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Assessing Memory Deficits in Elderly Adults: Repetition Errors, Misattributions, and Memory Slips

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To understand errors such as the repeated asking of questions, it is necessary to distinguish between intentional memory processes (recollection) and automatic influences of memory. This distinction is important because there is evidence that elderly adults possess preserved automatic abilities in the presence of significant recollection deficits. We investigate misleading effects of memory that can arise when automatic influences are unopposed by recollection. Standard memory tests fail to separate out contributions to performance of these two bases of responding that can lead to an overestimation of memory abilities in older adults. We describe an opposition procedure used to assess recollection deficits in elderly adults and discuss the advantages of such a procedure as a diagnostic tool. Finally, some preliminary results from a training procedure designed to rehabilitate recollection are presented.

"Where are your kids now?" When visiting our aging parents some of us will be repeatedly asked a question like this. Most striking and frustrating is the repetition. The first asking of the question is viewed as concern for the children and is gladly answered. However, for our parent, it is as if asking the question and having it answered does not allow the question to be put to the side but, instead, increases the probability of its being repeated. Later askings of the question create annoyance that turns into concern as we realize the tragedy that our parents might be suffering. As the aging population continues to grow in society, it is inevitable that a significant proportion of people will suffer devastating effects on memory as a result of Alzheimer's disease (AD). Among the most obvious memory deficits that will be apparent is the repeated asking of questions.

Although frustrating, repeatedly asking a question gives reason for hope because it provides evidence of preserved memory abilities of the sort measured by indirect tests. Indirect tests reveal automatic influences of memory by demonstrating, for example, that a word is used more often as a completion for a word stem or fragment if it was seen earlier, regardless of whether participants were aware of its presentation (for a review, see Moscovitch, Vriezen, & Goshen-Gottstein, 1993). Such demonstrations are striking because they illustrate the effects of the past in the absence of conscious remembering. Findings of dissociations between performance on indirect and direct tests of memory have been cause for a great deal of excitement in cognitive psychology over the last few years. Even very dense amnesics show evidence of memory on indirect tests although they are impaired in their performance on direct tests (Roediger & McDermott, 1993). Similarly, when applied to an elderly population, it is recollection, the intentional use of memory, that shows a dramatic decline with age. In contrast, indirect tests generally show an absence of age-related differences in performance, although small effects are sometimes found (Light, 1991).

We have been very interested in separating out automatic and intentional bases of responding in order to examine the effects of aging on specific aspects of memory. One of our recent research objectives has been to develop a diagnostic device that is particularly sensitive to differences in recollection, in hopes that we might be able to identify elderly adults who are experiencing early signs of dementia. Moreover, we intend to extend our diagnostic measure into a memory rehabilitation program for elderly adults, as well as other special populations. Baddeley and Wilson (1994) exploited preserved automatic influences of memory as a means of rehabilitating the performance of those who are memory impaired. Our goal is somewhat more ambitious in that we want to measure and train intentional uses of memory. Our hope is that we can return control of memory to the memory-impaired individual rather than place the control of memory in the environment. At the end of this

chapter, we report some preliminary results from a new procedure that has been designed to rehabilitate recollection.

FALSE FAME AND OPPOSITION

The story of our search for a diagnostic device begins with experiments showing that one can become famous overnight, or even sooner if the audience is not paying sufficient attention (Jacoby, Kelley, Brown & Jasechko, 1989; Jacoby, Woloshyn, & Kelley, 1989). In these experiments, automatic influences of memory (familiarity) were placed in opposition to recollection, allowing us to infer recollection deficits through the errors that people commit. In the first phase of the experiment, participants read a list of names that they were told were nonfamous; next they were given a fame-judgment test consisting of old nonfamous names mixed with new famous and new nonfamous names. The prior presentation of nonfamous names serves to increase their familiarity, which in turn, makes it more likely that the names will later be mistakenly identified as being famous. However, if participants can remember the source of the name correctly, then any automatic influence of familiarity will be opposed, allowing them to be certain that the name is nonfamous. Therefore, to the extent that one is able to recollect, one can avoid undesirable effects of the past.

Fame-judgment tests were performed either immediately after Phase 1 or 24 hours later. Results of this experiment revealed a false-fame effect after the delay in that young adults frequently judged old nonfamous names to be famous. In contrast, when participants performed the fame-judgement task immediately after Phase 1, the false-fame effect did not appear. These findings suggest that young adults were able to escape misleading effects of automatic influences of memory by recollecting source information. However, when recollection was reduced by extending the retention interval, or dividing attention at study or test, then the false-fame effect became very apparent. These results have implications for special populations who are impaired in their ability to recollect because it is these memory-impaired people who will be most susceptible to misleading effects of familiarity. Indeed, elderly adults do show a pronounced false-fame effect (Dywan & Jacoby, 1990; Jennings & Jacoby, 1993a), as do amnesics (Cermak, Verfaellie, Butler, & Jacoby, 1993; Squire & McKee, 1992) and patients who have sustained a closed-head injury (Dywan, Segalowitz, Henderson, & Jacoby, 1993). We have made use of the misleading effects of automatic influences of memory, similar to the false-fame effect described here, to diagnose deficits in recollection in elderly adults. Furthermore, the logic of this opposition procedure serves as the basis of our memory training procedure described later.

TWO EFFECTS OF REPETITION

What effect might earlier askings of a question have on the probability that the question is later repeated? Answering this question requires that one separately examine the effects of repetition on both automatic and intentional memory processes. A friend whose mother is suffering symptoms of AD tells the story of taking her mother to visit a nursing home. On arriving at the home, the rules and regulations were explained, one of which regarded the dining room. It was mentioned that the dining hall was set up in a restaurant style except that tipping was not required. The lack of tipping in the dining hall was emphasized and reiterated several times. In a meeting that followed later that day, the friend's mother was asked if she had any unanswered questions about the nursing home. She replied that she only had one question: She wondered if she was supposed to tip in the dining room!

This example again illustrates an opposition condition. Repeatedly hearing about tipping practices in the dining room should make that information more familiar and, therefore, it should be more likely to come to mind. In contrast, recollection of the earlier discussion should prevent one from asking about tipping practices again later. The two bases of responding lead to different outcomes but when recollection fails, as it often does with aging, or more dramatically with AD, then automatic influences are left unopposed and repetition errors result. We attempted to investigate the effects of repetition on memory performance in elderly adults in a similar situation in the lab.

In the initial phase of the experiment (Jacoby, in press), first-year university undergraduates and elderly volunteers over the age of 60 years read words on a computer screen either one, two, or three times. Following the initial study list of read words, participants were then presented with a second study list in which different words were heard on a tape recorder only once. Participants were instructed to remember the heard words for a later memory test. At test, they were presented with words that were earlier read in List 1 (once, twice, or three times), earlier heard in List 2, or were new words that had not been encountered before. Although instructed to report the words that were earlier heard in List 2, participants were warned that the test list would also include words that were earlier read. Read words were meant to be excluded and thus they were not supposed to be reported. Furthermore, participants were told that none of the words in the read list appeared in the heard list and vice-versa. Because repeated presentation of a read word increases its familiarity, participants could misattribute this familiarity to it being earlier heard and mistakenly identify read words as heard words. If participants could recollect the source of the read word, then the automatic influence of familiarity would be opposed and participants would correctly identify the word as being read

at study. Relying on familiarity alone would produce one type of response, whereas recollection would lead to a different response.

The probability of mistakenly identifying an earlier read word (repeated once, twice, or three times at study) as a heard word was determined across short and long deadline manipulations. In the short deadline condition, a test word was exposed for 750 msec and participants were expected to respond during that interval. In contrast, for the long deadline condition, each word was exposed for 1,250 msec before participants were allowed to respond and then they too were required to respond in a 750 msec interval.

The effects of repetition on performance are summarized in Table 4.1. The results demonstrated that as the number of repetitions increased for read items, young participants were less likely to confuse read words with words that were earlier heard. This finding suggests that young participants were better able to recollect read words the more often they were repeated. However, when young participants were forced to respond at a faster rate, the opposite pattern of results was obtained. At a short deadline, the read items that were most often repeated in the study list were the ones that were most likely to be confused for heard words. The pattern of results with the elderly at a long deadline looked very similar to the pattern shown by young adults when they were pressed to respond quickly. That is, as the number of repetitions increased, elderly adults were more likely to confuse read words with words that were heard. These repetition errors produced by elderly adults are similar to the earlier "Should I tip?" example. Why does repetition increase the likelihood of errors by older adults and by young adults at short deadlines? The dissociations in performance that emerged as a function of age and deadline condition can be taken as evidence for two effects of repetition on memory performance: Repetition increases recollection, as well as familiarity. Given that recollective abilities have been shown to be diminished in older adults (Jacoby, Jennings, & Hay, 1996; Jennings & Jacoby, 1993a, 1997), as well as at short as compared to longer deadlines (Hay & Jacoby, 1996; Yonelinas & Jacoby, 1994), automatic influences of memory are frequently left unopposed in these situations, and thus attribution errors often result. When recollection is reduced, the unopposed effects of familiarity become more apparent with increasing repetition because familiarity also increases with the number of presentations. These results provide support for the anecdotal suggestion that as one becomes older, unwanted repetitions become more common.

DIAGNOSING RECOLLECTION DEFICITS IN OLDER ADULTS

The evidence thus far suggests that elderly adults experience pronounced declines in recollection, which in turn can lead to repetition errors. But are

TABLE 4.1
Probability of Identifying Words as Earlier Heard

Age Group	Response Deadline	Read Presentations 1x	2x	3x	New	Heard
Young						
	Long (1,250 + 750 ms)	.32	.26	.20	.18	.56
	Short (750 ms)	.24	.35	.38	.16	.37
Elderly						
	Long (1,250 + 750 ms)	.27	.35	.38	.13	.35

we able to identify individuals who are most likely to produce such errors and therefore, detect the severity of memory deficits present? For example, one would be less concerned about a parent who repeats the question, "Where are your kids now?" 1 month later than a parent who repeats the question afteronly a few minutes. In order to differentiate normal elderly from those in the early stages of dementia, we need a diagnostic measure to reveal the degree of memory impairment.

An opposition procedure was devised by Jennings and Jacoby (1997) to provide a more diagnostic index of age-related deficits in recollection. They measured severity of recollection deficits in a situation where unwanted repetition had to be avoided, similar to the repeated asking of a question. This type of error may occur if automatic influences of memory, which compel such a repetition, are not successfully opposed by recollecting that the question was already asked and answered. The length of interval required to demonstrate age differences in repetition errors was determined in the expectation that it would provide a more sensitive measure of memory deficits than that shown by standard, direct tests of memory that are typically used in neuropsychological assessments. Their experiments were modeled after the situation of avoiding repeating oneself across increasing delays.

In Jennings and Jacoby's (1997) opposition paradigm, young and elderly participants studied a list of words and then performed a recognition test for those words. The recognition test consisted of old, studied words intermixed with new words, with the catch being that each new word was repeated in the test list at various intervals (e.g., 0, 1, 3, 4, 7, 12, 24, or 48 intervening items between repetitions of new, nonstudied words). Participants were instructed to report only the old items from the earlier list, each of which was presented once and thus never repeated. However, they were also cautioned about the repetitions of new items in the test list and were instructed *not* to report these catch items during the recognition test. Repeated items served a function similar to that of repeatedly asking the same question of the same person. Recollection of the first presentation of a new item should allow participants to reject the item although familiarity gained from its earlier presentation would have the opposite effect and lead to erroneously categorizing a new item as an old item. Jennings and Jacoby were interested in determining the extent to which participants were able to avoid reporting catch items. It was expected that this type of repetition error would be more pronounced with age and would increase as the interval between presentations was lengthened.

The results of this experiment revealed that elderly adults showed striking age-related deficits in detecting repeated items after only four items intervened between the first and second presentations! In contrast, there were no age differences detected on a standard test of recognition memory that was incorporated into the earlier opposition task. Jennings and Jacoby (1997)

argued, as we do here, that an opposition procedure provides a more sensitive measure of memory deficits in elderly adults than does a direct test and sometimes may lead to very different conclusions about the effects of aging on memory. That is, the striking age-related impairments revealed by repetition errors in an opposition paradigm contrast a great deal with findings that elderly adults sometimes do not even demonstrate impairments on standard tests of recognition memory, as shown by Jennings and Jacoby as well as others (e.g., Craik & McDowd, 1987; Rabinowitz, 1984).

Repetition errors, as defined here, can be viewed as a failure in source memory. Most studies investigating source memory have relied on tasks that explicitly instruct participants to report source information. In contrast, our approach entails source monitoring while engaging in other activities and therefore may offer a more sensitive measure of source errors than has been traditionally used. For example, consider the difference between the task of avoiding repeatedly asking the same question while engaging in conversation, compared to the task of listing all the occasions on which one has asked that question. Guiding the responding of participants through direct questioning can alter the nature of the task in important ways, as demonstrated in an experiment by Multhaup (1995). Multhaup increased the structure of a false-fame task by explicitly asking participants about source information. During the fame-judgment test, participants were instructed to categorize each name as a famous name, a nonfamous name seen earlier, or a new nonfamous name. It was found that this additional support benefited performance in older adults to such an extent that the typical false-fame effect was eliminated. Although this finding is encouraging, it also suggests that the severity of memory impairments in older adults can be underestimated if they are tested in highly structured situations. Tasks that require participants to explicitly make source judgments may overlook a critical difficulty experienced by elderly adults—an inability to monitor in unstructured situations. We propose that the opposition procedure just outlined offers a more sensitive measure for assessing memory deficits than either standard source-monitoring tests or standard recognition tasks. Furthermore, this diagnostic measure provides a useful means for determining the severity of recollection deficits and thus promises to be an important tool for diagnosing memory impairments in special populations in the future.

ASSUMPTIONS, ESTIMATES, AND CONTROVERSY

It is possible that deficits in recollection, measured by repetition errors, could be underestimated if elderly adults also experience a decline in automatic influences of memory. To ensure that this is not the case, one must have a

means of separately examining estimates of automatic and intentional influences of memory. Using Jacoby's (1991) process dissociation procedure, we have been able to estimate the contribution of these processes to performance for both young and elderly adults. The results we have obtained across several experiments have consistently shown that aging produces impairments in recollection but does not affect the automatic component of memory (see Jacoby, Jennings, & Hay, 1996; Jennings & Jacoby, 1993a, 1997).

However, the utility of the process dissociation procedure has been somewhat controversial because of the assumptions it makes about the nature of the relationship between automatic and intentional influences (for a review, see Yonelinas & Jacoby, in press). In particular, it is the assumption that recollection and automatic influences make independent contributions to performance that has received some criticism. These difficulties can be avoided altogether if one's goal is to demonstrate the existence of recollection deficits rather than estimate the contribution of the underlying processes. That is, by making use of the opposition task alone, one is able to obtain an effective and sensitive measure of recollection capable of diagnosing age-related deficits in memory performance. Nevertheless, we believe many of the current criticisms of the process dissociation procedure are unfounded and have presented evidence in support of independence elsewhere (for a review, see Jacoby, Yonelinas, & Jennings, 1996).

MEMORY SLIPS: SEPARATING HABIT AND RECOLLECTION

We have seen that automatic influences of memory can arise from a single presentation of an item (e.g., Jennings & Jacoby, 1997) and that these influences can become stronger when items are repeated on two or three prior occasions (Jacoby, in press). The effects of repetition can also be demonstrated on automatic influences that have been built up by multiple presentations of stimuli, as in the case of a habit. For example, we (Hay & Jacoby, 1996) created habits of specific strengths during an experimental session and then examined how these habit strengths affected likelihood of making errors, or memory slips, when automatic responding dominates over the ability to recollect a prior event.

Hay and Jacoby (1996) separated the contribution of recollection and habit to cued recall performance. In their experiments, responses were made typical or atypical by an initial training session designed to create habits of specific strengths. During this initial phase, participants were exposed to pairs of associatively related words with the probabilities of the pairings being varied. For example, a stimulus word "knee" was paired with a response word "bend" on 75% of occurrences (typical response), whereas for the other 25% of

occurrences, it was paired with the response "bone" (atypical response). In another condition, pairings appeared with a 50-50 probability. Once these habits were established, the second phase of the experiment presented participants with specific items to study (e.g., knee - bend) for a cued recall test that followed. At test, participants received a stimulus word and fragment (knee - b_n_) and were asked to complete the fragment with the response they remembered from the study list (bend or bone). Word fragments were constructed such that both responses could always be used as completions. Participants could respond at test by recollecting the previously presented item, by relying on their habit for the typical item, or both. We made use of Jacoby's (1991) process dissociation procedure to separate out and measure these different bases of responding.

To understand the rationale underlying the process dissociation procedure as used in this paradigm, consider the example of searching your home for the keys to your car. The typical place you keep your keys is on a table near the front door of your home. However, sometimes you leave your keys on the dresser in your bedroom, which is what happened on this occasion. Given a failure in recollection, is it likely that you will mistakenly begin the search for your keys at their typical location? One factor that influences the likelihood of this memory slip is the past probability of leaving the keys in their typical place. The higher that probability, the stronger the habit of searching for them at that location will be and, consequently, the more likely one will be to commit an error, or memory slip, when the keys are elsewhere.

The results of our experiments indeed showed that participants were more likely to make memory slips when habit was strong (75%) as compared to weak (50%), suggesting that a strong habit is difficult to overcome. However, in situations where habit and recollection worked in concert to produce the same response, automatic responding was a basis for correct responding rather than a source of errors. Under these conditions, performance was assisted to a greater extent when habit was stronger (75% vs. 50%). Furthermore, the estimates of habit reflected the probability with which items were presented in the training session and thus probability matching was revealed (e.g., Estes, 1976). It has been suggested that probability matching, producing responses at a rate that matches their occurrence, occurs without awareness and intention and therefore qualifies as implicit learning (Reber, 1989). Our procedure allowed us to separate the contributions of habit and recollection so that habit could be examined uncontaminated by intentional influences of memory. In doing so, we found that only estimates of the automatic component reflected probabilities from training: Recollection was not affected by this habit strength manipulation. In another experiment (Jacoby & Hay, 1993), we compared young and elderly adults on this task and found that recollection was impaired in older adults but estimates of habit did not differ by age. Furthermore,

probability matching was demonstrated for both young and elderly groups. The previous two experiments in combination show opposite dissociations and thus provide support for independent bases of responding in memory.

These results have implications for training automatic retrieval processes. Several recent memory rehabilitation techniques have focused on creating habits or automatic responses through repeated rehearsal, allowing memory-impaired individuals to acquire a limited amount of new information (e.g., Camp & Schaller, 1989). Although our findings suggest that elderly adults are very capable of developing habits in this manner, these rehabilitation techniques nevertheless have some shortcomings. Automatic responding may assist performance under certain conditions but it can also be a source of errors: Strong habits can increase the likelihood of producing memory slips if automatic influences are not successfully opposed by recollection. Given that recollection is impaired in older adults, the elderly are particularly at risk for memory slips. Furthermore, creating highly structured, routinized environments to support automatic responding can limit the potential stimulation for active information processing and thus lead to self-induced dependence and perceived loss of control (Langer, 1981). Rather than create highly structured environments where automatic responding aids memory, we favor a more internal rehabilitation approach that attempts to restore controlled uses of memory to the individual.

REHABILITATING RECOLLECTION

Is it possible to rehabilitate the elderly's ability to use recollection as a means of avoiding unwanted repetition? We believe that training recollection may be possible in older adults, as well as other memory-impaired populations who show some degree of spared recollective abilities. Jennings and Jacoby (1993b) presented some preliminary results from a procedure they devised to improve memory performance in elderly adults. The rationale that underlies their approach attempts to train recollection in situations where it is easy, and then gradually increase the difficulty to shape recollective processing. Moving elderly adults slowly through situations of increasing difficulty may allow them to adapt their recollective abilities to more demanding situations. The logic of this approach can be understood in terms of older adults' propensity to repeatedly ask the same question. Even if memory is significantly impaired, one would not expect an elderly adult to repeatedly ask the same question immediately after asking it the first time. However, after some time has passed, the question is more likely to be repeated. Is it possible to train people to extend the delay before which they might repeat themselves?

Jennings and Jacoby (1993b) adapted the opposition condition from the recognition lag paradigm described earlier for their rehabilitation procedure.

Participants studied a list of 30 words, followed by a recognition test in which 30 new words appeared and were repeated at one of two lags. The task required participants to respond "yes" to items that were old and "no" to new items at their first presentation and when they were repeated. Recollection deficits were inferred by measuring errors (responding "yes" to repeated words), as this task put recollection and automatic influences in opposition. Initially, participants had to recollect repeated words after a brief interval following their presentation (one intervening item) and thus the task was quite easy. However, a shaping procedure was used to increase the lag intervals between repeated test words as performance improved across the training sessions and thus the task gradually became more difficult. Improvements in performance were assessed by comparing the length of the interval in which participants reached criterion performance. If the interval length increased across training, recollection was considered to be improved.

Ten elderly adults received four training sessions a day for 7 days. Preliminary results using this procedure suggested some significant improvement in recollection. Initially, elderly participants performed to criterion when only one item intervened between repeated presentations, however, after the training sessions, these adults performed to criterion with 28 intervening items! Furthermore, the benefits of training appeared to be intact at a 3-month follow-up session (Jennings & Jacoby, 1993b). Control participants, who performed the same lag intervals but did not receive the shaping procedure, did not show the same level of improvement found with the experimental group. These preliminary results appear encouraging and suggest that it may be possible to improve recollection in older adults. Future work will strive to further increase these training effects, produce positive transfer to everyday life, and maintain long-term performance.

CONCLUDING COMMENTS

To understand errors such as memory slips and the repeated asking of questions, it is necessary to distinguish between automatic and intentional influences of memory. This distinction is an important one, especially if one's goal is to identify deficits in controlled responding in the presence of preserved automatic abilities, a pattern typical of elderly adults. Standard memory tests used in neuropsychological batteries, as well as in many experimental paradigms, fail to separate out the contributions to performance of two bases of responding. This omission can lead to an overestimation of the memory abilities of elderly adults and may result in professionals missing early warning signals for dementia. We suggest a task that places recollection and automatic influences in opposition is better suited to detect age-related deficits in

memory and, furthermore, should serve as a very useful tool in the diagnosis and treatment of memory disorders.

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