DECEIVING THE ELDERLY: EFFECTS OF ACCESSIBILITY BIAS IN CUED-RECALL PERFORMANCE

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Two experiments examined age-related differences in a misinformation paradigm. Young and elderly participants studied a list of related word pairs (e.g. bed sheet) and were then given a cued-recall test ("bed s_ee_" presented as cues for recall of "sheet"). A "prime" stimulus was presented briefly before each test trial. On congruent trials the prime was the target word from study (sheet) whereas on incongruent trials the prime was a plausible response but not the target (sleep). On baseline trials, the prime was a string of ampersands. When forced to respond (Expt. 1), both young and elderly participants demonstrated a bias to respond with the prime word, although the elderly showed a larger false memory effect as measured by higher false recalls on incongruent relative to baseline trials. When given the option to pass (Expt. 2), elderly participants continued to exhibit a large bias toward the prime word whereas young participants tended to pass when they were unable to recall the target. Results are interpreted in terms of an accessibility bias, which influences guessing and is a basis of responding independent of recollection. Discussion focuses on the importance of studying age-related changes in bias and recollection along with neural correlates of these changes.

INTRODUCTION

"I told you earlier that ..." My wife recently informed me that her mother was coming for a visit. When I expressed surprise, she responded that she had informed me earlier of the upcoming visit. However, I was unable to remember her having done so. One possibility is that, perhaps as a result of ageing, I am suffering a deficit in recollection. Another possibility, an unlikely one in this case, is that I was a victim of a "scam"—the earlier conversation may not have occurred but, rather, been invented as a convenience by my wife. A possibility of that sort is one for which elderly people need be alert. Any memory deficit suffered by the elderly might make them particularly vulnerable to untrue claims about past events. Much more than an unexpected visitor can be at stake.

The elderly are a favourite target for fraud, and some fraudulent practices rely on the victim accepting a false "I-told-you" claim. According to the Cleveland Better Business Bureau (http://www.cleveland.bbb.org/alerts/senior.html), in one such scam, con artists telephone seniors and chat with them, in the process collecting as much personal information as possible. In a subsequent callback, the con artists ask questions based on the personal information collected in the first phone

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call. If the senior fails to recollect the previous conversation, the con artists exploit the memory deficit by means of a false claim about an earlier event. As an example, the senior might be told: "We received your cheque for \$1200, but it should only have been for \$950. Send us another cheque for \$950 and we'll simply return the first cheque to you." Actually, no cheque had been sent earlier, but victims of the scam respond by sending a cheque out of guilt or embarrassment.

Does an I-told-you claim create a false memory for the supposed earlier conversation? Other misinformation effects have been explained in that way. Loftus (1975; Loftus & Palmer, 1974) found that exposure to misleading questions about an experience resulted in an apparently permanent loss from memory of details of the original experience. Memory for the original experience was said to be replaced or "overwritten" by the misleading information. Similarly, the misinformation provided by a false I-told-you claim might be added to memory, and replace memory for what was actually said in a prior conversation. However, alternative accounts of misinformation effects have been offered (for a review, see Ayers & Reder, 1998). By a "blocking" account, exposure to incorrect information impairs access to memory for the correct information but does not replace it (e.g. Bekerian & Bowers, 1983; Chandler, 1991). A "source memory" account of misinformation effects also holds that memory for an original experience co-exists with memory for misleading information. However, rather than blocking retrieval of memory for the original experience, misinformation is said to be accepted because of confusion regarding its source (e.g. Avers & Reder, 1998; Lindsay & Johnson, 1989).

It seems improbable that effects of a false I-told-you claim are fully reliant on memory alteration. In part, at least, I-told-you effects are likely because of an influence on bias or guessing. A false claim might be effective only if people are unable to remember the original experience, and then it may only serve as a source for guesses. The possibility of a particular prior experience having occurred is made more accessible by the I-told-you claim. However, acceptance of the claim might rely on a person's forgetting of the original experience and willingness to guess that the claim is a valid one. Similarly, McCloskey and Zaragoza (1985; Zaragoza, McCloskey, & Jamis, 1987) argued that apparent memory impairment found in misinformation effect studies might be due to task demands along with forgetting and influences on guessing rather than to real changes in memory.

Cohen and Faulkner (1989) found that elderly participants were more often misled by false information in an eyewitness testimony paradigm and were also more confident in their erroneous responses than were younger participants. The goal of the experiments reported here was to determine whether elderly participants are also more vulnerable to misinformation in a situation that is similar to the I-told-you example. The procedure of the experiments is outlined in Fig. 1. In Phase 1, people studied a list of related word pairs (e.g. bed sheet, eagle bird, knee bone) that they were told to remember for a later test. In Phase 2, memory was tested by presenting the first word (the cue word) along with a fragment of the second word (the target word) of each pair (e.g. knee b_n_) as cues for recall of the studied target word. Participants were informed that the target word was related semantically to the presented cue word and would complete the fragment. For "incongruent" tests, a "prime" word that would fulfill those requirements but was not the target word was presented immediately prior to the presentation of the test cue (e.g. sleep; bed s ee). In contrast, for baseline tests, no prime word was presented (e.g. &&&&; eagle b_d). For a third type of test, a "congruent" test, the prime word was the same as the target word (e.g. bone; knee b_n_). Participants were warned that the prime word often would be misleading, and were instructed to recall the earlier-studied target word rather than being misled.

Presenting a prime that is plausible but invalid (incongruent test condition) is akin to a false I-told-you claim. Elderly participants, as compared to university students, were expected to show a larger misinformation effect by more often giving the invalid prime as a response. However, that difference simply might reflect elderly participants' poorer ability to remember the target words. Even for baseline tests, for which primes are not pre-

PHASE 1	PHASE 2		TEST
<u>STUDY</u>	<u>TEST</u>		<u>CONDITIONS</u>
-	Prime	Cue Word Word Fragment	
bed sheet	sleep	bed s_ee_	Incongruent (invalid prime)
eagle	&&&&	eagle	Baseline
bird		bd	(no prime)
knee	bone	knee	Congruent
bone		b_n_	(valid prime)

Fig. 1. The basic procedure used for all the experiments.

sented, elderly participants are likely to recall fewer studied words. As an attempt to eliminate that baseline difference, a second group of young participants studied pairs under conditions of divided attention. We expected that for baseline tests, the performance of elderly participants would not differ from that of young participants whose attention was divided during study (e.g. Craik, 1982; Rabinowitz, Craik, & Ackerman, 1982) and that the performance of both groups would be poorer than that of young participants who studied under conditions of full attention.

Unlike other paradigms used to investigate misinformation effects (e.g. Loftus, 1975), the source of (mis)information provided by a prime was made obvious by presenting primes immediately prior to the memory tests. Otherwise, the arrangements for investigating effects of an invalid prime were the same as for investigating other misinformation effects. However, prior investigations of misinformation effects have not included a congruent test condition. Rather, investigators have relied on comparisons between a condition in which misinformation is presented (invalid prime) and a control condition in which misinformation is not presented to measure false memory. Following that convention, we use "false-memory effect" to refer to findings that participants were more likely to mistakenly claim to have earlier studied a word presented as an invalid prime than they would have been had the prime not been presented (baseline condition). Later, we describe advantages of using performance on congruent tests in combination with performance on incongruent tests to analyse the bases for false-memory effects.

After studying under conditions of full attention, the false-memory effect produced by invalid primes was expected to be larger for elderly than for young participants (cf. Cohen & Faulkner, 1989). Dividing young participants' attention during study was expected to produce performance on baseline tests that was the same as that found for elderly participants who devoted full attention to study, but result in a level of false memory that was intermediate to that found for young, full-attention and elderly participants. That is, even if dividing attention of young participants during study did equate performance on baseline tests, we still expected elderly participants to be more vulnerable to misinformation effects. A popular justification for a prediction of this sort is to claim that elderly participants suffer a deficit in their ability to inhibit (e.g. Hasher & Zacks, 1988) preponderant responses. Hasher and Zacks proposed a general theory of cognitive ageing that postulates age-linked deficits in inhibitory processes, and have since reported a great deal of evidence to support their theory. Zacks and Hasher (1997) briefly

reviewed the supporting evidence and responded to critics (Burke, 1997; McDowd, 1997) of their approach. Although elderly participants do show greater interference effects (e.g. Winocur & Moscovitch, 1983), we did *not* base our predictions on differences in inhibitory processes.

By an inhibition-deficit account, elderly participants are unable to inhibit giving an invalid prime word as a response even though, had they been able to do so, they would have been able to recall the earlier-studied word correctly. As an example, they might fail to correctly recall "sheet" when given the cue "bed s_ee_" because they were unable to inhibit giving the invalid prime (sleep) as a response. However, against that account, the causative sequence might be in the opposite direction: Elderly participants might be more likely to produce the invalid prime as a response because they are less able to remember the study word. That is, false recall of an invalid prime might be a consequence, rather than the cause, of memory failure. Anderson and Bjork (1994) noted that a similar ambiguity exists for interpreting the tip-of-the-tongue (TOT) phenomenon. The TOT state is one in which a person is temporarily unable to produce a sought-after word although absolutely certain that they know the word. A common interpretation of the TOT phenomenon is that it arises because of failure to inhibit alternative responses and, in line with that interpretation, people do often report alternate, competing words that come to mind during a TOT. However, the alternative responses might come to mind because of failure to recall the sought-after word rather than being responsible for that failure. Problems in word finding are well documented as increasing with age and older adults suffer more TOTs. However, older adults are less likely to report alternate words than young adults during TOTs in either the laboratory or everyday life (Burke, MacKay, Worthley, & Wade, 1991; Cohen & Faulkner, 1986; Maylor, 1990). The report of fewer alternates is inconsistent with the claim that an age-linked deficit in ability to inhibit alternative responses causes the greater likelihood of a TOT state (Burke, 1997).

Performance on congruent test items in combination with that on incongruent test items can be

used to show that people produce the prime as a response only when they are unable to remember the target. When people do not remember the earlier-studied target word, they might be more likely to produce the prime word as a guess because of its increased accessibility (relative to the baseline test where there is no prime). If people were forced to give a response for each test item, an accessibility bias of this sort would result in the probability of correct recall on congruent and incongruent tests being symmetrical around that on baseline tests. Relative to baseline, giving the prime word as a guess when recollection fails would increase the probability of correct recall for congruent tests but would produce a perfectly offsetting decrease in that probability for incongruent tests. The effect should be perfectly offsetting because materials were constructed such that there were only two acceptable responses for each test item-the target and its alternate. Consequently, if responding is forced, a decrease in correct recalls on an incongruent test must be accompanied by an increase in false recalls (i.e. a larger misinformation effect).

For all groups (young full-attention; young divided attention; and elderly), we expected symmetric effects of valid and invalid primes to show that priming effects do reflect accessibility bias. Given that result, differences in false memory could, at least, in part be explained as because of differences in recollection. Because of a deficit in ability to recollect, elderly participants more often guess and, so, show a larger effect of the prime. For the same reason, dividing attention of young participants during study should increase the likelihood of false memory. However, any difference in false memory between elderly and divided-attention young participants could not be explained as due to a difference in recollection, not if performance on baseline tests was equated.

Strategic avoidance of the prime as a response would allow one to counter accessibility bias when the target word could not be remembered, and differences in strategic avoidance would explain age-related differences in false memory that occur when recollection is equated. Avoidance of the prime as a response when unable to remember the target word is seen as being a strategy that is similar to reversing claims made by an untrusted salesperson so as to avoid being gullible. Reliance on such a strategy would be reasonable in our situation because participants were warned that the prime word often would be misleading. However, although avoiding the prime would avoid false memory, it would carry the cost of decreasing the probability of correct responding on congruent tests. Also, avoiding the prime requires that one be able to generate a suitable alternative response; in this case, a word other than the prime that completes the word fragment and is semantically related to the cue word. Doing so likely requires a good deal of cognitive effort along with vigilance to the possibility of being misled by the high accessibility of the prime word. We expected elderly adults to be more gullible—less likely to strategically avoid the prime when unable to remember the target word.

In sum, our experiments were designed to show that there are two means by which a misinformation effect can be avoided. First, presenting misinformation in the form of an invalid prime was only expected to have an effect when people were unable to remember the target and, so, ability to remember protects one from being misled. Symmetrical effects of valid and invalid primes would show that primes had their effect by means of accessibility bias, a basis for responding that comes into play only when memory fails. Second, when memory does fail, accessibility bias can be countered by strategically avoiding the prime so as to avoid false memory. Elderly participants were expected to be more vulnerable to misinformation both because of their poorer ability to remember and because of their being less likely to avoid the prime strategically when unable to remember. Yet a third means of avoiding a misinformation effect is simply not to respond when unable to remember. Experiment 2 examined age-related differences in willingness to respond. In contrast to Experiment 1, participants in Experiment 2 were allowed to say "pass" when

unable to remember the target word rather than being forced to guess. The question was whether allowing participants not to respond would reduce age-related differences in false memory. In the General Discussion, we further emphasise the advantages of using congruent and incongruent tests to separate the contributions of different bases for responding rather than only examining false memory. Also, we speculate that the different means of avoiding being misled might have different anatomical bases.

EXPERIMENT 1

Method

Participants

Seventy-two young adults and 24 older adults participated in the experiment. The young adults were New York University undergraduates who received credit for an introductory psychology course. Forty-eight of the young adults were selected randomly and assigned to the full attention at study condition, while the remaining 24 were assigned to the divided attention at study condition¹. The older adults were community-dwelling volunteers from the New York City area who were reimbursed for travel expenses. The older adults ranged in age from 64 to 89 years (mean = 73.6 years, SD 7.2), and had a mean of 16.9 years of education. All the older adults were tested in the full attention at study condition. Participants were tested individually.

Materials and design

A pool of 87 cue words, each paired with two associatively related responses (e.g. knee bend, knee bone), was selected mainly from the norms reported by Jacoby (1996). Some additional pairs were constructed based on the same criteria as used in Jacoby's norms. Both associatively related responses

¹ This experiment was run as two separate experiments. One experiment manipulated attention between groups (full vs. divided) with only young participants, and the other experiment looked at different age groups (young vs. elderly) under full-attention conditions. The experiments were identical in all other aspects so they were combined into one which resulted in there being twice as many participants in the young full-attention group than in the other two groups. No Mill Hill Vocabulary test scores were collected on these groups of participants.

contained the same number of letters and could be used to complete the same word fragment (e.g. knee b_n; bone/bend). Three sets of 25 cue words along with their 2 associatively related responses were selected, and with each response word acting equally often as the target response word, this resulted in 6 sets. All sets had an equal distribution of word frequencies (as indexed by Thorndike & Lorge, 1944) for the cue words as well as the two response words, and equal probabilities of completing the word fragments when new (mean = 0.33 for both response words). The sets were balanced also on word length for the cue words (mean = 5.2 letters) and the response words (mean = 4.7 letters). With regard to the placement of the missing letters within each fragment, particular care was given to the first letter so that each set had an equal number of fragments missing the first letter (mean = 9.3 words). Each response set was rotated through each of three test conditions: congruent, incongruent, and baseline. This design resulted in 6 formats (2 response groups × 3 test conditions). To avoid primacy and recency effects, the remaining 12 items in the stimulus pool were used as buffer items with 6 items being presented at the beginning and at the end of the study list. The buffer items stayed constant across all formats.

This setup resulted in a study list of 87 pairs made up of 75 critical pairs and 12 buffer pairs. A test list of 75 items consisted of the 75 critical items from the study phase, with 25 items each presented as congruent, incongruent, and baseline trials. The 12 buffer items from the study phase were used in a separate practice test with 4 items each representing the 3 experimental test conditions. In all phases of the experiment, order of presentation was random with the restrictions that no more than three items representing the same combination of conditions could be presented in a row and all conditions were presented evenly throughout the list.

The listening task used in the divided-attention condition was one previously used by Craik (1982). In this task, participants monitored an auditory list of digits (1 to 9) to detect target sequences of three consecutive odd numbers (e.g. 9, 3, 7). The digits were random with the restriction that a minimum of one number and a maximum of three numbers occur between the end of one target sequence and the beginning of the next target sequence. Digits were recorded at a 1.5sec rate.

Procedure

Words were presented and responses were collected on an IBM-compatible computer with a VGA colour monitor, using Micro Experimental Laboratory (MEL) software (Schneider, 1990). Words were presented in lower-case white letters (approximately 3 × 5mm in size), on a black background in the centre of the computer screen.

In the study phase for both attention conditions, participants were told they would see a list of associatively related word pairs presented one pair at a time with one word placed immediately above the other in the middle of the screen. The pairs were presented for 2sec each with a 0.5sec intertrial interval during which the screen was blank. Participants in both conditions were instructed to pronounce the words out loud and to remember each pair for a later memory test. Participants in the divided-attention condition were told also that they would be required to do a listening task at the same time as doing the reading task. They were informed that it was very important not to miss a target sequence in the listening task. Participants responded by tapping the table whenever they detected a target sequence. Performance on the listening task was monitored by the experimenter. The number tape was presented alone for 15sec prior to the reading task to allow the participants to settle into one task before starting the other.

In the test phase, which followed immediately after the study phase, participants were told they would be required to alternate between two tasks. That is, they would have to study briefly presented single words (the prime words) for a later test as well as do a cued-recall test for the word pairs that they studied in the first part of the experiment. They were informed that we were interested in their ability to memorise the briefly presented single words without confusing those single words with the words they were trying to recall. It was mentioned that this would be a difficult task because sometimes the single word would be the same as the word they were trying to recall but other times it would be a different word. For the cued-recall test, the participants were told they would be presented with a cue word and a fragmented word, a word with some of the letters replaced with underscores. They were to use the word and fragment as cues to help them recall the word (the target word) that accompanied the cue word in the study phase of the experiment. They were instructed to try to recall but, if they couldn't recall, they were to guess but to keep in mind that their guess must be a word related to the cue word and also must fit the fragment. They were again warned not to be misled by the briefly presented single word when doing the recall task. Lastly, they were informed that on some trials no single word would be presented but rather just a string of symbols (&&&&&). For these trials, they were told there was no word to remember for later and that they should just do the recall task. It was explained that these trials allowed us to look at recall performance without the interference of the other task. A demonstration of the test procedure using the example cherry p_ (pie/pit) was presented prior to the practice test.

Each test trial started with a pair of plus signs (10 spaces apart), which were presented for 1sec. The plus signs marked the location on the screen where the single word (prime) appeared. The prime was presented for 500msec followed by an interstimulus interval of 500msec of blank screen. The cue word and word fragment were then presented with the word fragment presented in the same location as the prime while the cue word was on the line immediately above. The cue word and fragment stayed on the screen until the participant either gave a response or 20sec elapsed, at which time the screen cleared and the next trial was presented. The participants were to give their responses out loud. The experimenter keyed in the response and after an intertrial interval of 500msec, the next trial was presented. There was no test of memory for the prime words.

Results and Discussion

In the divided-attention condition, the probability of young adults failing to detect a target sequence for the listening task was .16 (SD = 11).

Although participants were instructed to respond to each test item, they did not always do so. Rather, they sometimes allowed the response interval to lapse without responding or, more rarely, produced a response that was not one of the two responses that we chose for the test item. Errors of this sort were more common for baseline tests than for congruent or incongruent tests (tests preceded by a valid or an invalid prime), and were less common for young participants who studied under conditions of full attention than for participants in the other two groups (Table 1), as indicated by a significant interaction of test condition and group [F(4,186) = 4.05, MSe = 0.003]. This pattern of results is consistent with the suggestion that presentation of a word as a prime increased its accessibility as a response. For baseline tests, participants' inability to think of the alternate as a possible response probably helped to protect against its false recall when they were unable to remember the target. Presenting the alternate as an invalid prime made it more accessible as a response and thereby made it less likely that participants would allow the response interval to lapse without responding.

Because of the rather high probability of failure to respond for baseline tests, it was necessary to examine both correct and false recalls when using those tests to evaluate memory performance. Recall performance was corrected for guessing by subtracting the probability of false recall from that of correct recall. Analysis of these corrected scores revealed that memory performance was higher for young participants who devoted full attention to study (.51) than for elderly participants (.24) or young participants who studied under conditions of divided attention (.22) [F(2,91) = 26.55,

 Table 1. Proportion of Trials on Which Participants Failed To

 Give Either the Target Response or the Alternate Response across

 Groups and Tests in Experiment 1

	Type of Test		
Group	Congruent	Baseline	Incongruent
Young, full attention	.01	.10	.03
Young, divided attention Elderly	.02 .02	.16 .17	.03 .02

MSe = 0.036] A posthoc Newman-Keuls analysis revealed that the difference in performance between the latter two conditions did not approach significance. That is, dividing attention of young participants during study was successful as a means of equating performance of young and elderly participants in their performance on baseline tests.

Examining probabilities of false recall on baseline and incongruent tests revealed that elderly participants showed a much larger false-memory effect than did young full-attention participants (Fig. 2b). For elderly participants, the probability of false recall was much higher on incongruent tests than on baseline tests, whereas this difference was smallest for young full-attention participants and intermediate for young divided-attention participants [F(2,91) = 9.23, MSe = 0.030]. In part, the differences in magnitude of the false-memory effect reflect differences in ability to recall the target item. Young participants who devoted full attention to study were better able to recall target words, as shown by their performance on baseline tests, and so were less likely to show false recall of the prime word for incongruent tests.

Accessibility Bias

Analysis of the probabilities of correct recall revealed a highly significant interaction between Test Condition and Groups [F(4,186) = 13.13,MSe = 0.013]. For each of the groups of participants, probabilities of correct recall on congruent and incongruent tests were almost perfectly symmetrical around performance on baseline tests (Fig. 2a). That is, presenting a valid prime (congruent test) increased the probability of correct recall by an amount that was nearly identical to the decrease in the probability of correct recall that resulted from presentation of an invalid prime (incongruent test). This is the pattern of results that would be expected if participants gave the prime word as a guess when they were unable to remember the earlier-studied target word.

Strategic Avoidance of the Prime

Comparisons of performance of young dividedattention participants with performance of elderly participants was of particular interest because



Fig. 2. Probability of (a) correct recall and (b) false recall for each group for each test condition for Experiment 1.

performance of those two groups was equated on baseline tests. Although the two groups were equal in their ability to remember the earlier-studied target word, they did differ in effects of accessibility bias revealed by their performance on congruent and incongruent tests (Fig. 2a). Young divided attention participants were more likely, as compared to elderly participants, to respond correctly on incongruent tests but less likely to respond cor-[F(1,46) = 7.74,congruent rectly on test MSe = 0.019 for the interaction of Type of Test and Group.

Analysis of the false recalls revealed convergent results. That is, young divided-attention participants, as compared to elderly participants, were less likely to be misled by an invalid prime word on incongruent tests (i.e. fewer false recalls) but more likely to avoid a valid prime word on congruent tests (i.e. more false recalls), [F(1,46) = 7.62,MSe = 0.020 for the interaction of Type of Test and Group]. Indeed, for the congruent test (prior to which the alternate solution had never been shown), the divided-attention participants incorrectly responded with the alternate solution more than twice as often as did the elderly group (. 14 and .06, respectively).

These results show that elderly participants were less likely to strategically avoid the effects of accessibility bias. Young participants who divided attention during study were aware of their poor ability to remember the target word and were more vigilant of the possibility of being misled by the prime than were elderly participants. To counter accessibility effects, they sometimes strategically avoided the prime word by generating the alternative completion as a guess when unable to remember the target word. Their doing so reduced the probability of being misled by the prime on incongruent tests but carried the cost of their being less likely to correctly recall the target word on congruent tests.

EXPERIMENT 2

Results of Experiment 1 showed that elderly participants were more vulnerable to an I-told-you effect than were younger participants. Presenting a potential response, as a valid or invalid prime, that fit the constraints of an immediate situation increased the likelihood that participants would give that primed response. Their doing so produced a misinformation effect when the prime was invalid-the incongruent test condition. However, the misinformation effect was because of guessing rather than because the invalid prime created a false memory or because of a failure to inhibit the prime. The decrease in correct recall produced by presenting an invalid prime was nearly identical to the increase in correct recall produced by presenting a valid prime. This pattern of results would be expected if presentation of the prime had its effect by an influence on guessing.

In part, elderly participants' greater vulnerability to false memory was a result of their poorer ability to remember the earlier-studied target word. Young participants who devoted full attention to study, as compared to elderly participants, were better able to remember the target word for baseline tests, and showed a smaller false-memory effect. An I-told-you effect can be avoided if one is able to remember the relevant earlier experience. However, equating memory performance on baseline tests did not equate the magnitude of the false-memory effect shown by young, as compared to elderly, participants. Young participants who studied under conditions of divided attention performed the same as elderly participants on baseline tests, but differed from elderly participants in their performance on congruent and incongruent tests. Young participants strategically avoided misleading effects of the prime by sometimes generating a completion word other than the prime to be given as a guess when they were unable to remember the target word. Their doing so reduced the magnitude of the false-memory effect but carried the cost of also reducing the probability of correctly responding when the prime was valid. Indeed, the probability of correct recall on congruent tests was lower for young divided-attention participants than for elderly participants.

Experiment 2 was designed to reduce the misinformation effect observed in Experiment 1. A study manipulation was meant to increase memory for the target word in Experiment 2; participants focused on the meaning of the members of word pairs by judging whether the words were related. Materials were the same as in Experiment 1 except that some pairs of unrelated words were added to the study list to legitimatise the participants' task of judging whether members of a pair were related. Memory for words in those unrelated pairs was not tested. As in Experiment 1, elderly participants and one group of young participants devoted full attention to words presented during the study phase whereas young participants in a second group divided their attention between judging the relatedness of words in pairs and engaging in a listening task. Dividing attention during the study phase was expected to equate performance on baseline tests of young participants with that of elderly participants.

Did participants experience their false recall of invalid primes as resulting from a guess or did they mistakenly experience those words as having been earlier studied? Perhaps the large false-memory

effects observed in Experiment 1 were owed to participants being forced to respond to each test item. For the cued-recall tests in Experiment 2, participants were told to try hard to recall the earlier-studied word but were given the option of responding "pass" if they were unable to do so. Giving people the option not to guess was expected to reduce the false-memory effect produced by presenting invalid primes. Age differences in the effect of allowing a "pass" response were of particular interest. Some (e.g. Basowitz & Korchin, 1957; Botwinick, 1959; Botwinick, Brinley, & Robbin, 1958) have found that older, as compared to younger, adults are more conservative-more likely to withhold responding to avoid an error when allowed to do so. However, such differences are not reliably found (e.g. Ferris, Crook, Clark, McCarthy, & Rae, 1980; Harkins, Chapman, & Eisdorfer, 1979).

Method

Participants

Forty-eight young adults and 24 older adults participated in the experiment and were drawn from the same participant pool as in Experiment 1. Twenty-four young adults were assigned randomly to two between-participant conditions in which attention was manipulated during study (full attention and divided attention). The mean age for the full-attention group was 19.2 years (SD 1.2) and for the divided-attention group was 19.5 years (SD 2.0). On the Mill Hill Vocabulary test (Raven, 1965), average scores of 51% and 57% were obtained by the full-attention and dividedattention groups respectively. The older adults ranged in age from 57 to 89 years (mean = 72.6 years, SD 7.1), and had an average of 16.7 years of education. They scored an average of 77% on the Mill Hill Vocabulary test. An analysis of the vocabulary scores showed a main effect of Group [F(2,69) = 30.965, MSe = 0.015]. A posthoc Newman-Keuls analysis revealed that the elders' score was significantly greater than the two young groups, which did not differ from each other.

Design and procedure

The design and procedure of Experiment 2 were very similar to Experiment 1. The major differences were in the study manipulation and in the cued-recall test instructions. In the study phase, the participants judged the relatedness of the pairs of words. In order to facilitate this procedure 25 unrelated foils were added to the related critical pairs in the study list. The related pairs that formed the foils were selected based on the same criteria used for the critical items. Only one target response word for each cue word was chosen to be used and then the response words were shuffled to create unrelated pairs. The foils were distributed evenly throughout the study list. Four primacy and four recency buffers (seven related and one unrelated) were added to the main list. This setup resulted in a study list of 108 trials: 75 critical, 8 buffer, and 25 foil pairs. A separate practice of five related and three unrelated pairs was presented prior to the critical study list in order to give the participants some experience in responding within the allotted time. The foils, buffers, and practice items remained constant across all formats.

The young divided-attention group responded verbally whenever they heard a sequence of three odd digits in the distractor task so as not to interfere with their manual responding to the relatedness. question. Also there was a change in the stimulus display on the monitor. The words in each pair were presented side by side instead of one above the other in both the study and test phases. In the test phase, the prime word was presented in the same location on the screen as the word fragment, but the cue word was presented immediately to the left of the word fragment in the recall task. Otherwise, the test procedure remained the same as in Experiment 1.

In the study phase, it was explained that we were interested in people's judgements about the relatedness of words. Participants were informed that the two words in each pair were related meaningfully to each other in some of the pairs and unrelated in other pairs. Examples were given to demonstrate the various aspects of relatedness (e.g. doctor nurse, cherry pie, scream yell) and unrelatedness (phone ankle). Each pair appeared for 2.5sec followed by 0.5sec of blank screen. The task was to decide if each pair was related and to press the "1" key on the numberpad to enter a "yes" (the pair is related) and the "2" key to enter a "no" (the pair is not related). Participants were instructed that since 2.5sec was a very short time for judging some of the pairs and since relatedness was not always a straightforward matter, that they should try to base their judgements on their first impression about the relatedness of the pair because it was important that they stay apace of the presentation rate. The young participants in the divided-attention condition were given the same instructions as the full-attention conditions along with the instructions used in Experiment 1 for the distractor task. The only change in these instructions was that they were to say "now" aloud whenever they heard a sequence of three consecutive odd numbers. The divided-attention condition had 15sec of practice with the number monitoring task prior to the start of the study phase.

The test instructions were identical to those of Experiment 1 with the added instruction in the cued-recall test that if participants were unable to recall the earlier presented study word, they should respond "pass." However, they were encouraged to try hard to remember rather than give up easily.

Results and Discussion

In the divided-attention condition, the probability of the young adults failing to detect a target sequence for the listening task was .19 (SD = 13). Consistent with the results of the Mill Hill Vocabulary score, the proportion of correct relatedness judgements within the 2.5sec deadline in Phase 1 was lower for the two groups of young participants (mean = .84 for divided and .90 for full attention) than for the elderly participants (mean = .95).

In Experiment 2, participants were allowed to "pass" if they could not recall the studied word. As in Experiment 1, we analysed the proportion of trials on which neither of the two chosen responses was given (i.e. passes, timeouts, and other responses). Analysis revealed a main effect of Test Condition [F(2,138) = 74.13, MSe = 0.004] and of Group [F(2,69) = 13.22, MSe = 0.007], with no interaction [F < 1]. As can be seen in Table 2, fail-

Table 2. Proportion of Trials on Which Participants Failed To

 Give Either the Target Response or the Alternate Response across

 Groups and Tests in Experiment 2

	Type of Test		
Group	Congruent	Baseline	Incongruent
Young, full attention	.02	.15	.06
Young, divided attention	.07	.21	.12
Elderly	.02	.14	.03

ure to respond with either the target or the alternate was highest for the baseline test (as in Experiment 1) compared to the other two types of test.

More interestingly young participants who studied under conditions of divided attention were more likely not to give the target or alternate as a response than were either young full-attention participants or elderly participants. The smaller number of failures to respond made by young full-attention participants is understandable if they were better able to remember the target word than were young divided-attention participants. However, we expected elderly participants not to differ from young divided-attention participants in their ability to remember and, perhaps, be more conservative. The higher probability of not responding for young divided-attention participants might reflect that they were more aware of their poor memory for target words than were elderly participants and therefore sought to avoid being misled. Even though given the option to pass, elderly participants responded in a way that risked producing a misinformation effect. That is, results were opposite to what would be expected if the elderly were more conservative than the young participants (e.g. Basowitz & Korchin, 1957).

As shown by performance on baseline tests, young participants in the full-attention condition were better able to remember target words than were participants in the other two groups. Recall performance was corrected for guessing by subtracting the probability of false recall from that of correct recall. Analysis of these corrected scores revealed that memory performance was higher for young participants who devoted full attention to study (.66) than for elderly participants (.46) or young participants (.44) who studied under conditions of divided attention [F(2,67) = 11.38, MSe = 0.031].

Examining probabilities of false recall on baseline and incongruent tests (Fig. 3b) revealed that elderly participants showed a false-memory effect that was twice as large as that shown by participants in the young full-attention condition whereas there was little difference between the two groups of young participants in the magnitude of the misinformation effect [F(2,67) = 11.74, MSe = 0.036].

Analysis of the probabilities of correct recall on congruent and incongruent tests revealed a highly significant interaction between Test Condition and Groups [F(4,138) = 13.92, MSe = 0.013]. For all participants, probabilities of correct recall on congruent and incongruent tests were symmetrical around performance on baseline tests (Fig. 3a). That is, for correct recall, the congruent test was higher than the baseline test by nearly the same



CORRECT RECALL Expt. 2





Fig. 3. Probability of (a) correct recall and (b) false recall for each group for each test condition for Experiment 2.

amount that the incongruent test was lower than baseline. As in Experiment 1, this result supports the claim that guessing is biased by the prime word. That the symmetry for the elderly group was not as striking as that for the two young groups merely reflects a ceiling effect on the congruent test. Elderly participants produced such a large decrease in correct recalls on the incongruent test that it would have been impossible for them to increase by the same amount on the congruent test.

Comparing the young divided-attention participants and the elderly participants again revealed differences in strategic avoidance of the prime. Even though both groups were given the option to pass when they failed to recall, and even though the groups were equated on baseline tests, the elderly were much more likely to be swayed by the prime word (Fig. 3a). Examining the data for correct recalls, elderly participants, as compared to young divided-attention participants, were more likely to respond correctly on congruent tests but less likely respond correctly on incongruent tests to [F(1,46) = 16.20, MSe = 0.026 for the interaction of test and group]. Also, elderly, as compared to young divided-attention participants, made more false recalls on incongruent tests but fewer false recalls on the congruent tests [F(1,46) = 20.43], MSe = 0.027 for the interaction of type of Test and Group]. As in Experiment 1, divided-attention participants incorrectly responded with the alternate solution on congruent tests more often than did the elderly group (mean = .10 and .03, respectively).

Together with the first experiment, these results highlight age-related differences in the countering of accessibility bias. Young participants who divided attention during study were aware of their poor ability to remember the target word and took steps to avoid being misled by the prime. To counter accessibility effects, divided-attention participants sometimes avoided the prime word by generating the alternative completion as a guess when they were unable to remember the target word. They also responded less often than did the elderly participants on congruent and incongruent tests (Table 2). So, when faced with a situation in which they could not remember the target, young divided-attention participants were willing to withhold responding rather than risk being misled by the prime, and when they did respond, they sometimes did so by generating an alternative to the prime. Elderly participants faced with the same situation were inclined to go with the prime.

GENERAL DISCUSSION

Elderly, as compared to younger, adults are more vulnerable to deception in a situation similar to that of being faced with a false I-told-you claim. If we had used only incongruent and baseline tests, as has been done in other investigations of misinformation effects, this would be all that we could conclude. However, by using congruent tests as well as incongruent and baseline tests we were able to analyse the bases responsible for the larger effect shown by elderly participants. The strategy of combining performance from different types of tests to separate effects on accessibility bias from differences in memory is the same as the process-dissociation approach (e.g. Jacoby, 1991, 1998). In the discussion that follows, we consider results from the current experiments in the context of that approach.

Accessibility Bias Reflects a Basis of Responding That Is Independent of Recollection

By using results from congruent tests in combination with those from baseline and incongruent tests, we were able to show that the I-told-you effect arose from an influence of accessibility bias. The probability of a correct response after valid and invalid primes was symmetrical around performance on baseline tests, just as would be expected if presentation of the prime only influenced guessing. In part, the greater vulnerability of elderly participants to misinformation resulted from their poorer ability to remember a relevant earlier event, making it necessary for them to guess more often than did young participants.

As well as showing a larger misinformation effect, elderly participants show larger interference effects in a variety of tasks (e.g. Winocur &

Moscovitch, 1983). Poorer ability to remember is sometimes responsible for those larger effects. Just as is found for congruent and incongruent primes, habit can also serve as a source of accessibility bias. The elderly, because of their poorer ability to recollect, are more vulnerable to misleading effects of habit. Recent studies have utilised the process-dissociation procedure to separate experimentally developed habits from recollection (Hay & Jacoby, 1996, in press). In those studies, habits were established during a training phase, where cue words were paired with a typical response on 75% of the occasions (e.g. knee bone) and an atypical response on 25% of the occasions (e.g. knee bend). A condition in which the two responses appeared equally often, 50%, served as a baseline. In a second phase, participants studied lists of word pairs that included some word pairs for which the cue word was paired with a typical response, some word pairs for which the cue word was paired with an atypical response, and some baseline items. After studying each list, memory was tested by presenting the cue word along with a fragment of the response word (e.g. knee b_n_). That is, the experiments were comparable to those reported in this article except congruent and incongruent tests were created by means of prior training rather than by presenting valid and invalid primes.

Correct recall of typical pairs could be based either on memory for the list (R) or on the habitual response (H). Assuming independence of recollection and habit, the probability of correct recall for typical pairs can be represented as: Prob (typical) = R + H(1-R). People sometimes respond incorrectly with the typical response after having studied an atypical pair. Such a "memory slip" or false memory indicates that habit, in the absence of recollection, determined their response. The probability of such errors after study of atypical pairs is represented by: Prob (typical) = H (1-R).

The different levels of habit for typical and atypical responses produced probabilities of correct responding that were symmetrical around baseline tests, just as has been found for valid and invalid primes (Fig. 4). Because responding was forced and participants were able to produce a response for all test items, probabilities of correct and false recall





Fig. 4. Probability of correct recall and false recall for Hay and Jacoby (1996), Experiment 1.

summed to 1.0. Hay and Jacoby used the above equations to solve for estimates of the contributions of habit (H) and memory (R) to cued-recall performance. They found that manipulating the strength of the habit established in the training phase did not affect the estimates of R in later cued recall, but did affect the estimates of H. The estimates of habit matched the probabilities established in the training phase. Manipulations of the presentation rate of the study list and response deadline in cued recall affected the estimates of R, but did not affect the estimates of H. Hay and Jacoby (in press) showed that cued-recall performance of elderly and young participants differed only because elderly participants were less able to recollect, the contribution of habit was age invariant. These dissociations support the assumption that habit and memory make independent contributions to performance, and converge with results from experiments using other variants of the process-dissociation procedure (for a review, see Jacoby, Jennings, & Hay, 1996).

The finding that estimates of habit show probability matching suggests that habit is a form of implicit learning. Reber (e.g., 1989) has argued that probability matching reflects implicit learning of an event sequence that is acquired independently of a conscious effort to learn and without intentional strategies. Knowlton, Squire, and Gluck (1994) described probability learning as a task that relies primarily on the form of memory preserved by amnesics who have suffered damage to the hippocampus. They found that such amnesics show evidence of probability learning but perform more poorly than people with normally functioning memory. They suggested that the poorer probability learning of amnesics is a result of their inability to recollect (declarative memory), a type of memory used by people with normal memory to supplement the more automatic, unintentional form of memory (procedural memory) that is fully relied on by those with amnesia. Performance in probability learning tasks is unlikely to serve as a pure measure of more automatic bases of responding (e.g. implicit learning or habit) in cued-recall performance. The process-dissociation procedure offers the advantage of separating the contributions of different forms or uses of memory within a task, rather than identifying processes with different tasks.

Ratcliff and McKoon (1997) presented a "counter" model that describes effects of implicit memory as produced by bias. They noted that in experiments using indirect tests of memory, prior presentation of an item can increase both hits and false alarms, which is the signature of bias effects (e.g. Ratcliff & McKoon, 1995). We (e.g. Jacoby, Toth, & Yonelinas, 1993) agree that automatic influences of memory (implicit memory) can be expressed as bias. However, we see the term "bias" as synonymous with the claim that an automatic influence of memory, such as that produced by habit or a prime, can serve as an alternative to recollection as a basis for responding. Jacoby, McElree, and Trainham (in press) have shown that results reported by Ratcliff and McKoon (1997) as support for their counter model, when re-analysed, reveal striking dissociations that are the same as those found by Hay and Jacoby (1996).

Implicit memory from a single prior presentation of a word can serve as a source of accessibility bias. Smith and Tindell (1997) found that word fragments were not as likely to be correctly completed when an orthographically similar but incorrect completion word was earlier presented as compared to a baseline condition in which a dissimilar prime was presented. In contrast, prior presentation of the completion word itself facilitated correct completion of the fragment. These priming effects were largely symmetrical around the baseline condition, and occurred even when participants were warned about the effects and told not to try to remember the prime. This and other details of the effects support the authors' claim that they originated from implicit memory for the primes.

Repetition can have a strengthening effect and, thereby, increase the likelihood of later false memory. Jacoby (1999) required participants to read words one, two, or three times and then listen to a second list of words. For a later test of recognition memory, participants were instructed to respond "old" only if the test word was one that had earlier been heard. They were correctly informed that none of the words that they read were in the list of words that they heard. For elderly participants, repeatedly reading a word increased the probability of its later being falsely recognised as having been earlier heard. In contrast, repetition had an opposite effect for young adults-repeatedly reading a word made it less likely the word would later be falsely recognised as earlier heard. An experiment reported in the same article used the process-dissociation procedure to show that repeatedly reading a word increased its familiarity equally for elderly and young participants. However, elderly participants were less able to recollect earlier reading a word as a means of excluding the word as earlier heard. The opposite effects of repetition resulted from elderly participants mistakenly accepting earlier-read words because of their familiarity, whereas young participants were able to use recollection successfully to counter the increased familiarity produced by repetition. Similarly, Kensinger and Schacter (this issue) found that repetition of words that were all associated to a nonpresented target did not reduce false recognition of the nonpresented target for elderly adults but did so for young adults. Using similar procedures, Schacter, Verfaellie, Anes, and Racine (1998b) showed that, for Korsakoff amnesic patients, repeated presentation and testing of lists of semantic associates produced an increase in the probability of false recognition.

A Deficit in Recollection vs. an Age-linked Deficit in Inhibitory Processes

Results reported by Hay and Jacoby (1996, in press) show that interference does *not* differentially influence young and elderly participants' ability to recollect an earlier event. Rather, by using congruent

along with incongruent test conditions, prior training was shown to only influence accessibility bias-the probability of recollection was invariant across the different forms (congruent, incongruent, and baseline) of prior training. Similarly, results of the experiments reported in this article suggest that presenting a valid versus an invalid prime did not influence participants' ability to recollect earlier-studied words. Rather, the symmetric effect of valid and invalid primes on the probability of correct recall, relative to baseline tests, suggests that effects were because of an influence on accessibility bias. Results are only suggestive because symmetry was not found for false recalls, presumably because participants were sometimes unable to think of the alternative response and, so, did not respond rather than falsely recalling the alternative. Invariance in recollection is most easily shown if participants respond with one of the two alternative words for each test item.

An experiment that was recently completed eliminated failures to respond by requiring participants to read each of the two possible responses to a context word and fragment (e.g. bed sheet; bed sleep) in a first phase of the experiment. Otherwise, the experiment was the same as those reported here. Results showed that prefamiliarisation of the alternatives eliminated failures to respond, allowing it to be demonstrated that presenting an invalid versus a valid prime does not influence recollection but, rather, influences only accessibility bias. Recollection for baseline tests was the same as for conditions in which valid and invalid primes were presented. Results are the same as found for manipulations of habit. These dissociations cannot be explained in terms of differential interference that results from an age-linked deficit in ability to inhibit responses. A deficit in inhibiting responses would not predict the invariances in recollection that are found across manipulations of prior training or priming (Hay & Jacoby, in press; Jacoby, 1999).

Recent interest in inhibitory processes has been inspired by findings from special populations, such as patients who have suffered frontal lobe damage (e.g. Shimamura, 1995) and by connectionist models that acknowledge the existence of inhibitory as well as excitatory connections between neural units

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and formally specify the role of both types of connections (e.g. McClelland & Rumelhart, 1981). However, more informal theorising about inhibitory processes has failed to specify the locus at which inhibitory processes operate. (As an example, see criticisms by Burke, 1997 and McDowd, 1997 of Hasher and Zacks' inhibition theory.) When not explicitly specified, the tone of arguments about inhibitory processes is often such as to imply that the inhibition in question operates only after a candidate response has already been computed and serves the function of allowing inappropriate responses to be withheld (e.g. Dempster, 1992). In contrast, within connectionist models, inhibitory links are intermixed with excitatory links at levels prior to the level at which a response is computed.

Our dissociations are consistent with connectionist models that postulate inhibitory connections at levels prior to the computation of a response. In particular, our results are consistent with the proposal by McClelland, McNaughton, and O'Reilly (1995) of complementary learning systems in the hippocampus and neocortex. The hippocampal system is described as fast learning and as having the characteristics that we have ascribed to recollection, whereas neocortical synapses are said to change slowly across repetitions of a pattern, in ways required for development of a habit. Both memory systems probably rely on inhibitory as well as excitatory connections. That is, it is likely to be the configuration of connections, rather than the presence or absence of inhibitory connections, that differentiates the two learning systems. The model that McClelland et al. (1995, p. 445) proposed for combining outputs from the learning systems to determine performance is based on an independence assumption and is expressed in equations that are essentially identical to those used by the process-dissociation procedure. O'Reilly, Norman, and McClelland (1997) provided a connectionist model of recollection, subserved by the hippocampus, in recognition memory. The goal of their model was to capture characteristics of recollection revealed by use of process-dissociation procedures (e.g. Yonelinas, 1994, 1997).

Almost certainly, recollection involves inhibitory as well as excitatory processes and the same might be true for strategically avoiding a prime. However, the two means of preventing false memory are likely to involve inhibition of different sorts. Jacoby, Kelley, and McElree (in press) distinguish between early selection and late correction means of gaining cognitive control of performance, and discuss the relation between memory monitoring and self-monitoring in social settings. They describe recollection as illustrating an early selection means of control. In contrast, strategic avoidance of a prime might rely on a late correction method of control by requiring the conscious assessment of a candidate response so as to measure its adequacy and make any necessary corrections prior to output. Regardless, the two means of cognitive control differ in that recollection relies on a form or use of memory that has been identified with the hippocampus, whereas strategic avoidance of a prime provides a means of countering attempts at deception when recollection fails. Strategic avoidance of a prime might most heavily rely on frontal lobe functions. Glisky, Polster, and Routhieaux (1995) reviewed evidence showing age-related decline in both hippocampal and frontal functions, and used a battery of neuropsychological tests to measure decline in the two types of function separately (also, see Henkel, Johnson, & De Leonardis, 1998).

Countering Deception: Generating Alternatives and Knowing When Not To Respond

Even when performance was matched on baseline tests, elderly adults were more vulnerable to deception in the form of a misinformation effect than were young adults. Young adults countered effects of accessibility bias by generating the alternative to the prime as a response, whereas elderly adults were more likely to give the prime as a guess when unable to remember the target word. Countering effects of accessibility did not confer any overall advantage to young over elderly participants in accuracy of responding. Avoiding the prime reduced the probability of being misled by invalid primes but also reduced the probability of responding correctly after valid primes. However, had the primes been invalid most of the time, as is the case in attempts to deceive, the young participants' countering of accessibility bias would have been advantageous. Elderly participants not countering effects of accessibility might reflect their inability to generate an alternative to the prime as a guess when they did not remember the target word.

Ability to counter deception by strategically avoiding a prime probably reflects frontal lobe function. Verbal fluency is required to generate an alternative to a prime so as to avoid deception. Reduction in verbal fluency, as measured by the FAS test, is treated as indicative of a deficit in frontal lobe function and is correlated with poor source memory shown by older adults (e.g. Craik, Morris, Morris, & Loewen, 1990). Also, as revealed by their performance on a cognitive estimation task, patients suffering a deficit in frontal lobe function are less able to make a sensible guess when an answer is unknown (Shallice & Evans, 1978). Instead, they seem to give an answer that is most accessible, without using general knowledge or constraints provided by a situation to restrict their guesses. Frontal lobe deficits also have been associated with findings of confabulation (Moscovitch. 1989: Schacter, Norman, & Koutstaal, 1998a) as well as interference effects (Shimamura, 1995). Showing a large misinformation effect could be described as "situationassisted" confabulation. The prerequisites for confabulation are the same as for false memory: A failure to recollect in combination with a willingness to give any response that readily comes to mind, without questioning the reasons for its accessibility.

Another way to avoid being misled is to refuse to respond unless one is able to recollect. When given the choice to withhold responding if unsure, young participants whose attention was divided during study did respond less often so as to reduce the probability of being misled. In contrast, elderly participants did not reduce their probability of responding. Koriat and Goldsmith (1996) discuss the role of monitoring and control processes in the strategic regulation of memory accuracy. When given the freedom to withhold responding, increasing the accuracy of responding requires the ability to accurately monitor memory. Snodgrass and Corwin (1988) suggested that measures of bias, defined as willingness to respond, might identify members of special populations better than do measures of discriminability. For example, they found that participants with dementia associated with Alzheimer's and Parkinson's disease were more liberal in their responding compared to normal controls.

Neural bases for false memory is a research topic that has generated much interest (e.g. Schacter et al., 1998a). Further progress toward specifying brain-behaviour relations requires more analytic procedures to measure the contributions of different forms or uses of memory (Aggleton & Brown, in press). Most research on false memory has been done from the perspective of eyewitness testimony. In contrast, our research focuses on deceiving the elderly. Defrauding the elderly is a growth industry and it is important to identify those who are most at risk. Because of a deficit in recollection, older, as compared to younger, adults are more prone to errors that reflect inappropriate reliance on habit and other forms of accessibility bias such as that produced by an invalid I-told-you claim. It is important to devise means to measure such deficits in recollection for purposes of diagnosis and treatment (Hay & Jacoby, in press). Further, differences in ability to counter effects of accessibility bias by strategic means are as important as are differences in ability to recollect. Ability to generate an alternative to a response or an interpretation that is highly accessible but potentially misleading is the key to avoiding deception when recollection fails. The "send a cheque" scam described at the beginning of this article depends as much on an inability to generate alternatives as on a deficit in memory. To avoid being a victim of the scam, it would only be necessary to ask that the supposed, earlier-sent cheque be returned prior to sending a new one-a reasonable request in any case.

REFERENCES

- Aggleton, J.P., & Brown, M.W. (in press). Episodic memory, amnesia, and hippocampal-anterior thalamic axis. *Behavioural and Brain Sciences*.
- Anderson, M.C., & Bjork, R.A. (1994). Mechanisms of inhibition in long-term memory. A new taxonomy. In D. Dagenbach & T.H. Carr (Eds.), *Inhibitory processes in attention, memory and language* (pp. 265–326). San Diego, CA: Academic Press.
- Ayers, M.S., & Reder, L.M. (1998). A theoretical review of the misinformation effect: Predictions from an activation-based memory model. *Psychonomic Bulletin and Review*, 5, 1–21.
- Basowitz, H., & Korchin, S.J. (1957). Age differences in the perception of closure. *Journal of Abnormal Social Psychology*, 54, 93–97.
- Bekerian, D.A., & Bowers, J.M. (1983). Eyewitness testimony: Were we misled? *Journal of Experimental Psychology: Learning, Memory and Cognition*, 9, 139–145.
- Botwinick, J. (1959). Drives, expectancies, and emotion. In J.E. Birren (Ed.), *Handbook of aging and the individual* (pp. 639–768). Chicago IL: University of Chicago Press.
- Botwinick, J., Brinley, J.F., & Robbin, J.S. (1958). The interaction effects of perceptual difficulty and stimulus exposure time on age differences in speed and accuracy of response. *Gerontologia*, 2, 1–10.
- Burke, D.M. (1997). Language, aging, and inhibitory deficits: Evaluation of a theory. *Journal of Gerontology: Psychological Sciences, 52B*, P254–P264.
- Burke, D.M., MacKay, D.G., Worthley, J.S., & Wade, E. (1991). On the tip of the tongue: What causes word finding failures in young and older adults? *Journal of Memory and Language*, 30, 542–579.
- Chandler, C.C. (1991). How memory for an event is influenced by related events: Interference in modified recognition tests. *Journal of Experimental Psychology: Learning, Memory and Cognition, 17*, 115–125.
- Cohen, G., & Faulkner, D. (1986). Memory for proper names. Age differences in retrieval. British Journal of Developmental Psychology, 4, 187–197.
- Cohen, G., & Faulkner, D. (1989). Age differences in source forgetting: Effects on reality monitoring and eyewitness testimony. *Psychology and Aging*, 4, 10–17.
- Craik, F.I.M. (1982). Selective changes in encoding as a function of reduced processing capacity. In F. Klix, J. Hoffman, & E. van der Meer (Eds.), *Cognitive research in psychology* (pp. 152–161). Berlin: Deutscher Verlag der Wissenschaffen.

- Craik, F.I.M., Morris, L.W., Morris. R.G., & Loewen, E.R. (1990). Aging, source amnesia, and frontal lobe functioning. *Psychology and Aging*, 5, 148–151.
- Dempster, F.N. (1992). The rise and fall of the inhibitory mechanism: Toward a unified theory of cognitive development and aging. *Developmental Review*, 12, 45–75.
- Ferris, S.H., Crook, T., Clark, E., McCarthy, M., & Rae, D. (1980). Facial recognition memory deficits in normal aging and senile dementia. *Journal of Gerontology*, 35, 707–714.
- Glisky, E.L., Polster, M.R., & Routhieaux, B.C. (1995). Double dissociation between item and source memory. *Neuropsychology*, 9, 229–235.
- Harkins, S.W., Chapman, C.R., & Eisdorfer, C. (1979). Memory loss and response bias in senescence. *Journal of Gerontology*, 34, 66–72.
- Hasher, L., & Zacks, R.T. (1988). Working memory, comprehension, and aging: A review of a new view. In G.H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 22, pp. 193–225). New York: Academic Press.
- Hay, J.F., & Jacoby, L.L. (1996). Separating habit and recollection: Memory slips, process dissociations and probability matching. *Journal of Experimental Psychology: Learning, Memory and Cognition, 22*, 1323–1335.
- Hay, J.F., & Jacoby, L.L. (in press). Separating habit and recollection in young and elderly adults. Effects of elaborative processing and distinctiveness. *Psychology and Aging*.
- Henkel, L.A., Johnson M.K., & De Leonardis, D.M. (1998). Aging and source monitoring: Cognitive processes and neuropsychological correlates. *Journal* of Experimental Psychology: General, 127, 251–268.
- Jacoby, L.L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, 30, 513–541.
- Jacoby, L.L. (1996). Dissociating automatic and consciously-controlled effects of study/test compatability. *Journal of Memory and Language*, 35, 32–52.
- Jacoby, L.L. (1998). Invariance in automatic influences of memory: Toward a user's guide for the process-dissociation procedure. *Journal of Experimental Psychology: Learning, Memory. and Cognition, 24.* 3–26.
- Jacoby, L.L. (1999). Ironic effects of repetition: Measuring age-related differences in memory. *Journal of Experimental Psychology: Learning, Memory and Cognition, 25*, 3–22.

- Jacoby, L.L., Jennings, J.M., & Hay, J.F. (1996). Dissociating automatic and consciously controlled processes: Implications for diagnosis and rehabilitation of memory deficits. In D.J. Herrmann, C.L. McEvoy, C. Hertzog, P. Hertel, & M.K. Johnson (Eds.), *Basic* and applied memory research: Theory in context, Vol.1 (pp. 161–193). Mahwah, NJ: Lawrence Erlbaum Associates Inc.
- Jacoby, L.L., Kelley, C.M., & McElree, B. (in press). The role of cognitive control: Early selection vs. late correction. In S. Chaiken & Y. Trope (Eds.), *Dual* process theories in social psychology. New York: Guilford Press.
- Jacoby, L.L., McElree, B., & Trainham, T.N. (in press). Automatic influences as accessibility bias in memory and Stroop-like tasks: Toward a formal model. In A. Koriat & D. Gopher (Eds.), *Attention and performance XVII*. Cambridge, MA: MIT Press.
- Jacoby, L.L., Toth, L.P., & Yonelinas, A.P. (1993). Separating conscious and unconscious influences of memory: Measuring recollection. *Journal of Experimental Psychology: General*, 122, 139–154.
- Kensinger, E.A., & Schacter, D.L. (this issue). When true memories suppress false memories: Effects of aging. *Cognitive Neuropsychology*, 16, 399–415.
- Knowlton, B.J., Squire, L.R., & Gluck, M.A. (1994). Probabilistic classification learning in amnesia. *Learning and Memory*, 1, 106–120.
- Koriat, A., & Goldsmith, M. (1996). Monitoring and control processes in the strategic regulation of memory accuracy. *Psychological Review*, 103, 490–517.
- Lindsay, D.S., & Johnson, M.K. (1989). The eyewitness suggestibility effect and memory for source. *Memory and Cognition*, 17, 349–358.
- Loftus, E.F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology*, 7, 560–572.
- Loftus, E.F., & Palmer, J.C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behaviour*, 13, 585–589.
- Maylor, E.A. (1990). Age, blocking and the tip of the tongue state. *British Journal of Psychology*, 81, 123-134.
- McClelland, J.L., McNaughton, B.L., & O'Reilly, R.C. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the successes and failures of connectionist models of learning and memory. *Psychological Review*, 102, 419–457.
- McClelland, J.L., & Rumelhart, D.E. (1981). An interactive activation model of context effects in letter

perception: Part I. An account of basic findings. *Psy-chological Review*, 88, 375-407.

- McCloskey, M., & Zaragoza, M. (1985). Misleading post-event information and memory for events: Arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology: General*, 114, 1–16.
- McDowd, J.M. (1997). Inhibition in attention and aging. *Journal of Gerontology: Psychological Sciences*, 52B, P265–P273.
- Moscovitch, M. (1989). Confabulation and the frontal systems: Strategic versus associative retrieval in neuropsychological theories of memory. In H.L. Roediger & F.I.M. Craik (Eds.), *Varieties of memory* and consciousness: Essays in honour of Endel Tulving (pp. 133–156). Hillsdale, NJ: Lawrence Erlbaum Associates Inc.
- O'Reilly, R.C., Norman, K.A., & McClelland, J.L. (1997). A hippocampal model of recognition memory. In M.I. Jordan, J.J. Kearns, & S.A. Solla (Eds.), Advances in neural information processing systems 10. Cambridge, MA: MIT Press.
- Rabinowitz, J.C., Craik, F.I.M., & Ackerman, B.P. (1982). A processing resource account of age differences in recall. *Canadian Journal of Psychology*, 36, 325–344.
- Ratcliff, R., & McKoon, G. (1995) Bias in the priming of object decisions. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 21, 754–767.
- Ratcliff, R., & McKoon, G. (1997). A counter model for implicit priming in perceptual word identification. *Psychological Review*, 104, 319–343.
- Raven, J.C. (1965). *Mill Hill Vocabulary Scale*. London: H. K. Lewis.
- Reber, A.S. (1989). Implicit learning and tacit knowledge. *Journal of Experimental Psychology: General*, 118, 219–235.
- Schacter, D.L., Norman, K.A., & Koustaal, W. (1998a). The cognitive neuroscience of constructive memory. *Annual Review of Psychology*, 49, 289–318.
- Schacter, D.L., Verfaellie, M., Anes, M.D., & Racine, C. (1998b). When true recognition suppresses false recognition: Evidence from amnesic patients. *Journal* of Cognitive Neuroscience, 10, 668–679.
- Schneider, W. (1990). Micro experimental laboratory [Computer program, Version 1.0]. Pittsburgh, PA: Psychology Software Tools.
- Shallice, T., & Evans, M.E. (1978). The involvement of the frontal lobes in cognitive estimation. *Cortex*, 14, 294–303.

- Shimamura, A.P. (1995). Memory and frontal lobe function. In M.S. Gazzaniga (Ed.). *The cognitive neurosciences* (pp. 803–813). Cambridge, MA: MIT Press.
- Smith, S.M., & Tindell, D.R. (1997). Memory blocks in word fragment completion caused by involuntary retrieval of orthographically related pairs. *Journal of Experimental Psychology: Learning, Memory and Cognition, 23*, 355–370.
- Snodgrass, J.G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychol*ogy: General, 117, 34–50.
- Thorndike, E.L., & Lorge, l. (1944). *The teachers' handbook of 30,000 words*. New York: Columbia University.
- Winocur, G., & Moscovitch, M. (1983). Pairedassociate learning in institutionalized and noninstitutionalized old people: An analysis of inter-

ference and context effects. *Journal of Gerontology, 38*, 455–464.

- Yonelinas, A.P. (1994). Receiver-operating characteristics in recognition memory: Evidence for a dual-process model. *Journal of Experimental Psychol*ogy: Learning, Memory and Cognition, 20, 1341–1354.
- Yonelinas, A.P. (1997). Recognition memory ROCs for item and associative information: The contribution of recollection and familiarity. *Memory and Cognition*, 25, 747–763.
- Zacks, R., & Hasher, L. (1997). Cognitive gerontology and attentional inhibition: A reply to Burke and McDowd. *Journal of Gerontology: Psychological Sciences*, 52B, P274–P283.
- Zaragoza, M.S., McCloskey, M., & Jamis, M. (1987). Misleading postevent information and recall of the original event: Further evidence against the memory impairment hypothesis. *Journal of Experimental Psychology: Learning, Memory and Cognition, 13*, 36–44.

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