. Those who could immediately notice that mediation helped them, however, may have embraced the strategy. This, of course, is speculation, and more research is needed to determine if this reasoning is correct.

Although not a statistically significant finding, it is interesting that younger adults seem to have benefitted from mediation mainly in the first name list, whereas older adults benefited mainly in the second name list. This may indicate that older adults need practice using this relatively complicated technique but that, for unknown reasons, younger adults stop using the technique.

Another important finding of the present experiment was that older adults were more impaired in name memory than occupation memory, when compared to the young adults. This is in alignment with previous findings (e.g., Evrard, 2002; James, 2004; James, et al., 2008) . One possible explanation for this common finding involves the Transmission Deficit Hypothesis (TDH; MacKay & Burke, 1990) and Node Structure Theory (NST; MacKay, 1987). According to NST, name memory is relatively poor because names have less rich connections than do other forms of words, and thus there is less chance for various activations to "summate" on the name. Additionally, TDH holds that aging is one factor that results in slowed or weakened connections. This differentially impacts name memory because, if the one connection leading to that name

is quite weak, activation from other sources cannot aid retrieval as happens with information such as occupations. By asking participants to first learn links between names and occupations, we may be providing them with a richer context from which to recall a name.

Using a lenient scoring method, in which names were accepted if they began with a similar sound to the target and occupations were accepted if they were synonyms with the targets or shared a similar job, yielded highly similar results to the strict scoring method. The lenient scoring method did improve older adults' memory scores somewhat more than those of young. This finding runs contrary to Cohen and Faulkner (1986), who reported that younger adults are more likely to have partial information about a name than are older adults. The present findings may simply be a result of older adults' high rate of mistakes via strict scoring, giving them more chance to receive points in lenient scoring only.

Older and younger adults showed a similar degree of improvement with mediation in terms of correct responses. However, the two age groups' improvement stemmed from different sources. Older adults gave more reponses to the names with mediation than without it. (That is, they had a reduced rate of "no" responses.) Younger adults' improvement in name memory with mediation, however, stemmed mostly from a decrease in within-list target errors. This may indicate that older adults, on this particular task, were less likely to produce a guess than were younger adults.

In terms of response times (when correct responses were given), both age groups were slower to respond during the mediated than the unmediated lists. This is one indication that they were, in fact, attempting to use the mediator to help remember both

names and occupations, although they were helped only in the former case. Additionally, response times indicate that older (but not younger) adults took longer to respond to names than to occupations, providing another suggestion that names are especially difficult for older adults. These results are rather different than those from Experiment 1, in which there was no main effect of age, with older adults' response times stable across the four conditions and younger adults' response times the highest in the unmediated name condition. As noted above, it is likely that with only two choices, response times were not good indicators of the use of mediation. Younger adults likely realized that name retrieval required more thought than retrieval of occupations, but with the mediated name list, they often retrieved only characteristics, which were directly linked to names.

Effects found on the pre-learning memory task were unsurprising. Older adults were significantly more impaired, compared to young adults, on the mediated stimuli (i.e., choosing the name associated with a given occupation or vice-versa) than on the unmediated stimuli (i.e., remembering that a given occupation or name had been presented before). The pre-learning tests are closely tied to the distinction between item and associative memory (e.g., Naveh-Benjamin, 2000). Results have consistently supported Naveh-Benjamin's Associative Deficit Hypothesis, which holds that older adults' episodic memory difficulties are partially due to their problems in binding together components of an episode and retrieving those bindings. For example, Naveh-Benjamin et al. (2004) found quite small age differences in recognition of individual names and faces, but large age differences in recognizing the name that belonged to a specific face. In the present experiment, pre-learning of unmediated stimuli required item

memory, whereas pre-learning of mediated stimuli required binding a name and occupation together, leading to older adults' deficit in the latter case.

Performance on the pre-learning task was somewhat low in the mediated condition, especially for the older adults. This may have rendered the use of mediation less effective than if participants' performance had reached a higher level during pre-learning. However, pre-learning stimuli in the present experiment were studied three times each before being tested, and were tested twice with feedback. This amount of pre-learning was deemed to last the maximum amount of time to deter fatigue effects, although ideally, associations between the names and occupations would have been learned more equally between the age groups. Regardless, it is quite telling that even older adults were able to use their relatively low rate of name-occupation binding to aid their memory for names in the cued-recall test. This strengthens the idea that the mediation technique could be quite useful for older adults in their everyday lives.

It is not surprising that young adults performed better in response to young faces and that older adults performed best with older faces. This "own-age bias" has been demonstrated in a variety of studies (e.g., Anastasi & Rhodes, 2006; Backman, 1991; Perfect & Harris, 2003) and is one reason why equal numbers of younger and older faces were used as stimuli in the present experiment. Whereas young participants' own-age bias was similar across conditions, older adults' bias stemmed largely from improved performance in the unmediated occupation condition for older than younger stimulus faces. This could be partially due to older adults' experience with people of their own age group of varying occupations.

A final finding is that both younger and older adults, following completion of the experiment, reported that mediation had helped them. This effect was stronger in older than in younger adults. Thus, it appears that both age groups understood the purpose of mediation and correctly believed that they had performed better with use of a mediator. It is also telling, however, that neither age group realized that mediation had helped them more on the name tests than on the occupation tests. This finding may indicate that demand characteristics were at play and that participants' estimates of their performance should not be depended upon for accurate results. These demand characteristics should be reduced in Experiment 3, in which participants are not explicitly told to use the mediation strategy.

Experiment 3

Experiment 2 showed that both younger and older adults can use their knowledge about a person—that is, the person's occupation—to help remember that person's name, when instructed to do so. A logical next step is to investigate whether this same benefit occurs when no strategy instructions are provided. This is the main goal of Experiment 3. If participants must be instructed to use mediation as a strategy, then the effect of mediation on name recall should not be found in Experiment 3. This effect can be determined separately for younger and older adults.

As mentioned earlier, there is evidence to suggest that whereas young adults are able to use successful strategies spontaneously, older adults do not (see, e.g., Naveh-Benjamin, et al., 2007). This would predict that Experiment 3 would replicate the effect of mediation seen in Experiment 2 for younger adults only. A similar prediction is made

by the results of Rahhal et al. (2002), mentioned earlier. Their findings suggested that young adults were, without strategy instructions, able to use their knowledge about a person's character to remember the voice which had described that person. Older adults, however, did not seem to use this strategy.

In contrast, results of Stanhope and Cohen (1993) might suggest that, without instruction, even young adults would not make use of a mediator. In their experiment, participants were asked to learn either the name, the occupation, or the name and occupation belonging to a given face. A cued-recall test, in which participants were asked to state the information belonging to a given face, revealed that name recall was poorer when occupations were also shown than in the name-only condition. There are several differences between the Stanhope and Cohen study and the present study, however. First, in the former study, participants were not instructed to use a mediation strategy. Second, Stanhope and Cohen's procedure made the use of mediation quite difficult. Participants had only 3 seconds to learn the information accompanying a face, and this information was presented auditorily, which may have made binding of the two words difficult. Furthermore, participants did not have any opportunities to bind together the occupation and name before seeing the face. Thus, Stanhope and Cohen's finding that knowing an occupation might actually impede name learning could be due to a lack of a mediation strategy on the participants' parts, but may also be the result of participants' lack of opportunity to use mediation. Results of Experiments 1 and 2 confirmed that, together, these two possibilities can account for Stanhope and Cohen's results. The present experiment attempts to determine whether the first premise alone—no mediation strategy being explicitly provided—is responsible for their findings. This

would be the case if even younger adults in Experiment 3—who are not told to use mediation—do not show a benefit of mediation on the name lists.

Method

Participants. Participants were drawn from the same pool as those in Experiments 1 and 2, but none had participated in either prior experiment. There were 28 participants in each age group. Additional information is presented in Table 1. Older adults had significantly more education than younger adults, $t(54)=5.17$, $p<.001$. However, level of education was not correlated with performance on any of the tests for either age group.

Design and materials. This experiment used the same 3 factors as Experiment 2: Age, Mediation, and Test. The same materials were used, as well, with the change that all instructions showing participants how to use mediation (including the slides shown in Figure 4 C and D) were dropped from the study.

Procedure. The only differences between Experiments 3 and 2 involved instructions. In Experiment 3, no mention of using occupation to remember names, or vice-versa, was made. During study of the faces, participants were told that they only needed to learn the to-be-recalled information. For example, on name lists, participants were told that even though some people's occupations appeared on the screen along with the names, they would later have to recall only the names.

Results

Memory performance. As with Experiment 2, the proportion of correctly recalled names and occupations was calculated for each participant. Results of the cued-

recall memory tests were initially assessed using a Test x Mediation x Age ANOVA.

These results are shown in Figure 11. The only two significant effects were the main

effect of Test, $F(1,54)=11.60$, $p=.001$, and that of Age, $F(1,54)=43.88$, $p<.001$.

Participants performed better on the occupation tests ($M=.547$, $SD=.20$) than on the name

tests ($M=.462$, $SD=.21$), and young adults ($M=.62$, $SD=.15$) outperformed older adults

($M=.38$, $SD=.13$).

It is worth noting that the Test x Mediation interaction did approach significance,

$F(1,54)=3.38$, $p=.072$. Mediation significantly aided performance on the name test,

$t(55)=2.11$, $p=.039$ ($M=.49$ and $.43$; $SD=.24$ and $.23$, for mediated and unmediated name

tests, respectively). Mediation, however, did not change performance on the occupation

tests, $t(52)=-.15$, $p=.88$ ($M=.54$ and $.54$; $SD=.20$ and $.23$, for mediated and unmediated

occupation tests, respectively).

Finally, in order to compare the results from Experiments 2 and 3, an additional

ANOVA was conducted which included Test, Age, Mediation, and Strategy (Experiment

2 versus Experiment 3). Strategy was not involved in any significant interactions, and it

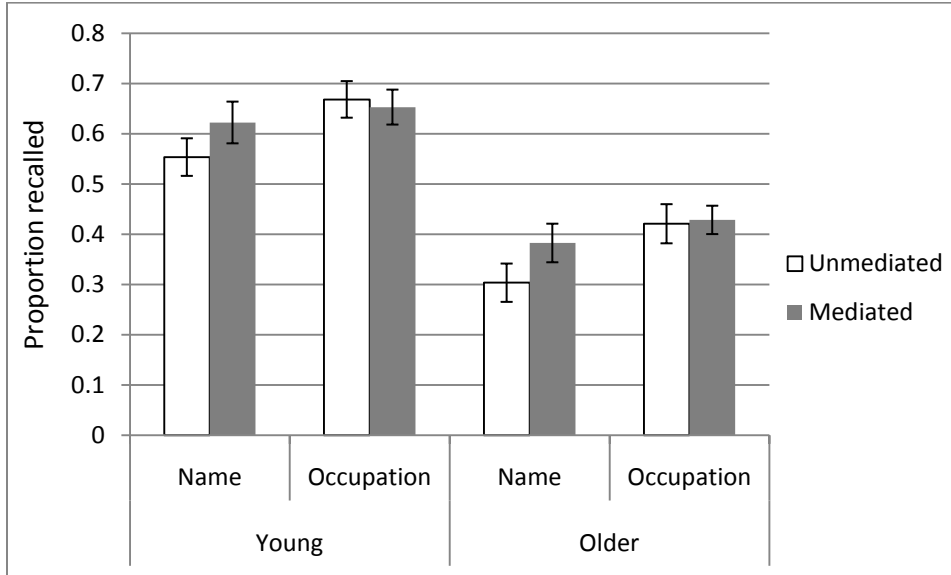did not have a significant main effect.

Figure 11. *Average proportion correct cued-recall responses in Experiment 3 (with standard error bars) for each age group, as a function of test and mediation.*

Effects of list number. Next, to determine whether there might be different patterns of performance according to list number (i.e., whether a given list was the first or second list in its test category), a List Number x Test x Mediation x Age ANOVA was conducted. There was not a significant main effect of List Number, $F(1,54)=.068$, $p=.80$. However, List Number was involved in a highly significant interaction with Mediation, $F(1,54)=19.36$, $p<.001$. As in Experiment 2, there was a large effect of mediation in list 1, $t(55)=3.62$, $p=.001$, with higher performance in the mediated condition ($M=.56$, $SD=.22$) than in the unmediated condition ($M=.45$, $SD=.23$). However, in list 2, this pattern was reversed, $t(55)=-1.92$, $p=.06$, with somewhat lower performance on mediated stimuli ($M=.48$, $SD=.20$) than on unmediated stimuli ($M=.52$, $SD=.22$). Results for the separate lists are plotted in Figures 12 A and B.

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(A)
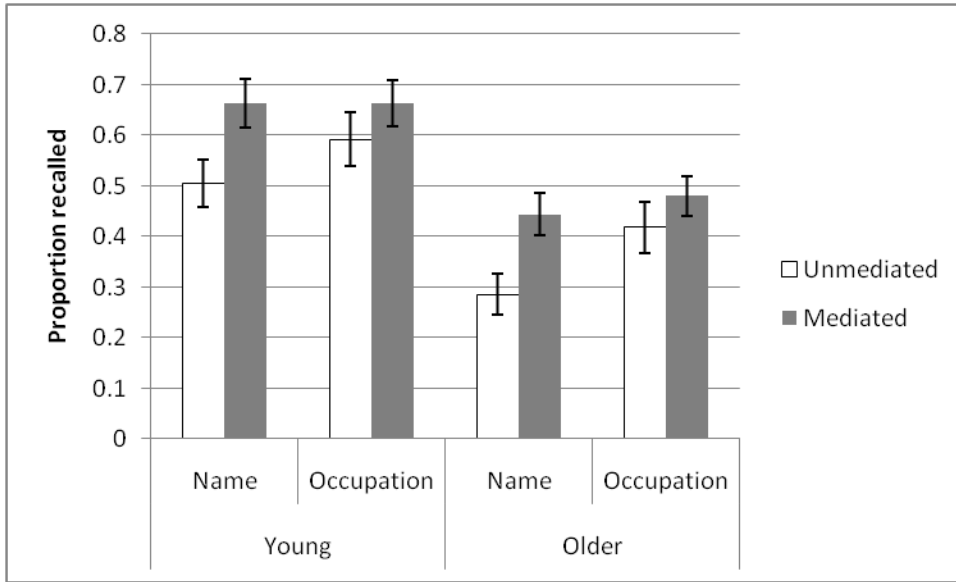
(B)
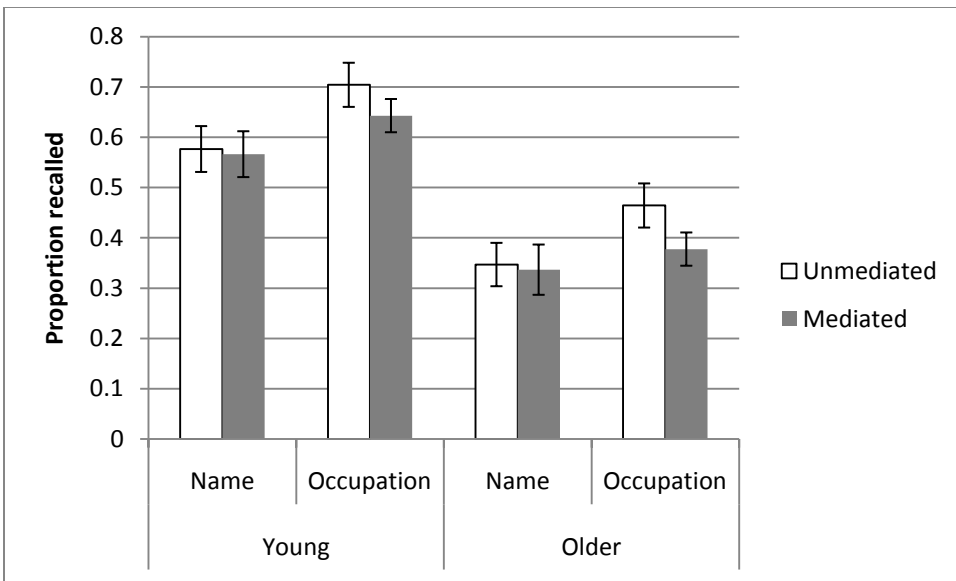
Figures 12 A and B. *Results from Experiment 3, separated into separate figures for each participant's first name list and first occupation list (A) and for each participant's second name list and second occupation list (B).*

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Effects of test order. To assess whether the order in which participants received the tests (i.e., name tests or occupation tests first) affected performance, an Age x Test x Mediation x Test Order ANOVA was conducted. These data are depicted in Figures 13 A and B. Test order did not have a significant main effect, $F(1,52)=1.11$, $p=.30$. The 4-way interaction was also not significant, $F(1,52)=.00$, $p=.99$. However, the Test x Mediation x Test Order interaction did approach significance, $F(1,52)=3.80$, $p=.057$. For participants who took part in the name tests first, there was a large Test x Mediation interaction, $F(1,26)=9.62$, $p=.005$; Mediation resulted in a highly significant improvement in performance on the name lists, $t(26)=5.97$, $p<.001$, but this effect was somewhat reduced in the occupation tests, $t(26)=1.86$, $p=.074$. For participants who received the occupation tests first, however, the Test x Mediation interaction was not significant, $F(1,28)=0$, $p=1.0$. As with Experiment 2, Age was not involved in any significant interactions including Test Order, indicating that the effect of Test Order was similar for older and younger adults. Test order was not involved in any other significant interactions.

(A)
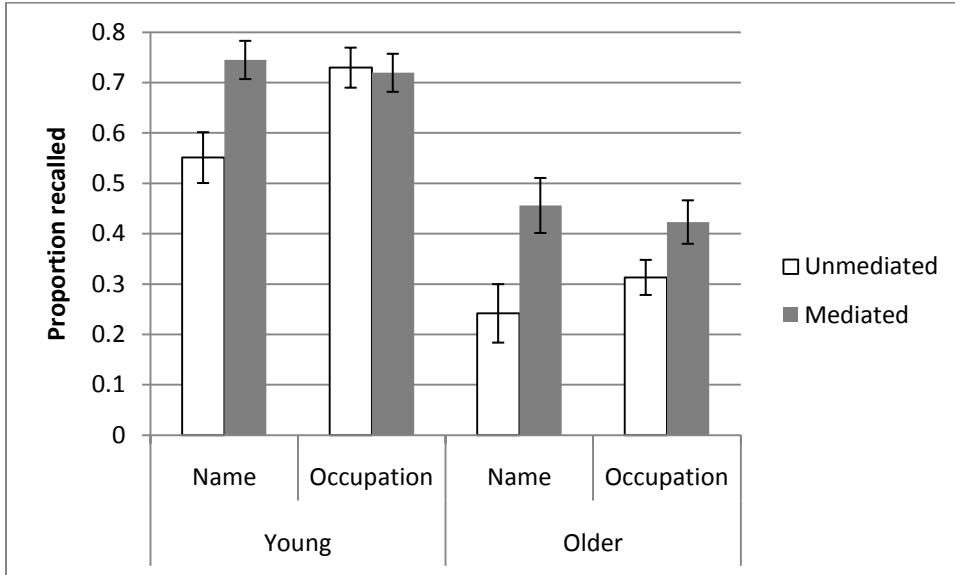
(B)
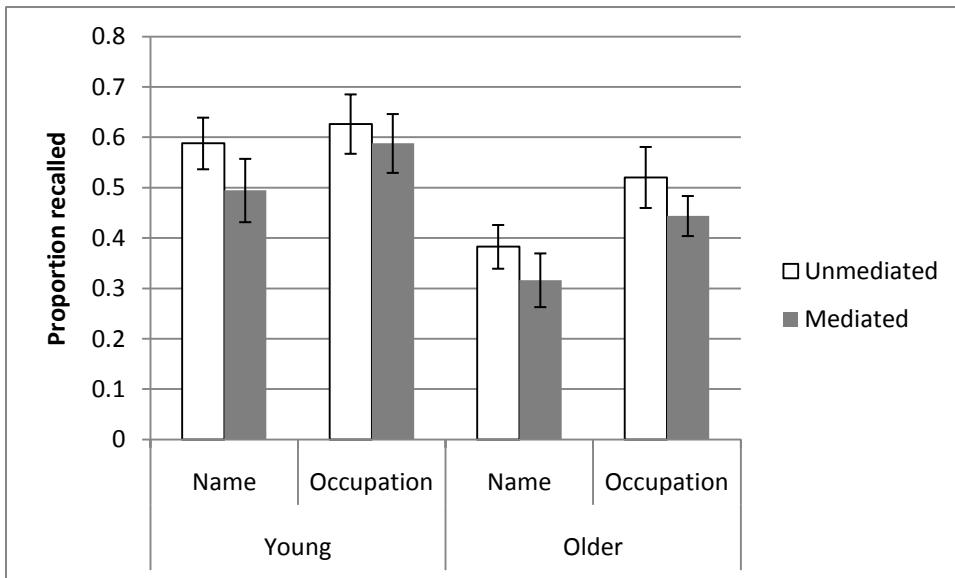
Figures 13 A and B. *Experiment 3 results separated between participants who received the name lists first (A) and those who received the occupation lists first (B).*

Response times. As with Experiment 2, response times included the time from presentation of a face until the experimenter finished typing the response. Again, the average response time from each age group was subtracted from that age group's average response time in each of the four conditions, and the results are plotted in Figure 14; exact values appear in Appendix E. Thus, the lower the bars, the faster the response times.

A Test x Mediation x Age ANOVA was conducted on these data. All three main effects were highly significant. There was an effect of Age, $F(1, 53)=22.63$, $p<.001$, with young adults ($M=4981$, $SD=791$) much faster than older adults ($M=6123$, $SD=1791$). The main effect of Test was significant, $F(1,53)=6.68$, $p=.013$, with faster responses to occupations ($M=5339$, $SD=1202$) than to names ($M=5901$, $SD=2063$). The main effect of Mediation was also significant, $F(1,53)=32.24$, $p<.001$, with faster responses on unmediated trials ($M=4998$, $SD=1318$) than on mediated trials ($M=6223$, $SD=1773$).

The 3-way interaction approached significance, $F(1,53)=3.30$, $p=.075$. For young adults, there was no interaction between Mediation and Test, $F(1,27)=.95$, $p=.34$. Older adults, however, showed a large Mediation x Test interaction, $F(1,26)=6.40$, $p=.018$. Their response times on the mediated and unmediated occupation lists were statistically similar, $t(27)=.75$, p=.46 ($M=5940$ and 5653, $SD=1721$ and 1681, for mediated and unmediated occupation conditions, respectively). For the name lists, however, older adults were much slower in the mediated ($M=8268$, $SD=3291$) than in the unmediated ($M=5641$, $SD=2219$) condition, $t(26)=3.81$, $p=.001$. (Note that the different df's reflect that some older adults produced no correct responses in a certain condition, and that these data are for correct responses only.)

All three 2-way interactions from the omnibus test were also significant. For the Test x Mediation interaction, $F(1,53)=7.41$, $p=.009$ participants were slower to respond to mediated than to unmediated stimuli in both tests, but this effect was stronger in the name test, $t(54)=4.37$, $p<.001$ ($M=6863$ and 5095, $SD=2936$ and 1784, for mediated and unmediated name conditions, respectively), than in the occupation test, $t(55)=1.86$, $p=.069$ ($M=5559$ and 5161, $SD=1496$ and 1392, for mediated and unmediated occupation conditions, respectively). The Mediation x Age interaction was also significant, $F(1,53)=4.24$, $p=.044$. Young participants were faster in the unmediated condition ($M=4619$, $SD=759$) than the mediated condition ($M=5343$, $SD=1141$), $t(27)=3.43$, $p=.002$; this effect was even stronger in older adults, who also were faster in the unmediated condition ($M=5390$, $SD=1642$) than the mediated condition ($M=7136$, $SD=1865$), $t(26)=4.27$, $p<.001$. Finally, the Test x Age interaction was significant, $F(1,53)=4.53$, $p=.038$. Young had similar response times for Name ($M=5039$, $SD=973$) and Occupation ($M=4923$, $SD=828$) tests, $t(27)=.70$, $p=.49$, whereas older adults were somewhat faster at reporting occupations ($M=5770$, $SD=1383$) than names ($M=6794$, $SD=2496$), $t(26)=3.09$, $p=.085$.
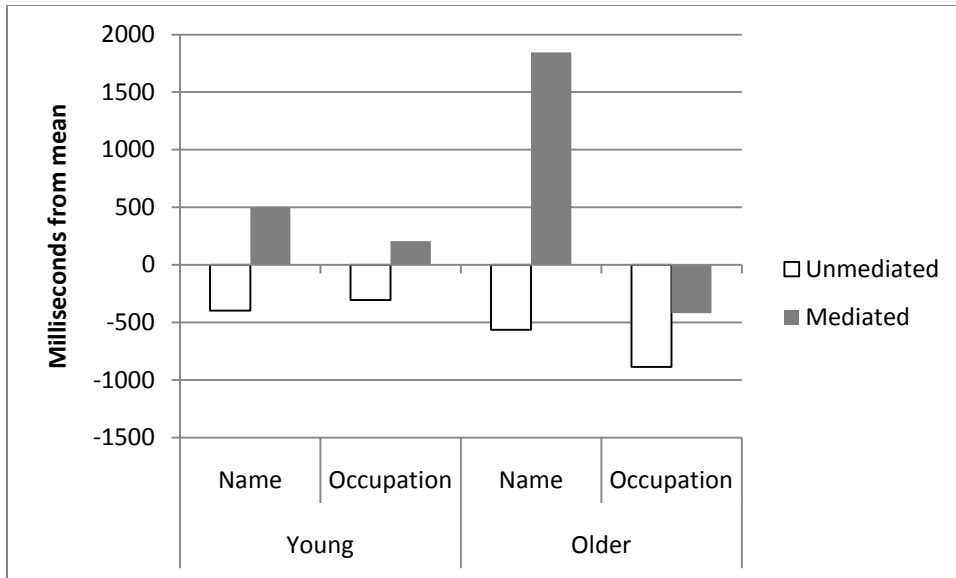
Figure 14. *Difference from each age group's mean RT as a function of test and mediation in Experiment 3. The lowest values depict the fastest responses.*

Memory errors. Types of errors were assessed, as described in Experiment 2, and are depicted in Figures 15 A and B. (See Appendix E for a full listing of error types.) As with Experiment 2, younger adults' benefit of mediation on the name list is due largely to a decrease in within-list target errors. Unlike Experiment 2, however, older adults' benefit of mediation is now also due to fewer within-list target errors, rather than a decrease in "no" responses.

(A)
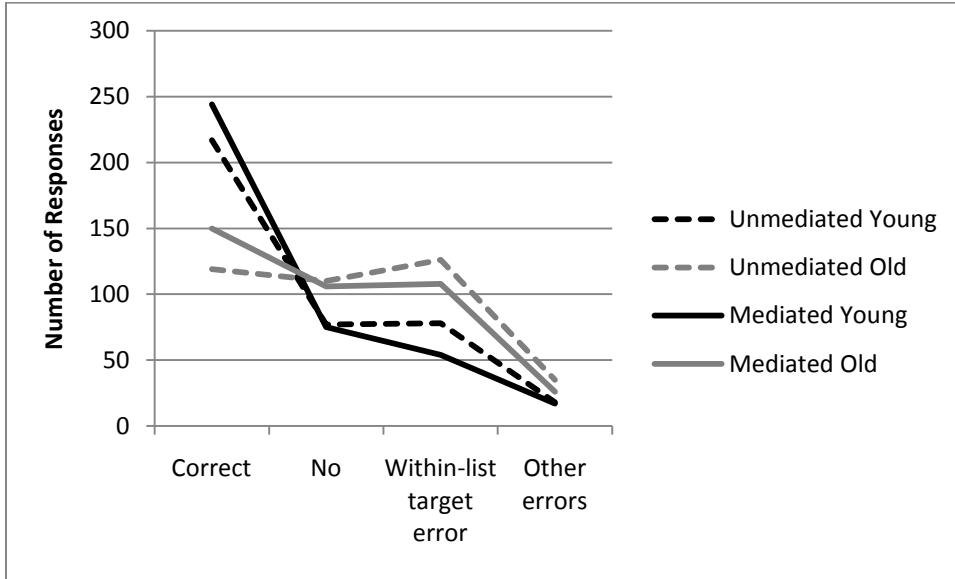
(B)

Figure 15. *The number of responses made in each response category by each age group in each condition of Experiment 3. (A) Responses in the name tests. (B) Responses in the occupation tests.*

Pre-learning memory performance. Scores on the pre-learning tests, shown in Table 6, were subjected to a Test x Mediation x Attempt x Age ANOVA. All four main effects were significant. There was a significant effect of Age, $F(1,54)=6.31$, $p=.015$, with young adults ($M=.90$, $SD=.10$) outperforming old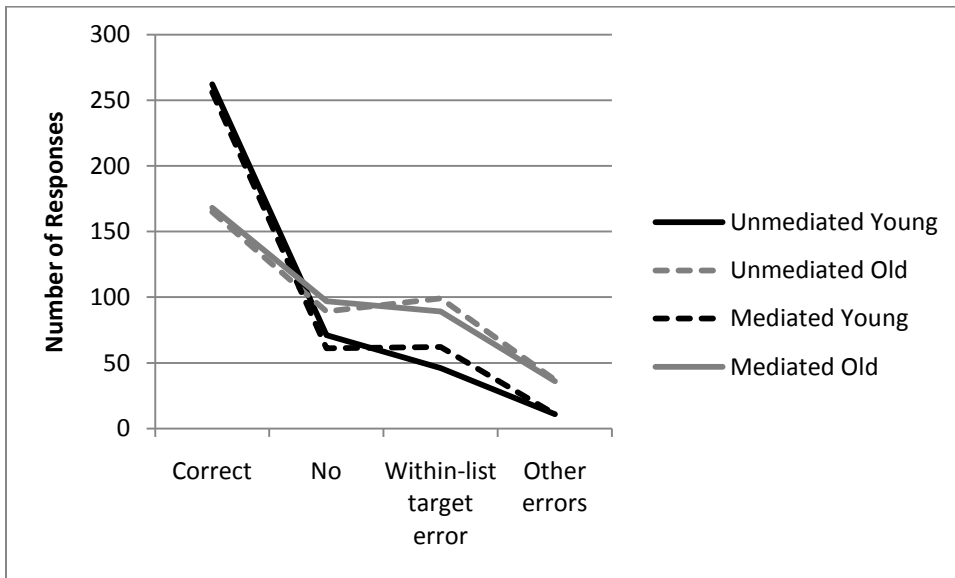er adults ($M=.83$, $SD=.11$). There was a main effect of Mediation, $F(1,54)=54.05$, $p<.001$, with higher performance in the unmediated condition ($M=.92$, $SD=.078$) than the mediated condition ($M=.81$, $SD=.16$). There was a main effect of Test, $F(1,54)=7.09$, $p=.010$; performance was higher on the occupation lists ($M=.88$, $SD=.11$) than on the name lists ($M=.85$, SD=.12). Finally, there was a main effect of Attempt, $F(1,54)=12.75$, $p=.001$, with better performance on the second attempt ($M=.88$, $SD=.12$) than on the first attempt ($M=.85$, $SD=.11$).

The main effects were qualified by a three-way interaction among Attempt, Mediation, and Age, $F(1,54)=4.78$, $p=.033$. For the First Attempt, Age and Mediation did not interaction, $F(1,54)=1.71$, $p=.20$. For the Second Attempt, however, there was a significant interaction between Age and Mediation, $F(1,54)=11.58$, $p=.001$. There was a significant effect of Age in the mediated condition for the second attempt, $t(54)=3.34$, $p=.002$, with young ($M=.90$, $SD=.135$) outperforming old ($M=.76$, $SD=.18$), but the interaction was not significant in the unmediated condition, $t(54)=1.50$, $p=.14$.

Table 6. *Proportion of correct responses (with SDs) during the prelearning phase of Experiment 3.*

| | First Attempt | | | |
| | Names | | Occupations | |
	Unmediated	Mediated	Unmediated	Mediated
Young	.916 (.094)	.809 (.156)	.935 (.090)	.844 (.188)
Old	.888 (.089)	.730 (.186)	.901 (.092)	.776 (.172)
	Second Attempt			
	Names		Occupations	
	Unmediated	Mediated	Unmediated	Mediated
Young	.934 (.092)	.875 (.180)	.945 (.094)	.929 (.117)
Old	.902 (.087)	.730 (.212)	.907 (.122)	.791 (.180)

Pre-learning response times. Response times from the pre-learning phase of the experiment are shown in Table 7. An Age x Test x Mediation x Attempt ANOVA was conducted on these data. All main effects were significant. The effect of Age, $F(1,54)=29.93$, $p<.001$ indicated that young adults ($M=2676$, $SD=741$) responded much faster than older adults ($M=4225$, $SD=1303$). There was an effect of Attempt, $F(1,54)=15.73$, $p=.001$, with faster responses on the second attempt ($M=3310$, $SD=1360$) than the first attempt ($M=3591$, $SD=1310$). The effect of Test, $F(1,54)=11.77$, $p=.001$ indicated faster responses on occupation lists ($M=3273$, $SD=1336$) than name lists

(M=3628, SD=1397). Finally, there was a large effect of Mediation, $F(1,54)$=255.70, p<.001, with much faster responses on unmediated trials (M=2864, SD=1169) than on mediated trials (M=4037, SD=1494).

The only other significant effect from this analysis was the interaction between Mediation and Age, $F(1,54)$=8.98, p=.004. There was a strong effect of Mediation for older adults, $t(27)$=11.13, p<.001, with slower performance on the mediated stimuli (M=4922, SD=1494) than on the unmediated stimuli (M=3529, SD=1175). This effect was even stronger in young adults, $t(27)$=12.46, p<.001, who also responded more slowly on the mediated stimuli (M=3153, SD=833) than on the unmediated stimuli (M=2200, SD=697).

Table 7.

Response times (and SDs), in milliseconds, for the first and second attempts of the pre-learning session of Experiment 3, as a function of age, test, and mediation.

	First Attempt			
	Names		Occupations	
	Unmediated	Mediated	Unmediated	Mediated
Young	2371 (666)	3333 (765)	2189 (841)	3227 (1035)
Old	3885 (1299)	5455 (1648)	3419 (1290)	4847 (1527)

	Second Attempt			
	Names		Occupations	
	Unmediated	Mediated	Unmediated	Mediated
Young	2186 (754)	3174 (872)	2051 (859)	2877 (1251)
Old	3661 (1407)	4959 (1754)	3149 (1398)	4426 (1784)

Effects of stimulus age. As with Experiment 2, characteristics of the stimulus faces were investigated. A Test x Mediation x Participant Age x Stimulus Age ANOVA was conducted. Unlike Experiment 2, there were no main effects or interactions involving the age of the stimulus face or of the participant.

Estimated percentages correct. As with Experiment 2, participants were asked after completing the experiment to estimate their percentages of correct responses in each of the four conditions. Data from the 26 younger and 23 older respondents, shown in

Table 8, were submitted to an Age x Test x Mediation ANOVA. There was not a significant effect of Test $F(1,47)=.28$, $p=.60$. The effect of Mediation did reach signifance, $F(1,47)=5.07$, $p=.029$, with higher estimates in the mediated condition ($M=58.69$, $SD=28.95$) than in the unmediated condition. Age was also highly significant, $F(1,47)=37.63$, $p<.001$; young adults produced higher estimates ($M=72.86$, $SD=18.25$) than older adults ($M=36.46$, $SD=23.23$). No interactions approached significance. List order did not affect predictions.

Table 8.

Average of each age group's estimate of their percentage of correct recall in Experiment 3, as a function of test and mediation.

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young	69.31 (26.75)	73.46 (25.05)	73.08 (16.56)	75.58 (22.42)
Old	31.39 (25.96)	42.17 (26.75)	32.83 (24.35)	39.43 (25.36)

Discussion

In most respects, Experiment 3 produced a remarkable replication of Experiment 2. The main finding was that, even without being instructed to use mediation, both age groups increased their memory for names if they also knew those people's occupations. This finding, however, was not as robust as in Experiment 2, as the interaction between Test and Mediation was only marginally significant. This suggests, perhaps, that some

participants do not use the strategy spontaneously. It is helpful at this point to break down

results by individual participants' patterns of performance. Table 9 presents the

proportion of participants in each age group who showed an effect of mediation—either

an improvement or a decrease in performance—for each age group in each test, for both

Experiments 2 and 3. Data in this table nicely replicate the overall findings. Clearly,

fewer participants benefited from mediation in the name list in Experiment 3 than in

Experiment 2, but a majority of participants still benefited in the latter.

Table 9.

The proportion of each age group with either an increase or a decrease in performance

with mediation, in each type of test, for Experiments 2 and 3.

	Experiment 2			
	Young Adults		Older Adults	
	Names	Occupations	Names	Occupations
Proportion Improved with Mediation	.76	.40	.58	.29
Proportion Decreased with Mediation	.20	.40	.29	.46
	Experiment 3			
	Young Adults		Older Adults	
	Names	Occupations	Names	Occupations
Proportion Improved with Mediation	.61	.39	.57	.42
Proportion Decreased with Mediation	.29	.43	.36	.46

The effects of List Number and Test Order found in Experiment 2 were also replicated. Mediation was found only in the first name list, and only when the name lists were completed before the occupation lists. These findings were not expected prior to Experiment 2, but given that they were replicated, they must be further investigated. Again, participants may learn that the mediation strategy does not work well in the occupation lists, so they abandon the strategy. This idea, however, runs contrary to results of the post-experiment questionnaire, in which participants indicated that they felt they had performed better in both name and occupation lists when given a mediator.

While most findings from Experiment 2 were replicated, Experiment 3 did not show the effects of stimulus age. This may indicate that the finding from Experiment 2 was not particularly stable. However, it would be worth investigating this interesting effect in future experiments.

Response times to the cued-recall task also support the idea that both age groups used mediation even when not instructed to do so. Participants were much slower to respond to the mediated than to the unmediated names, suggesting that they also retrieved the occupations for the former condition. This effect was especially great—greater than in Experiment 2—for older adults. Thus, there was a slight cost of withholding strategy instructions in terms of recall accuracy, but a greater cost for older adults in terms of recall speed. This may indicate a difficulty in figuring out how to use the unexplained mediation strategy. An alternative explanation for older adults' slow responses in the mediated name condition is that they may have been attempting to suppress their memory for the occupations, rather than using the occupations to their advantage. This, of course,

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cannot be the entire story, as older adults showed some improvement in the name lists with mediation than without mediation, but it may still have contributed to the results.

Results from the pre-learning task were quite similar to those from Experiment 2, except that the interaction between Age, Mediation, and Attempt now reached significance. This was due to a greater improvement in performance in the mediated condition from attempt 1 to attempt 2 in younger adults than in older adults, an effect which was present (although not significantly so) in Experiment 2. Again, older adults showed evidence of an associative deficit (Naveh-Benjamin, 2000), with a greater age-related impairment in the mediated than in the unmediated trials.

Finally, it was surprising that there was not an Age x Test interaction in the present study. Typically, age differences are larger in memory for names than in memory for occupations (e.g., Evrard, 2002; James, 2004; James, et al., 2008). The only difference between the present experiment and Experiment 2 relates to instructions. While it is possible that instructions to use mediation resulted in especially low name memory for older adults, thus creating an Age x Test interaction in Experiment 2, this explanation seems quite unlikely. First, there is evidence that mediation was used in Experiment 3, even without instructions to use it. Second, many previous studies have shown such an Age x Test interaction. To further investigate whether such an interaction exists, an additional brief experiment was conducted, and is described in Appendix F. In short, when asked to remember the names or occupations presented with faces (with no mediating information presented) in a cued-recall paradigm, age differences were much larger in the name tests than in the occupation tests.

The present findings run in contrast with previous findings that older adults have difficulty spontaneously using strategies (Naveh-Benjamin, et al., 2007). It may be that the mediation strategy occurs somewhat automatically. Upon seeing a face from the study list, participants may automatically be reminded of that person's occupation, which may then prime memory for the name. Typical strategies explained to older adults require more action on the participants' parts, meaning that they are more difficult to implement on one's own. Teaching participants to create sentences binding two words together, for example, improves memory for those bindings to a greater extent in older than in younger adults (Naveh-Benjamin, et al., 2007).

In summary, Experiment 3 showed that, even without being instructed to use mediation, both age groups are able to better remember names when occupations are also known than when occupations are not known. This suggests that younger and older adults spontaneously used the mediation strategy. However, effects were not as strong as when participants were given specific instructions to use mediation, perhaps indicating that some participants must be provided with such training.

General Discussion

Review of Findings

The present dissertation takes a novel approach to the improvement of memory for people's names in both younger and older adults. This approach is based on the well-supported idea that a person's name cannot be recalled without previous retrieval of other information about that person (e.g., Bruce & Young, 1986). Experiment 1 established that, at a simple level, with only two names and two pieces of semantic information, both older and younger adults were better able to remember which name went with a given face if that person's character information was also known. Experiments 2 and 3 extended this finding to a more realistic setting. Both age groups were better at remembering a person's name if that person's occupation had also been learned, even when there were 14 different names or occupations per list. This effect of mediation was strongest when participants were told how to use the mediation strategy (Experiment 2), but was also present when no mention of strategy was made (Experiment 3). In all experiments, knowing a person's name did not help in memory for the semantic piece of information about that person.

An interesting, and unexpected, finding was that the effect of mediation in both Experiments 2 and 3 depended on the order in which participants received the tests. Only when the name lists (using occupations as mediators) were completed before the occupation lists (which used names as mediators) did mediation help with memory for *names. As noted previously, one possible explanation for this finding is that participants in the name-first condition found the mediation technique quite useful and therefore continued to use it, at least until they began the occupation lists. Those

completing the occupation lists first, however, may have abandoned the mediation technique upon finding it to be of little use. Given the notable consistency of this finding in Experiments 2 and 3, the effect of test order should be taken seriously and should be explained in future experiments.

Another unexpected finding was that participants in both Experiments 2 and 3 were unable to report that they had performed better at remembering occupations than names. Furthermore, participants seemed to realize that mediation had helped them overall, but were unable to make the distinction between test type—that mediation had helped only in the name lists. In Experiment 1, however, young adults' estimates of their performance were quite accurate in terms of patterns (e.g., they estimated that name memory had increased with mediation but that character memory had not), whereas older adults' estimates were the same regardless of condition. These findings are difficult to explain. One possibility is that participants in Experiments 2 and 3 simply supplied similar estimates for the name and occupation lists because memory of the first test type had been obscured by the second test type. Use of a within-list test factor, then, would have shown a difference between name and occupation estimates. This may also be why participants could detect the effect of mediation, which was a within-list factor. In turn, participants (at least the younger adults) may have been able to estimate higher performance on the character tests than on the name tests in Experiment 1 because, in that experiment, test type was not blocked. That is, participants' last two lists always included a name list and a character list.

Results of the pre-learning sessions from Experiments 2 and 3 confirmed expectations: There were larger age differences in performance on mediated stimuli (in

which participants had to choose the name that had been presented with a given occupation, or vice-versa) than on unmediated stimuli (in which participants stated whether a stimulus had been presented alone or not presented). Although this procedure is a departure from the paradigm developed by Naveh-Benjamin (2000) to investigate the Associative Deficit Hypothesis, the present findings offer more support to the idea that older adults have a special difficulty binding together two items and/or in retrieving those bindings.

In everyday life, these findings suggest that an appropriate name-learning strategy is to, before meeting someone in person, learn that person's name bound with something else about that person; when seeing the person's face, then, you should attempt to bind the face both with the name and the other information. Having difficulty retrieving the person's name at a later encounter, it will be useful to think about the other learned information about that person, which has already been linked with the appropriate name. This strategy, of course, cannot be used when meeting someone unexpectedly, but there are many times when we know information about a person before meeting face-to-face, such as when being introduced to a friend's significant other.

Difficulty of Remembering People's Names

The present studies add to a plethora of previous findings that memory for people's names poses a unique challenge. Character information in Experiment 1, and occupation information in Experiments 2 and 3, were better remembered than names; this was the case for both younger and older adults. The present results suggest that the difficulty in remembering names is partially due to the potentially small number of

connections to a name; by adding one connection (character information or an occupation) to the name, participants' memory for names was brought closer to their memory for other information about a face.

Findings were not as clear, however, regarding whether there is a differentially large impairment of name memory in older adults. Experiment 2 showed a significant Age x Test interaction, with age differences being larger on memory for names than for occupations. However, neither Experiment 1 nor Experiment 3 showed such an effect. This was not so surprising a finding in Experiment 1; as discussed earlier, that experiment involved a 2-choice forced-choice recognition task, which brings age effects to a minimum.

The lack of interaction in Experiment 3 is more difficult to explain. The only methodological difference between Experiments 2 and 3 lies in instructions to participants, with strategy instructions provided only in Experiment 2. It seems that having instructions to use mediation aided scores on the mediated name stimuli for young participants, but reduced performance on the unmediated name stimuli for older participants, leaving the other conditions relatively untouched. Thus, it is possible that older adults in Experiment 2 became dependent upon knowing a person's occupation in order to recall that person's name, whereas those in Experiment 3 used a different strategy, one which may have been less complicated and more appropriate for at least some participants. Nevertheless, results of an additional experiment, mentioned earlier and presented in Appendix F, confirm that, without the particular conditions used in Experiments 2 and 3 (i.e., mediation and pre-learning), there is a clearly larger impairment with age for name memory than occupation memory.

Another factor which must be considered in the assessment of age differences between name and occupation memory is that older adults may have stronger occupational stereotypes than do younger adults. (First names certainly can produce some stereotypes, but these are likely less strong than are those associated with occupations.) Indeed, older adults seem to have trouble suppressing their existing stereotypes (see, e.g., Hess, 1985). Although this cannot explain differences between patterns of performance in Experiments 2 and 3, it should be kept in mind that, had an attempt been made to match occupations to faces (e.g., the librarian would have had glasses), this may have benefited older adults more than young adults, leading to larger age differences on the occupation tests than on the name tests. This idea is supported by evidence that older adults are quite good at remembering associative information if that information is supported by their previous knowledge (e.g., Castel, 2005). Additionally, during each of the present experiments, several older adults (but no young adults) remarked that they would have performed better if the names and occupations had better "fit" the faces. (For example, several older adults commented that "he's too young to be a judge".)

Is Name Retrieval Dependent on Retrieval of Other Information?

The present studies do not directly test the idea discussed earlier that names cannot be retrieved directly from faces (see, e.g., Bruce & Young, 1986; Craigie & Hanley, 1997; Valentine, et al., 1996). However, they do indirectly support the notion. Results show that strengthening the link between a person's name and other information about that person aids in the encoding and recall of the person's name given his or her

face. If participants were able to use a direct link from face to name, then also knowing the relevant occupation should not have affected performance on the name tests. Of course, participants were able to remember some names even in the unmediated condition, but self-report indicated that they often produced their own type of "mediator" (e.g., one older participant noted that "'Anna' is a Scandinavian name, and she has blond hair").

Just as important, knowing a person's name did not aid in the retrieval of that person's occupation. This provided further evidence that there is a direct link between a face and information about that person, but no direct link between the face and name. Were a name linked to a face directly, participants should have sometimes used the route from face to name to occupation when attempting to retrieve the occupation.

One remaining theoretical question is whether pre-learning the name-occupation or name-characteristic connections might actually cause the name to be stored with the other information (refer to Figure 1). In the present experiments, this did not seem to occur—at least not completely—as indicated by the longer response times in the mediated than in the unmediated trials. Producing stronger pre-learning, however, might allow this question to be answered. If participants store "Anna" and "doctor" at the same level, they should be able to recall either word as quickly as if they had learned only one of the words. Other possibilities for further experiments are noted below.

Future Directions

Results from all three experiments illuminate the need for future related research. The knowledge that older adults are highly capable of using mediation produces a world

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of possibilities. One method that should be investigated is to ask participants to pre-learn the link between a face and an occupation before learning the associated name, rather than pre-learning the name-occupation association before seeing the face. This method, theoretically, should have a similar effect to that in the present experiments, because it would strengthen the indirect route from face to occupation before forming the link from occupation to name.

In the present studies, one unachieved goal was to reach near-perfect pre-learning of the name-occupation pairings in Experiments 2 and 3. However, this proved to be a difficult task; achieving it would have increased the length of the experiment to an amount of time surpassing most participants' levels of comfort. It is likely that, given proper training, the mediation technique could be even more helpful for older adults than the present experiments suggest. As discussed earlier, there was definitive evidence from the pre-learning phases of the experiments that older adults do have extra trouble binding a name to an occupation. Had performance during pre-learning been equivalent for younger and older adults, mediation may have aided the older adults more than the young, at least with instructions to use the mediation strategy. Another very real possibility is that the within-list nature of the mediation condition in Experiments 2 and 3 may have reduced performance in older adults (see Verhaeghen & Cerella, 2002, for a review showing larger age costs when task-switching is required). Having shown in the present experiments that mediation does not improve memory for occupations, future experiments might be able to omit the occupation tests, leaving time to improve scores on the pre-learning tests. Mediation could also be tested as a between-list variable, as in

Experiment 1, but with the more realistic paradigm of Experiments 2 and 3; such a procedure would reduce task-switching.

It is also necessary to investigate whether participants can make use of "online" mediators—i.e., if participants can benefit from mediation when they must learn the name-occupation-face triplets in a single study session, without pre-learning. Results of an unreported pilot study suggested that the pre-learning phase was necessary for using the present methodology, but it is possible that with more intense training in the mediation technique or with longer or more study periods, mediation would aid name memory even without pre-learning.

Conclusions

The present studies investigated a new technique to help people better remember other people's names. Evidence was found suggesting that the learning of the name belonging to a new face is enhanced in both younger and older adults if one already knows another piece of information belonging with that name. This is a technique that can be put into use in many instances of meeting new people in everyday life. More studies are necessary to determine if the technique can be even more effective, but it is a promising idea which may assist both older and younger adults in their quest to better learn others' names.

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Appendix A: Sample Stimuli for Experiment 1

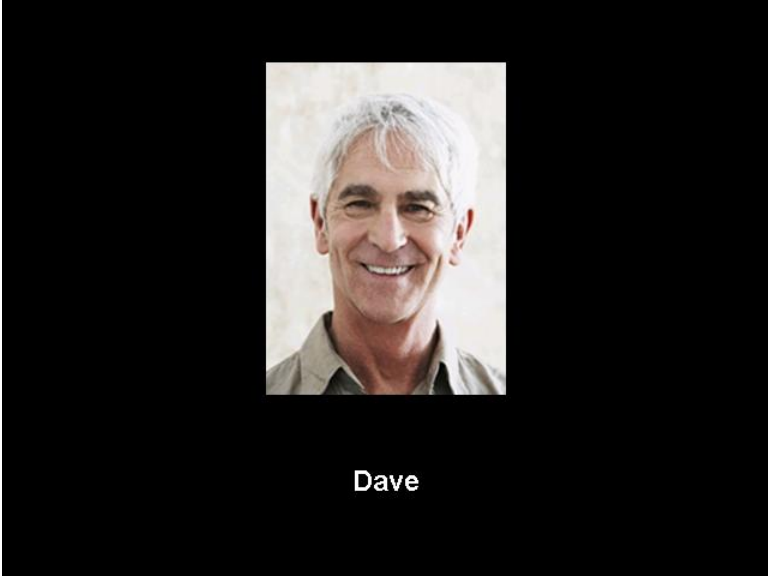Section 1: Sample Stimuli for an Unmediated Name List

   Study: Participants are told that each person they will see is named either John or Dave, and that they should learn the name that goes with each face.
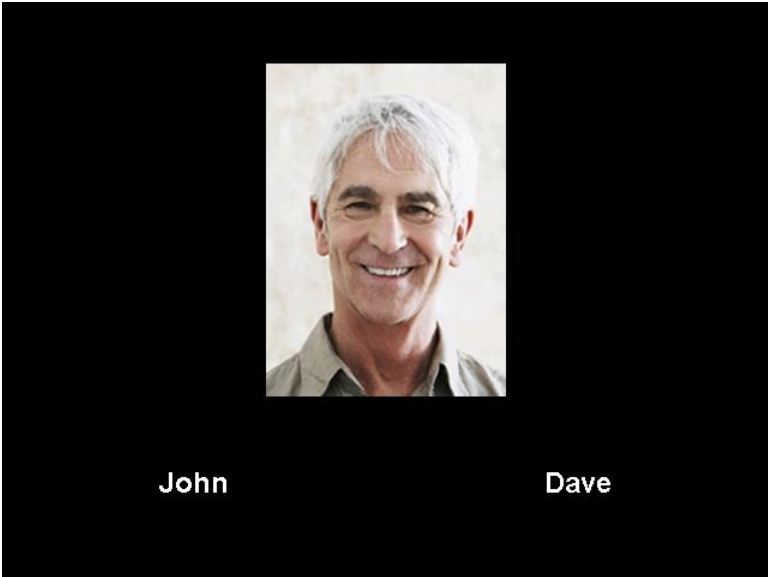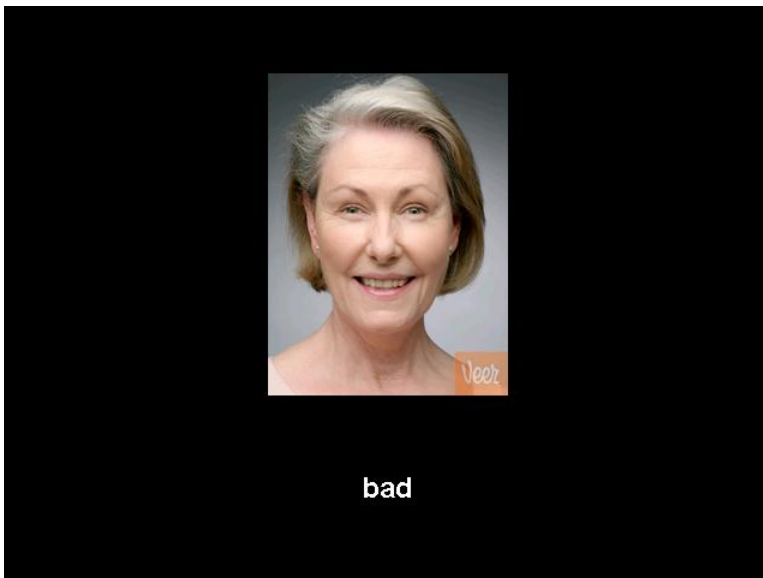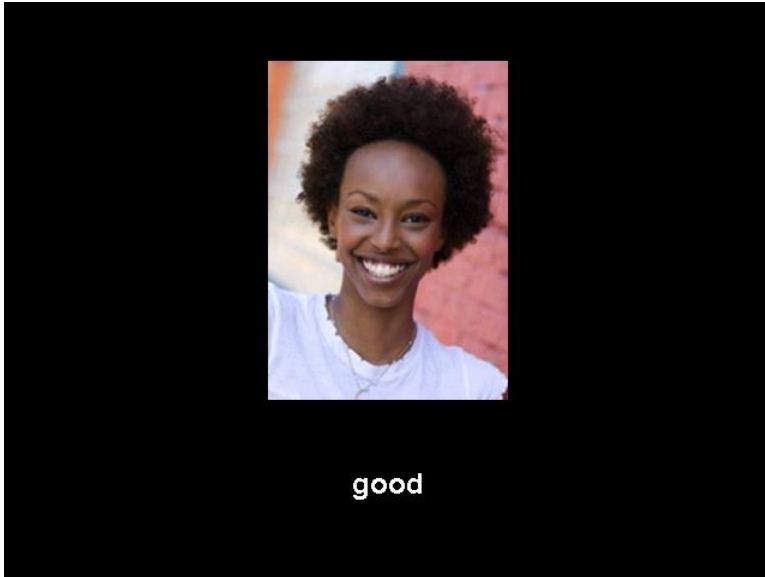

John

Dave

Test: Participants choose one of the two names belonging with each face.

Section 2: Sample Stimuli for an Unmediated Character List.

> *Study*: Participants are told that each person they will see is either a "good" person or a "bad" person, and that they should remember who is good and who is bad.
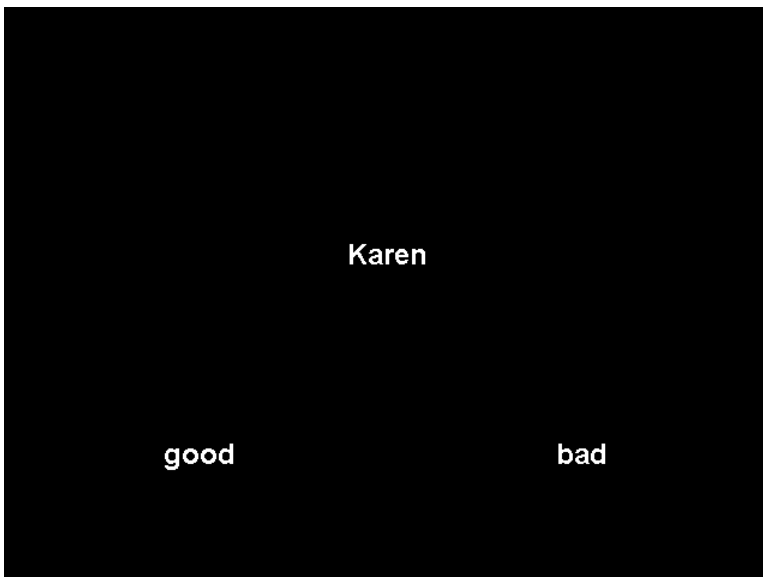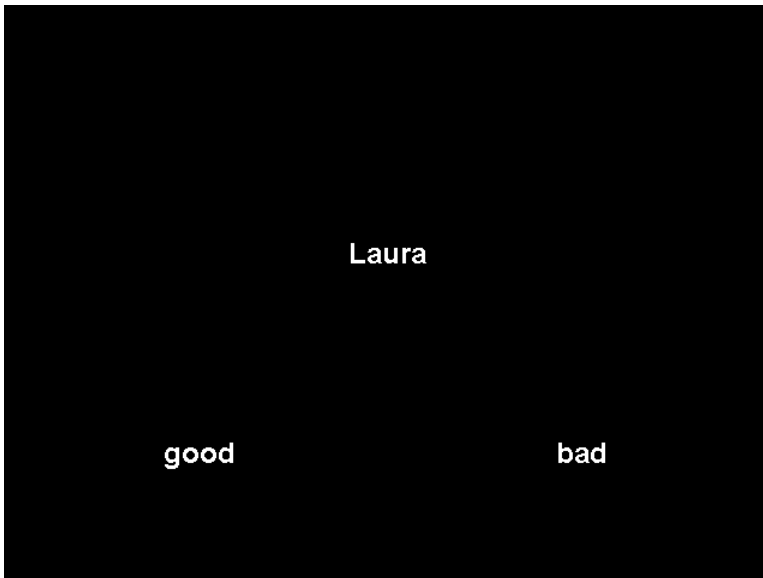

good

bad

good

Test: Participants choose the characteristic belonging with each face.

good   bad

Section 3: Sample Stimuli for a Mediated Name List.

> *Pre-learning*: Participants are told, for example, that everyone named Laura is a "good" person and that everyone named Karen is a "bad" person. To make sure that this is well-understood, participants then take a test in which they press a key corresponding to "good" or "bad" for a series of names.

Study: Participants are asked to remember the name belonging with each face. They are also told that it might help them to remember whether each person is good or bad.
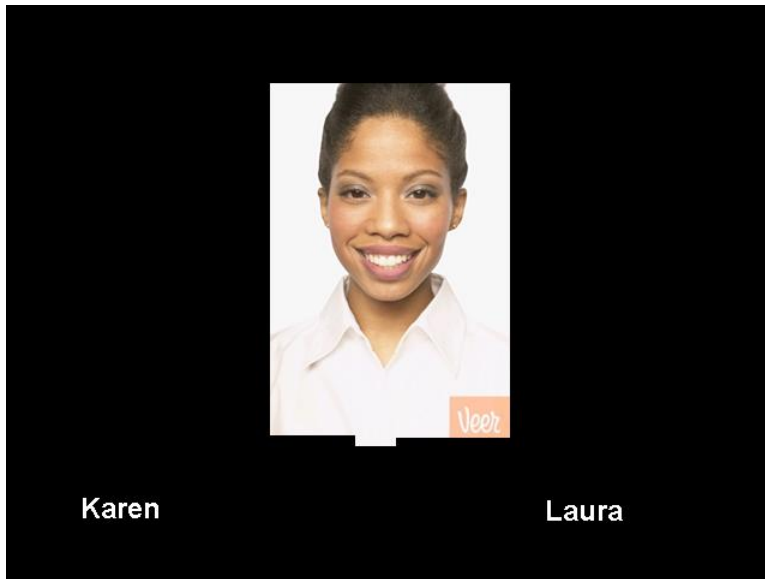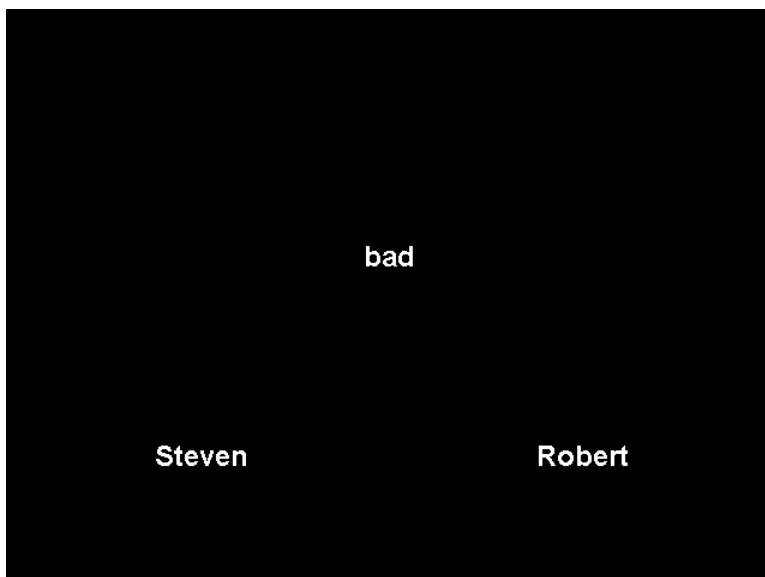

Laura

Karen

Test: Participants are asked to press a key corresponding to one of the two names, given each face seen during study. They were reminded to use the character information to help remember the names.


Section 3: Sample Stimuli for a Mediated Character List.

> *Pre-learning*: Participants are told, for example, that everyone "bad" is named Steven and everyone "good" is named Robert. They then complete a test in which they press a key corresponding to Steven or Robert for a series of "good" and "bad".

Study: Participants are asked to remember "good" or "bad" belonging with each face. They are also told that it might help them to remember each person's name.

bad
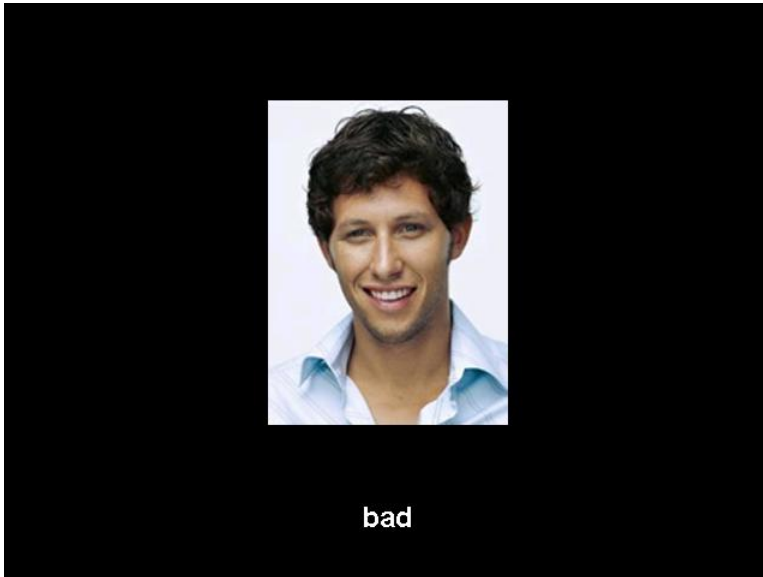
Test: Participants are asked to press a key corresponding to either "good" or "bad", given each face seen during study. They are reminded to think back to the name to help them remember the character information.

good   **bad**
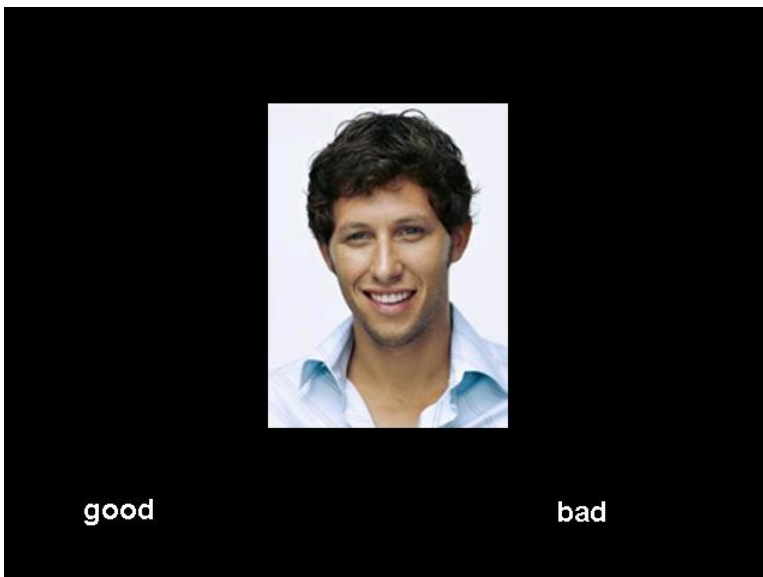
Appendix B: Additional Results from Experiment 1

Table B1

Correct cued-recall proportions, (with SD's), by younger and older adults, in each of the four conditions, in Experiment 1.

|	Unmediated Name	Mediated Name	Unmediated Character	Mediated Character
Young	.667 (.149)	.714 (.166)	.782 (.130)	.769 (.150)
Old	.621 (.136)	.700 (.105)	.741 (.132)	.733 (.124)

Table B2

Average response times on correct responses (with standard deviation bars) from Experiment 1.

	Unmediated Name	Mediated Name	Unmediated Character	Mediated Character
Young	2306 (1111)	1927 (770)	1952 (793)	1849 (614)
Old	2125 (740)	2212 (678)	2084 (645)	2015 (651)

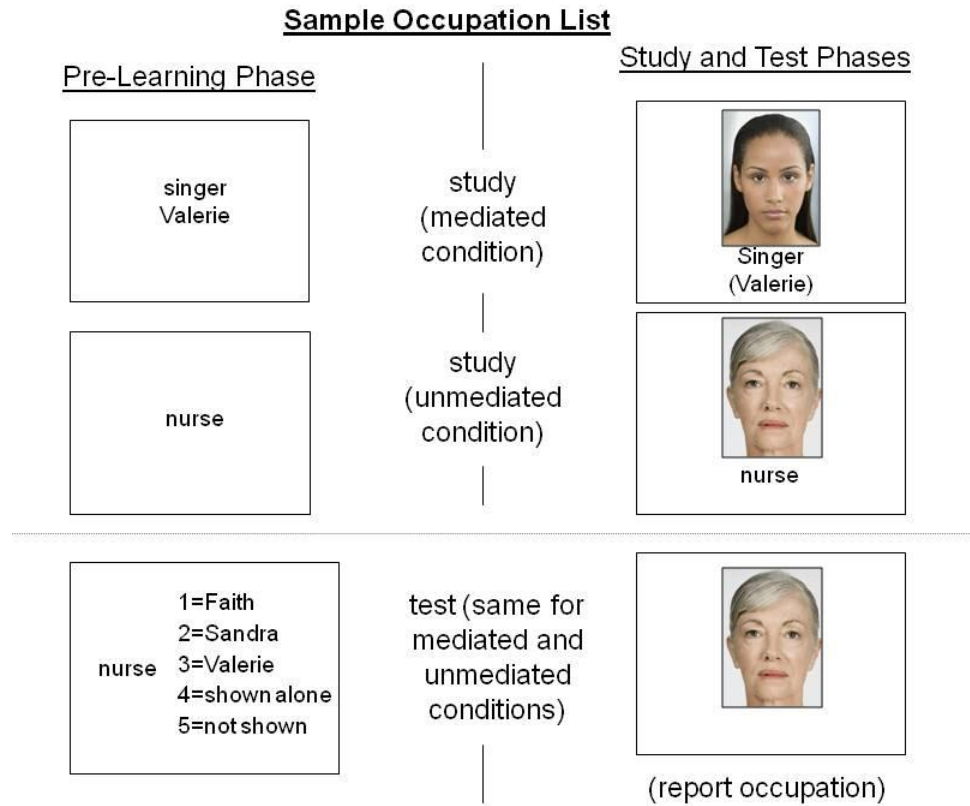**Appendix C: Diagrams of Experimental Method for Experiments 2 and 3**

(A).
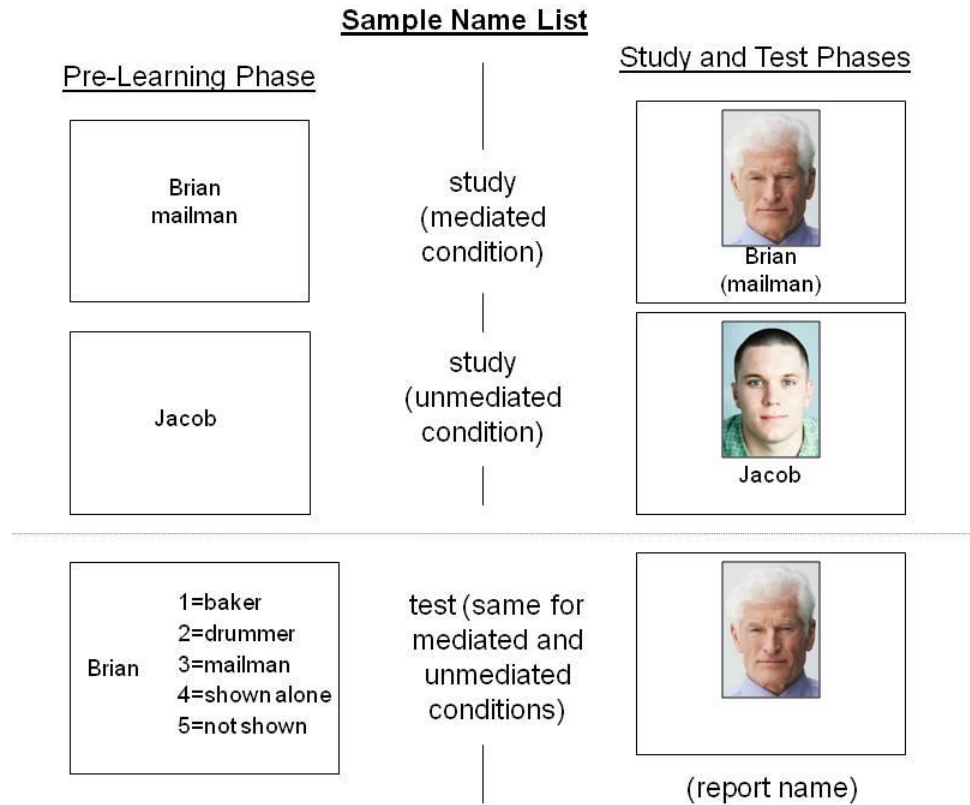
(B)

Figure C1. *Diagram of the experimental procedure for a name list (A) and an occupation list (B) in Experiments 2 and 3. The procedure began with a pre-learning study phase (upper left), then proceeded to the pre-learning test phase (bottom left). Study (upper right) and test (lower right) of the face-name or face-occupation pairs followed.*

Appendix D: Additional Results from Experiment 2.

Table D1.

Correct cued-recall proportions, (with SD's), by younger and older adults, in each of the four conditions, in Experiment 2.

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young Adults	.60 (.22)	.73 (.22)	.70 (.22)	.71 (.18)
Older Adults	.23 (.19)	.35 (.25)	.42 (.21)	.41 (.20)

Table D2.

*Average response times on correct responses (with standard deviation bars) from Experiment 2. *The large SD for older adults in the unmediated name condition may reflect the low rate of correct responses in this condition, thus producing more variable results.*

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young	4944 (1141)	6291 (2135)	5281 (929)	6322 (1433)
Old	8626 (6635)	9133 (3173)	6980 (1904)	7962 (2081)

Table D3.

*Correct cued-recall proportions, (with SD's), by younger and older adults, in each of the four conditions, in Experiment 2, using **lenient scoring**.*

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young Adults	.62 (.22)	.74 (.22)	.71 (.22)	.70 (.17)
Older Adults	.26 (.21)	.40 (.25)	.44 (.22)	.42 (.21)

Table D4.

Total number of responses per response/error type, per condition, for older and younger adults in Experiment 2.

|	Unmediated Name		Mediated Name		Unmediated Occupation		Mediated Occupation	
	Y	O	Y	O	Y	O	Y	O
Correct	211	77	255	117	246	143	248	138
No	41	133	28	95	32	101	38	114
Outside	8	6	5	7	3	3	3	3
Within-list target error	80	106	52	100	63	70	52	63
Within-list distractor error	2	5	1	7	3	1	3	1
Between-list target error	6	5	6	3	2	7	2	7
Between-list distractor error	0	0	0	1	0	3	0	3
Between-list mediator error	4	5	2	6	2	4	2	4

(A)
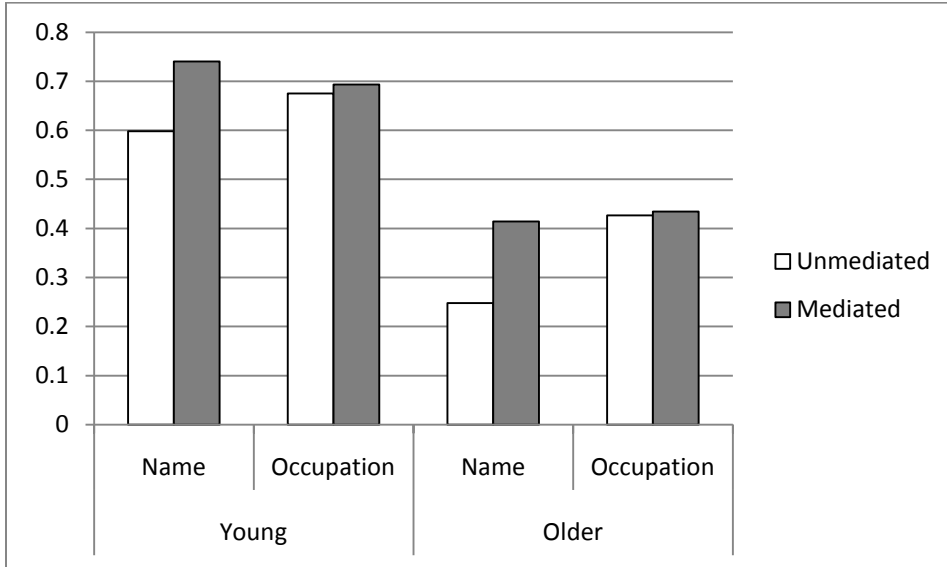
(B)

Figures D1 A and B. The proportion of recalled names and occupations in each mediation condition when a particular item was correctly pre-learned (A) and when the item was incorrectly pre-learned (B), in Experiment 2.

Effects of Stimulus Face Characteristics on Memory Performance in Experiment 2.

To investigate whether there might be an effect of participants' sex, sex of the stimulus face, or an interaction, these factors were entered into a 5-way ANOVA: Mediation x Test x Stimulus Sex x Participant Age x Participant Sex. (See Figure D1 A and B). This analysis revealed a significant interaction among Stimulus Sex, Test, Mediation, and Participant Age, $F(1,45)=6.91$, $p=.012$. The Stimulus Sex x Test x Mediation interaction was significant for older adults, $F(1,23)=4.50$, $p=.045$, but not for younger adults, $F(1,24)=.90$, $p=.35$. Further breaking down the 3-way interaction in older adults, there was no Test x Mediation interaction for female faces, $F(1,23)=0$, $p=1.0$, but a large effect in male faces, $F(1,23)=10.07$, $p=.004$. Without mediation, older adults recalled males' occupations better than names, $t(23)=5.78$, $p<.001$, but there was no difference between name and occupation recall in the mediated lists, $t(23)=.53$, p=.60. In sum, then, there is evidence that younger adults used mediation to help remember names of both male and female faces, but for older adults, this effect was limited to male faces. This may relate to older adults' lower ability to suppress stereotypes (e.g., Hess, 1985).

(A)

Female Faces

(B)

Male Faces
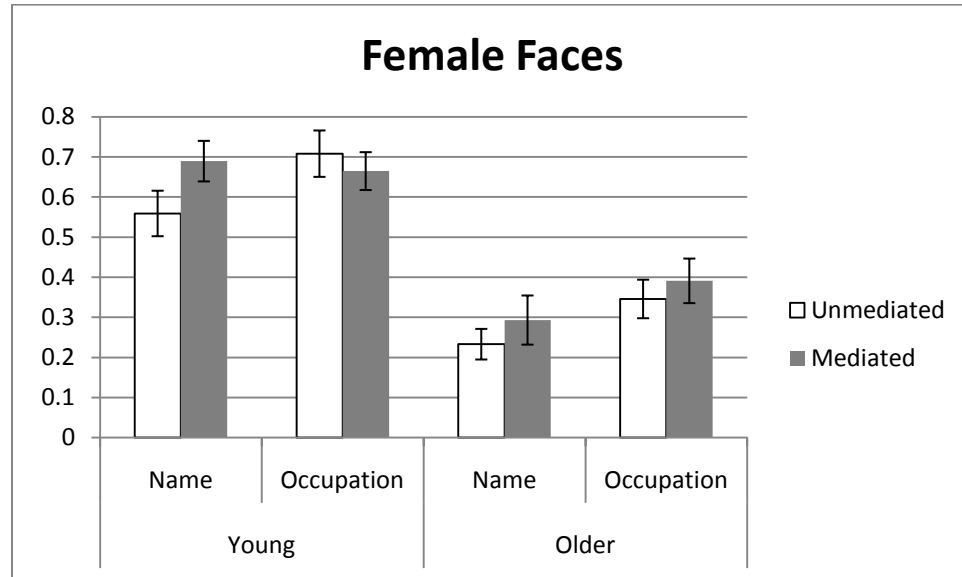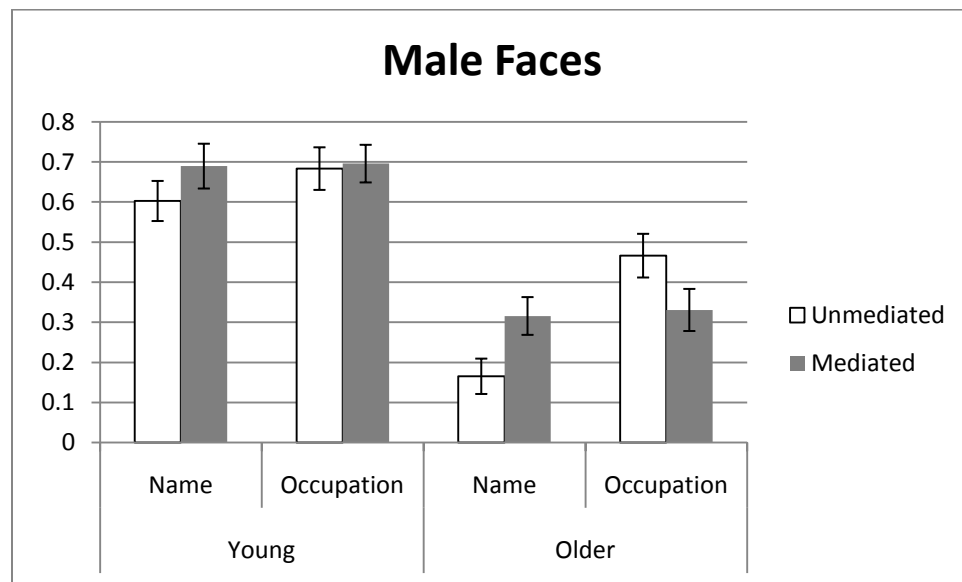
Figures D2 A and B. *Performance separated by sex of the stimulus face, for female stimuli (A) and male stimuli (B).*

The 5-way ANOVA described above yielded one other interaction involving both participant sex and stimulus sex: there was a significant interaction among Participant Age, Stimulus Sex, and Participant Sex. These data are shown in Figure D2. Follow-up analyses showed that for older adults, there was no interaction between Participant Sex and Stimulus Sex, $F(1,22)=1.13$, $p=.30$. For young adults, however, this interaction was significant, $F(1,23)=11.68$, $p=.002$. There was no effect of participants' sex on memory for male stimuli, $t(23)=.20$, $p=.85$, but a significant effect on memory for female stimuli, $t(23)=2.11$, $p=.046$, with female participants performing higher than male participants. This likely reflects an own-sex bias, although it is usually women, rather than men, that show such an effect (e.g., Cross, Cross, & Daly, 1971; Lewin & Herlitz, 2002; Rehnman & Herlitz, 2007).
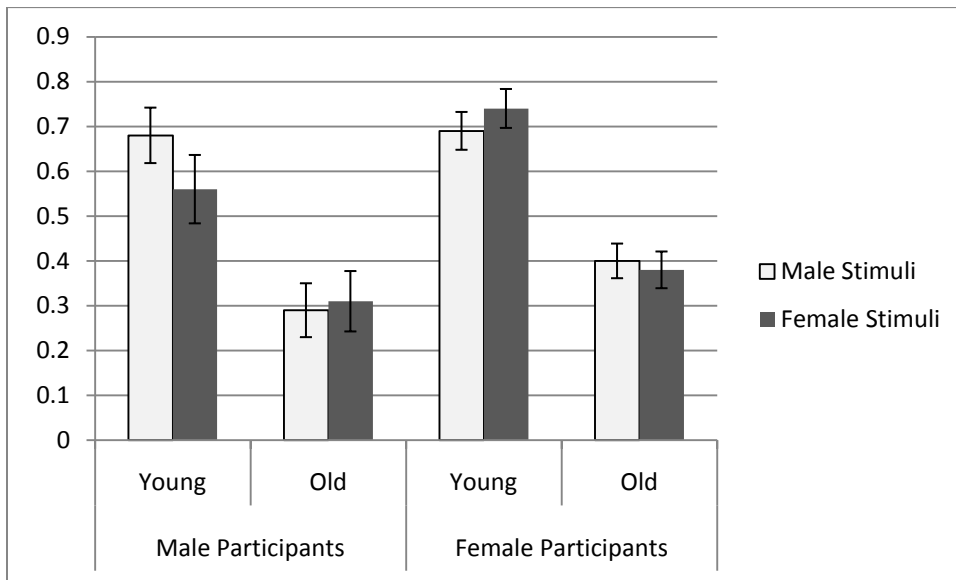

Figure D3. *Performance as a function of participant sex, participant age, and sex of the stimulus face.*

Appendix E: Additional Data from Experiment 3

Table E1.

Correct cued-recall proportions, (with SD's), by younger and older adults, in each of the four conditions, in Experiment 3.

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young Adults	.554 (.198)	.622 (.220)	.668 (.193)	.653 (.184)
Older Adults	.304 (.202)	.383 (.203)	.421 (.206)	.429 (.149)

Table E2.

Average responses times for each age group, for each of the four conditions.

	Unmediated Name	Mediated Name	Unmediated Occupation	Mediated Occupation
Young	4569 (1019)	5508 (1713)	4670 (786)	5158 (1139)
Old	5641 (2219)	8268 (3291)	5536 (1592)	6004 (1719)

Table E3.

Total number of responses per response/error type, per condition, for older and younger

adults.

	Unmediated Name		Mediated Name		Unmediated Occupation		Mediated Occupation	
	Y	O	Y	O	Y	O	Y	O
Correct	217	119	244	150	262	165	256	168
No	77	110	75	106	71	89	61	97
Outside	6	16	8	11	1	6	2	12
Within-list target error	78	126	54	108	46	99	62	89
Within-list distractor error	0	4	0	4	2	3	0	2
Between-list target error	8	9	6	5	7	19	6	17
Between-list distractor error	1	1	1	0	0	1	0	0
Between-list mediator error	3	5	2	7	1	6	2	4

Appendix F: Additional Experiment Investigating Age Differences in Retrieval of

Names Versus Occupations

Most previous studies have shown a differentially larger age-related impairment in memory for names than in memory for occupations (e.g., Barresi, et al., 1998; James, et al., 2008; Maylor & Valentine, 1992). However, the present Experiment 3 did not yield such a result. The main difference in procedure between Experiment 3 and previous experiments is that in the present study, participants pre-learned the names and occupations. To determine whether the present stimuli would replicate the usual findings without pre-learning, an additional brief experiment was conducted.

Method. Participants, none of whom had participated in an earlier experiment, were drawn from the same pool as Experiments 1-3. There were 8 younger and 9 older adults in the present experiment. Participants viewed two lists of face-name pairs and two lists of face-occupation pairs. In each list, 10 faces were presented along with the to-be-learned information, for 4 seconds each. Immediately afterwards, each face was presented again, and participants were asked to state the name or occupation aloud.

Results. The proportion of correct responses made by each participant in each test condition was calculated; see Figure F1. An Age x Test ANOVA revealed a significant interaction, $F(1,15)=5.63$, $p=.031$. Age differences were significant on the name test, $t(15)=3.07$, $p=.008$, but not on the occupation test, $t(15)=1.25$, $p=.23$.
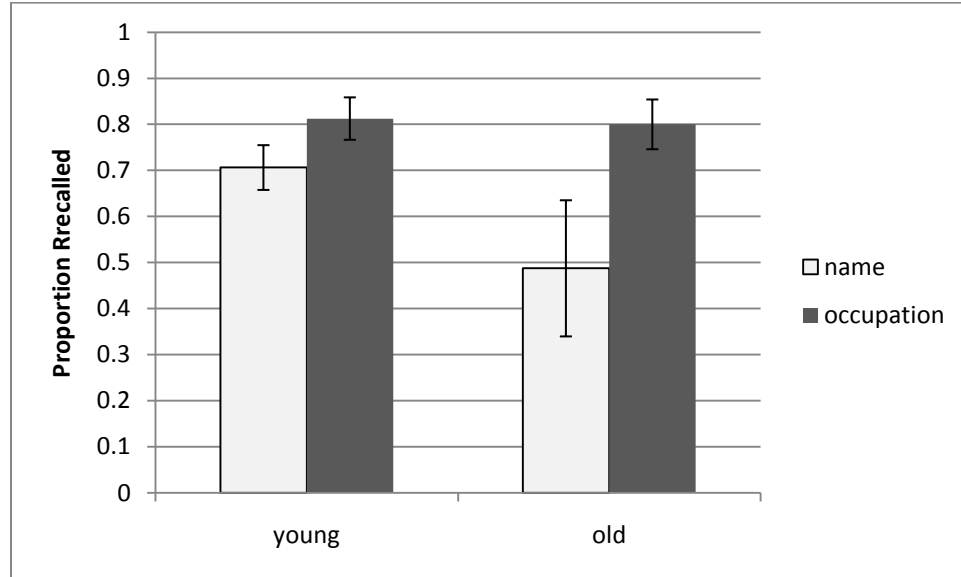
Figure F1. Proportion of names and occupations recalled by each age group.

Discussion. There was a clear age-related deficit in memory for names, but not for occupations, even with a small sample size. Thus, it is likely that the pre-learning session of Experiment 3 boosted older adults' performance on the name tests enough to offset their usual name-memory deficit. This does not explain, however, the finding of such a deficit in Experiment 2. Comparing results from Experiment 2 and 3, the main difference is that, in Experiment 2, young adults had a larger advantage of mediation than in Experiment 3. Thus, at least some younger adults may have needed to be instructed to use the mediation strategy to produce a benefit. In turn, this benefit helped produce older adults' (who did not benefit more from mediation in the name list in Experiment 2 than in Experiment 3) differential name deficit in Experiment 2, but not in Experiment 3.

In summary, then, it seems that pre-learning may reduce older adults' usually greater age-related impairment in memory for names than for occupations, but that

younger adults' greater ability to use the strategy instructions in Experiment 2 increased

the age-related name memory impairment.

VITA

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