Research Report

OLDER ADULTS ENCODE—BUT DO NOT ALWAYS USE—PERCEPTUAL DETAILS: Intentional Versus Unintentional Effects of Detail on Memory Judgments

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Abstract—*Investigations of memory deficits in older individuals have concentrated on their increased likelihood of forgetting events or details of events that were actually encountered (errors of omission). However, mounting evidence demonstrates that normal cognitive aging also is associated with an increased propensity for errors of commission—shown in false alarms or false recognition. The present study examined the origins of this age difference. Older and younger adults each performed three types of memory tasks in which details of encountered items might influence performance. Although older adults showed greater false recognition of related lures on a standard (identical) old/new episodic recognition task, older and younger adults showed parallel effects of detail on repetition priming and meaning-based episodic recognition (decreased priming and decreased meaning-based recognition for different relative to same exemplars). The results suggest that the older adults encoded details but used them less effectively than the younger adults in the recognition context requiring their deliberate, controlled use.*

Studies of memory deficits in older individuals (and the memory complaints of older adults themselves) have primarily focused on their increased likelihood of forgetting events or details of events that were actually encountered—shown as misses or errors of omission. However, mounting evidence demonstrates that normal cognitive aging also may be associated with an increased propensity to make errors of commission—false alarms or false recognition responses (e.g., Balota et al., 1999; Koutstaal & Schacter, 1997; Rankin & Kausler, 1979; Searcy, Bartlett, & Memon, 1999; Smith, 1975; Tun, Wingfield, Rosen, & Blanchard, 1998; see Schacter, Koutstaal, & Norman, 1997, and Schacter, Norman, & Koutstaal, 1998, for reviews). In errors of commission, novel stimuli (words, faces, pictures, etc.) that have not been encountered but that are perceptually or conceptually similar to experienced items are mistakenly thought to have been encountered. Such errors often are made with a high level of confidence (Koutstaal & Schacter, 1997; Koutstaal, Schacter, Galluccio, & Stofer, 1999; Koutstaal et al., in press).

Does the age-related difference in the frequency of such errors predominantly arise from age-related processing differences during initial encoding, when individuals are first processing and attending to an event or stimulus, or does the difference arise at the time of retrieval or testing? Or are both encoding and retrieval factors essential contributors? Although this question has been addressed from several perspectives (e.g., Kensinger & Schacter, 1999; Koutstaal et al., 1999; Koutstaal & Schacter, 2001; Koutstaal, Schacter, & Brenner, 2001; Searcy et al., 1999), this study takes a novel approach—examining the intentional versus unintentional influence of perceptual details on memory performance within the same individuals across several types of memory tests with different retrieval requirements, while holding conditions at encoding constant.

Patterns of performance for older and younger adults were examined for three types of items (all pictures of common objects) on three types of memory tests. The three item types were previously studied items (hereafter referred to as *same exemplars*), items that were perceptually and conceptually similar to studied items but were not presented during study (*different exemplars*), and novel or nonstudied items (*new exemplars*). The three types of memory tests were *identical recognition*, *meaning-based recognition*, and *repetition priming*.

The identical recognition test involved simple old/new episodic recognition. However, in addition, the instructions to participants strongly emphasized that they were to call an item "old" only if it was identical to an item they had encountered previously. For example, if participants had encountered Key 1 during study (Fig. 1), they should classify Key 1 as "old," but Key 2 as "new." In many previous studies of false recognition (cited earlier), this task has led to higher levels of false recognition among older than younger adults, and the same result was expected in the present study.

The meaning-based recognition test also involved episodic recognition instructions, but the type of judgment requested was different. Participants were asked to designate an item as old either if it was identical to an item presented earlier or if it was similar in meaning to, or conceptually related to, an item presented earlier. For example, if they had encountered Umbrella 1 during study (see Fig. 1), then they should classify both Umbrella 1 and Umbrella 2 as "old" (cf. Brainerd & Reyna, 1998; Schacter, Cendan, Dodson, & Clifford, 2001).

This task provides evidence relevant to several questions. First, do older and younger adults differ in the ability to make recognition decisions on the basis of meaning, when this is the explicit task requirement? Second, are older and younger adults able to make meaning-based judgments in a way that circumvents any *perceptual specificity effects* arising from the recognition probe itself? Although the task requires recognition decisions to be made on the grounds of meaning, so that the precise perceptual format of the exemplar is not relevant, do the perceptual details of the actually studied items—reinstated in the recognition probe for same but not for different exemplars—lead to higher meaning-based recognition for same than different exemplars? Equally important, if there is such a specificity cost on this task, is it of similar magnitude for the two age groups? If so, this would suggest that perceptual details are available to both groups (and so must be encoded during study) but differentially influence performance depending on the task requirements and whether detailed information is directly and intentionally called upon for task decisions (identical recognition) or, instead, might influence recognition indirectly and without intention (meaning-based recognition).

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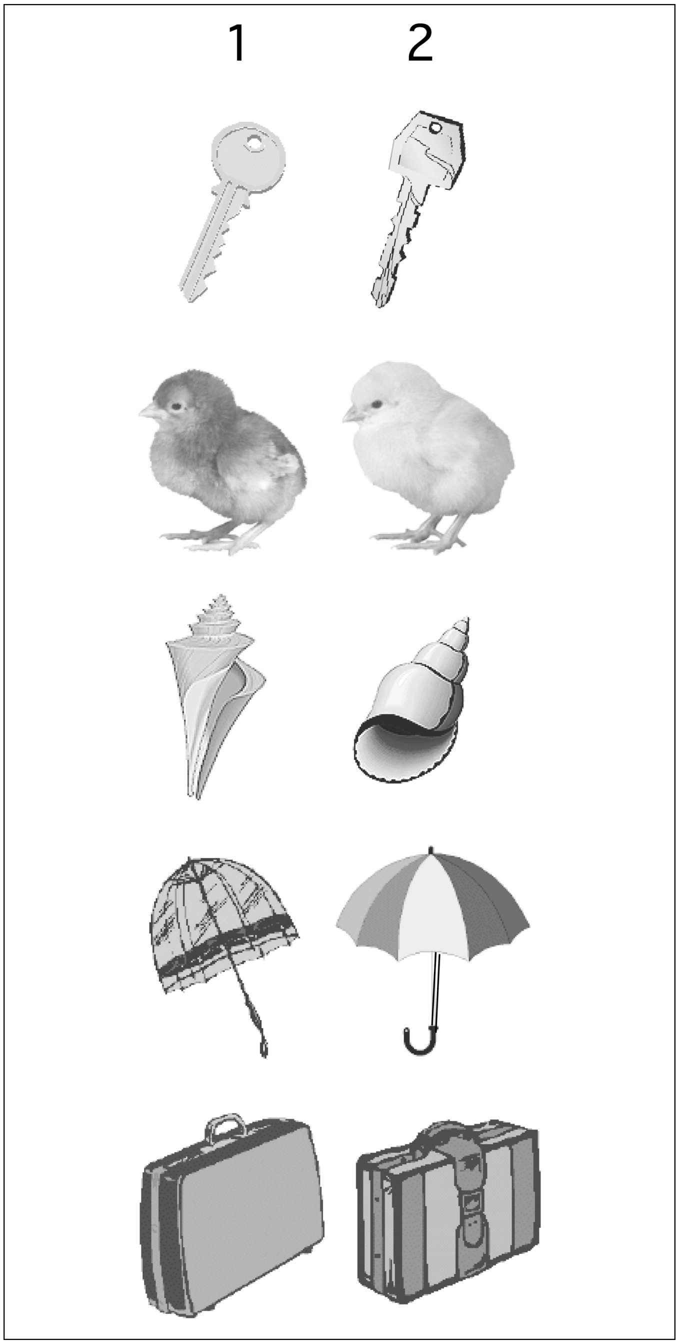

Fig. 1. Examples of the stimuli. Although shown here in gray scale, stimuli in the experiment were shown in color. See the text for details.

The final memory test involved repetition priming. The incidental study task used for all of the memory tests was a size-judgment task. In the repetition priming task, participants were asked to perform this size-judgment task again, for both same and different exemplars of items that had been presented earlier. Previous research using tasks such as picture naming (Bartram, 1974; Cave & Squire, 1992) or the same size-judgment decision used here (Koutstaal, Wagner, et al., 2001) has demonstrated that there is priming (i.e., facilitated responding), particularly in response times, for previously encountered compared with new items. Such priming has been found both for same and for different exemplars, but is greater for same exemplars. This pattern has also been found for older adults (Cave & Squire, 1992: control participants, mean age = 60.8 years). Thus, in the present study, this pattern (priming for both types of exemplars, but greater priming for same than different exemplars) was expected for younger adults and somewhat less assuredly for older adults (for discussion, see Rybash, 1996; Sommers, 1999; Wiggs & Martin, 1998). If older and younger individuals showed a similar perceptual specificity effect in repetition priming, this result, together with the expected pattern of elevated false recognition responding in older adults, would again demonstrate that differentiating perceptual details had been encoded by both age groups (otherwise there would not be a priming cost associated with exemplar change in the repetition priming task) but had parallel effects on performance only under some conditions.

METHOD

Participants

Participants were 24 older adults (mean age = 68.6 years, *SD* = 5.2) and 24 younger adults (mean age = 20.3 years, *SD* = 3.2). Older participants were volunteers recruited through posted flyers and were screened for conditions known to adversely affect cognitive function; they also attained a score of 26 or greater on the Mini Mental State Examination (Folstein, Folstein, & McHugh, 1975; cf. Lezak, 1995, p. 741). Older participants had an average of 12.5 years (*SD* = 3.0) of formal education. Younger participants (undergraduates) were recruited through posted flyers and had an average of 14.5 years (*SD* = 1.3) of education. All participants reported normal or corrected-to-normal vision and color vision, and were native speakers of English.

Stimulus Materials

The stimuli were colored photographs or detailed line drawings of common objects or animals (Fig. 1). There was a total of 240 object pairs (plus practice items); 120 items (1 each from 120 pairs) were presented at study, and 120 from the remaining pairs were presented as new items at test. Which items were presented at study versus test, and the type of test on which they appeared, was counterbalanced across participants, and any given item was tested only once per participant. Each of the three memory tests consisted of 120 items, including the presented and nonpresented exemplars of one set of 40 items (i.e., 40 same and 40 different exemplars), plus 40 new exemplars, presented in a pseudo-randomly intermixed order.

Procedure

All participants were tested individually and either were paid or received course credit for taking part. The order of administration of the three memory tests was chosen so as to minimize across-task changes in strategy. Thus, participants first performed the two tasks that involved no mention of memory testing per se: first the incidental study task of size judgments (involving presentation of all of the studied items for the entire experiment), and then the repetition priming task. In both the study phase and the repetition priming task, participants performed a size-judgment task, in which they indicated whether the real-world referent of the object shown was larger than a 13-in. box (an example of a 13-in. × 13-in. × 13-in. box was provided). Next participants performed the identical recognition task (old/new recognition decisions, with the identical recognition instructions described earlier), and last they performed the meaning-based recognition task (again old/new recognition decisions but with the meaning-based, or conceptual recognition, instructions described earlier). Examples of identical and conceptually related items were provided.

RESULTS

Study Phase

Both older and younger adults were highly accurate on the size-judgment task (older adults: .88, younger adults: .87), $F < 1$ for the effect of age. However, older adults provided their size judgments more slowly (M = 1,177 ms) than did younger adults (M = 1,011 ms), $F(1, 46) = 8.81$, $p = .005$.

Identical Recognition

Figure 2a shows the outcomes for the identical recognition test: The bars for the same exemplars indicate the mean true recognition, and the bars for the different exemplars indicate the mean false recognition for related lures. The figure shows the proportion of "old" responses, after subtracting baseline false alarms to new items (older adults: .07, younger adults: .10).

The figure shows that true recognition was essentially equivalent for older (.54) and younger (.56) adults. However, as expected, false recognition for the older group (.25) substantially exceeded that for the younger group (.12), leading to a significant Age × Item Type interaction, $F(1, 46) = 7.80$, $p = .008$.

Repetition Priming

The priming scores for the size-judgment response times are shown in Figure 2b. Priming scores are shown separately for same and different exemplars (i.e., mean response time for new exemplars minus mean response time for same exemplars and mean response time for new exemplars minus mean response time for different exemplars). As can be seen from the figure, older adults actually showed greater priming than did younger adults, $F(1, 46) = 8.94$, $p = .005$, and $F(1, 46) = 5.82$, $p = .02$, for the effect of age for same- and different-exemplar priming, respectively. However, as expected, for both age groups the magnitude of priming was greater for same than for different exemplars, $F(1, 46) = 14.01$, $p = .0005$, for the main effect of exemplar type. For this incidental task, this perceptual specificity effect was manifested to a similar degree in the two age groups, $F < 1$ for the Age × Item Type interaction. Accuracy on the task was slightly higher for same (.90) and different (.91) exemplars than for new exemplars (.89), $F(2, 92) = 3.77$, $p = .03$, but showed no effect of age (older adults: .91, younger adults: .89) and no Age × Item Type interaction, $F = 1.2$.

Meaning-Based Recognition

The outcomes for the meaning-based recognition test are shown in Figure 2c. The bars for the same exemplars indicate the average veridical meaning-based recognition for items that were identical to those that were encountered at study, and the bars for the different exemplars indicate the average veridical meaning-based recognition for

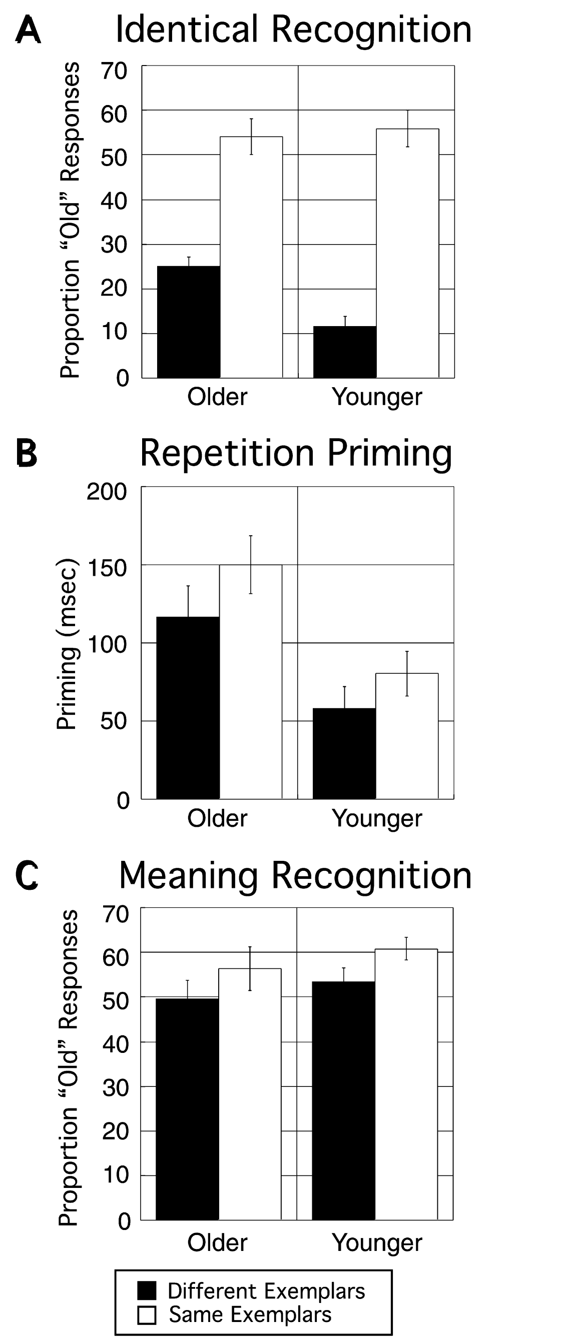

Fig. 2. Performance on the three memory tasks: identical recognition (a), repetition priming (b), and meaning-based recognition (c). For identical recognition, the graph shows the mean proportion of "old" responses to studied items (same exemplars) and nonstudied related lures (different exemplars), after subtracting false alarms to new items. For repetition priming, the graph shows the difference in mean response times for new versus repeated items, separately for same exemplars (new exemplar minus same exemplar) and different exemplars (new exemplar minus different exemplar). For meaning recognition, the graph shows the mean proportion of "old" responses to studied items (same exemplars) and nonstudied conceptually related items (different exemplars), after subtracting false alarms to new items. Error bars show the standard error of the mean.

items that were similar but not identical to exemplars that were studied. The figure shows the proportion of "old" responses, after subtracting baseline false alarms to new items (older adults: .16, younger adults: .18).

Three key observations can be drawn from Figure 2c. First, older and younger adults showed similar levels of meaning-based recognition for the same exemplars (means of .56 and .61). Second, the two age groups also showed similar—but lower—levels of meaning-based recognition for the different exemplars (.50 and .53), $F(1, 46) = 16.43$, $p = .0002$, for the main effect of item type. Finally, but critically, unlike the findings for identical recognition, but like the findings for repetition priming, this effect of item type was similar for the two age groups, $F < 1$ for the Age × Item Type interaction. Thus, on this indirect measure of perceptual specificity, both age groups again showed that item-specific details had been encoded, and at the time of retrieval, those details exerted similar and parallel effects in the two groups: In this case, the retrieval was intentional and required a recognition decision based on meaning, but changes in details for the different exemplars had an (unintended) detrimental effect, or reinstatement of the same details had an (unintended) facilitatory effect, on those meaning-based recognition decisions.

DISCUSSION

In summary, these findings suggest that older adults do, indeed, encode differentiating perceptual details—possibly even to the same extent as do younger adults, at least for certain types of task-relevant features—but the extent to which those details are used depends on the nature of the memory probe and the participant's retrieval intentions. Information on perceptual details affected performance of older and younger adults similarly when the task involved incidental use of that information (greater repetition priming and greater meaning-based recognition for same than for different exemplars). However, older adults were less likely than younger adults to successfully use perceptual details under deliberate retrieval conditions that required them to employ those details to differentiate between items that were encountered previously and similar-appearing lures that were not, in fact, encountered.

If, as these findings demonstrate, older adults encode differentiating perceptual details, what implications may this have for remedial strategies for reducing errors of commission in older individuals? Should remedial efforts (and future research) focus on what happens at retrieval, seeking to identify situational or cognitive factors that will enhance older adults' deliberate access to, and appropriate use of, differentiating details? The answer to this question hinges crucially on whether the differentiating information can be made available to deliberate recollection.

On the one hand, the finding of parallel effects of exemplar type for the two age groups in meaning-based recognition indicates that detailed exemplar information can influence performance on an explicit episodic memory probe in older adults; such influence is not confined to implicit tasks. On the other hand, however, these findings do not necessarily indicate that those details could be equivalently retrieved under conditions of intentional *recollection*. Considerable research demonstrates important behavioral and neuroanatomical differences between recognition memory judgments involving the recollection of contextual or specific information and familiarity-based recognition made without retrieval of such information (see Yonelinas, 2002, for a comprehensive review). Because the meaning-based task likely encouraged reliance on familiarity-based responding, the parallel decrements for different compared with same exemplars on this test might reflect parallel effects on familiarity-based decisions (e.g., a stronger "familiarity signal" for same than different exemplars that is equally manifested for the two age groups), possibly reflecting comparatively preserved parahippocampal familiarity-based processing in the older group.

This account would also explain the intact performance of the older adults on the meaning-based task, because other findings suggest that older individuals may have largely preserved familiarity-based recognition, but greater deficits in recollection (e.g., Parkin & Walter, 1992; Yonelinas, 2002). Deliberate, controlled, or intentional use of differentiating details to oppose false recognition might depend on hippocampal and frontal lobe functioning that is especially impaired in older adults and that subserves recollection. Yet there is also evidence that, for nonverbal materials such as the common objects used in this study, changing the perceptual format of items between study and test sometimes influences familiarity, but at other times influences recollection, or both recollection and familiarity (Rajaram, 1996; Srinivas & Verfaellie, 2000; Yonelinas & Jacoby, 1995). Thus, it remains an open question as to whether the detailed exemplar information that was shown here to exert unintentional effects on the recognition performance of older individuals might, under some conditions, be drawn upon to support more discerning and discriminating intentional memory judgments and decisions.

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