The Foundations of Remembering

Essays in Honor of Henry L. Roediger, III

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Toward Analyzing Cognitive Illusions: Past, Present, and Future

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Do you remember the first time you met Roddy Roediger? Are you certain your answer is correct? As shown by a great deal of Roddy's work in the Deese–Roediger–McDermott (DRM; Deese, 1959; Roediger & McDermott, 1995) paradigm, our memories of the past are often mistaken. Striking levels of inaccuracy have been demonstrated in a number of paradigms (e.g., Jacoby, 1999a; Lindsay, Hagen, Read, Wade, & Garry, 2004; Loftus & Pickrell, 1995) indicating that we are often subject to compelling illusions of the past that are confidently held (e.g., Roediger & McDermott, 1995). The preponderance of such memory illusions raises significant questions about both the veridicality of memory and its relation to the subjective experience of memory. For example, can subjective experience permit one to distinguish true from false memories? How does subjective experience relate to the control of memory?

Like Roddy (Roediger, 1996; see also Jacoby, Kelley, & Dywan, 1989), we suggest that memory illusions highlight general principles of memory function and, further, tell us much about the subjective experience and control of memory. For our chapter in honor of Roddy, we first discuss the nature of memory illusions, drawing on classic work indicating that memory, like perception, results from the construction of experience. Next, we examine approaches to the subjective experience of memory, highlighting both quantitative and qualitative factors that influence subjective experience and control over memory. We focus on the performance of older adults, who exhibit diminished memory accuracy in comparison to younger adults (see Jacoby & Rhodes, 2006, for a review). However, we go beyond memory illusions by examining the calibration of subjective experience—the relationship between memory confidence and memory accuracy. As will be described, older adults' memories are sometimes less well calibrated than those of younger adults. This is important for applied purposes as older adults' poor calibration of confidence and memory leaves them susceptible to scams. For theory, we forward a dual-process model of memory and extend that model to examine the multiple processes underlying age-related differences in memory accuracy and

confidence. To anticipate, we argue that older adults are more likely to be captured by highly accessible but misleading information than are young adults. We end by briefly describing our recent attempts to improve the correspondence between confidence and memory in older adults. By improving the calibration between memory and confidence we hope to make older adults less susceptible to memory illusions.

THE CONSTRUCTION OF EXPERIENCE (ILLUSORY AND OTHERWISE)

Roddy's work in the DRM paradigm (e.g., Roediger & McDermott, 1995) provides an example of a compelling memory illusion. In the DRM paradigm, participants study lists of semantically related words (e.g., *bed*, *rest*, *awake*, *pillow*, *dream*, etc.), all related to a central theme word (e.g., *sleep*), termed the critical lure, that is never presented. The typical finding is that participants will often recall or recognize the critical lure at levels comparable to presented list items. Moreover, participants are usually very confident in their memory for the critical lure (e.g., Anastasi, Rhodes, & Burns, 2000) and report specific details of its occurrence (e.g., Roediger & McDermott, 1995). This is likely the product of "normal" memory processes. For example, a list of related words is best encoded through an elaborative strategy that emphasizes the semantic attributes that the words share. Focusing on semantic similarities between words likely makes the central concept of the list (e.g., *sleep*) highly accessible, later leading it to be mistakenly reported as having been studied. Ignoring the semantic qualities of presented list items does have the effect of reducing false memories, but at the cost lowering veridical recall (e.g., Rhodes & Anastasi, 2000).

Memory illusions such as the DRM effect are important in that they illustrate that memory reports are influenced by general knowledge, along with details for a prior event. That is, memory for the past reflects what usually happens, what it would make sense to have happened, and what one wants or fears happened, as well as what actually happened. Bartlett (1932) was among the first to demonstrate that encoded information was used in conjunction with prior knowledge to reconstruct memory rather than memory serving as a faithful reproduction of past events (see Bergman & Roediger, 1999, for a replication of some of Bartlett's findings). Decades later, Bruner (1957) revisited the importance of prior knowledge as well as the needs and motivations of the observer to propose the "New Look" approach to perception (see Greenwald, 1992, for a discussion of the New Look along with commentaries). The New Look was new in that it suggested that perception was not purely a function of the physical stimulus. It instead emphasized the contributions of the observer, particularly the accessibility of categories. A well-known example of a category accessibility effect that was used to support the New Look is the finding that poor children judge a quarter as larger than do children who are not poor (Bruner & Goodman, 1947).

Effects on perception of the sort revealed by the New Look show that general knowledge, in the form of category accessibility, influences the interpretation of

the present as well as memory of the past. Social psychologists have been greatly influenced by Bartlett's (1932), arguments along with those made by Bruner (1957). A common theme in research on social cognition is that reality is constructed by means of an attribution process. Support for that theme has been gained by varying category accessibility through priming manipulations. For example, Stanley Schacter (Schacter & Singer, 1962) suggested that emotion was in large part based on the perception and interpretation of an arousing situation. In one experiment, Schacter (1971) injected participants with epinephrine (a chemical that speeds heart rate and produces other arousing effects) and exposed them to conditions that elicited different emotions. Participants experienced the arousal as anger, fear, or happiness, depending on the particular environmental cues they were given.

Accessibility effects have also been important for theorizing about decision making. In particular, Kahneman and Tversky (1973) proposed that the probability of an event is judged using an availability heuristic. Specifically, people estimate the frequency of events by judging the ease with which examples come to mind. (Kahneman, 2003, later noted that the availability heuristic should have been termed the "accessibility heuristic," as it really describes the ease or fluency with which an exemplar comes to mind.) Jacoby and Dallas (1981) extended this idea to memory, suggesting that an attribution to the past is often based on the ease or relative fluency with which information comes to mind (for reviews see Jacoby et al., 1989; Kelley & Rhodes, 2002). Evidence for a relative fluency heuristic comes from work showing that manipulating ease of processing influences memory judgments. For example, in some of the original work on the fluency heuristic, Jacoby and Dallas had participants identify words presented visually for very brief durations. As would be expected if a fluency heuristic guided memory judgments, later recognition of these items was correlated with the ease with which they were identified.

The relative fluency with which information comes to mind may also guide subjective experience and attribution, as illustrated by the work of Jacoby and Whitehouse (1989). In their experiments, participants first studied a list of words and were then given a recognition test. Each recognition test trial was briefly preceded by a masked presentation of either the item to be judged (*match* trials) or an unrelated word (*mismatch* trials). By a relative fluency account, a matching prime should enhance the perceptual fluency of an item and increase the chance that it is recognized. Results were consistent with this account, as participants were significantly more likely to endorse test items on *match* trials than on *mismatch* trials, an effect that held for both previously studied and new items. However, when the prime was presented for a longer duration (such that participants were aware of its presentation), the matching effect was eliminated. Thus, when aware of the prime's presentation, enhanced fluency due to the flashed prime no longer created the subjective experience of remembering but was instead considered a feature of the test. Such data highlight the dynamic nature of attribution and subjective experience. Further evidence of this is provided by Westerman, Lloyd, and Miller (2002) who replicated Jacoby and Whitehouse's original matching effect. They also reported that when items were studied aurally

visual primes had no influence on test performance, likely because visual cues contributed little to the subjective experience of remembering from an auditory presentation.

These data demonstrate that the subjective experience of information coming to mind, and not the sheer experience of the strength of a memory trace, plays a vital role in memory and memory illusions. Ideally, subjective experience should be well-calibrated, capturing instances in which low and high levels of confidence (or weak or strong impressions) are appropriate. We examine issues of calibration, including their import for aging populations, next.

MEMORY MONITORING: CALIBRATION OF SUBJECTIVE EXPERIENCE

Poor calibration of memory and confidence might reflect a deficit in monitoring the bases for confidence, leading to memory illusions based on highly accessible but incorrect information. As noted previously, false memories elicited in the DRM paradigm are often held with high levels of confidence (e.g., Anastasi et al., 2000; Roediger & McDermott, 1995). Illusions of this sort highlight extreme cases in which subjective experience may be led astray; generally, subjective experience is an accurate indicator of prior experience.

The existence of confidently held memory illusions does indicate that subjective experience can be dissociated from what is retrieved and should be examined in conjunction with accuracy rather than as the *sine qua non* of retrieval. Koriat and Goldsmith (1996) have incorporated this idea into their influential model of memory. They suggest that memory is not just the product of retrieving a latent trace, but depends on the degree to which the rememberer is sensitive to the correctness of the information they have retrieved and relies on that information to guide responding. A key element of their model holds that memory should be examined under conditions of both forced and free report. Specifically, candidate responses retrieved under conditions of forced report index the *quantity* of information available to the rememberer. However, control processes may then operate during a subsequent, free report stage (when responses can be withheld or volunteered), permitting participants to control the *accuracy* of their output. A decision to volunteer a response during free report will be a function of whether one can accurately assess the probability that a candidate response is correct (*monitoring effectiveness*) and whether one is sufficiently confident in their accuracy that it exceeds a particular criterion. Those responses that do not exceed the response criterion are withheld.

This framework is exemplified by data reported by Koriat and Goldsmith (1996, Exp. 1). In a first, forced-report phase of their experiment, participants were required to answer general knowledge questions, even if it required a guess. Each answer was then followed by a confidence judgment assessing the likelihood that the response given was correct. Results from this first phase showed that participants correctly answered approximately 47% of the questions, providing an index of the *quantity* of correct information available. Participants also demonstrated high levels of monitoring effectiveness. For example, average assessed confidence (50%) was close to the actual proportion correct (47%) and there was also a strong relationship between confidence and accuracy, as assessed by the Kruskal–Goodman gamma correlation (a common measure of the association between confidence and accuracy used in metacognition research). In a second, free-report phase of the experiment, participants were given the same questions again, but with the option to withhold their answer to any question. If participants can effectively control their memory, they should predominantly volunteer correct responses (when assessed confidence exceeds a criterion) and withhold incorrect responses (when assessed confidence is below a criterion). Results from this second phase showed that the majority of answers volunteered (76%) were, indeed, correct. That is, *accuracy* increased when participants were given the opportunity to control which responses they volunteered.

The notion that judgments are based on a response criterion is not itself novel and in fact forms one of the tenets behind analyses of recognition memory that utilize signal detection theory (SDT; Green & Swets, 1966). SDT assumes that old and new items on a recognition test comprise separate distributions that lie along a continuum of familiarity or strength. Old items will generally have greater familiarity than new items, but the distributions overlap. The rememberer sets a response criterion, calling items whose familiarity exceeds the response criterion "old" and deeming items whose level of familiarity falls below the response criterion "new". The distance between the old and new distributions (or the difference in memory strength) is assessed via measures of discriminability. Measures of discriminability in SDT are predicated on *forced-report* instructions at test. Koriat and Goldsmith's (1996) model, in contrast, allows the rememberer to control responding through the option of free report, permitting retrieval (i.e., memory) to be distinguished from the monitoring of memory. Moreover, unlike Koriat and Goldsmith's model, SDT treats memory confidence as isomorphic with memory strength. For example, confidence judgments are used to construct ROC (receiver operating characteristic) curves by assuming that higher confidence corresponds to higher memory strength.

Assumptions of redundancy between subjective experience and memory have particular difficultly coping with evidence that subjective experience is sometimes unrelated to memory accuracy. For example, Chandler (1994) reported data from experiments in which participants studied sets of pictures. Either immediately following or just prior to study, participants also viewed additional pictures, some of which were related to the studied set. Results across a number of experiments showed that studying related pictures decreased recognition accuracy for target items while increasing confidence.

Kelley and Sahakyan (2003) report a similar discrepancy between confidence and accuracy in a direct application of Koriat and Goldsmith's (1996) framework. Specifically, Kelley and Sahakyan had older and younger adults study lists of word pairs (e.g., "table–cheer," "clock–dollar"). Following study, participants were given a recall test, cued with the first word and a fragment from each studied pair. For some items, termed *deceptive items*, a semantically related competitor was easily accessible at test (e.g., "chair" in the case of "table–ch_ _r"). For other, *control*

items, there were no semantically related competitors easily accessible at test (e.g., "clock–do_ _ _r"). For the test phase, participants first engaged in forced report by either recalling the item they had studied or guessing an item that fit the cue. Immediately following their response, participants made a confidence judgment, assessing the probability that their response was correct. Finally, participants decided whether or not to volunteer their response (free report). Results showed that while participants' confidence judgments closely matched the probability that a candidate response was correct for control items, participants were poorly calibrated on deceptive items, exhibiting high levels of overconfidence (cf. Koriat & Goldsmith, 1996, Exp. 2).

Further inspection of Kelley and Sahkyan's (2003) data reveal that older adults began with fewer correct candidate responses at forced report, exhibited higher levels of overconfidence than younger adults, and did not achieve the same level of accuracy at free report as younger adults, particularly for deceptive items. Such findings beg the question of whether age-related deficits in memory (see Balota, Dolan, & Duchek, 2000, for a review) may be a function of poorly calibrated subjective experience. While other aspects of metacognition, such as the prediction of future recall in paired associate learning tasks, remain largely stable with age (see Hertzog & Hultsch, 2000, for a review), older adults frequently exhibit higher confidence in false memories than young adults (e.g., Jacoby, Bishara, Hessels, & Toth, 2005). The relationship between confidence and accuracy likely hinges on the quality of information available to the rememberer and their ability to correctly monitor that information (Kelley & Sahakyan, 2003). For example, if older adults' monitoring must rely on impoverished memorial information, their subjective experience will be weakly related to memory accuracy.

The quantity of correct memorial information available and the ability to monitor that information may also comprise an important source of individual differences in memory accuracy. Rhodes and Kelley (2005) examined this issue using the same paradigm employed by Kelley and Sahakyan (2003). In addition to assessing performance on the memory test, older and younger adults were also administered a battery of tests designed to capture individual differences in executive function. Several investigators (e.g., West, 1996) have suggested that deficits in executive function, including the ability to suppress irrelevant information and control and monitor behavior, are a primary contributor to age-related and individual differences in cognition. By utilizing Koriat and Goldsmith's (1996) framework, Rhodes and Kelley could examine the influence of executive function on memory accuracy, distinguishing between the retrieval of candidate responses and the monitoring of those responses. Results from a path model showed that executive function measures were primarily related to the quantity of correct information retrieved during forced report. The quantity of correct candidate responses retrieved in turn had a strong effect on memory accuracy at free report that was mediated in part by the efficacy of monitoring, particularly for deceptive items. Thus, while the quantity of correct information retrieved at forced report was the strongest predictor of memory accuracy, the ability to monitor that information also made a significant contribution to accuracy.

Monitoring is clearly important as it is used to control responding. As noted previously, Koriat and Goldsmith's (1996) model suggests that if assessed confidence in a candidate response exceeds a certain criterion it is volunteered; otherwise, the response is withheld if assessed confidence is below the criterion. Control over memory is evident in the decision to withhold or volunteer a candidate response and varies based on demands for accuracy. For example, a person would be far more careful about what they chose to volunteer as a memory if they were testifying in a courtroom rather than conversing with friends.

Can people control responding to achieve accuracy when given the option of free report? The answer seems to be affirmative (e.g., Kelley & Sahakyan, 2003; Koriat & Goldsmith, 1996; Rhodes & Kelley, 2005; see also Goldsmith, Koriat, & Weinberg-Eliezer, 2002, for data on controlling the precision of volunteered responses). For example, participants in Kelley and Sahakyan's (2003) study were given the option to either volunteer or withhold responses produced during forced report. By using this method, one can compare the proportion of correct responses given under forced report instructions to the proportion of correct responses (out of the total number of responses volunteered) given at free report. Results from Kelley and Sahakyan's study showed that younger and older adults made, on average, a 39% gain in accuracy from forced to free report (Exp. 1). Using an identical procedure, Rhodes and Kelley (2005) likewise reported that participants made, on average, a 45% gain in accuracy from forced to free report. In both studies, this finding is qualified by the fact that older adults' gains in accuracy from forced to free report were slightly less than those of younger adults.

These data highlight the advantage of using Koriat and Goldsmith's (1996) framework, as one can distinguish between what is retrieved and the monitoring of that information in the interest of controlling memory accuracy. At times, monitoring may in fact be more influential than is assumed. For example, Rhodes and Kelley (2005) suggested that participants may sometimes engage in a form of monitoring and control prior to outputting a response at forced report, with the result that the contribution of monitoring is underestimated. As we will describe in the next section, control over memory may not only reflect a monitoring process but may involve controlling what comes to mind in the first place.

CONTROLLING MEMORY: THE ROLE OF EARLY SELECTION

Koriat and Goldsmith's (1996) model allows one to quantify the contribution of memory monitoring to the control of memory accuracy. While age differences in monitoring are sometimes evident, significant age differences in the quantity of correct responses retrieved are also apparent under conditions of forced report (e.g., Kelley & Sakhakyan, 2003). Rather than reflecting a deficit in monitoring, such data suggests that controlling memory accuracy may also involve processes that restrict what comes to mind in response to a cue. Jacoby, Kelley, and McElree (1999; cf. Burgess & Shallice, 1996) have distinguished between these possibilities, holding that control over memory can be achieved by either editing what comes to mind (a process they term *late correction*) or by using cues available such

that what comes to mind immediately in response to a cue is correct (a process they term *early selection*). Thus, control over memory may be achieved not only by adjusting the criterion for volunteering a response (a *quantitative* means of monitoring to control memory) but, rather, by adjusting the kind of information that is retrieved and taken as a memory (a *qualitative* means of controlling memory). For example, a test cue may be used to reinstate prior encoding and elicit details that are likely to be indicative of prior experience rather than used to generate and evaluate a plausible response.

One way we have examined qualitatively different methods of controlling memory is through an analysis of memory for foils following a recognition test. For example, Jacoby, Shimizu, Daniels, and Rhodes (2005) had participants study two lists of words under encoding instructions that varied in the level of processing (Craik & Lockhart, 1972) required. For one list, participants indicated whether each word contained an "O" or "U" (shallow processing) and for the other list, participants judged the pleasantness of each item (deep processing). In a second phase, participants were administered separate recognition tests for each study list. For the recognition test of shallowly processed, vowel-judged items, participants were correctly informed that all "old" items had been vowel judged. Likewise, for the test of deeply processed, pleasantness-judged items, participants were correctly informed that all of the "old" items had been judged for pleasantness. As one would expect (Craik & Lockhart, 1972), recognition accuracy was far better for items from the test of deeply processed items than from the test of shallowly processed items.

Of greater importance is performance in a third phase of the experiment. Specifically, once both recognition tests had been given, participants were administered a surprise test for *new* items (i.e., foils) presented in each of the previous recognition tests. Results showed that participants were significantly more likely to recognize foils from the test of deeply processed (i.e., pleasantness-judged) items than from the test of shallowly processed (i.e., vowel-judged) items. We suggest that participants demonstrated superior memory for foils from the test of deeply processed items because they recapitulated encoding processes in order to make recognition judgments on the initial recognition test. For example, when making recognition decisions for the test of pleasantness-judged items, participants likely evaluated the pleasantness of each item. A pleasantness judgment would emphasize the semantic qualities of the items, with the consequence that when later tested on memory for foils from this test, details of their presentation would be available. For items from the vowel-judged recognition test, scrutinizing the types of vowels in each word would not be as likely to engender details that would later be diagnostic of its presentation. Thus, the manner in which participants use the cue can be elucidated by subsequent memory for foils.

We have replicated this effect a number of times (e.g., Shimizu & Jacoby, 2005) with one exception: Older adults do not exhibit differences in memory for foils (Jacoby, Shimizu, Velanova, & Rhodes, 2005). That is, unlike younger adults, older adults show no memory advantage for foils from tests of deeply processed items compared to foils from tests of shallowly processed items. One explanation is that older adults rely on the general familiarity of each item to make recognition decisions and are less likely to seek specific details of prior encoding. By not reinstating prior encoding, there is little to differentiate foils from the different tests. In the next section, we describe a dual process model of memory which suggests that older adults suffer from a deficit in consciously-controlled memory processes that likely support such early selection, and discuss a recent extension of that work.

A DUAL (AND MULTIPLE) PROCESS MODEL OF MEMORY

Jacoby (1999b) has suggested that older adults' memory deficits reflect a breakdown in controlled memory processes. This idea draws on work (see Kelley & Jacoby, 2000, for a review) examining dual process theories of memory. In its most general form, dual process theories suggest that memory judgments can be accomplished using a consciously controlled process of memory that relies on cues such as reinstating encoding context during retrieval. That process of *recollection* can be distinguished from more automatic bases for memory, in which memory judgments rely on the *accessibility* (also termed *habit* or *familiarity* in some cases) of information coming to mind. In order to distinguish between these bases for memory, one must design experiments in which the influence of recollection can be placed in opposition to that of accessibility.

Jacoby, Debner, and Hay (2001) have done so with older and younger adults using a variant of the process dissociation framework (Jacoby, 1991). Participants in Jacoby et al.'s experiment were first exposed to sets of word pairs in a training phase. Each pair was composed of a word presented next to fragmentary version of a related word (e.g., "knee–b_n_"). Participants were instructed to predict which of two associatively related words would complete the fragment and their prediction was followed by a presentation of the completion word. Across several training blocks, words were paired frequently with one response (e.g., "knee–bend") and infrequently with a different response (e.g., "knee–bone") with the training phase intended to make some pairs (e.g., "knee–bend") more accessible than others (e.g., "knee–bone"). Following this training phase, participants were given several study–test blocks. In each study block, some of the word pairs were consistent with those that had been presented most frequently during training (e.g., "knee–bend"). These *congruent* pairs may be contrasted with other study pairs (termed *incongruent* pairs) that were identical to those presented less frequently during training. Following each study list, participants were given a cued-recall test for the pairs they had just studied, cued with the first word and a fragmented version of the target (e.g., "knee–b_n_"). Participants were instructed to report the word they had studied and indicate whether they could recall specific details of its occurrence. Results showed that younger adults had higher levels of correct recall on congruent trials ($M = 0.83$) than older adults ($M = 0.73$). In addition, younger adults ($M = 0.35$) also exhibited lower levels of false recall on incongruent trials than older adults ($M = 0.44$).

Jacoby et al. (2001) were primarily interested in whether age-related deficits in memory reflected a deficit in recollection. The use of congruent and incongruent

items allows for recollection to be estimated, as one can compare performance from an "in-concert" condition (congruent) to that of a condition that opposes the initial training phase (incongruent). Specifically, correct recall of a congruent item can occur either because one recollects (R) the studied item or, failing recollection (i.e., $1 - R$), because of a reliance on the accessibility (A) established by training: $P(\text{correct}|\text{congruent}) = R + A(1 - R)$. For incongruent items, false recall will occur if the item made typical by training is volunteered: $P(\text{error}|\text{incongruent}) = A(1 - R)$. Subtracting the probability of false recall on incongruent trials from the probability of correct recall on congruent trials provides an estimate of recollection (R). In turn, given an estimate of recollection, the contribution of accessibility (A) can be estimated by dividing the probability of an error on incongruent tests by $(1 - R)$.

Estimates based on these equations showed that while accessibility bias (A) did not differ between age groups ($A = 0.62$ and 0.63 for younger and older adults, respectively), estimated recollection was significantly higher for younger ($R = 0.44$) than older ($R = 0.29$) adults. Interestingly, participants' subjective judgments of whether they could "recall" details of prior study were strongly related to estimates of recollection. In particular, probabilities of correct subjective recall for congruent items were combined with probabilities of false subjective recall on incongruent items (using the formulas described previously) to derive estimates of subjective R. These data showed that objective and subjective estimates of memory were highly correlated ($r = .71$ for younger adults; $r = .81$ for older adults). Thus, subjective experience was closely aligned with objective estimates of performance.

Taken together, Jacoby et al. (2001) demonstrated that aging was associated with a decreased ability to recollect details of prior study and that subjective experience was strongly associated with objective measures of performance. Jacoby, Bishara, et al. (2005) have recently shown that, in addition to a deficit in recollection, older adults may be captured by misleading information, such that they forgo any attempt at recollection. The effects of misleading information are particularly insidious for older adults. For example, in one scam, a con man will overcharge an older adult for a repair with the claim that "I told you that the repair cost X, and you agreed to pay." If the older adult is captured by this information and falsely remembers specific details of the fraudulent oral contract, they will fall victim to the scam.

Jacoby, Bishara, et al. (2005) used an analog of this situation to examine the degree to which misleading information disrupts memory in older adults. Their procedure was similar to Jacoby et al.'s (2001) with the exception that just prior to a test, a word was briefly presented that was either congruent or incongruent (misleading) with what was studied. Across several experiments, older adults were significantly more likely to report an incorrect response (a false memory) after being cued with a misleading word. Along with impairments in memory accuracy, older adults' subjective reports were also disrupted by misleading primes. For example, in one experiment, older adults were 10 times more likely to claim to "remember" specific details from prior study following instances of false recall than younger adults. Results also showed that older adults were less able to exercise control over their responding than younger adults. Specifically, participants in one condition were given the option to withhold responses. While younger adults reduced their level of false recall by 41% with such free report instructions, older adults made essentially no gain in accuracy when given the option of free report.

Jacoby, Bishara, et al. (2005) fit several models to these data and found that younger adults' performance was well accounted for by a model based on parameters for recollection and accessibility, just as used by Jacoby et al. (2001). That model holds that responses may be given on the basis of recollection (R). If recollection fails (i.e., $1 - R$), participants may rely on accessibility, volunteering information which exceeds a certain accessibility threshold (AT) or, if the information does not exceed the AT, use an alternative strategy such as generating a word. However, to account for older adults' performance, an additional model parameter (termed *capture*) was necessary that allowed recollection to be completely bypassed. The capture parameter reflects the fact that misleading primes were sometimes so powerful for older adults that they neglected any attempt to remember what was studied. Such a parameter accords with data showing that older adults' false recall was accompanied by a number of "remember" responses.

This model is consistent with Jacoby et al.'s (1999) idea that cognitive control may be achieved by monitoring responses (*late correction*) or by controlling what comes to mind (*early selection*) and, further, suggests that there are two routes by which false remembering occurs. First, false remembering can occur via accessibility bias. That is, a response may come to mind because it is accessible, and is subsequently evaluated and accepted as remembered only if it is sufficiently familiar or passes a criterion (i.e., late correction). Second, as indicated by the performance of older adults, false remembering may occur when one is captured by misleading information. For older adults, a "capture" mechanism likely reflects deficits in controlling what comes to mind during retrieval (early selection; cf., Jacoby, Shimizu, Velanova, & Rhodes, 2005).

Such dual routes to false remembering also point to methods of rehabilitating memory in older adults. For example, while the majority of memory rehabilitation programs have focused on teaching older adults to use mnemonics (see Verhaeghen, Marcoen, & Gossens, 1992, for a review), rehabilitating older adults' memory may involve enhancing their ability to distinguish between correct and incorrect responses or altering processes integral to early selection, insuring that what comes to mind is accurate. We are currently undertaking a rehabilitation program with older adults using the latter method (Rhodes, Jacoby, Daniels, & Rogers, 2006). Briefly, the training centers on performance on a cued recall test in which a large proportion of test items have easily accessible but incorrect competitors, similar to the paradigm used by Jacoby et al. (2001). Participants make confidence ratings for each test response and, in one condition, they earn or lose points based on their confidence rating. For example, if a response is given a confidence rating of "5", the participant would earn five points if they were correct. However, an incorrect response would result in a deduction of five points. Results have shown that participants given feedback in this manner exhibited significant improvements in accuracy compared to a group of older adults who

were not given feedback on their responses. Benefits of feedback were also evident for confidence judgments. For example, participants given feedback made a 37% gain in accuracy for items (with interfering competitors) reported at the highest level of confidence. By comparison, participants who were not given feedback made only a 2% gain in accuracy. Thus, providing older adults with feedback on their memory responses was sufficient to improve calibration. These data suggest that the poor calibration of older adults in high interference situations is open to remediation. We are currently running additional experiments with this procedure and suggest that attempts such as these to educate subjective experience are important for both theory and application (cf. Jacoby, Bjork, & Kelley, 1994).

CONCLUSIONS: ATTRIBUTION, SUBJECTIVE EXPERIENCE, AND CONTROL

In this chapter we have suggested that memory and subjective experience are the product of an attributional process through which past experience is reconstructed to fit current needs, expectations, and prior knowledge. Models such as Koriat and Goldsmith's (1996) hold that subjective experience is an important factor in the attainment of accuracy and should not be treated as synonymous with the quantity of correct information available. We concur with this assumption but also hold that control of memory is achieved not only through an editing process but may sometimes rely on using cues to bring to mind information that is veridical (Jacoby et al., 1999). Deficiencies in control of memory may characterize age-related deficits in memory along with basic deficits in the ability to use memory to recollect. In turn, subjective experience may be poorly calibrated at times in older adults if the information that comes to mind is fragmentary, vague, or simply wrong (cf. Kelley & Sahakyan, 2003).

While memory illusions are often held with high levels of confidence (e.g., Anastasi et al., 2000; Jacoby, Bishara, et al., 2005), other data demonstrate that subjective reports can be an accurate indictor of prior experience (e.g., Jacoby et al., 2001). An attributional framework provides a means of reconciling such disparate findings. That is, those details that give rise to veridical, confidently-held memories may also support illusory and, likewise confidently-held memories if the details used by the attributional process are similar in both cases. Consider the overconfidence exhibited by participants for deceptive items (e.g., "table–ch_ _r") in Kelley and Sahakyan's (2003) study. In that case, participants often mistakenly and confidently reported semantically related items (e.g., "chair" when "cheer" was studied), likely because they came to mind easily in response to the test cue (cf. Lindsay & Kelley, 1996). We suggest that this occurs because what comes to mind easily is usually correct, leading people to assume that their subjective experience is an accurate indictor of the past. Thus, information that is usually indicative of prior experience sometimes leads the rememberer astray. However, this does not suggest a breakdown in memory, in the same way that the misperception of length in the Müller–Lyer visual illusion does not suggest a serious breakdown in vision. Both are excellent examples of a normally functioning cognitive system. The challenge for the cognitive system is to understand what information is diagnostic of prior experience (cf. Kelley & Rhodes, 2002) and to use this information to control responding and achieve accuracy.

The issue of control over responding extends far beyond memory illusions and has implications in many domains. From our view, the ability to control responding in social situations involves the same modes of cognitive control as does controlling responding in a memory task. In a social setting, early selection might entail using contextual cues to constrain what comes to mind as an appropriate response. For example, a bawdy joke would be unlikely to come to mind during a formal job interview (early selection). However, if the joke did come to mind, control could operate by influencing whether or not it was volunteered (late correction). Likewise, the distinction between early selection and late correction can be applied to decision making. Klein (1998) notes that expert decision makers do not consider a host of options when working under pressure but, instead, their experience dictates that only a single option comes to mind. Early selection in that case can be contrasted with other frameworks suggesting that monitoring processes correct decisions and allow one to overcome illusions (Kahneman, 2003).

Overall, control over behavior will best be understood by examining its influence across a number of areas. Research on memory illusions has highlighted how control may go awry when easily accessed but incorrect responses come to mind (Jacoby, Bishara, et al., 2005) and how it may operate to mitigate memory illusions through control over responding (e.g., Kelley & Sahakyan, 2003) or in what comes to mind (Jacoby et al., 1999). Echoing the work of Bruner (1957), social psychology has illustrated how automatic effects in the form of accessibility influence interpretation of the present. Work on decision making (e.g., Kahneman, 2003) shows that accessibility effects influence predictions about the future. Thus, principles derived from memory illusions not only tell us something about our past, but also are equally applicable to the present and to the future.

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