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Aging and Qualitative Characteristics of Memories for Perceived and Imagined Complex Events

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Older and younger adults' memory for perceived and imagined events was examined with a procedure in which everyday situations are simulated in the laboratory. Subjects perceived some situations and imagined others. Later, they were asked to rate their memory for various aspects of these situations (e.g., amount of perceptual detail, thoughts and feelings). A recall test followed the ratings. On the rating scale, for both perceived and imagined events, older subjects reported better memory for their thoughts and feelings than did younger subjects. In addition, on the recall test, older subjects produced more thoughts and feelings than did younger subjects, whereas younger subjects produced more perceptual and spatial information. These results suggest that older subjects may not inhibit personal information (e.g., thoughts and feelings), and this information may interfere with memory for other aspects of information, such as perceptual and contextual details (Hasher & Zacks, 1988).

Older adults often complain of poor memory not only for externally derived information but also for internally generated information, such as thoughts, plans, and intentions. Although age-related deficits in remembering externally derived (perceived) events have been clearly established (Craik, 1977; Kausler, 1982), the issues of whether older adults have problems in remembering internally generated (imagined) events and whether they have more difficulty than younger adults discriminating between their memories for the two types of events (*reality monitoring*, Johnson & Raye, 1981) have received little attention (Cohen & Faulkner, 1989; Hashtroudi, Johnson, & Chrosniak, 1989; Kausler, Lichty, & Freund, 1985; Mitchell, Hunt, & Schmitt, 1986; Rabinowitz, 1989). The purpose of this experiment was to examine older adults' memory for perceived and imagined complex events and their ability to discriminate between memories for these two types of events.

A theoretical framework that addresses these issues was proposed by Johnson and Raye (1981). According to this framework, memories for both perceived and imagined events consist of several at least partially independent qualities. On average, memories originating in perception should have more perceptual information (e.g., color and sound), more spatial–temporal information, and more meaningful details. Memories originating in imagination, on the other hand, should, on average, have more information about the cognitive operations by which the memory was established. These differences in memory characteristics between perceived and imagined events can be used as bases for discriminating the origin (external or internal) of a memory. For example, a memory with a great deal of visual and spatial information, and with very little record of cognitive operations, should be judged to have been externally derived.

Although not mentioned in the original Johnson and Raye (1981) framework, memories for perceived events may also typically include more information about thoughts and feelings than do memories for imagined events (Suengas & Johnson, 1988). Thoughts and feelings should be distinguished from cognitive operations. Cognitive operations refer to mental activities that are part of creating or establishing a target event—for example, those involved in hearing or imagining a person speaking (Johnson, Foley, & Leach, 1988) and reading a word or generating a word to a cue (Johnson, Raye, Foley, & Foley, 1981; Rabinowitz, 1989). Thoughts and feelings refer to what might be called *apperceptive* reactions to target events (Johnson & Suengas, 1989; Suengas & Johnson, 1988), such as feeling frustrated or deciding an event is not interesting. Although cognitive operations and apperceptive reactions often may have some processes in common, and thus the distinction is not entirely clear-cut, it is nevertheless important. A relatively large amount of cognitive operations in a remembered event implies that the event was initially self-generated (e.g., Finke, Johnson, & Shyi, 1988; Johnson et al., 1981). In contrast, a large amount of apperceptive information in a memory suggests that the event occurred and was not just imagined.

The differences between memories for perceived and imagined events do not necessarily remain constant over time. Initial differences in qualitative characteristics of memories that reflect differences in perceptual and imaginal processes may become larger or smaller, depending on time and subsequent

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events. For example, Suengas and Johnson (1988) found that perceptual aspects of information became unavailable more rapidly for imagined than for perceived events and that the relative impact of thinking about events depended on which aspects (perceptual or apperceptive) of events the subject focused on while thinking about them.

In this experiment, we compared older and younger adults with respect to qualitative characteristics of memories for perceived and imagined events. In addition, we examined whether changes in certain memory characteristics over time are different for younger and older subjects. Because memory characteristics are used as a basis for decisions involving the source (perceived or imagined) of memories, age differences in the availability of these characteristics not only would affect recall of perceived and imagined events but also could lead to difficulties in identifying the source of memories. For example, if older adults forget perceptual information for perceived events more rapidly than do younger adults, perceived events would become more similar to imagined events, thereby creating confusion in discriminating between them.

Discriminating the source of information is critical for normal memory functioning because it is knowledge of the source that makes a memory specific and autobiographical. A feeling of personal past and a sense of continuity of experiences require remembering the source of memories. A disruption in remembering source, or the loss of autobiographical specificity, is a central aspect of various types of memory disorders, such as acute and chronic amnesia (e.g., Hashtroudi, Parker, DeLisi, Wyatt, & Mutter, 1984; Schacter, Harbluk, & McLachlan, 1984; Warrington & Weiskrantz, 1970) and Alzheimer's disease (Moscovitch, Winocur, & McLachlan, 1986). More important, recent evidence suggests that the inability of older adults to remember the source of information is an important part of the age deficit in memory (Hashtroudi et al., 1989; McIntyre & Craik, 1987).

There have been no systematic attempts to examine the effect of aging on various memory characteristics within the same experiment. However, age-related deficits in remembering perceptual aspects (Kausler & Puckett, 1980, 1981a, 1981b), spatial–temporal attributes (Kausler, Lichty, & Davis, 1985; Light & Zelinski, 1983; Perlmutter, Metzger, Nezworski, & Miller, 1981), and semantic details of information (Craik & Simon, 1980; Rabinowitz & Ackerman, 1982) have been reported in separate experiments. In addition, there is evidence suggesting that older adults may not spontaneously engage in cognitive operations, such as elaboration (Craik & Simon, 1980) and organization (Hultsch, 1969). Thus, it seems important to determine whether some memory characteristics are affected more by aging than others or whether aging has the same effect on all these characteristics.

To examine the effect of aging on various memory characteristics within the same experiment, we used a procedure in which complex perceived and imagined events are simulated in the laboratory (Suengas & Johnson, 1988). A frequent criticism of the research on aging and memory is that laboratory tasks using simple materials, such as words and sentences, are poorly suited for assessing memory performance of older adults, who rarely need to remember these types of materials. Thus, complex, simulated everyday events should be particularly useful for exploring age differences in memory. Suengas and Johnson's results suggest that the basic assumptions and predictions of the reality-monitoring framework derived from studies with simple materials can be extended to these complex events.

Subjects in this experiment perceived four everyday situations and imagined four situations (e.g., packing a picnic basket and looking at photographs). After the presentation of the situations, subjects rated their memory for half of the situations (two perceived and two imagined) using a Memory Characteristics Questionnaire (MCQ; Johnson, Foley, Suengas, & Raye, 1988) that assesses qualitative characteristics of memories (e.g., amount of perceptual and contextual detail and thoughts and feelings). After 24 hr, subjects returned to the laboratory and rated all eight situations using the MCQ. A recall test followed the ratings. Performance on the ratings and recall test on Day 2 would indicate whether older adults have lower memory for all aspects of the situations or whether they experience difficulty only for certain aspects. Day 1 ratings for half of the situations were included to assess the effect that thinking about the events (during the rating task) would have on later memory for these events. Thinking or rehearsal may affect perceived and imagined events differently and thus may maintain, reduce, or enlarge the phenomenal differences between the perceived and imagined events (Suengas & Johnson, 1988). In addition, rehearsal may have different effects on the performance of younger and older adults.

Method

Subjects

Forty younger adults (13 men and 27 women) and 40 older adults (22 men and 18 women) participated in this experiment. The younger adults were undergraduate and graduate students at George Washington University who received course credit or payment for their participation in two sessions. The older adults were community-dwelling residents from the Washington, DC, area who were solicited through advertisement and received payment for participation in two sessions. They were in good health (self-report) and apparently free from sensory difficulties or had corrected vision and hearing. The mean age of the younger group was 19.8 (range = 17–25), and the mean age of the older group was 68.7 (range = 60–79). The mean years of education were 13.2 (SD = 1.08) for younger adults and 15.5 (SD = 2.10) for older adults, $F(1, 78)$ = 38.85, MS_e = 2.78. All subjects completed the Vocabulary subtest of the Wechsler Adult Intelligence Scale–Revised (WAIS–R; Wechsler, 1981). The mean score was 51.2 (SD = 6.79) for younger adults and 58.0 (SD = 5.75) for older adults, $F(1, 78)$ = 23.54, MS_e = 39.58.

Design and Procedure

Three variables were manipulated within subjects: origin of event (perceived vs. imagined), whether or not the event was rated on Day 1 (rated vs. not rated), and time of ratings (Day 1 vs. Day 2). Age (younger vs. older) was a between-subjects variable. The design of the experiment allowed for two $2 \times 2 \times 2$ comparisons. Each comparison included age and origin of events as variables. The first comparison examined the forgetting rate over the 24-hr retention interval (Day 1 ratings vs. ratings on Day 2 for events not rated on Day 1), and the second examined the effects of rehearsal (Day 1 rated vs. Day 1 not rated) on Day 2 performance.

Day 1: Acquisition and initial ratings. During the first session, subjects were tested individually or with another person. Subjects perceived

four and imagined four target situations. On perception trials, subjects actually participated in the situation. For example, they visited a seminar room or packed a picnic basket. On imagination trials, subjects listened to a script describing the situation as closely as possible to its perceived version. For example, a portion of the script describing the picnic basket was as follows: "Imagine that you are preparing to go on a picnic. You have a woven wicker basket with a lid on a hinge and two handles. Imagine that you spread a red- and white-checkered napkin inside the basket. You tuck in the corners and smooth it out. Now, imagine that there are on the table in front of you a bottle of red wine, a wedge of cheese wrapped in plastic, and a loaf of French bread. You take the bottle of wine and put it in the basket. . . ."

The scripts were read slowly, with 10-s pauses between sentences, to allow subjects time to imagine the situations. The purpose of the scripts was to ensure that perceived and imagined versions of the events were comparable in terms of content. The use of the scripts also helped to equate the time either participating in or imagining some of the situations (e.g., examining three works of art). However, on average, perceived versions of the situations took longer than imagined versions. Perceived and imagined situations alternated. Situations were counterbalanced across subjects so that any given situation was perceived and imagined by an equal number of subjects.

After the acquisition phase, subjects were given an unexpected rating task in which they rated their memory for half of the situations (two perceived and two imagined). Ratings were made with 30 questions from the MCQ used by Johnson et al. (1988). These questions assess several memory characteristics (e.g., visual detail, spatial–temporal information). For all items on the MCQ, the subject responds by circling a number on a 7-point scale (e.g., "My memory for this event involves: *little or no visual detail* 1 2 3 4 5 6 7 *a lot of visual detail*"; "I remember how I felt at the time the event took place: *not at all* 1 2 3 4 5 6 7 *clearly*"; "Relative spatial arrangement of objects in my memory for the event is *vague* 1 2 3 4 5 6 7 *clear/distinct*").

After the eight situations were presented, and prior to the ratings, subjects were given two additional situations, one perceived and one imagined. The procedure for presenting these situations was identical to the eight target situations, except that the MCQ was presented immediately after each situation. The purpose of these two situations was to obtain a baseline measure of rating for younger and older subjects against which to evaluate memory factors. This baseline measure assesses whether older subjects differ from younger subjects in the way they rate events initially, after a minimal retention interval.

Thus, a total of 10 situations were used in the study, 2 baseline and 8 target situations. Across subjects, all 10 situations were used equally often as baseline and as target situations. The 10 situations were having coffee and cookies, having soda and snacks, making an abstract collage, making a pot with clay, looking at photographs of two people, looking at three pictures of works of art, packing a picnic basket, wrapping a parcel, visiting a seminar room, and visiting a room for psychology experiments.

Day 2: Ratings and recall. At the end of Day 1, subjects were reminded to return the next day and were led to believe that they would do additional, similar tasks. They were not warned in advance that they would be tested on the events experienced on Day 1. During the second session, subjects rated their memories for the eight target situations they had experienced the previous day using the MCQ. After the ratings, subjects were presented with a booklet containing eight blank pages with the name of each situation written at the top of each page. They were instructed to write all they could remember about each situation. For the ratings and written recall tests, situations were presented in a random order. The ratings and the recall tests were self-paced.

Reality-monitoring test. To examine whether subjects could discriminate between the relatively complex perceived and imagined situations after some time had elapsed, 3 weeks after the experiment, we contacted subjects by phone for a reality-monitoring test. The names of the eight target situations were presented in a random order, and subjects were asked to decide whether each situation was one that they had perceived or one that they had imagined. Twenty-nine older adults and 24 younger adults were reached by telephone.

Results

Ratings

The MCQ used to rate memories included questions that were designed a priori to sample a wide range of memory characteristics. Suengas and Johnson (1988) grouped the items into five categories on the basis of the results of principal component analyses. The factor structures for perceived and imagined events were very similar, and grouping of the items according to the results of factor analyses or according to a priori expectations produced similar results. Thus, instead of examining each individual item from the MCQ, Suengas and Johnson reported results averaged across items designed to draw on a common memory characteristic.

Because the number of subjects tested in our experiment was small, we did not conduct a factor analysis on the data. Rather, we grouped the items according to the factor structure used in the Suengas and Johnson (1988) study. Five factors were formed: a Clarity factor (e.g., visual detail and vividness), a Contextual factor (spatial arrangement of objects and people), a Nonvisual Sensory factor (e.g., sounds and smells), a Thoughts and Feelings factor (e.g., memory for thoughts), and an Intensity of Feelings factor (e.g., how intense feelings were at the time of the event).

Scores for individual subjects were calculated for each factor by averaging across ratings on the items that formed each factor. For example, for each subject, the simple mean of his or her ratings on memory for sound, smell, and taste for each situation (Items 4, 5, and 7 on the MCQ; see Johnson et al., 1988) was used as that subject's score on the Nonvisual Sensory factor. The .05 level of significance was used for all statistical tests reported in this article unless otherwise specified.

Baseline performance. To determine whether there were any differences in the way that older and younger subjects rated perceived and imagined events immediately after they occurred, we performed analyses of variance (ANOVAs) on each composite factor using only the data from the two baseline situations. Two-by-two ANOVAs, with age (younger and older adults) as a between-subjects variable and origin of event (perceived vs. imagined) as a within-subject variable, showed that perceived events received higher ratings than did imagined events in the factors of Clarity (M perceived = 6.13, M imagined = 5.65), $F(1, 78) = 17.20$, $MS_e = 0.55$; Context (M perceived = 6.22, M imagined = 4.97), $F(1, 78) = 45.98$, $MS_e = 1.35$; and Thoughts and Feelings (M perceived = 4.85, M imagined = 4.54), $F(1, 78) = 5.06$, $MS_e = 0.76$. These findings are consistent with the reality-monitoring model, except that perceived events did not receive higher ratings than imagined events on nonvisual sensory information as the model would predict.

There were no main effects of age nor interactions of age with origin of event. These data indicate that older adults did not differ from younger adults in the baseline level of performance when the retention interval was minimized. Thus, any differ-

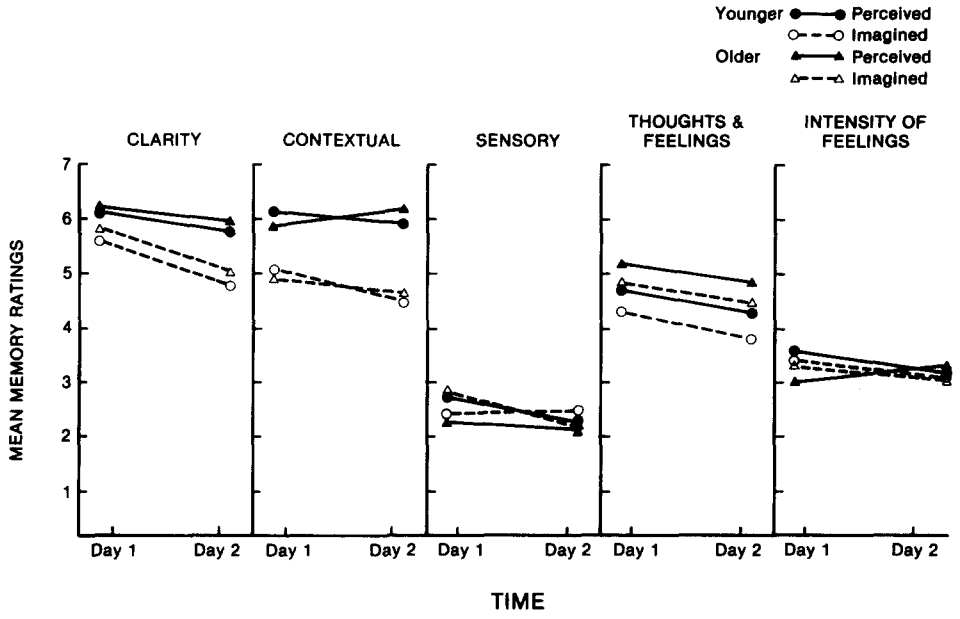

Figure 1. Mean ratings of perceived and imagined events on Day 1 and Day 2 for older and younger adults.

ences between the groups on the target events should reflect age differences that emerge with increasing retention interval rather than differences in how older and younger subjects rate the events initially.

Effect of delay. To assess differences in the forgetting rate for younger and older adults, we compared ratings made on Day 1 for half of the situations with ratings made on Day 2 for the other half of the situations that were *not* initially rated. This comparison provides a measure of forgetting over 24 hr for the situations that were not rehearsed (rated) on Day 1. A 2 × 2 × 2 ANOVA, with age as a between-subjects variable and origin of event (perceived and imagined) and time (Day 1 rated vs. Day 2 not previously rated) as within-subject variables, was performed on each factor. The mean ratings for all factors are shown in Figure 1.

The only significant main effect of age occurred for the Thoughts and Feelings factor, $F(1, 78) = 6.43$, $MS_e = 4.73$. Older subjects indicated that they had better memory for thoughts and feelings than did younger subjects. The only significant interaction involving age was a three-way interaction of age, origin of event, and time for the Intensity of Feelings factor, $F(1, 78) = 5.76$, $MS_e = 0.42$. Analyses of the simple effects of this interaction showed that for younger adults, ratings for both perceived events, $F(1, 78) = 4.09$, $MS_e = 0.59$, and imagined events, $F(1, 78) = 3.27$, $MS_e = 0.70$, $p < .07$, dropped over 24 hr. For older adults, ratings for imagined events dropped over 24 hr, $F(1, 78) = 7.36$, $MS_e = 0.70$, but there was no change in ratings for perceived events, $F(1, 78) = 1.07$, $MS_e = 0.60$. Inspection of Figure 1 shows that the finding of no decrease over time in the ratings of perceived events may have been a consequence of the unusually low ratings given by older subjects to these events on Day 1.

Overall, there was a clear difference between older and younger adults only on the Thoughts and Feelings factor. As indicated earlier, younger and older adults did not differ in baseline performance on the Thoughts and Feelings factor. Therefore, the age difference in this factor occurred only after a substantial retention interval, suggesting that the salience to older subjects of thoughts and feelings, relative to other aspects of the events, increases over time.

When the data were collapsed across age, our results were generally consistent with those reported by Suengas and Johnson (1988, Experiment 3). As with the Suengas and Johnson results, ratings for perceived events were higher than ratings for imagined events, for the factors of Clarity, $F(1, 78) = 54.06$, $MS_e = 0.73$; Context, $F(1, 78) = 89.45$, $MS_e = 1.38$; and Thoughts and Feelings, $F(1, 78) = 28.31$, $MS_e = 0.44$. In addition, we found that for Clarity, $F(1, 78) = 6.79$, $MS_e = 0.66$, and Context, $F(1, 78) = 5.42$, $MS_e = 0.80$, forgetting rates were more rapid for imagined events than for perceived events.

Suengas and Johnson (1988, Experiment 3) found more forgetting of nonvisual sensory information for imagined than for perceived events, and in this study, we found more forgetting of contextual information for imagined than for perceived events. This difference in outcome should not obscure the consistency in pattern across the two studies, namely greater forgetting for imagined than for perceived events. One can assume that the particular memory characteristics that reveal this pattern will vary depending on the nature of the events, and there were some differences in events used in the two studies. The fact that both studies showed greater forgetting of imagined events on the Clarity factor suggests that visual information is especially sensitive to differential forgetting of imagined and perceived events.

Effect of ratings. To evaluate whether rating events on Day 1 affected memory, we performed a 2 × 2 × 2 (Age × Origin × Rating: Day 1 rated vs. Day 1 not rated) ANOVA on ratings taken on Day 2. There was no main effect of age, and there were no interactions involving age. Day 2 ratings for events rated on Day

1 were higher than the events not rated on Day 1 for the factors of Clarity (M rated = 5.68, M not rated = 5.41), $F(1, 78) = 12.43$, $MS_e = 0.49$; Context (M rated = 5.45, M not rated = 5.26), $F(1, 78) = 5.63$, $MS_e = 0.52$; and Thoughts and Feelings (M rated = 4.53, M not rated = 4.37), $F(1, 78) = 9.69$, $MS_e = 0.20$. In addition, imagined memories profited more from rehearsal induced by ratings than did perceived memories for the Clarity factor (M perceived rated = 5.99, M perceived not rated = 5.88, M imagined rated = 5.38, M imagined not rated = 4.94), $F(1, 78) = 3.12$, $MS_e = 0.67$, $p < .08$, and Context factor (M perceived rated = 5.98, M perceived not rated = 6.00, M imagined rated = 4.93, M imagined not rated = 4.53), $F(1, 78) = 5.51$, $MS_e = 0.62$. A similar effect was reported by Suengas and Johnson (1988).

Recall

There were 320 recall protocols for younger adults and 320 protocols for older adults (40 subjects in each age group × 8 situations). Nine recall protocols (2 for younger and 7 for older adults) were excluded because subjects could not remember the events. Two judges evaluated the recall protocols according to 10 categories: number of words, number of ideas, and how often subjects mentioned colors, objects, nonvisual sensory information (e.g., touch, sound, and smell), spatial references (e.g., right and left), people (e.g., "The other subject drank all his coffee"), actions (e.g., "I attempted to fit the collage pieces together"), thoughts and feelings (e.g., "I had an idea in my mind of what I wanted it [my pot] to look like"; "I felt pleased the collage turned out the way I wanted it"), and evaluative statements (e.g., "The photo was at best unimaginative").

The judges had perfect agreement in all measures except for ideas, thoughts and feelings, and evaluative statements. Agreement in these measures was 97% for ideas, 75% for thoughts and feelings, and 76% for evaluative statements. Disagreements were resolved through discussion. Mean values for each measure are shown in Table 1. These means represent recall per event, averaged across the four events of each type (i.e., perceived and imagined). As the table shows, the overall level of recall was relatively low. For example, out of an average of 27.5 possible ideas in the scripts for imagined events, subjects recalled on average only 6.7 ideas. Similarly, on average, subjects reported less than one color and less than one statement of thoughts and feelings. In spite of small differences among conditions in absolute terms, there were several interesting, statistically significant differences between perceived and imagined events and between older and younger subjects.

A 2 × 2 ANOVA was performed on each measure, with age as a between-subjects variable and origin of event (perceived or imagined) as a within-subject variable. The key finding was that older adults reported fewer colors, $F(1, 78) = 8.31$, $MS_e = 0.32$; objects, $F(1, 78) = 12.39$, $MS_e = 0.76$; references to nonvisual sensory information, $F(1, 78) = 3.72$, $MS_e = 0.09$, $p < .06$; spatial references, $F(1, 78) = 6.63$, $MS_e = 0.77$; and actions, $F(1, 78) = 5.45$, $MS_e = 0.92$, than did younger adults. In contrast, older subjects reported thoughts and feelings, $F(1, 78) = 5.01$, $MS_e = 1.73$, and evaluative statements, $F(1, 78) = 7.28$, $MS_e = 0.34$, more often than did younger subjects. Older adults did not differ from younger adults in the total number of words produced, $F(1, 78) = 1.18$, $MS_e = 297.65$; ideas reported, $F(1, 78) = 2.20$, $MS_e = 9.68$; or references to people ($F < 1$).

Table 1
Mean Recall Scores of Younger and Older Adults for Each Measure

	Older		Younger	
Measure	Perceived	Imagined	Perceived	Imagined
Words	32.57	27.43	34.00	31.93
Ideas	7.62	6.13	7.93	7.27
Colors	0.76	0.56	0.98	0.86
Objects	2.53	2.01	2.85	2.66
Sensory	0.13	0.23	0.15	0.38
Spatial	1.00	0.79	1.29	1.21
People	0.14	0.04	0.19	0.04
Actions	0.88	0.64	1.21	1.01
Thoughts & feelings	1.17	0.96	0.71	0.49
Evaluative	0.46	0.47	0.24	0.19

The interaction of age and origin was not significant for any of the measures, indicating that the difference in recall between perceived and imagined events was the same for younger and older adults. Across age groups, the number of words, $F(1, 78) = 6.17$, $MS_e = 84.07$, and ideas, $F(1, 78) = 12.14$, $MS_e = 3.82$, in the protocols were higher for perceived events than for imagined events. In addition, subjects reported more colors, $F(1, 78) = 4.37$, $MS_e = 0.22$; objects, $F(1, 78) = 10.23$, $MS_e = 0.51$; people, $F(1, 78) = 30.46$, $MS_e = 0.02$; actions, $F(1, 78) = 4.35$, $MS_e = 0.43$; and thoughts and feelings, $F(1, 78) = 6.78$, $MS_e = 0.27$, for perceived events than for imagined events. There were no differences in the number of spatial references, $F(1, 78) = 2.46$, $MS_e = 0.34$, or evaluative statements ($F < 1$) for perceived and imagined events. Nonvisual sensory information was reported more for imagined events than for perceived events, $F(1, 78) = 14.69$, $MS_e = 0.08$. This last finding may reflect the fact that the scripts for imagined events included specific references to nonvisual sensory information (touch, smell, etc.) that may not have been salient for the corresponding perceived events.

In sum, for both perceived and imagined events, older subjects reported more thoughts and feelings as well as more evaluative statements than did younger subjects, but older subjects had lower scores in most other measures. Clearly, the recall test produced more age differences than did the ratings test. Older adults did not differ from younger adults in their ratings of clarity, contextual information, or nonvisual sensory information, whereas their recall was lower for similar measures, such as colors, objects, spatial references, and nonvisual sensory information. The finding of lower recall for older adults in this study is consistent with other studies that have demonstrated age-related declines in memory for activities and events (Kausler, Lichty, & Davis, 1985; Kausler, Lichty, & Freund, 1985). There are, however, other studies that have reported no effect of aging on event memory (Sinnott, 1986), and it is possible that the age deficit depends partly on the type of event studied (Padgett & Ratner, 1987).

Reality Monitoring

The telephone test conducted approximately 3 weeks after the experiment indicated that subjects' overall ability to discriminate between memories for perceived and imagined events was quite good. Younger subjects correctly identified 100% of the perceived events and 96% of the imagined events. The corresponding numbers for the older subjects were 95% and 86%, respectively. In a 2 × 2 (Age × Origin: perceived vs. imagined) ANOVA, both the main effect of origin, $F(1, 51) = 5.17$, $MS_e = 0.02$, and of age, $F(1, 51) = 8.19$, $MS_e = 0.02$, were significant.

The apparent decline in reality monitoring in older adults is in agreement with recent findings (Cohen & Faulkner, 1989; Rabinowitz, 1989). However, older adults do not always show reality-monitoring deficits (Hashtroudi et al., 1989; Mitchell et al., 1986). Therefore, the conditions affecting age differences in reality monitoring remain to be specified. Some possibilities for future investigation include assessing the roles of retention interval, the extent to which materials engage thoughts and feelings, and the similarity of perceived and imagined events.

Discussion

When subjects were asked to rate various qualitative characteristics of memories for simulated everyday events, older subjects, like younger subjects, gave higher ratings to perceived events on several characteristics. Also, older subjects, like younger subjects, showed a greater decrease over time for imagined than for perceived events on some characteristics. Both of these findings replicate those of Suengas and Johnson (1988) and extend them to older individuals.

The increasing difference between perceived and imagined events over time provides a mechanism to help protect against reality-monitoring confusions, even when the overall level of memory performance is low, as is often the case with older adults. At short retention intervals, there is "supporting information" (such as the circumstances leading to an imagination) that helps discriminate perceived from imagined events (Johnson et al., 1988). This supporting information may not be accessible after longer retention intervals. Furthermore, as overall qualitative characteristics become less available over time, it may take a greater difference between perceived and imagined memories to differentiate reliably between them. An increasing difference over time between memories for perceived and imagined events on some characteristics would help offset this loss of supporting information and general degradation of memories over time.

In general, the ratings given by older and younger subjects were quite similar except on questions about thoughts and feelings, where older subjects gave higher ratings to their memories. When subjects were asked to recall these same events, compared with younger subjects, older subjects reported more thoughts and feelings for both perceived and imagined events, whereas younger subjects reported more colors, objects, sensory information, spatial information, and actions.

The recall data suggest that older adults have difficulty in remembering specific perceptual and contextual (spatial) aspects of information. These findings are consistent with other studies showing that older adults only encode general and global features of information (Craik & Simon, 1980; Rabinowitz & Ackerman, 1982). Alternatively, older adults may encode specific aspects of complex events but later have difficulty retrieving this information. The absence of a difference between younger and older subjects on perceptual and contextual items on the rating task is consistent with this latter possibility. That is, the questions on the MCQ rating scale may serve as retrieval cues, thus providing more guidance at retrieval than is available on the recall test. Craik (1984) has suggested that age differences in memory might be minimal if subjects are provided such support and guidance at either encoding or retrieval.

Another reason that older subjects may not show lower ratings for perceptual and contextual detail but show lower recall for this information is that the rating data may reflect a metamemory deficit with aging. That is, the rating data might be thought of as subjects' predictions about the probability of being able to recall various types of information. Older subjects may be less accurate in such predictions (Bruce, Coyne, & Botwinick, 1982; Murphy, Sanders, Gabriesheski, & Schmitt, 1981), at least about perceptual and contextual information. In any event, compared with the rating data, the recall data may more accurately index the information that is used in making reality-monitoring decisions. To make decisions about the origin of events, subjects do not typically have retrieval cues available as they did in the MCQ. Subjects would have to recall the perceived and imagined events and examine the memory characteristics for these events. As discussed next, the recall data provide reasonable clues about the potential sources of age differences in reality monitoring.

For thoughts and feelings, there was no apparent recall deficit for the older subjects. Older adults rated their memory for thoughts and feelings to be higher than that of younger adults, and the older adults in fact produced more thoughts and feelings on the recall test. Why would older adults have less retrieval difficulty with thoughts and feelings than with other types of information? One possibility is that at recall, older subjects selectively access thoughts and feelings first and other information suffers more output interference (Roediger, 1974), whereas the reverse may be true for younger subjects. An examination of output order provided only weak support for this hypothesis: For older adults, 17% of the information recalled first was thoughts and feelings and evaluative statements, whereas for younger subjects, 12% of statements recalled first were from this category. Another explanation is that remembering thoughts and feelings does not require the specificity (e.g., as extensive a search) required to remember other aspects, such as colors, sensory information, and so forth. A third possibility is that older subjects are not remembering thoughts and feelings they had originally but are generating new thoughts and feelings to fill in gaps in recall during the test. Regardless of the interpretation, the demonstration of relatively greater amounts of thoughts and feelings in the recall protocols of older subjects is an intriguing new finding.

Consider the consequences for older adults of memories that consist of relatively more of thoughts and feelings and relatively less of most other aspects of information. One important consequence is related to the possibility that thoughts and feelings may not be as reliable indicators that an event happened as are perceptual and contextual aspects of memories. There is some

evidence that focusing on thoughts and feelings makes imagined and perceived memories more similar, whereas focusing on perceptual aspects of memories does not increase the similarity of memories for perceived and imagined events (Suengas & Johnson, 1988). Suengas and Johnson also found that focusing on thoughts and feelings makes it more difficult to remember the perceptual aspects of information, and Johnson et al. (1988) reported that perceptual detail is a salient reality-monitoring cue. Thus, if older subjects selectively thought about apperceptive qualities of events during or after the events or selectively accessed these qualities later when asked to make reality-monitoring judgments (as the recall data suggest they would), they should have difficulty discriminating between perceived and imagined memories. The reality-monitoring data collected 3 weeks after the experiment were consistent with this hypothesis. Older adults made more errors in identifying the source of their memories than did younger adults.

This interpretation would account for why, despite the absence of significant interactions of age and origin for the ratings and recall measures, older adults had lower reality-monitoring performance than younger adults. That is, older adults did not show a smaller difference between perceived and imagined events on any of the characteristics assessed by the recall and rating data. Nevertheless, age differences in reality monitoring might occur because older subjects selectively access and give more weight to thoughts and feelings than to perceptual and contextual information in making reality-monitoring decisions.

The fact that older adults reported more thoughts and feelings and less perceptual and spatial information than did younger adults might reflect a combination of motivational and cognitive factors. One possibility is that with increasing age, there is an increase in the importance of personal values and information (Labouvie-Vief & Blanchard-Fields, 1982; Obler, 1980), and thus older adults may be more likely than younger adults to interpret the presented information in terms of their value system and their feelings. With increased focus on the personal or apperceptive aspects of information (thoughts and feelings), older adults may be less likely to attend to and remember perceptual aspects of information. Although clearly speculative, this interpretation is consistent with studies demonstrating that older adults' discourse is filled with personalistic references (Obler, 1980). It is also consistent with a recent framework proposed by Hasher and Zacks (1988) to explain age deficits in comprehension and memory.

According to Hasher and Zacks (1988), during normal functioning, inhibitory mechanisms may limit the entrance of irrelevant, "nongoal" information into working memory. With aging, there may be a breakdown in the efficiency of these mechanisms. The inefficient functioning of inhibitory mechanisms combined with an increase in the importance of one's values and experiences, which occurs as a result of aging, may allow entrance into working memory of irrelevant information such as personalistic memories and peripheral environmental details. This information may interfere with later retrieval of objective information. Hasher and Zacks also suggested that as a result of repeated retrieval failures and as a compensatory mechanism, older adults may rely more on highly accessible information such as personal experiences and opinions. If relatively little of the presented information is remembered, older adults may use the personal information to fill the gaps in their memory. Accordingly, in our experiment, older adults may not have inhibited thoughts and feelings elicited by various aspects of the presented information. This personal information, which in our procedure was not defined as obviously irrelevant, may have interfered with encoding or retrieval of perceptual and spatial information. The larger number of evaluative statements (e.g., "I would never have packed such a sparse picnic basket") reported by older adults compared with younger adults further supports this interpretation. The fact that older and younger subjects did not differ in their immediate ratings of apperceptive qualities of the baseline situations but did differ in later ratings of the target situations indicates that age differences in the relative salience of apperceptive information increases over time.

In summary, our results clearly indicate that older adults have difficulties in remembering imagined as well as perceived events on a test of free recall of the events. In addition, aging appears to have different effects on various memory characteristics. There is an age-related decline in remembering spatial information as well as perceptual information, such as colors and objects (this difference may be somewhat overcome with cuing as in the MCQ). In contrast, older adults seem to remember more thoughts and feelings and other personal information than do younger adults. The differential effects of aging on the relative accessibility of perceptual versus apperceptive memory characteristics may, in turn, lead to some difficulties in reality monitoring of complex events.

References

Bruce, P. R., Coyne, A. C., & Botwinick, J. (1982). Adult age differences in metamemory. *Journal of Gerontology, 37,* 354–357.

Cohen, G., & Faulkner, D. (1989). Age differences in source forgetting: Effects on reality monitoring and on eyewitness testimony. *Psychology and Aging, 4,* 10–17.

Craik, F. I. M. (1977). Age differences in human memory. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (pp. 384–420). New York: Van Nostrand Reinhold.

Craik, F. I. M. (1984). Age differences in remembering. In L. R. Squire & N. Butters (Eds.), *Neuropsychology of memory* (pp. 3–12). New York: Guilford Press.

Craik, F. I. M., & Simon, E. (1980). Age differences in memory: The roles of attention and depth of processing. In L. W. Poon, J. L. Fozard, L. S. Cermak, D. Arenberg, & L. W. Thompson (Eds.), *New directions in memory and aging: Proceedings of the George Talland Memorial Conference* (pp. 95–112). Hillsdale, NJ: Erlbaum.

Finke, R. A., Johnson, M. K., & Shyi, G. C. W. (1988). Memory confusions for real and imagined completions of symmetrical visual patterns. *Memory & Cognition, 16,* 133–137.

Hasher, L., & Zacks, R. T. (1988). Working memory, comprehension, and aging: A review and a new view. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 22, pp. 193–225). New York: Academic Press.

Hashtroudi, S., Johnson, M. K., & Chrosniak, L. D. (1989). Aging and source monitoring. *Psychology and Aging, 4,* 106–112.

Hashtroudi, S., Parker, E. S., DeLisi, L. E., Wyatt, R. J., & Mutter, S. A. (1984). Intact retention in acute alcohol amnesia. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 156–163.

Hultsch, D. F. (1969). Adult age differences in the organization of free recall. *Developmental Psychology, 1,* 673–678.

Johnson, M. K., Foley, M. A., & Leach, K. (1988). The consequences for memory of imagining in another person's voice. *Memory & Cognition, 16,* 337–342.

Johnson, M. K., Foley, M. A., Suengas, A. G., & Raye, C. L. (1988). Phenomenal characteristics of memories for perceived and imagined autobiographical events. *Journal of Experimental Psychology: General, 117,* 371–376.

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review, 88,* 67–85.

Johnson, M. K., Raye, C. L., Foley, H. J., & Foley, M. A. (1981). Cognitive operations and decision bias in reality monitoring. *American Journal of Psychology, 94,* 37–64.

Johnson, M. K., & Suengas, A. G. (1989). Reality monitoring and judgments of other peoples' memories. *Bulletin of the Psychonomic Society, 27,* 107–110.

Kausler, D. H. (1982). *Experimental psychology and human aging.* New York: Wiley.

Kausler, D. H., Lichty, W., & Davis, R. T. (1985). Temporal memory for performed activities: Intentionality and adult age differences. *Developmental Psychology, 21,* 1132–1138.

Kausler, D. H., Lichty, W., & Freund, J. S. (1985). Adult age differences in recognition memory and frequency judgments for planned versus performed activities. *Developmental Psychology, 21,* 647–654.

Kausler, D. H., & Puckett, J. M. (1980). Adult age differences in recognition memory for a nonsemantic attribute. *Experimental Aging Research, 6,* 349–355.

Kausler, D. H., & Puckett, J. M. (1981a). Adult age differences in memory for modality attributes. *Experimental Aging Research, 7,* 117–125.

Kausler, D. H., & Puckett, J. M. (1981b). Adult age differences in memory for sex of voice. *Journal of Gerontology, 36,* 44–50.

Labouvie-Vief, G., & Blanchard-Fields, F. (1982). Cognitive ageing and psychological growth. *Ageing and Society, 2,* 183–209.

Light, L. L., & Zelinski, E. M. (1983). Memory for spatial information in young and old adults. *Developmental Psychology, 19,* 901–906.

McIntyre, J. S., & Craik, F. I. M. (1987). Age differences in memory for item and source information. *Canadian Journal of Psychology, 41,* 175–192.

Mitchell, D. B., Hunt, R. R., & Schmitt, F. A. (1986). The generation effect and reality monitoring: Evidence from dementia and normal aging. *Journal of Gerontology, 41,* 79–84.

Moscovitch, M., Winocur, G., & McLachlan, D. (1986). Memory as assessed by recognition and reading time in normal and memory-impaired people with Alzheimer's disease and other neurological disorders. *Journal of Experimental Psychology: General, 115,* 331–347.

Murphy, M. D., Sanders, R. E., Gabriesheski, A. S., & Schmitt, F. A. (1981). Metamemory in the aged. *Journal of Gerontology, 36,* 185–193.

Obler, L. (1980). Narrative discourse style in the elderly. In L. Obler & M. Albert (Eds.), *Language and communication in the elderly* (pp. 75–90). Lexington, MA: Heath.

Padgett, R. J., & Ratner, H. H. (1987). Older and younger adults' memory for structured and unstructured events. *Experimental Aging Research, 13,* 133–139.

Perlmutter, M., Metzger, R., Nezworski, T., & Miller, K. (1981). Spatial and temporal memory in 20 and 60 year olds. *Journal of Gerontology, 36,* 59–65.

Rabinowitz, J. C. (1989). Judgments of origin and generation effects: Comparisons between young and elderly adults. *Psychology and Aging, 4,* 259–268.

Rabinowitz, J. C., & Ackerman, B. P. (1982). General encoding of episodic events by elderly adults. In F. I. M. Craik & S. Trehub (Eds.), *Aging and cognitive processes* (pp. 145–154). New York: Plenum Press.

Roediger, H. L., III. (1974). Inhibiting effects of recall. *Memory & Cognition, 2,* 261–269.

Schacter, D. L., Harbluk, J. L., & McLachlan, D. R. (1984). Retrieval without recollection: An experimental analysis of source amnesia. *Journal of Verbal Learning and Verbal Behavior, 23,* 593–611.

Sinnott, J. D. (1986). Prospective/intentional and incidental everyday memory: Effects of age and passage of time. *Psychology and Aging, 1,* 110–116.

Suengas, A. G., & Johnson, M. K. (1988). Qualitative effects of rehearsal on memories for perceived and imagined complex events. *Journal of Experimental Psychology: General, 117,* 377–389.

Warrington, E. K., & Weiskrantz, L. (1970). Amnesic syndrome: Consolidation or retrieval? *Nature, 228,* 628–630.

Wechsler, D. (1981). *Manual for the Wechsler Adult Intelligence Scale–Revised.* New York: Psychological Corporation.

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