

# Collaboration Reduces the Frequency of False Memories in Older and Younger Adults

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Older (mean age = 74.23) and younger (mean age = 33.50) participants recalled items from 6 briefly exposed household scenes either alone or with their spouses. Collaborative recall was compared with the pooled, nonredundant recall of spouses remembering alone (nominal groups). The authors examined hits, self-generated false memories, and false memories produced by another person's (actually a computer program's) misleading recollections. Older adults reported fewer hits and more self-generated false memories than younger adults. Relative to nominal groups, older and younger collaborating groups reported fewer hits and fewer self-generated false memories. Collaboration also reduced older people's computer-initiated false memories. The memory conversations in the collaborative groups were analyzed for evidence that collaboration inhibits the production of errors and/or promotes quality control processes that detect and eliminate errors. Only older adults inhibited the production of wrong answers, but both age groups eliminated errors during their discussions. The partners played an important role in helping rememberers discard false memories in older and younger couples. The results support the use of collaboration to reduce false recall in both younger and older adults.

*Keywords:* collaborative memory, false memories, aging, memory

Although psychologists typically study remembering as a solitary activity, people frequently turn to others for memory help. Conceivably, people's reliance on others increases with age: Individuals might seek collaboration to compensate for their age-related declines in individual memory (Dixon, 1999; Gould, Osborn, Krein, & Mortenson, 2002). In the present study, we investigated memory in older and younger couples with the goal of examining whether collaboration reduces the frequency of false memories.

Most previous studies of collaborative memory have been conducted with university students, and the focus has been on accurate rather than false memories. Researchers examine whether collaboration produces a synergy such that two individuals remember more together than they would if they pooled their independent recollections. To examine whether the combined effect of collaboration is greater than the sum of the individual memories, researchers compare participants remembering together with nominal group recall. In the nominal group condition, participants working alone are coupled, often randomly, and their recall is pooled. The recall score of a nominal group is the total amount of nonredundant information in the pooled recall. Researchers con-

sistently find that collaboration inhibits rather than improves memory of previously studied items relative to nominal group recall. In study after study, nominal group recall exceeds collaborative recall, which, in turn, surpasses individual memory (e.g., Basden, Basden, Bryner, & Thomas, 1997; Finlay, Hitch, & Meudell, 2000; Weldon & Bellinger, 1997; Yaron-Antar & Nachson, 2006). Although collaborative inhibition sometimes declines in well-acquainted groups, it is not reversed. Collaborating friends or spouses recall no more information than nominal groups, and typically recall less (Andersson & Ronnberg, 1995; Johannson, Andersson, & Ronnberg, 2000). When nominal group recall exceeds collaborative recall, collaboration apparently yields inadequate retrieval cues and interference rather than accurate emergent memories (Finlay et al., 2000; Meudell, Hitch, & Boyle, 1995).

Conceivably, collaborative recall would be more useful to older adults than to university students. Older people have difficulty with self-initiated retrieval (Craik & Jennings, 1992); consequently, even the somewhat inadequate retrieval cues provided by others might be helpful (Gould et al., 2002). However, the few published studies of collaborative memory in older adults suggest that two individuals remember less together than they would if they pooled their independent recollections. As in studies of younger adults, collaborating groups of older adults produce less correct recall than do nominal groups (Johannsson et al., 2000; Ross, Spencer, Lindardatos, Lam, & Perunovic, 2004). These studies did not compare the recall of older and younger collaborating and nominal groups; consequently, it is still conceivable that joint remembering provides some benefit for older people.

It is also possible that researchers fail to find evidence of collaborative synergy because they are looking in the wrong place. Perhaps collaboration would reduce memory errors even if it does not improve correct memory relative to nominal group recall. There are at least two reasons why collaboration may decrease

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memory errors. First, collaboration might inhibit the production of wrong answers. If collaborating individuals are uncertain about their memories, then they may rely on their partners' memories and not even state their own recollections. Alternatively, collaborating partners may produce false memories, which they eliminate through mutual error checking. It seems likely that memory errors are often unique to an individual, reflecting his or her knowledge base, associative linkages between items in long-term memory, preferences, and so forth (Ross et al., 2004). If memory errors are person specific, then a rememberer's partner could exercise a kind of quality control by inspecting the memory, assessing its accuracy, and rejecting false recall (see Jacoby & Rhodes, 2006, for a similar analogy in individual recall).

It is unclear from past research whether collaboration reduces memory errors. Few studies of collaborative memory in university students report memory errors. A measure of false positives—incorrectly recalling an item that was not among the previously studied items—is probably omitted in many studies because their frequency is very low for the memory tasks commonly used (e.g., recall of word lists shortly after presentation). The effect of collaboration is inconsistent in studies of this type that do present analyses of erroneous recall. Some researchers find that collaborative groups produce fewer errors than do nominal groups (Perlmutter & De Montmollin, 1952; Yunker, 1955); some researchers report no difference between collaborative and nominal groups (Finlay et al., 2000; Weldon & Bellinger, 1997); occasionally researchers report a greater number of errors for collaborative than for nominal groups (Basden et al., 1997).

Collaboration may not reliably reduce errors in these studies because of the nature of the memory tasks (very few errors). Collaboration should be more useful when memory tasks yield many false positives. In two recent studies of young adults, researchers examined collaborative recall using tests on which memory errors should be fairly common. In contrast to laboratory studies of collaborative memory, in which recall of word lists is obtained shortly after their presentation, Yaron-Antar and Nachon (2006) studied Israeli students' detailed long-term memory of an emotional event, the assassination of Prime Minister Rabin, which occurred about 7 years prior to the recall test. Collaborative responses contained both fewer accurate details and fewer errors than did nominal responses. Takahashi (2007) studied collaborative recall using the Deese-Roediger-McDermott paradigm (Roediger & McDermott, 1995), which is designed to produce memory errors. Collaboration reduced false recall.

Collaboration may be especially useful in reducing memory errors in older people because aging is associated with a dramatic increase in false memories (Jacoby & Rhodes, 2006). Relative to younger adults, older individuals are more likely to be misled by false information, more prone to forgetting or confabulating the context of a memory (source memory errors), and more confident of the accuracy of their false memories (Hashtroudi, Johnson, & Chrosniak, 1989; Jacoby, 1999; Jacoby, Bishara, Hessels, & Toth, 2005; Karpel, Hoyer, & Toglia, 2001; Kelley & Sahakyan, 2003; McCabe & Smith, 2002). Normal aging is associated with an increased tendency to make false recognition responses, even when true recognition (hits) does not change (Koustaal, 2003). The age-related increase in false memory is probably multiply determined. Plausible explanations include source memory confusions, the tendency of older people to regard readily accessible informa-

tion as memories, and their relative inability to suppress misinformation (Jacoby & Rhodes, 2006).

There is some evidence that collaboration reduces false recall in older adults. Using everyday memory tasks in which false memories were quite common (recall of shopping lists and locations of city landmarks), Ross et al. (2004) found that collaborative groups of older adults reported fewer errors in free recall than did nominal groups. Ross et al. (2004) did not include a comparison group of younger adults; therefore, it is unclear whether collaborating younger adults might also have shown a reduction in memory errors.

In the present experiment, we examined recall in a context in which false memories should be fairly plentiful among both younger and older adults (albeit more common among the latter). We compared the collaborative and individual memories of older and younger spouses using a paradigm developed by Roediger and Meade (Meade & Roediger, 2002; Roediger, Meade, & Bergman, 2001). Participants briefly viewed pictures of six rooms in a house and subsequently tried to recall the objects in each room. To boost the number of false positives, we followed the Roediger et al. (2001) procedure of increasing false memories through social influence. Immediately after viewing the pictures, participants were asked to remember six items from each scene. Participants took turns doing the recall with an anonymous "other participant," who also recalled six items from the scene. The "other participant" was actually a computer programmed to provide responses from a list of items in the photos. For three of the scenes, the computer provided the names of two items that had not appeared. As in Roediger et al. (2001), some of these false items would seem very likely to be in the target scene (high-expectancy items); other false items were less likely to be in the target scene (low-expectancy items), though not out of place.

The critical recall phase occurred next. Participants were asked to remember as many items from each scene as they could. Because they were interested in social influence, Roediger and his associates (2001) did not report hits or self-generated false positives. We assessed hits, self-generated false positives (recalled items not appearing in a target scene and not falsely listed by the computer), and computer-initiated false positives (recalled items not appearing in a target scene that had been listed by the computer) in nominal and collaborative groups of older and younger participants.

As in past research, we expected nominal groups to produce more hits than collaborating groups. Our major focus was memory errors. We expected a fair number of self-initiated memory errors, especially among older participants, because the scenes were presented briefly and because participants could confuse the contents of scenes with the contents of similar settings in their own homes. We also examined whether participants tended to report in free recall the false memories provided by the computer. We investigated whether collaboration reduced participants' self-initiated false positives and increased their resistance to reporting the computer-initiated errors in recall. We expected that participants recalling the scenes alone would be more likely to remember high-expectancy (or schema-consistent), computer-initiated false items as appearing in the scenes (Roediger et al., 2001). We examined whether collaboration would help participants eliminate even these high-expectancy false items from free recall.

Most important, we tape-recorded the memory conversations that occurred in collaborative groups during free recall to determine how collaboration reduces false memories. We studied whether collaboration inhibited the production of memory errors or whether participants discussed wrong answers but reduced the number of errors before answering the memory test. We looked especially for evidence that the partner exercised quality control over the memories during the conversations, thereby improving the accuracy of recall. To our knowledge, no previous study has analyzed memory talk with the goal of examining how collaboration reduces errors in recall.

As far as we know, ours is also the first study to directly compare the collaborative and individual recall of younger and older dyads, using nominal groups as controls. We assessed whether collaboration was especially useful in helping older adults avoid memory errors. To increase the ecological validity of the findings, we studied married couples. Married couples are likely to have a history and future of engaging in collaborative recall.

## Method

### Participants

Thirty-two younger (age 40 and under) and 34 older (age 65 and older) married couples participated in the study. Younger couples were recruited through posted advertisements in the community, children's swim classes, and preschools. Older couples were recruited through anniversary announcements in the local newspaper, posters in the community, retirement communities, shopping malls, and fitness classes. Couples received \$30 as compensation for their participation. The data from two older couples were excluded from the analyses: In one case, a spouse did not follow directions, and in the other case, one spouse was being treated for memory difficulties. The data analyses included 17 older and 16 younger couples randomly assigned to the collaborative condition and 15 older and 16 younger couples randomly assigned to the nominal group condition.

On average, older couples had been married for 51.55 years ( $SD = 4.25$ ), and husbands ( $M = 75.15$ ,  $SD = 4.30$ ) were significantly older than their wives ( $M = 73.30$ ,  $SD = 4.70$ ),  $t(32) = 3.63$ ,  $p = .001$ . Younger couples had been married an average of 8.16 years ( $SD = 3.61$ ), and husbands ( $M = 33.90$ ,  $SD = 4.32$ ) were slightly older than their wives ( $M = 33.09$ ,  $SD = 4.07$ ),  $t(30) = 1.99$ ,  $p = .06$ . One younger couple was excluded from this age analysis because the husband did not provide his age.

Participants rated their level of education on a 7-point scale where 0 = *grade school completed*, 1 = *some high school*, 2 = *high school completed*, 3 = *some college or university*, 4 = *college or university completed*, 5 = *some advanced degree*, 6 = *advanced degree completed*. Younger participants ( $M = 4.09$ ,  $SD = 0.92$ ) reported a significantly higher level of education than did older participants ( $M = 1.98$ ,  $SD = 1.73$ ),  $F(1, 122) = 75.10$ ,  $p < .001$ . Also, men ( $M = 3.28$ ,  $SD = 1.92$ ) indicated a significantly higher level of education than women did ( $M = 2.80$ ,  $SD = 1.52$ ),  $F(1, 122) = 3.90$ ,  $p = .05$ .

### Procedure

Couples were randomly assigned to either the collaborative or nominal group condition. In the collaborative condition, spouses

completed the series of tasks together. In the nominal group condition, spouses participated independently in separate rooms.

*Study phase.* Participants viewed color photos of six household scenes (a toolbox, bathroom, kitchen, bedroom, closet, and desk) identical to those used by Roediger et al. (2001). The scenes contained an average of 23.8 objects. Each scene was displayed on a computer screen for 25 s; the scenes were labeled by the experimenter (e.g., "The toolbox scene"). Participants were informed that their recollections for the objects in the scenes would be tested later. The study phase was followed by an unrelated filler task that lasted about 5 min. Participants were shown briefly exposed letter strings and asked to decide whether each string was a word.

*Implanting false recall.* Next, participants were told the name of each scene and asked to recall items in the scene, one at a time, for a total of six items. Participants in the collaborative groups recalled a total of six items together. Participants in the nominal groups individually recalled six items each. Scenes were named in the same order as they had appeared during the study phase. After participants recalled an item, it was entered into the computer by the experimenter. The computer was programmed to then provide the name of a different object from that particular scene. Participants were told that the researcher was studying collaborative recall and that the computer's answers were chosen randomly from responses provided by previous participants. In actuality, the computer was programmed to provide responses from a list of items in the photos in a set order. The participants and the computer took turns recalling items until both the participants and computer had had an opportunity to list six items, similar to the procedure used by Roediger et al. (2001).

If the participants named one of the items before it was presented by the computer, then the computer was programmed to skip to the subsequent item on the list. For three of the six scenes, the computer would name two items that had not actually appeared in the scene. These items were always the fourth and sixth items shown by the computer. One of the false items named by the computer for a scene was always high in expectancy, and the other one was always low in expectancy, as defined by Meade and Roediger (2002). The high-expectancy false items (e.g., screws, toothbrush, toaster, clock, shoes, and printer) were listed by most participants in a pilot study conducted by Meade and Roediger (2002) as objects that would be likely to appear in their respective scenes. Low-expectancy false items (e.g., ruler, hair brush, oven mitts, cologne, belt, and rolodex) were items that pilot participants expected to appear in their respective scenes but were rarely mentioned. The names of false items (e.g., *ruler*) were displayed on the computer screen during recall of three scenes, either the toolbox, kitchen, and closet scenes or the bathroom, bedroom, and desk scenes.

When the participants could not generate an item, the response was left blank, and the computer would name another item. On average, participants left just over 1 ( $M = 1.19$ ,  $SD = 2.45$ ) of a possible 36 items blank. Nominal groups were more likely to leave blanks ( $M = 2.36$ ,  $SD = 3.13$ ) than collaborating groups ( $M = 0.09$ ,  $SD = 0.29$ ),  $F(1, 60) = 17.87$ ,  $p < .001$ ,  $d = 1.04$ , but there was no effect for age of participants. If the participants repeated an item that they or the computer previously named for that scene, then they would be prompted to provide a different response. Participants provided less than one repeated answer per session

( $M = 0.57$ ,  $SD = 0.99$ ), and there were no effects of age or condition on frequency of repetition. If participants recalled a false item before the computer named it, then the computer was programmed to skip to another false item of similar expectancy. For those completing the task individually (nominal groups), 14 participants listed one of the false items before the computer (12 older, 2 younger), and 2 older participants listed two of the false items before the computer. Of those working together with their spouse, 5 older couples listed one of the false items, and 1 older couple listed two of the items.

The critical recall test occurred next. Participants were given 3 min per scene in which they were asked to write down as many items as they could recall from each specific scene. They were asked to write down only items that they were certain had appeared in each scene. The conversations between collaborating couples were tape-recorded.

## Results

Participants' level of education is omitted from the analyses reported below because its addition as a covariate did not alter the pattern of significant effects. In free recall, nominal group memory was created by adding the nonredundant, independent recollections of both spouses. We obtained three scores for each nominal and collaborative group: hits, self-generated false positives, and computer-initiated false positives. A 2 (age: older vs. younger couple)  $\times$  2 (condition: nominal vs. collaborative condition) analysis of variance (ANOVA) was conducted on the measures. The analysis of computer-initiated false positives also included high versus low expectancy as a repeated measures variable.

### Hits

As in previous studies, nominal groups ( $M = 70.47$ ,  $SD = 16.83$ ) listed more hits than did collaborative groups ( $M = 60.75$ ,  $SD = 18.09$ ),  $F(1, 60) = 12.73$ ,  $p < .01$ , partial  $\eta^2 = .18$ . Also, younger couples ( $M = 79.22$ ,  $SD = 12.42$ ) listed more hits than older couples ( $M = 52.01$ ,  $SD = 11.13$ ),  $F(1, 60) = 99.76$ ,  $p < .01$ , partial  $\eta^2 = .62$ . The Age  $\times$  Condition interaction was nonsignificant ( $F < 1$ ). Even when collaborating, older individuals performed much worse than their younger counterparts.

In line with past research, however, two heads working together were better than one head working alone. We assessed the total number of hits for each person who participated individually and derived an average for the 2 individuals in each nominal group. When we compared these averages with the number of hits obtained by collaborative groups, collaborative groups ( $M = 60.75$ ,  $SD = 18.09$ ) outperformed individuals ( $M = 47.76$ ,  $SD = 13.04$ ),  $F(1, 60) = 27.17$ ,  $p < .01$ , partial  $\eta^2 = .24$ .

### Self-Generated False Positives

Collaboration substantially reduced the number of self-generated false positives ( $M$  collaborative groups = 8.77,  $SD = 5.24$  vs.  $M$  nominal groups = 19.30,  $SD = 12.40$ ),  $F(1, 60) = 39.51$ ,  $p < .01$ , partial  $\eta^2 = .40$ . Also, older couples ( $M = 20.20$ ,  $SD = 11.23$ ) listed many more self-generated false positives than younger couples did ( $M = 7.88$ ,  $SD = 5.65$ ),  $F(1, 60) = 54.13$ ,  $p < .01$ , partial  $\eta^2 = .47$ .

The Age  $\times$  Condition interaction was significant,  $F(1, 60) = 9.93$ ,  $p < .01$ , partial  $\eta^2 = .14$  (see Table 1 for means). Older couples listed significantly more self-generated false positives than younger couples in both the collaborative,  $F(1, 60) = 9.13$ ,  $p < .01$ , partial  $\eta^2 = .47$ , and nominal,  $F(1, 60) = 53.54$ ,  $p < .01$ , partial  $\eta^2 = .52$ , group conditions. However, the decrease in self-generated false positives in the collaborative condition was greater for older,  $F(1, 60) = 44.44$ ,  $p < .01$ , partial  $\eta^2 = .51$ , than for younger couples,  $F(1, 60) = 4.92$ ,  $p = .03$ , partial  $\eta^2 = .22$ .

Collaboration might have a greater impact on older people for two reasons. Because older adults make more errors in the nominal condition than their younger counterparts, collaboration can exert a greater impact. In the extreme, collaboration and its associated correction processes would obviously show no effects if there were no errors to correct. Alternatively, older people might be superior collaborators and benefit more from collaboration than younger adults. We examined these possibilities in two ways. First, we conducted an analysis of self-generated false positives after performing a natural log transformation on the data. In this analysis, only under- or overproportional effects should be reliable. We obtained main effects for condition,  $F(1, 60) = 35.01$ ,  $p < .01$ , partial  $\eta^2 = .50$ , and age,  $F(1, 60) = 60.97$ ,  $p < .01$ , partial  $\eta^2 = .37$ , but no interaction ( $F < 1$ ). This analysis suggests that older and younger participants benefit similarly from collaboration.

To examine the issue further, we divided participants into high performers (those who make relatively few errors) and low performers (those who make relatively many errors) on the basis of median splits within each age group. A 2 (condition: nominal vs. collaborative)  $\times$  2 (performance: high vs. low) ANOVA revealed a condition main effect,  $F(1, 60) = 7.33$ ,  $p = .01$ , partial  $\eta^2 = .11$ , and a performance main effect,  $F(1, 60) = 42.98$ ,  $p < .01$ , partial  $\eta^2 = .42$ , which were qualified by a significant interaction,  $F(1, 60) = 10.17$ ,  $p < .01$ , partial  $\eta^2 = .15$ . High performers evidenced a similar number of false positives in the nominal ( $M = 10.91$ ,  $SD = 6.41$ ) and collaborative ( $M = 11.80$ ,  $SD = 5.29$ ) conditions ( $F < 1$ ). In contrast, low performers made many more errors in the nominal ( $M = 28.86$ ,  $SD = 10.69$ ) than in the collaborative ( $M = 18.00$ ,  $SD = 6.36$ ) condition,  $F(1, 60) = 17.28$ ,  $p < .01$ , partial  $\eta^2 = .30$ . When age was included as a factor in this analysis, it did not qualify the interaction ( $F < 1$ ). The evidence suggests that collaboration helps poor performers, regardless of their age.

### Computer-Initiated False Positives

A 2 (age)  $\times$  2 (condition)  $\times$  2 (expectancy: high vs. low as a repeated factor) ANOVA indicated a main effect of expectancy,

Table 1  
Mean Number of Self-Generated False Positives Recalled by Younger and Older Couples

Age of couple	Condition			
	Nominal		Collaborative	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Younger	10.50	6.67	5.25	2.59
Older	28.10	10.52	12.29	4.81

$F(1, 60) = 18.35, p < .01$ , partial  $\eta^2 = .23$ . Couples were more likely to recall high-expectancy ( $M = 1.59, SD = 0.76$ ) than low-expectancy false items ( $M = 1.01, SD = 0.91$ ). There was no main effect of age ( $F < 1$ ). However, the three-way interaction was significant,  $F(1, 60) = 4.96, p = .03$ , partial  $\eta^2 = .08$ .

We decomposed the interaction by examining effects separately within older and younger couples. Older couples recalled significantly more high-expectancy ( $M = 1.62, SD = 0.77$ ) than low-expectancy ( $M = 1.05, SD = 1.00$ ) computer-initiated false positives,  $F(1, 60) = 8.78, p < .01$ , partial  $\eta^2 = .17$ . Also, older couples in the nominal group condition ( $M = 1.55, SD = 0.85$ ) listed significantly more computer-initiated false positives than did those in the collaborative condition ( $M = 1.12, SD = 0.88$ ),  $F(1, 60) = 3.88, p = .05$ , partial  $\eta^2 = .12$ . The Expectancy  $\times$  Condition interaction was nonsignificant ( $F < 1$ ).

Younger couples recalled significantly more high-expectancy ( $M = 1.56, SD = 0.76$ ) than low-expectancy ( $M = 0.97, SD = 0.82$ ) computer-initiated false positives,  $F(1, 60) = 9.58, p < .01$ , partial  $\eta^2 = .35$ . The main effect of condition was nonsignificant ( $F < 1$ ), but the Condition  $\times$  Expectancy interaction was significant,  $F(1, 60) = 5.97, p = .02$ , partial  $\eta^2 = .25$  (see Table 2 for means). In the nominal group condition, younger couples listed significantly more high-expectancy than low-expectancy computer-initiated false positives,  $F(1, 60) = 15.33, p < .01$ , partial  $\eta^2 = .67$ ; this effect of expectancy was eliminated in the collaborative condition ( $F < 1$ ). The reduction in the expectancy effect in the collaborative condition was due to a slight increase in false positives in the low-expectancy condition and a slight decrease in false positives in the high-expectancy condition; neither of these trends approached significance ( $ps > .10$ ).

In summary, collaboration helped older participants reduce the frequency of both high- and low-expectancy computer-initiated false positives. For younger participants, collaboration led to a numerical decrease only for high-expectancy false positives. The lack of a reduction for low-expectancy false positives is likely due to their scarcity among younger participants. For high-expectancy items, older and younger adults in the nominal group condition reported similar numbers of false positives ( $M_s = 1.76$  and  $1.81$ , respectively).

*Memory Talk in Collaborative Groups*

To examine how collaboration reduces memory errors, we analyzed the conversations between collaborating partners as they

completed the free-recall task. We evaluated two major possibilities. First, error reduction could occur because collaborating spouses inhibit wrong responses—they state fewer erroneous answers aloud to their partners. To evaluate this inhibition hypothesis, we assessed the number of wrong responses that individuals in collaborative groups suggested while discussing *potential* answers to the recall task. We then compared the number of erroneous suggestions with the number of memory errors reported in nominal groups. The inhibition hypothesis predicts that collaborating couples will suggest fewer errors than nominal groups produce in their recall.

Alternatively, collaborating spouses do not inhibit their wrong answers but eliminate some of their errors while talking to their partners. To examine this possibility, we compared the number of memory errors that arose as collaborating couples discussed their responses with the number of errors that they subsequently entered as answers. We assessed whether partners discuss a greater number of erroneous answers than they subsequently enter as memory responses.

In conducting these analyses, we collapsed across self-generated and computer-initiated errors because the numbers for the latter were low. The pattern of means and significance level of findings we report are identical to those obtained when we examined only self-generated errors. The pattern of means for the computer-initiated errors is also identical to the overall pattern, but the significance levels are reduced likely because of the smaller number of computer-generated false positives.

The effects of collaboration are somewhat different in the two age groups (see Table 3 for means). When we compared the number of erroneous suggestions during discussion in collaborative groups with the number of memory errors reported in nominal groups, the Condition  $\times$  Age interaction was significant,  $F(1, 60) = 9.18, p < .01$ , partial  $\eta^2 = .13$ . Only older couples inhibited errors. Older couples discussed fewer erroneous answers than older nominal groups reported,  $F(1, 60) = 12.79, p < .01$ , partial  $\eta^2 = .24$ . In contrast, younger couples discussed nonsignificantly more wrong answers ( $F < 1$ ) than younger nominal groups reported.

Next, we compared the number of memory errors collaborating partners suggested with the number of errors that they subsequently entered as answers. We found evidence of active error checking in both age groups. Couples entered far fewer errors ( $M = 11.18, SD = 5.50$ ) as memory responses than they suggested ( $M = 18.27, SD = 6.96$ ) during their conversations,  $F(1, 60) = 62.69, p < .01$ , partial  $\eta^2 = .67$ . The interaction with age was nonsignificant ( $F < 1$ ).

Finally, we examined how active memory checking occurred by focusing on talk that took place when an answer was proposed by one person but subsequently discarded rather than entered as a memory response. We assessed whether either partner rejected (e.g., “No, you’re thinking of the bedroom scene. We’re in the closet now”) or expressed uncertainty (e.g., “Hmm, I don’t remember seeing that. Are you sure there was one?”) about the discarded item and whether the item would have been a correct memory response. The talk data from 4 couples (three older, one younger) were excluded from the analyses because the quality of the audio was too poor to code. Two coders, uninformed of the age of the dyad and the hypotheses, coded the verbal data. Coders agreed on

Table 2  
Mean Number of Computer-Generated False Positives Recalled

Expectancy	Condition			
	Nominal		Collaborative	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Younger couples				
High	1.81	0.75	1.31	0.70
Low	0.75	0.68	1.19	0.91
Older couples				
High	1.76	0.73	1.47	0.80
Low	1.33	0.96	0.76	0.97

Table 3  
Mean Number of False Positives Suggested During Memory Conversations or Entered as Answers

Age of couple	Nominal groups' entered answers		Collaborative groups' suggested answers		Collaborative groups' entered answers	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Younger	13.06	7.23	15.00	5.39	7.69	3.54
Older	31.20	10.77	21.35	6.99	14.47	5.00

98% of the codes, and the few disagreements were resolved by discussion.

In discussing their answers, younger couples suggested more items ( $M = 94.31$ ,  $SD = 21.36$ ) than older couples did ( $M = 69.80$ ,  $SD = 15.47$ ),  $t(26) = 3.51$ ,  $p < .01$ ,  $d = 1.38$ . Older and younger dyads did not differ significantly in the proportion of proposed answers entered as memory responses ( $M = 0.83$ ,  $SD = 0.07$  and  $M = 0.84$ ,  $SD = 0.05$ , respectively). On average, couples discussed 12.71 suggestions that were abandoned. The majority of these discarded answers (7.67, or 60.35%) would have been incorrect if entered as memory responses.

We obtained evidence that a rememberer's partner exerts a kind of quality control. Partners rejected a higher proportion of incorrect ( $M = 0.07$ ,  $SD = 0.08$ ) than of correct suggestions ( $M = 0.01$ ,  $SD = 0.02$ ),  $F(1, 26) = 14.04$ ,  $p < .01$ , partial  $\eta^2 = .35$ . The likelihood of rejecting incorrect as opposed to correct suggestions did not differ significantly as a function of the age of the dyad,  $F(1, 26) = 2.36$ ,  $p = .14$ , partial  $\eta^2 = .08$ .

We obtained similar results when a rememberer's partner expressed uncertainty about a memory. Partners expressed uncertainty about a higher proportion of the rememberer's incorrect ( $M = 0.04$ ,  $SD = 0.05$ ) than correct suggestions ( $M = 0.01$ ,  $SD = 0.02$ ),  $F(1, 26) = 6.79$ ,  $p = .02$ , partial  $\eta^2 = .21$ . The likelihood of expressing uncertainty about an incorrect as opposed to a correct suggestion did not differ as a function of the age of the dyad ( $F < 1$ ).

Sometimes both members of the couple responded unenthusiastically to a suggestion. In the only case of explicit rejection from both partners, the participants in one older couple jointly rejected a correct response. More often, members of the couple indicated mutual uncertainty about a response. Both participants expressed uncertainty for a higher proportion of incorrect ( $M = 0.15$ ,  $SD = 0.17$ ) than correct suggestions ( $M = 0.05$ ,  $SD = 0.06$ ),  $F(1, 26) = 10.14$ ,  $p < .01$ , partial  $\eta^2 = .28$ . Again, this effect was not qualified by the age of the dyad ( $F < 1$ ).

Occasionally, individuals would propose and then reject or express uncertainty about their own suggestions without any input from their partners. Self-rejections occurred for a higher proportion of incorrect ( $M = 0.02$ ,  $SD = 0.03$ ) than correct responses ( $M = 0.01$ ,  $SD = 0.02$ ),  $F(1, 26) = 7.14$ ,  $p = .01$ , partial  $\eta^2 = .22$ , in both age groups. The effect of age was nonsignificant ( $F < 1.4$ ). Similarly, people tended to be uncertain about a higher proportion of their own incorrect ( $M = 0.10$ ,  $SD = 0.14$ ) than correct ( $M = 0.04$ ,  $SD = 0.07$ ) suggestions,  $F(1, 26) = 3.67$ ,  $p = .07$ , partial  $\eta^2 = .12$ , but this finding seemed to be qualified by age,  $F(1,$

26) = 3.31,  $p = .08$ , partial  $\eta^2 = .11$ . Older people were just as likely to express uncertainty about their own incorrect ( $M = 0.06$ ,  $SD = 0.08$ ) or correct ( $M = 0.05$ ,  $SD = 0.08$ ) suggestions ( $F < 1$ ), whereas younger people were more likely to express uncertainty about their own incorrect ( $M = 0.14$ ,  $SD = 0.19$ ) than correct ( $M = 0.03$ ,  $SD = 9.05$ ) suggestions,  $F(1, 26) = 6.57$ ,  $p = .01$ , partial  $\eta^2 = .26$ .

In summary, there is evidence that the partner contributes to the reduction of false positives during collaboration in both older and younger couples. Of the false positives that were discarded by couples, 12.12% elicited rejections from the rememberer's partner, 6.51% expressions of uncertainty from the partner, and 24.25% expressions of uncertainty by both partners. Thus, the rememberer's partner apparently played a role in discarding 42.88% of wrong answers. An additional 18.25% of the responses were discarded after the rememberer alone expressed reservations about his or her suggestions. Finally, 38.87% of rejected false positives are not accounted for by the talk data.

### Relation Between Memory Errors and Hits

Finally, we assessed whether couples who produced more false positives were less likely to generate hits by examining within-cell correlations within older and younger nominal and collaborative conditions. In all cases, the relationships were negative (more errors were associated with fewer hits), but the finding was significant only among younger adults in the collaborative condition,  $r(16) = -.57$ ,  $p = .02$ .

## Discussion

This study is the first to compare the collaborative recall of older and younger participants with that of nominal groups. We were primarily interested in studying whether collaborative recall would produce fewer memory errors than nominal group recall. To make this comparison, we examined nonredundant errors in nominal group recall. If the two members of a nominal group made the same error, then it was only counted once. Collaboration reduced self-generated memory errors in both age groups. Collaboration did not eliminate the age difference in self-generated erroneous memories entirely, but it did narrow the gap.

Both older and younger adults profited from collaboration. To explore how collaborative recall reduces memory errors, we examined memory conversations between collaborating spouses. Older couples seemed to benefit in two ways from collaboration: They inhibited the production of some errors and edited out others during conversations with their spouses. In contrast, younger collaborating couples did not inhibit the production of memory errors, but they eliminated almost 50% of their errors while discussing potential answers with their spouses. Relative to their older counterparts, younger adults were more disposed to propose (and then reject) wrong answers in which they themselves felt uncertain. Further research will be needed to establish the reliability and psychological basis of this age difference.

Why are older adults more likely to inhibit memory errors in discussions with their spouses? Conceivably, they are reluctant to state answers that they think might be wrong because they lack faith in their partner's ability to check the validity of their answers. The present data suggest, however, that the partners in both age

groups are effective error checkers. To study the value of error checking, we examined conversations between collaborating spouses concerning items that were proposed by one of the spouses but subsequently discarded as memory responses. The majority of rejected responses were incorrect. Over 40% of these incorrect responses were discarded following expressions of reservation from the partner. Partners were much more likely to express such reservations in response to false rather than to accurate recall. Partners appear to play a valuable role in editing out memory errors in both age groups.

In the present study, we also explicitly examined whether participants incorporated misleading information provided by the computer into their own recall. Collaboration significantly increased older participants' resistance to misleading information. The effect of collaboration was less apparent among younger participants, though it tended to reduce high-expectancy false positives.

The computer-initiated misleading information contained items that differed in degree of schema consistency. Schema-consistent misleading information had a greater impact on recall in both age groups, replicating the results of Roediger et al. (2001) on university students. The finding in the present study that older and younger people were affected equally by computer-initiated misleading information is inconsistent with eyewitness testimony research in which older participants are more susceptible to false information (e.g., Karpel et al., 2001). The important difference between the paradigms is not clear, but the paradigm that we adopted from Roediger et al. (2001) produces a fairly high number of false memories even among younger participants. Indeed, older and younger adults in the nominal group condition reported similar numbers of false positives for high-expectancy items. Conceivably, the age difference is eliminated in the present study because younger participants were susceptible to the computer-initiated, misleading information.

There is a great deal of research documenting memory errors in older people (Jacoby & Rhodes, 2006). There is less research on techniques that might help reduce such errors, though some researchers have reported success with training procedures (e.g., Dodson & Schacter, 2002; Jennings & Jacoby, 2003). If the present results generalize across various memory tasks, then collaboration should be added to the list of potential memory aids. Collaboration has the advantage of being a readily available strategy in everyday life that people can use without any specific training. One practical context in which the potential advantage of collaborative recall should be investigated is the communication of health-related information, especially to older couples; their understanding and recall of medical and self-care procedures can be crucial.<sup>1</sup>

The present research, as well as many previous studies, does show a potential disadvantage to collaborative recall: It reduces hits as compared with pooled individual recall in both younger and older participants. However, the practical relevance of nominal group recall is minimal, despite its significance as a standard for assessing the effects of collaboration. Collaboration is not harmful; it simply produces fewer hits than the sum of two independent recollections. For everyday memory, the more important finding is that collaborative recall almost always produces more hits than either individual would generate alone. Our data suggest that joint remembering can be a useful tactic for people of any age. Collab-

oration may be particularly useful for older people, however, because it appears to reduce their self-generated false positives and increase their resistance to misleading information.

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