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Destination Memory Impairment in Older People

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Abstract

Older adults are assumed to have poor destination memory— knowing to whom they tell particular information—and anecdotes about them repeating stories to the same people are cited as informal evidence for this claim. Experiment 1 assessed young and older adults' destination memory by having participants tell facts (e.g., "A dime has 118 ridges around its edge") to pictures of famous people (e.g., Oprah Winfrey). Surprise recognition memory tests, which also assessed confidence, revealed that older adults, compared to young adults, were disproportionately impaired on destination memory relative to spared memory for the individual components (i.e., facts, faces) of the episode. Older adults also were more confident that they had not told a fact to a particular person when they actually had (i.e., a miss); this presumably causes them to repeat information more often than young adults. When the direction of information transfer was reversed in Experiment 2, such that the famous people shared information with the participants (i.e., a source memory experiment), age-related memory differences disappeared. In contrast to the destination memory experiment, older adults in the source memory experiment were more confident than young adults that someone had shared a fact with them when a different person actually had shared the fact (i.e., a false alarm). Overall, accuracy and confidence jointly influence age-related changes to destination memory, a fundamental component of successful communication.

Keywords

destination memory; source memory; episodic memory; confidence judgments; aging

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Many of us have had the embarrassing experience of recounting a story to someone, only to realize partway through that we have already told the person the story. Remembering to whom we tell particular things, referred to as *destination memory* (Gopie & MacLeod, 2009), is important for supervisors, who must remember the specific task that they delegate to each employee; for liars, who must remember the precise version of a story that they tell to each person; and for those in sales, who must remember the individually tailored deal that they pitch to potential clients. More commonly, destination memory facilitates everyday communication by allowing conversational shortcuts if we are able to remember what information we have previously told to our conversational partners.

Destination memory is generally believed to be problematic for older adults, some of whom seem to retell the same stories numerous times. Koriat, Ben-Zur, and Sheffer (1988) were the

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first researchers to report that older adults are more likely than younger adults to repeat previously said words on a recall test. In general, however, repeating information is not particularly problematic; it is the repetition of information to the same person that is troublesome, and this was not assessed by Koriat et al. Other research within the cognitive aging literature provides some support for the intuition that older adults have poorer destination memory than younger adults. In particular, older adults do not sufficiently elaborate on information, due to difficulties with self-initiated processing, and therefore fail to integrate information with its specific context (Craik & Byrd, 1982; McIntyre & Craik, 1987). Consistent with this view, older adults have been shown to be disproportionately impaired, relative to younger adults, on explicit memory for associations (e.g., Castel & Craik, 2003; Chalfonte & Johnson, 1996; Naveh-Benjamin, 2000). Given these findings, it is reasonable to assume that older adults have impaired destination memory, as destination memory clearly relies on the appropriate association of outgoing information with the person to whom one is speaking. What is unclear, however, is how the speculated poor destination memory performance of older adults manifests. One possibility is that older adults have a general decline in memory for the individual components of the episode (their conversational partner, the information being told), which would result in a corresponding impairment in destination memory relative to younger adults. Another possibility is that older adults have intact memory for individual components within a destination memory episode (e.g., what they said, to whom they spoke) but have a selective impairment in destination memory (i.e., knowing what they said to whom).

We also were interested in whether older adults are aware of their presumed destination memory decline, as determined here by their level of confidence in their memory decisions. In general, there should be a positive correlation between accuracy and confidence: If memory accuracy is high, confidence should also be high, whereas confidence should be low when memory accuracy is low. Research concerning the relationship between memory confidence and accuracy as people age is mixed: Some studies have demonstrated no age-related change in the relationship between confidence and accuracy (e.g., Dunlosky & Hertzog, 2000; Matvey, Dunlosky, Shaw, Parks, & Hertzog, 2002), whereas others have found less correspondence between the confidence and accuracy of older adults (e.g., Dodson, Bawa, & Krueger, 2007; Kelley & Sahakyan, 2003). To further complicate the picture, other studies have found that older adults have a closer accuracy–confidence relationship than younger adults (e.g., Pliske & Mutter, 1996).

Determining the cause of any age-related changes to destination memory and/or confidence will be useful for enhancing our knowledge of how people remember complex events. From a practical perspective, destination memory is critical for successful social interaction, which in turn benefits the emotional well-being of older people (e.g., Lee & Ishii-Kuntz, 1987). Knowledge of factors that may impair destination memory in older adults will ensure that appropriate remediation strategies are used to improve destination memory.

Experiment 1

Destination memory accuracy and confidence were assessed by adapting a procedure developed by Gopie and MacLeod (2009), whereby people tell facts (e.g., “The average person falls asleep in 12 minutes") to pictures of famous people (e.g., Tom Cruise). Each famous person was told one unique fact. Two counterbalanced recognition tests later assessed memory for the individual components of the destination memory episode (i.e., the famous person, the fact) and for destination memory (i.e., the association between the famous person and the fact). Therefore, one recognition test provided independent memory judgments for what people said and to whom they told facts (i.e., item memory), whereas the other recognition test assessed whether people recognized to whom they told a particular fact (i.e., destination memory). Unique to the current study, participants indicated both whether they had previously seen a face/fact or told a particular fact to a face and their level of confidence (low or high). Overall, this destination memory paradigm allowed us to pinpoint destination memory errors to a specific locus (faulty memory for the faces or for the facts or both) and to determine participants' level of memory confidence as a function of memory performance.

Method

Participants—Table 1 contains the demographic data for participants in this experiment: 20 young adults, who were undergraduates at the University of Toronto, and 20 older adults, who were volunteers from the community. As is typically the case in the gerontology literature, the older adults had more years of education than the young adults because the young adults were still pursuing their formal education, $F(1, 39) = 4.29$, $p < .05$. The older adults also had a higher Shipley (1976) Vocabulary score than the young adults, $F(1, 39) = 10.49$, $p < .01$, because scores on this test increase with age (Paulson & Tien-The, 1970). Participants had normal or corrected-to-normal vision and no history of neurological or psychiatric disorders. The older adults were also screened for cognitive impairment with the Mini-Mental State Examination ($M = 29.4$; all participants ≥ 27.0).

Materials—A 60-item fact pool consisting of interesting facts and a 60-item face pool consisting of color pictures of people famous through television, sports, music, movies, and politics were used. Ratings from a different group of young and older adults indicated that the famous people were equally familiar to both groups. All stimuli were presented at the center of the screen.

Fifty of the 60 facts and faces were randomly paired for study. On the destination memory test, 20 intact fact–face pairs and 20 mismatched fact–face pairs from study were shown in a random order. The remaining 10 facts and 10 faces from study, together with 10 new facts and 10 new faces, were presented individually in the item recognition test in a random order. Therefore, the two tests used entirely nonoverlapping sets of stimuli, preventing cross-test contamination.

Procedure—Participants were individually tested and were instructed to tell facts to faces. There was no mention of memory being tested later; indeed, many participants spontaneously indicated that they were surprised to learn about the recognition tests. Study trial presentation began with a 1,000-ms white fixation cross (+) on a black-background computer screen. The fact was then presented in white font. After reading the fact silently, the participant pressed the space bar. This resulted in a blank screen for 250 ms, followed by a picture of a famous person. The participant then told the person aloud the fact that had just been read and pressed the space bar, which resulted in a black blank screen for 250 ms. This procedure was repeated until the participant had told each of the 50 facts to a different face.

The next two phases were the counterbalanced item and destination memory tests. For the item memory test, 20 facts and 20 faces, half of them studied, were randomly intermixed and individually presented, with facts in white font and faces in color. A test face or fact remained visible until the participant indicated whether the item had previously been seen by pressing keys labeled “sure old,” “unsure old,” “unsure new,” and “sure new.” Unsure and sure options respectively corresponded to low and high confidence. Once a response was made, a blank screen was displayed (for 250 ms) followed by the next test trial.

For the destination memory test, a face–fact pairing was presented, with the fact below the face. There were 40 trials, 20 studied and 20 re-paired, which were randomly ordered. Participants indicated whether they had told the fact to the person by pressing keys labeled “sure old,” “unsure old,” “unsure new,” and “sure new.” After each response, a blank screen was displayed (for 250 ms) followed by the next test trial.

Results

Corrected recognition data (proportion hits minus proportion false alarms; see Figure 1a) were submitted to a 2 (age: young, old) × 3 (memory task: face, fact, destination) mixed analysis of variance (ANOVA). There were significant main effects of memory task, $F(2, 76) = 152.49$, $p < .001$, $\eta_p^2 = .80$, and age, $F(1, 38) = 3.63$, $p = .06$, $\eta_p^2 = .09$, as well as a significant interaction of memory task and age, $F(2, 76) = 10.25$, $p < .01$, $\eta_p^2 = .21$. This interaction was explored with one-way ANOVAs, which revealed that young and older adults had similar fact and face recognition memory (*F*s < 1; fact memory was at ceiling, but note that an age-related difference was found for this high-performance memory task in Experiment 2), whereas older adults had worse destination memory than young adults, $F(1, 39) = 8.93$, $p < .01$, $\eta^2 = .19$.

To obtain further information regarding the poor destination memory performance by older adults, we examined the proportions of hits and false alarms, shown in Table 2, for the destination memory test in a 2 (age: young, old) × 2 (response: hit, false alarm) mixed ANOVA. There was a significant main effect for response, $F(1, 38) = 98.87$, $p < .001$, $\eta_p^2 = .72$, as well as a significant interaction of response and age, $F(1, 38) = 9.34$, $p < .01$, $\eta_p^2 = .20$. One-way ANOVAs revealed that young and older adults had similar hit rates ($F < 1$) but that older adults had significantly more false alarms, $F(1, 39) = 5.25$, $p < .05$, $\eta^2 = .12$.

Proportions of high-confidence responses (i.e., “sure new” or “sure old”; shown in Table 2) for facts and faces were examined independently from the destination memory test. A 2 (age: young, old) × 2 (memory: face, fact) × 2 (response: hit, correct rejection) mixed ANOVA revealed a significant effect of memory, $F(1, 38) = 19.54$, $p < .001$, $\eta_p^2 = .34$, which indicated that facts had more high-confidence responses (.98) than faces (.89). A Response × Age interaction, $F(1, 38) = 4.49$, $p < .05$, $\eta_p^2 = .11$, revealed that young adults had a larger proportion of high-confidence hits (.96) than correct rejections (.91), $t(19) = 2.20$, $p < .05$, whereas older adults made similar amounts of high-confidence hits (.92) and correct rejections (.94; $p > .10$). No other effect or interaction was statistically reliable.

A 2 (age: young, old) × 4 (response: hit, miss, false alarm, correct rejection) mixed ANOVA for high-confidence responses within the destination memory test revealed a significant main effect of response, $F(3, 105) = 24.38$, $p < .001$, $\eta_p^2 = .41$, and a significant Response × Age interaction, $F(3, 105) = 3.12$, $p < .05$, $\eta_p^2 = .08$. There was no main effect of age, $F(1, 35) = 1.68$, $p > .10$, $\eta_p^2 = .05$. One-way ANOVAs indicated that older adults made significantly more high-confidence misses (.49) than young adults (26), $F(1, 38) = 9.84$, $p < .01$, $\eta^2 = .21$ (all other Fs < 2), and there were no age-related false alarm differences.

Discussion

Although recognition memory for individual items within the destination learning episode was unaffected by age, there was a large destination memory difference. The destination memory performance of older adults was 24% worse than that of young adults. Consequently, older adults have a selective impairment with destination memory. Because of the similarity of this impairment with source amnesia in older people (e.g., McIntyre & Craik, 1987; see also Johnson, Hashtroudi, & Lindsay, 1993), the impairment will be referred to, by analogy, as *destination amnesia.*

The performance profile of older adults may be explained by their decline in recollection. Destination memory relies on recollection—remembering the specific association of what was said to whom—whereas familiarity is sufficient for item information. Research suggests that aging impairs recollection but leaves familiarity unchanged or only slightly affected (e.g., Jennings & Jacoby, 1993; Light, Prull, La Voie, & Healy, 2000), perhaps because recollection, but not familiarity, relies on self-initiated processing, which is impaired in older adults (see Craik, 1986). Older adults consequently performed as well as young adults on the item test, because their familiarity processes are unchanged and familiarity was sufficient for the task. In contrast, recollection, which declines with age, was required to avoid falsely recognizing having said a fact to someone, because all faces and facts were familiar on the destination memory test. Indeed, older adults had 16% more false destination memory recognitions than young adults. Therefore, at the core of the destination amnesia of older adults is their susceptibility to falsely remember having told someone a particular piece of information when in fact they have not.

Memory performance also relies on metamemory monitoring of stored information, and, as noted in the Introduction, research is mixed regarding whether this changes with age. However, in recent source memory research, older adults were more likely to make high-confidence memory errors for recombined elements (e.g., Dodson, Bawa, & Krueger, 2007; Dodson, Bawa, & Slotnick, 2007). Older adults did not make more high-confidence false alarm errors than young adults in this destination memory experiment; instead, they were highly confident about not saying a particular fact to a person when they actually had done so (i.e., made misses). This result is illuminating because older and young adults have similar destination memory miss rates. Therefore, older adults may repeat information to a person because they are highly confident—with twice the number of high-confidence miss responses of young adults—that they had not said it to that individual before. This novel finding sheds light on why older adults may often recount stories to the same person.

Although the age-related confidence judgments in the destination memory experiment were different from those typically observed in source memory experiments, the age-related deficit in associative memory is not new. In particular, it has been shown that aging has more of a negative effect on the memory for associations of individual units of information than on the memory for the individual units (associative-deficit hypothesis; Naveh-Benjamin, 2000). Determining whether a similar source memory experiment, in which participants learned facts from famous people, would show age-related differences in memory and confidence that parallel those observed in this destination memory experiment was the goal of Experiment 2.

Experiment 2

To create a source memory experiment, we reversed the direction of information transfer, as was done in Gopie and MacLeod (2009), so that famous people now shared information with the participants. This was accomplished by switching the slide order of the destination memory experiment. Participants were instructed that facts would be told to them by famous people, and the picture now appeared before the fact. There was no mention of a later memory test.

Method

Participants—Table 1 contains the demographic data for the 20 young undergraduates at the University of Toronto and the 20 older volunteers from the community who participated in this experiment. None had participated in Experiment 1. As in Experiment 1, older adults had more years of education, $F(1, 39) = 10.15$, $p < .01$, and higher Shipley Vocabulary scores, $F(1, 39) = 28.29$, $p < .001$, than the young adults. Participants had normal or corrected-to-normal vision and no history of neurological or psychiatric disorders. The older adults were also screened for cognitive impairment with the Mini-Mental State Examination ($M = 29.2$; all participants ≥ 27.0).

Materials—The stimuli in this experiment were the same materials used in Experiment 1.

Procedure—Participants were instructed that facts would be told to them by famous people, and, as in Experiment 1, no mention was made of memory being tested later. Study trial presentation began with a 1,000-ms white fixation cross (+) on a black-background computer screen. A famous person's face then appeared. After viewing the famous face, the participant pressed the space bar. This resulted in a blank screen for 250 ms, followed by presentation of a fact. The participant then read silently the fact that the depicted famous person was "telling" him or her and pressed the space bar again, which resulted in a blank screen for 250 ms. This procedure repeated until the participant had seen 50 facts, each presented by a different person.

The recognition memory tests were identical to those in Experiment 1 except for a simple instructional change on the associative test. Instead of determining whether they had previously told a particular fact to a face (destination memory), participants now decided whether the face had told them the fact (source memory).

Results

Corrected recognition data (proportion hits minus proportion false alarms; see Figure 1b) were submitted to a 2 (age: young, old) × 3 (memory task: face, fact, source) mixed ANOVA. There were significant main effects for memory task, $F(2, 76) = 55.59$, $p < .001$, $\eta_p^2 = .59$, and age, $F(1, 38) = 5.94$, $p < .05$, $\eta_p^2 = .14$, but no interaction between memory task and age, $F(2, 76) = 0.02$, $p > .10$, $\eta_p^2 = .00$. Interest in this study centered on age-related differences in memory; therefore, despite the lack of an interaction, one-way ANOVAs were conducted. They revealed that older adults had worse face memory, $F(1, 39) = 4.98$, $p < .05$, and fact memory, $F(1, 39) = 4.19$, $p < .05$, than the young adults, whereas older and young adults had similar source memory, $F(1, 39) = 1.67$, $p > .10$. Although there was an age-related destination memory difference in Experiment 1, there was no age-related source memory difference in this experiment.

To yield further information regarding the source memory performance, we examined the proportions of hits and false alarms shown in Table 3 for the source memory test in a 2 (age: young, old) × 2 (response: hit, false alarm) mixed ANOVA. There was a significant main effect of response, $F(1, 38) = 212.62$, $p < .001$, $\eta_p^2 = .85$, and there was no main effect of age, $F(1, 38) < 1$, and no Age × Response interaction, $F(1, 38) = 1.66$, $p > .10$, $\eta_p^2 = .05$. Therefore, both young and older adults made more source memory hits than false alarms.

Proportions of high-confidence responses (i.e., “sure new” or “sure old”; shown in Table 3) for facts and faces were independently examined from the source memory test. One young and one older adult were excluded from this and the subsequent confidence analysis because they exclusively used the high-confidence responses during both recognition tests; their absence did not change any other analysis. A 2 (age: young, old) × 2 (memory: face, fact) × 2 (response: hit, correct rejection) mixed ANOVA on the remaining participants revealed a significant Memory × Response interaction, $F(1, 36) = 8.50$, $p < .01$, $\eta_p^2 = .19$, which indicated that faces had proportionately more high-confidence hits (.96) than high-confidence correct rejections (.91; $p < .05$). No main effects or other interactions were statistically reliable.

A 2 (age: young, old) × 4 (response: hit, miss, false alarm, correct rejection) mixed ANOVA for high-confidence responses within the source memory test revealed a significant main effect of response, $F(3, 93) = 38.05$, $p < .001$, $\eta_p^2 = .55$, which was qualified by a marginally significant Age × Response interaction, $F(3, 93) = 2.39$, $p = .07$, $\eta_p^2 = .07$. There was no main effect of age, $F(1, 31) = 2.34$, $p > .10$. A one-way ANOVA indicated that older adults made significantly more high-confidence false alarms (.31) than young adults (.12), $F(1, 34) = 6.20$, $p < .05$.

Discussion

Simply changing how information is transferred by having famous people provide facts to participants resulted in a different pattern of results in the source memory experiment than in the destination memory experiment. Young adults had slightly better item memory than the older adults, but there was no age-related source memory difference in this incidental learning paradigm. This result may, at first, seem to be at odds with the literature, which contains evidence for age-related source memory impairment in older adults (e.g., Naveh-Benjamin, 2000). A recent meta-analysis by Old and Naveh-Benjamin (2008) indicates, however, that age-related deficits trend toward a disproportionate deficit for associative versus item information under incidental learning conditions. Therefore, the absence of an age-related source memory deficit in this incidental experiment is not entirely startling. What is surprising, though, is that there was a substantial impairment among older adults versus young adults in the incidental destination memory experiment with identical stimuli and tests. We return to this point in the General Discussion.

Turning to the confidence judgments, older adults were more likely than young adults to make high-confidence memory errors for recombined facts and faces (i.e., false alarms). This is consistent with the results from other source memory experiments (e.g., Dodson, Bawa, & Krueger, 2007; Dodson, Bawa, & Slotnick, 2007) and demonstrates that older adults may rely more on the familiarity of individual faces and facts rather than recollection of the association between them as a basis of source confidence judgments. In contrast, older adults were more confident than young adults about their misses in the destination memory experiment. Therefore, age-related differences in memory confidence may change depending on whether people are inputting or outputting information.

General Discussion

Researchers may be skeptical about further partitioning episodic memory into source memory and destination memory and exploring within each various empirical and theoretical queries. Indeed, destination memory and source memory are similar: They rely on remembering relations among individual items of information, so that at retrieval these relations can be assembled to form the previously encoded episode. We do not disagree that destination memory and source memory recruit a similar subset of processes (e.g., feature binding during encoding and evaluation processes during remembering). However, as Gopie and MacLeod (2009) demonstrated, destination memory is different at least in terms of having an additional self-focus component, whereas source memory does not. That is, while one tells someone information, attention is focused on the processes required to transmit that information, which reduces the resources available to associate the fact to the person to whom one is telling it. Consequently, destination memory is less accurate than source memory in young adults. The current study extended those findings to older adults.

Older adults had worse overall memory than young adults in the source memory experiment. Older adults, however, were not more impaired relative to young adults on source memory than on item memory for the faces and facts. This result differs from research that demonstrates a disproportionate impairment for source memory relative to item memory (e.g., McIntyre & Craik, 1987; Naveh-Benjamin, 2000), but the current study is not unique in this regard. In fact, Old and Naveh-Benjamin's (2008) meta-analysis with 90 episodic memory studies for both item and associative information indicated that approximately 28% of the studies did not find an age-related disproportionate impairment on associative memory measures relative to item memory measures. It is speculatively suggested that our source memory experiment's incidental learning condition and recognition memory test format mitigated the age-related decrement in source memory. As Old and Naveh-Benjamin noted, the age-related source memory deficit is less pronounced under incidental versus intentional learning conditions and the effect size of age differences in source memory is smallest when recognition tests versus recall tests are used. That an age-related difference in destination memory was found, using the same materials and tests, suggests that destination memory may be more sensitive to the aging process than source memory, because destination memory involves an additional task at encoding: transmitting information. This additional task may be particularly problematic for the associative memory processes of older adults because of their limited cognitive resources (e.g., Craik & Byrd, 1982). There may be other components further delineating destination memory as distinct from source memory that warrant further research. For example, only in destination memory and not in source memory are decisions made regarding to whom to tell information and from whom information will be withheld.

The destination amnesia of older adults is characterized by their false beliefs that they have told someone a particular piece of information. This finding has significant practical implications. For example, an erroneous diagnosis may result if information is unintentionally withheld from a physician due to an elderly patient's belief that it has been previously told. Older adults are also highly confident compared to young adults that they have never told particular things to people (i.e., misses). Being highly confident about their destination misses presumably causes older adults to repeat information more often to the same person. In contrast, older adults had the same level of high-confidence responses as young adults for their misses in the source memory experiment. The age-related difference in high-confidence false alarms in the source memory experiment suggests that older adults may more often falsely believe that someone told them information than young adults. This may result in older people telling information to others who lack the appropriate background information.

In summary, the present study shows that destination memory is disproportionately affected relative to item memory by the aging process. Our understanding and subsequent rehabilitation of the age-related impairment in destination memory will benefit from future research that investigates factors that influence the accuracy and confidence of destination memory in older people.

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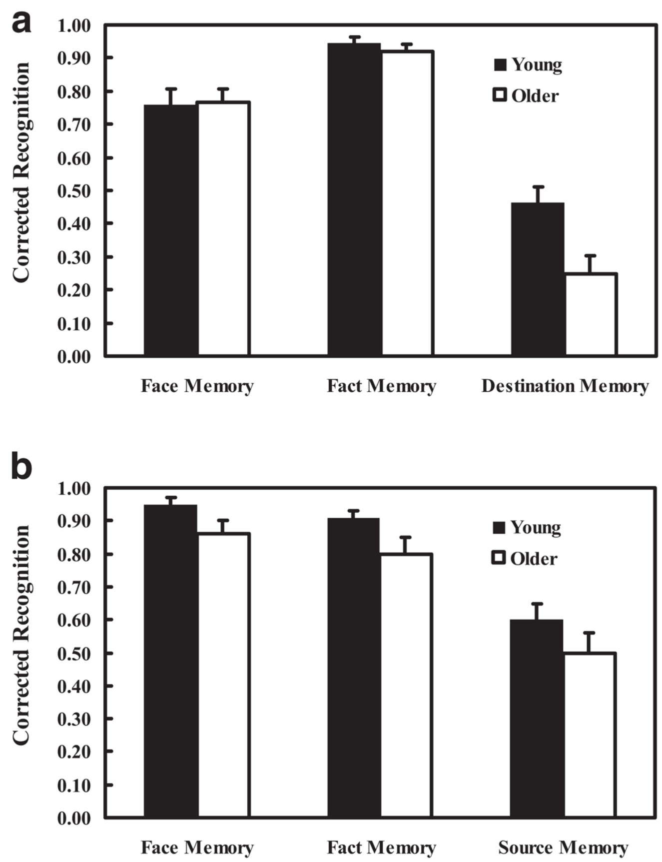

Figure 1.

Results from Experiments 1 and 2. Figure 1a shows the mean corrected recognition scores for Experiment 1's individual face memory, individual fact memory, and destination memory by age-group. Figure 1b shows the mean corrected recognition scores for Experiment 2's individual face memory, individual fact memory, and source memory by age-group. Error bars represent standard errors of the mean.

Table 1

Demographic Characteristics for Participants in Experiments 1 and 2

Group	Age, years			Years of education		Shipley Vocabulary		Mini-Mental State Exam	
	M	Range	*SE*	*M*	*SE*	*M*	*SE*	*M*	*SE*
Experiment 1: Destination memory									
Young	20.1	18–24	0.40	14.4	0.29	31.5	0.79		
Older	71.8	62–83	1.23	15.9	0.70	35.2	0.85	29.4	0.21
Experiment 2: Source memory									
Young	21.2	18–30	0.94	14.6	0.65	30.3	0.96		
Older	70.4	60–81	1.10	17.4	0.60	36.3	0.60	29.2	0.20

Note. Shipley Vocabulary = Vocabulary subtest of the Shipley Institute of Living Scale; *SE* = standard error.

Table 2

Proportions of Hits, False Alarms, and High-Confidence Responses by Age-Group in Experiment 1

			High-confidence responses			
Group and test	**Hit**	**False alarm**	**Hit**	**Miss**	**Correct rejection**	**False alarm**
Young						
Face	0.83 (0.04)	0.07 (0.03)	0.92 (0.02)		0.84 (0.05)	
Fact	0.95 (0.02)	0.01 (0.01)	0.99 (0.01)		0.97 (0.01)	
Destination	0.73 (0.03)	0.27* (0.04)	0.67 (0.04)	0.26* (0.05)	0.56 (0.04)	0.26 (0.07)
Older						
Face	0.86 (0.03)	0.09 (0.02)	0.88 (0.04)		0.91 (0.02)	
Fact	0.93 (0.02)	0.01 (0.01)	0.97 (0.01)		0.97 (0.01)	
Destination	0.68 (0.06)	0.43* (0.06)	0.66 (0.04)	0.49* (0.05)	0.54 (0.06)	0.31 (0.07)

Note. The proportions of high-confidence responses for misses and false alarms were not calculated for individual face and fact recognition because misses and false alarms were infrequent for many participants. Standard errors are shown in parentheses. Significant age-group differences are indicated by an asterisk.

Table 3

Proportions of Hits, False Alarms, and High-Confidence Responses by Age-Group in Experiment 2

			High-confidence responses			
Group and test	**Hit**	**False alarm**	**Hit**	**Miss**	**Correct rejection**	**False alarm**
Young						
Face	0.98 (0.01)	0.03 (0.02)	0.96 (0.02)		0.91 (0.03)	
Fact	0.92 (0.02)	0.01 (0.01)	0.92 (0.03)		0.96 (0.02)	
Source	0.78 (0.04)	0.18 (0.04)	0.73 (0.04)	0.22 (0.06)	0.64 (0.05)	0.12* (0.04)
Older						
Face	0.93 (0.03)	0.07 (0.02)	0.95 (0.03)		0.91 (0.03)	
Fact	0.83 (0.05)	0.03 (0.01)	0.92 (0.02)		0.93 (0.03)	
Source	0.75 (0.03)	0.25 (0.04)	0.70 (0.05)	0.36 (0.07)	0.61 (0.04)	0.31* (0.06)

Note. The proportions of high-confidence responses for misses and false alarms were not calculated for individual face and fact recognition because misses and false alarms were infrequent for many participants. Standard errors are shown in parentheses. Significant age-group differences are indicated by an asterisk.