

## Aging and Autobiographical Memory: Dissociating Episodic From Semantic Retrieval

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Cognitive aging research documents reduced access to contextually specific episodic details in older adults, whereas access to semantic or other nonepisodic information is preserved or facilitated. The present study extended this finding to autobiographical memory by using a new measure; the Autobiographical Interview. Younger and older adults recalled events from 5 life periods. Protocols were scored according to a reliable system for categorizing episodic and nonepisodic information. Whereas younger adults were biased toward episodic details reflecting happenings, locations, perceptions, and thoughts, older adults favored semantic details not connected to a particular time and place. This pattern persisted after additional structured probing for contextual details. The Autobiographical Interview is a useful instrument for quantifying episodic and semantic contributions to personal remote memory.

Most research on real-world autobiographical memory in older adults has examined life-period effects on numbers of memories recalled (e.g., Franklin & Holding, 1977; Hyland & Ackerman, 1988; Rubin & Schulkind, 1997b). Relatively little is known about the quality of older adults' autobiographical recollections in comparison to those of younger adults. Cognitive aging research predicts that the quality of older adults' autobiographical recollection would differ from that of younger adults, yet the direction of these differences depends on the task. Age-related decline is greatest for explicit, effortful, and unstructured retrieval tasks (Zacks, Hasher, & Li, 2000). Relative to younger adults, older adults are impaired at retrieving episodic contextual details (McIntyre & Craik, 1987; Spencer & Raz, 1995), report a lesser degree of reexperiencing

(Java, 1996; Mäntylä, 1993; Norman & Schacter, 1997), and have difficulty suppressing off-target or extraneous information in recall (Arbuckle & Gold, 1993; Hasher & Zacks, 1988; but see James, Burke, Austin, & Hulme, 1998).

On the other hand, age effects are reduced or eliminated for general semantic knowledge, implicit, or habitually acquired information (Hay & Jacoby, 1999; Jennings & Jacoby, 1993), emotional material (Carstensen & Turk Charles, 1994), or when retrieval support (i.e., cuing or recognition) is provided (Craik, 1983; Craik & McDowd, 1987). Moreover, older adults are significantly better than younger adults in the mnemonic representation of underlying meanings in parables (Adams, Smith, Nyquist, & Perlmutter, 1997). These findings have been interpreted as reflecting psychological growth, a positive change in the exercise of narrative intelligence, and a shift in attention to social or psychological needs that accompany aging (Carstensen, 1995; Isaacowitz, Turk Charles, & Carstensen, 2000; Labouvie-Vief & Blanchard-Fields, 1982; Randall, 1999).

This pattern of spared and impaired processes is mirrored in a small body of research on everyday autobiographical recollection. In a laboratory study that used naturalistic events manufactured in the laboratory, older adults' recall was characterized by reduced perceptual and contextual details (Hashtroudi, Johnson, & Chrosniak, 1990). Similarly, eyewitness testimony studies show that older adults report fewer correct details and provide more false information regarding simulated crimes than do younger adults (Cohen & Faulkner, 1989; Coxon & Valentine, 1997; Yarmey, 1996). Reduced retrieval of contextual information negatively affects the formation of flashbulb memories in older adults (Cohen & Faulkner, 1988). Holland and Rabbitt (1990) showed that very old adults (over 70) produce fewer thematically relevant details than younger adults (over 60). In another study that used a struc-

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tured interview, older adults' autobiographical recollections were rated as less vivid than those of middle-aged adults (Borrini, Dall'Ora, Della Salla, Marinelli, & Spinnler, 1989).

On the positive side, older and younger adults provide similar amounts of gist information in autobiographical free recall (Holland & Rabbitt, 1990). Older adults' recollections of manufactured real life events contain more elaborative statements related to personal thoughts or feelings than do those of younger adults (Hashtroudi et al., 1990). Additionally, older adults' autobiographical recollections are judged as more interesting and informative than those of younger adults (James et al., 1998).

The episodic-semantic distinction (Tulving, 1972) provides a useful framework for interpreting these findings. Whereas episodic memory was originally defined in terms of tasks and materials, recent formulations emphasize the state of consciousness accompanying recollection of an event from a specific time and place, including the reexperiencing of contextual details and awareness of the self as a continuous entity across time (i.e., autoeotic awareness; Tulving, 2002; Wheeler, Stuss, & Tulving, 1997). Semantic memory pertains to general knowledge about the world and ourselves and does not entail reexperiencing past events.

This distinction corresponds with hierarchical models of autobiographical memory in which lower level event-specific sensory and perceptual episodic information is linked to higher level self-knowledge structures spanning longer time periods (Barsalou, 1998; Conway, 2001; Conway & Pleydell-Pearce, 2000). Episodic autobiographical information is necessary for high-fidelity representation of personally experienced events, whereas semantic autobiographical information enhances coherence of self-knowledge and identity over time. As semantic information represents accumulated experiences, it is useful for social system maintenance (a higher order goal associated with later adulthood; Labouvie-Vief & Blanchard-Fields, 1982). In general, lower level cognitive representations are more vulnerable to disruption than are higher level cognitive representations (Cohen, 2000). In particular, retrieval of episodic contextual details is sensitive to damage to the prefrontal cortex (Schacter, 1987; Wheeler et al., 1997), which is implicated in age-related changes in strategic mnemonic retrieval (Moscovitch & Winocur, 1992; Raz, Gunning-Dixon, Head, Dupuis, & Acker, 1998; West, 1996). Craik and Grady (2002) characterized this age-related effect as a loss of "resolving power" due to changes in prefrontal cortical function.

The research on autobiographical memory described above is consistent with the hypothesis that aging negatively affects episodic autobiographical memory, whereas semantic autobiographical memory is preserved or even facilitated among older adults. The purpose of this study was to address this hypothesis directly by using a new measure: the Autobiographical Interview. In this test, participants' extemporaneous autobiographical recollections are sampled across five life periods and scored according to a standardized and reliable system in which details are assigned to various phenomenological categories. The scoring system assumes a distinction between episodic and nonepisodic facets of autobiographical memory. Episodic details are scored by using categories adapted from the Memory Characteristics Questionnaire, an instrument useful in the distinction between perceived from imaged events (Johnson, Foley, Suengas, & Raye, 1988) and sensitive to age differences in autobiographical recall (Hashtroudi et al., 1990). Nonepisodic details include semantic information as well as rep-

etitions and editorial and metacognitive statements. An earlier version of this measure was used by Moscovitch, Yaschyshyn, Ziegler, and Nadel (1999) to document specific episodic retrieval deficits in patients with amnesia resulting from medial temporal lobe and diencephalic damage. This earlier version, however, did not separate episodic from nonepisodic details. The current version also incorporates a standardized qualitative rating system as an additional measure of episodic reexperiencing.

The Autobiographical Memory Interview (AMI; Kopelman, Wilson, & Baddeley, 1989, 1990) also quantifies personal semantic and personal episodic autobiographical memory, but it does so through two separate subtests. Episodic autobiographical memories are elicited in a similar manner to our test, the Autobiographical Interview, and scored on a 0–3 scale of episodic specificity. Personal semantic autobiographical memory is assessed through a structured interview (e.g., home addresses). In contrast, our measure extracts indices of semantic and episodic autobiographical information from within a single narrative, characterizing participants' biases toward one or the other in a way that is unconstrained by the examiner.

Comparison of composite scores reflecting episodic and nonepisodic information allowed us to identify age effects on potentially separable components of autobiographical memory, moving beyond a generic, single-factor analysis. We further studied these effects by analyzing the specific content areas (e.g., recollection of perceptual or emotional details) contributing to episodic and nonepisodic composite scores. To assess whether the beneficial effects of retrieval support extend to autobiographical memory, we administered a structured interview that provided cues for additional episodic contextual details for each of the participants' recollections. Finally, we examined the effects of retention interval that can confound interpretation of age-group effects.

## Method

### *Participants*

Participants were 15 younger (aged 19–34 years;  $M = 23.5$ ,  $SD = 3.91$ ) and 15 older (aged 66–89 years;  $M = 73.5$ ,  $SD = 5.77$ ) healthy adults recruited from University of Toronto undergraduate classes and the Rotman Research Institute volunteer database. Both groups had attained comparable levels of education (younger adults:  $M = 14.7$ ,  $SD = 1.05$ ; older adults:  $M = 14.0$ ,  $SD = 2.56$ ). Potential participants were rigorously screened for evidence of learning disability (i.e., childhood diagnosis or failure of a grade), history of neurological disorders, significant psychiatric disorders and substance abuse, and medical disorders known to affect cognitive functioning. Participants on medications that affect cognitive functioning were excluded. Additionally, older adults were screened for dementia with the Mini Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975). The mean MMSE score was 28.14 and the range, 26–30, was well above the cutoff score of 23 for this instrument.

### *Procedure*

#### *Event Selection and Instructions*

Participants were asked to choose events from five life periods: early childhood (early childhood to age 11), adolescent–teenage years (ages 11–17), early adulthood (ages 18–35), middle age (35–55), and the previous year. With the exception of younger adults who selected two events from the early adulthood period (in lieu of the middle-age period), all

participants selected one event from each life period. Younger participants were asked to produce memories more than one year old for Time Periods 1–4, so that for all participants, only Time Period 5 contained events from the previous year. In selecting the life periods, we considered both retention interval and age at time of encoding. Focusing on one of these considerations only (i.e., equating all memories for either retention interval or age at encoding across groups) would have eliminated a large portion of the life span material for the older adults. Our final selection reflected a compromise between these two considerations such that participants' memories for the previous year were equated for retention interval, and memories for the first three life periods were equated for age at encoding.

To assist with memory retrieval, we presented a list of approximately 100 typical life events (e.g., seeing someone famous in-person). Participants were allowed to select events from the list or events not on the list. The following instructions were administered:

I am going to ask you to tell me about an event from each of these time periods of your life (list of life periods is given). You can choose any events you wish. I will ask you to describe the events, then I will ask you some questions about them. The event must be one you were personally involved in, and you must have a recollection of being personally involved. Do not pick events that you heard about from others. They must be events from a specific time and place. For example, playing basketball in school would not be sufficient. However, an event involving a specific basketball game would be good. I want you to provide as much detail as you can about the event. Our interest is not so much in which events you choose, but rather how you describe them. So do not feel pressured to pick any particular event. I want you to know that I will be asking you to give some details for these events later, so be sure to only choose events that you feel comfortable discussing in detail.

### Conditions of Retrieval Support

Retrieval support was manipulated by increasing structure in three conditions: recall, general probe, and specific probe.

**Recall.** In this condition, participants simply spoke about the event extemporaneously without any interruption from the examiner, continuing until it was evident that they had reached a natural ending point.

**General probe.** After an event was recalled, general probes were used to clarify instructions and to encourage greater recall of details. For instance, a general probe was given if the participant did not recall a specific event (i.e., "Can you tell me a specific instance of . . . ?") or if a recollection was overly terse (i.e., "Is that everything you can say about it? I want to know all the details that come to mind."). If general probing did not elicit a specific event, then the participant was given the option of selecting a different event that was more likely to result in successful recall (this option was rarely necessary). The examiner followed strict instructions to limit general probes to nonspecific statements or repetitions of the instructions. However, there was no limit to the number of times the instructions could be repeated to ensure understanding.

Preliminary analyses indicated that the effect of general probe was minimal in comparison to specific probe. Data from recall and general probe were therefore combined, providing two levels of retrieval support (recall plus general probe, hereafter referred to as recall and specific probe).

**Specific probe.** This condition consisted of a structured interview, adapted from the Memory Characteristics Questionnaire (Johnson et al., 1988) and designed to elicit additional details that were not spontaneously recalled. The questions were organized into five separate categories: event (happenings, weather, other people and their behavior, clothing), time (year, month or season, date, day, and time of day), time integration (events occurring before and after the main event), place (country, state/province, city, street, address, building, room within building, and location within room), other sensory information (visual images, colors, tastes, smells,

sounds, physical sensations, body position, and event duration) and emotion/thought (feelings and thoughts at the time of the event). Each item was addressed with a standardized question, with modifications according to the event. For example, if an event occurred outdoors, the place questions were modified appropriately. Examiners were trained to elicit as much information as possible and to assist participants in distinguishing inferences or guesses from truly recollected information.

Specific probing was administered after all five events were recounted under the recall and general probe conditions. That is, after all five events had been recalled, the examiner returned to the first event and administered specific probing for each event, preventing the specific probe process from contaminating recall of subsequent memories.

### Protocol Preparation and Scoring

The tape-recorded protocol was transcribed and reorganized such that specific probe followed recall and general probe for each memory. A standardized, manual-based procedure was used for scoring (manual is available on request). Quantitative scores were based on text segmentation and their categorization. Qualitative scores were derived from ratings assigned to the various categories.

### Text Segmentation and Categorization

Each memory was segmented into informational bits or details. A detail was defined as a unique occurrence, observation, or thought, typically expressed as a grammatical clause (i.e., a subject and predicate: "I dropped my sandwich"). Additional information in the clause was scored separately. For instance, "I dropped my sandwich in Portland last Wednesday" contains three details: an event (dropping the sandwich), a location (Portland), and a time (last Wednesday).

There were two broad groups of details: *internal* and *external*. Internal details were those that pertained directly to the main event described by the participant, were specific to time and place, and were considered to reflect episodic reexperiencing. In cases where the main event was unclear (e.g., more than one event was described, or the event was vague), the main event was defined by selecting one that occurred within a relatively brief time frame (i.e., half a day or less). When more than one event fit this criterion, the event that garnered the most details was considered the main event. Internal details were separated into five mutually exclusive categories: (a) event (i.e., happenings or the unfolding of the story), (b) place, (c) time, (d) perceptual, and (e) emotion/thought (see Table 1). A scoring sample is presented in Figure 1.

The main category of external details was semantic (factual information or extended events that did not require recollection of a specific time and place). Repetitions and other details were also classified as external. Finally, details pertaining to specific autobiographical events other than the main defined internal event were classified as external event details (see Table 1).

Details were tallied for each category and summed to form internal and external composites, which were the main variables of interest in the present study. The ratio of internal-to-total details indicated the proportion of details per memory reflecting episodic reexperiencing unbiased by the total verbal output. Scoring was done separately for each condition (recall, general probe, specific probe), but scores were analyzed cumulatively across levels of recall. That is, for each category, general probe and specific probe details were added to details generated from the prior condition. This scoring method followed the natural discursive tendency for participants to assume that information given in earlier conditions was implicit in later conditions (i.e., participants did not repeat information they had already given). This cumulative scoring of quantitative details also made the quantitative ratings comparable to the qualitative ratings that had been assigned cumulatively across conditions (see below).

Table 1  
*Description of Scoring Categories*

| Category          | Description   |
|-------------------|---|
| Internal          |   |
| Event             | Happenings, individuals present, weather conditions, physical/emotional actions, or reactions in others                             |
| Time              | Year, season, month, day of week, time of day   |
| Place             | Localization of an event including the city, street, building, room, part of room   |
| Perceptual        | Auditory, olfactory, tactile, taste, visual and visual details, body position, duration   |
| Thought/emotion   | Emotional state, thoughts, implications   |
| External          |   |
| Event             | Specific details from other incidents (from all of the above categories) external to the main event recalled                        |
| Semantic          | General knowledge or facts, ongoing events, extended states of being  |
| Repetition        | Unsolicited repetition of details   |
| Other             | Metacognitive statements, editorializing  |
| Ratings           |   |
| Episodic richness | Qualitative estimate of reexperiencing  |
| Time              | (see above description)   |
| Place             | (see above description)   |
| Perceptual        | (see above description)   |
| Thought/emotion   | (see above description)   |
| Time integration  | Integration into a larger time scale as evidenced by inclusion of temporal contextual information or relation to other life periods |

### Rating Assignment

Ratings were assigned for episodic richness, time, place, perception, and emotion/thoughts, and time integration (see Table 1). Time, place, perception, and emotion/thoughts were each rated on a scale of 0 to 3 according to the following general guidelines:

- 3 points: A rich, highly specific, evocative, and/or vivid description that appears to emerge from a feeling of reexperiencing.
- 2 points: A detailed description that falls short of 3 points in the degree of richness.
- 1 point: A description that is limited to general, nonspecific information but is still episodic in nature.
- 0 points: No mention of information pertaining to the specified category, or a response that is based on semantic knowledge rather than episodic memory.

Additional criteria for each of these categories were listed in the scoring manual. Episodic richness (the overall degree to which a feeling of reexperiencing was conveyed) was rated on a similar scale that was extended to 6 points to provide a finer grained rating and to account for the greater importance of this category relative to the others. The time integration rating (on a scale of 0–3) was meant to gauge a person's ability to integrate the recalled episodic event into a larger time scale by giving additional temporal contextual information or relating it to other life periods. Although ratings in the first four categories were mutually exclusive (i.e., aspects of a memory could not be counted in more than one category), the episodic richness and time integration categories were based on an overall assessment of the event. The sum of the ratings pertaining to episodic reexperiencing formed the ratings composite (maximum = 18). Time integration was examined as a separate rating category as it related to life history information and not reexperiencing, by definition.

An additional rating was assigned according to the four level (0-1-2-3) scheme for personal episodic memories as described in the AMI manual (Kopelman et al., 1990). The AMI episodic rating scheme takes into consideration the amount of detail provided and the specificity to time and place of a particular recollection. This rating was used as a measure of external validity and not included in our ratings composite. Assignment of ratings is illustrated in the Figure 1 caption.

When scoring responses to general and specific probes, ratings were carried over from prior conditions. For example, if a rating of two had been assigned during recall, this rating was automatically assigned during general probe and augmented to a three if additional information had been given. As with scoring of details, this procedure was necessary as the successive conditions were treated as supplementing the prior ones.

Participants' memories were placed in a common pool and scored at random. The primary scorer (Eva Svoboda) had undergone extensive training and participated in the development of the scoring manual. To assess interrater reliability, 10% of the memories were selected at random (with the constraint that age groups and life periods were equally represented) and scored by three additional trained scorers.

## Results

### *Reliability and Validity of the Autobiographical Interview*

Interrater reliability of the composite scores across the four raters in the reliability study was assessed with intraclass correlation (one-way random effects model; McGraw & Wong, 1996), which indicated general high agreement across four scorers. Coefficients for internal and external detail composites were 0.88 and 0.96, respectively, for recall, and 0.89 and 0.94 for specific probe. Agreement on ratings composites was high for recall (0.79) but not for specific probe (0.41). This latter result was not due to inconsistency in scores but rather limited range as most partici-

**Time**                      **Semantic**  
 This summer, I'm dating a guy for three and a half years, and we're

**Semantic**    **Repetition**    **Place**    **Ext. Event**  
 really serious and this summer I went back home I ask him to come.

**Time**                      **Event**                      **Event**  
 It was really, really, late. So, me and my friends, my sister, we

**Percep**    **Place**                      **T/Em**  
 were sitting at the airport and I was tired and I remember I was so

**T/Em**    **T/Em**  
 nauseous that day because I was, I think so excited that he was coming

**T/Em**    **Event**  
 but again not aware of it. And I remember me and my father went

**Place**    **Event**  
 upstairs when they announced that the plane is coming, and I remember

**Event**    **Event**                      **Percep**  
 looking outside and saw him walking with his bags and it was just a

**T/Em**  
 strange, a strange moment that he was there and I was thinking, I am

**T/Em**    **Event**  
 going to introduce him to my parents, and I just remember he smiled at

**Event**    **T/Em**  
 me, I smiled at him because we knew that it was going to be funny

*Figure 1.* Younger adult's autobiographical memory protocol. This protocol was scored as follows: *Main event*: Meeting boyfriend at the airport. Internal details: event = 8, place = 3, time = 2, perception (Percep) = 2, thought/emotion (T/Em) = 7; external details: external (Ext.) event = 1, semantic = 2, repetitions = 1, other = 0; ratings: place = 2/3 (larger scale information, lacking specific context), time = 2/3 (two pieces of time information, lacking specific context), perception = 2/3 (two perceptual details, lacking in richness), thought/emotion = 3/3 (response reflected specific cognitive/emotional state at the time of the event), episodic richness = 4/6 (response had moderate detail but fell short of a rich re-lived description), time integration = 2/3 (a few details were given about a larger time frame, but lacked a fuller description), Autobiographical Memory Interview (AMI) = 3/3 (response was detailed and specific to time and place according to criteria specified in the AMI manual).

pants received maximum rating scores after specific probing. Agreement for individual categories was also generally acceptable. For detail categories, most coefficients were in the range from 0.60 to 0.90. The exceptions were for categories with ceiling effects (e.g., place and time details after specific probing) and ratings categories after specific probing. All memories were also rated according to the AMI instructions for autobiographical episodic memory. Spearman rank-order correlations showed a significant relationship between the AMI and the Autobiographical Interview detail and rating composite (collapsed across all five memories),  $\rho(28) = .65$  and  $.68$ , both  $ps < .001$ , respectively. These correlations were not significant for the specific probe condition because of the ceiling effect in the AMI ratings. The AMI was sensitive to age differences in recall,  $t(28) = 3.82$ ,  $p < .001$ , but there were no significant age effects after specific probing. These results support the construct validity of the Autobiographical Interview vis-à-vis an established measure. They further suggest that although AMI ratings are sensitive to age-related changes in recall, they lack the range to detect age differences in the specific probe condition (Moscovitch et al., 1999).

### *The Effects of Age Group and Retrieval Support on Composite Measures of Autobiographical Recall*

As seen in Figure 2, older adults produced fewer internal details and more external details than younger adults, even though overall speech output (i.e., total details produced) was not affected by age.

#### *Recall: Five Life Periods*

The effects of age group on detail composites collapsed across all five life periods was examined with mixed-factor analyses of variance (ANOVA) with the Greenhouse–Geisser correction applied to effects involving repeated measures. There was a significant interaction between age group and internal/external detail composite in the recall condition,  $F(1, 28) = 15.65$ ,  $p < .001$ , with follow-up tests indicating significantly more internal details produced by younger adults,  $t(28) = 4.15$ ,  $p < .001$  (see Figure 2, top left). The simple effect of age group on external details fell short of significance,  $t(28) = 1.63$ ,  $p = .11$ . Age-group effects on internal-to-total detail ratios and ratings composites were assessed with  $t$  tests. The main effects of age group and internal/external detail composite were not significant. The tendency for older adults to produce less specific memories in the recall condition was also reflected in a significant effect of age group on internal-to-total detail ratios,  $t(28) = 4.27$ ,  $p < .001$ , and on the ratings composites,  $t(28) = 4.15$ ,  $p < .001$  (see Table 2).

#### *Specific Probe: Five Life Periods*

The cumulative scoring from recall to specific probe rendered these conditions highly dependent on one another; therefore, they were not amenable to statistical comparison. Mixed-design ANOVAs were instead conducted separately for these two conditions. The hypothesis that retrieval support would reduce age-group differences was examined by comparing the results of these separate analyses. Five younger adults and one older adult did not have specific probing recorded for one event each because of problems with the recording equipment, affecting  $Ns$  for certain life-period analyses of specific probing.

The overall pattern observed in the recall condition held after specific probing (see Table 2 and Figure 2, top right). The interaction between age group and internal/external detail composite was significant,  $F(1, 28) = 18.40$ ,  $p < .001$ , with follow-up analyses indicating greater recall of internal details for younger adults,  $t(28) = 3.18$ ,  $p < .005$ , and greater recall of external details for older adults,  $t(28) = 2.57$ ,  $p < .05$ . As in recall, the main effect of age group was not significant. Whereas the main effect of internal/external detail composite was not significant in recall, this effect was significant for specific probe, with more internal than external details produced,  $t(28) = 3.12$ ,  $p < .005$ . The age-group effect after specific probing was also significant for internal-to-total detail ratios,  $t(28) = 4.58$ ,  $p < .001$ , and ratings composites,  $t(28) = 3.88$ ,  $p < .001$  (see Table 2). Age-group differences as measured by the internal and external details and ratings composite scores were not attenuated by specific probing.

#### *Recall: Life Period 5*

With one exception (see below), retention interval did not appear to be a factor in the above results, as indicated by restricting

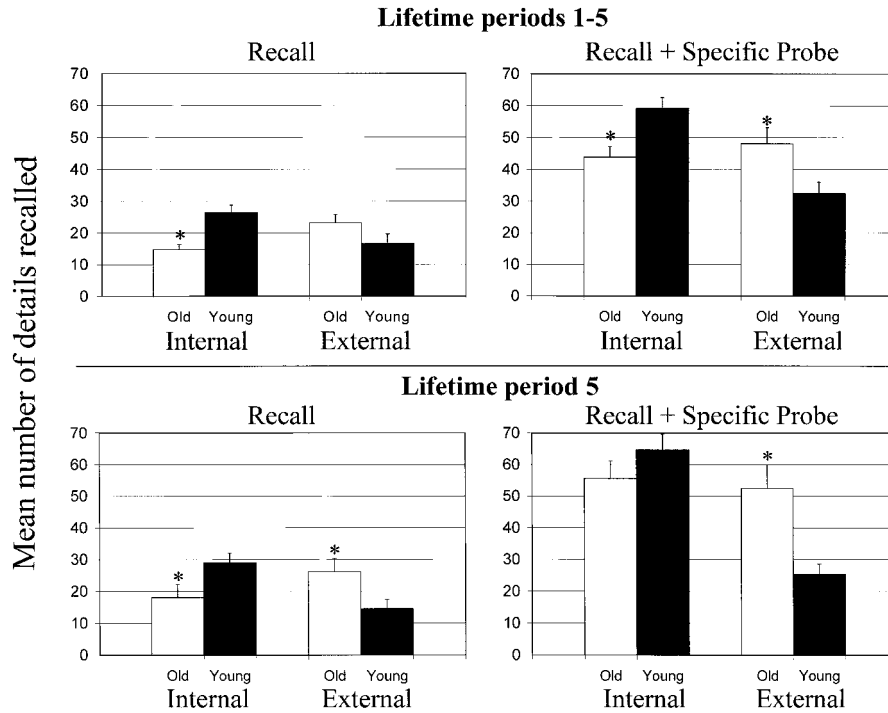


Figure 2. Mean number of internal and external details given per event during recall (left) and after specific probing (right) by younger and older adults for all five life periods (top) and for period 5 alone (bottom). Asterisk indicates significant difference between age groups.

analyses to Life Period 5, when retention interval (within the previous year) was comparable across age groups. For recall, the Age Group  $\times$  Internal/External Detail Composite interaction held,  $F(1, 28) = 9.44, p < .005$ , with age-group differences for both internal and external details statistically significant,  $t_s(28) = 2.15$  and  $2.26, p < .05$ , respectively (see Figure 2, bottom left). The main effects of age group and internal/external detail composite were not significant. Age-group differences for internal-to-total detail ratios and ratings composites were significant,  $t_s(28) = 3.35$  and  $3.02, p < .005$ , respectively (see Table 2).

*Specific Probe: Life Period 5*

The only exception to absence of retention-interval effects was noted in the analysis of age-group effects under specific probing for Life Period 5, where age-group differences for internal details were attenuated. As demonstrated with all five life periods combined, a significant main effect of internal/external composite,  $t(28) = 4.77, p < .001$ , indicated that both age groups produced more internal than external details, but the age-group differences for internal details was not significant (see Figure 2, bottom right).

Table 2  
Internal-to-Total Ratios and Ratings for Recall and Specific Probe

| Group                     | Recall                  |     |         |      | Specific probe          |     |         |      |
|---------------------------|-------------------------|-----|---------|------|-------------------------|-----|---------|------|
|                           | Internal-to-total ratio |     | Ratings |      | Internal-to-total ratio |     | Ratings |      |
|                           | M                       | SD  | M       | SD   | M                       | SD  | M       | SD   |
| Life Periods 1-5          |                         |     |         |      |                         |     |         |      |
| Young                     | .61                     | .16 | 10.77   | 2.40 | .65                     | .08 | 16.28   | 1.36 |
| Older                     | .39                     | .14 | 7.13    | 2.42 | .48                     | .12 | 14.04   | 1.79 |
| Last year (Period 5 only) |                         |     |         |      |                         |     |         |      |
| Young                     | .67                     | .20 | 11.47   | 4.07 | .72                     | .12 | 16.92   | 1.50 |
| Older                     | .42                     | .21 | 7.13    | 3.80 | .53                     | .10 | 15.20   | 2.21 |

Note. Means for the young adults were significantly higher than for the older adults.

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A significant Age Group  $\times$  Internal/External Detail Composite interaction,  $F(1, 28) = 16.34, p < .001$ , was driven by greater external details in older adults,  $t(26) = 3.02, p < .01$ . There was no significant main effect of age group. The effect of age group on internal-to-total ratios,  $t(26) = 4.40, p < .001$ , and ratings composites,  $t(26) = 2.38, p < .05$ , remained significant (see Table 2).

### Summary

The composite scores reflected reduced episodic reexperiencing and enhanced production of nonepisodic information in older adults' autobiographical recollections. Internal details, internal-to-total detail ratios, and ratings were lower and external details were higher in older adults. The consistency of these findings across recall and specific probe suggests that these age-group differences were resistant to our retrieval support manipulation. This general pattern was not affected by retention interval. When Life Period 5 was examined in isolation, age-group effects for all composites were significant under recall. Specific probe did attenuate the age-group effect for internal details, but not for external details or ratings.

### The Effects of Age Group and Retrieval Support on Specific Categories of Autobiographical Recall

The analyses of composite scores demonstrated younger and older adults' biases toward internal and external details, respectively. Supplementary analyses of individual detail and rating categories indicated which aspects of participants' protocols contributed to these effects. Differences among individual detail and rating categories were assessed with three mixed-design ANOVAs: Age Group  $\times$  Internal Detail Category, Age Group  $\times$  External Detail Category, and Age Group  $\times$  Rating Category. The Greenhouse–Geisser correction was applied to effects involving repeated measures. Post hoc comparisons were corrected using the Bonferroni procedure. Time integration (not considered to reflect episodic reexperiencing) was analyzed separately.

#### Recall: Five Life Periods

There was a significant Internal Detail Category  $\times$  Age Group interaction,  $F(4, 112) = 9.09, p < .001$ . As seen in Figure 3, top left, both groups favored event details over other internal details (for simple effects of detail category within groups, event details were significantly higher than other internal details, all  $ps < .001$ ), but younger adults produced more event details than older adults,  $t(28) = 3.50, p < .005$ , and also provided greater elaboration through recollection of place,  $t(28) = 2.76, p = .01$ ; perceptual,  $t(28) = 3.48, p < .005$ ; and thought/emotion details,  $t(28) = 3.86, p = .001$ .

The Ratings Category  $\times$  Age Group interaction was not significant. Although the effect of age group on time integration was not significant, this was the only category for which older adults received numerically higher scores than younger adults.

Among external details, the tendency to recall semantic details was significantly enhanced for older adults, as indicated by a significant External Detail Category  $\times$  Age Group interaction,  $F(3, 84) = 7.72, p < .001$  (see Figure 3, lower left). Semantic was

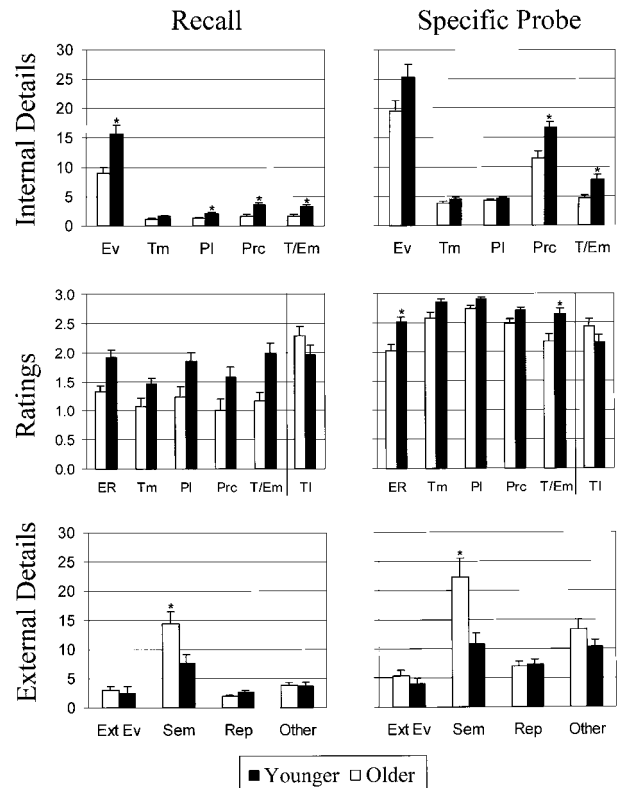


Figure 3. Mean number of details given per event for recall in different internal detail categories (top row), mean scores per event in different rating categories (middle row), mean number of details given per event in different external detail categories (bottom row). Asterisks indicate a significant difference between age groups following application of the Bonferroni correction ( $p < .01$  for internal details and ratings,  $p < .0125$  for external details). Internal details: Ev = event; Tm = time; Pl = place; Prc = perceptual; T/Em = thought/emotion. Ratings: ER = episodic richness; Tm = time; Pl = place; Prc = perceptual; T/Em = thought/emotion; TI = time integration. External details: Ext Ev = external event; Sem = semantic; Rep = repetitions.

the only external detail category that significantly differentiated the two groups,  $t(28) = -2.72, p = .01$ .

#### Specific Probe: Five Life Periods

The Internal Detail Category  $\times$  Age Group interaction remained significant after specific probing:  $F(4, 112) = 3.74, p < .05$ . As in recall, the age-group effect for event details was significant,  $t(28) = 2.10, p = .05$ . Age-group differences in internal details after specific probing were limited to the younger adults' relatively high perceptual,  $t(28) = 3.32, p < .005$ , and thought/emotion,  $t(28) = 3.19, p < .005$ , details.

The Age Group  $\times$  Ratings Category interaction was significant,  $F(4, 112) = 2.78, p < .05$ , with episodic richness,  $t(28) = 3.52, p = .001$ , and thought/emotion,  $t(28) = 2.98, p < .01$ , ratings significantly higher in younger adults. This interaction may reflect ceiling effects for time and place, which typically represented finite information and were therefore more likely to achieve full marks after specific probing than other categories (see Figure 3,

middle right). Time integration ratings were again nonsignificantly higher for older adults than younger adults.

The External Detail Category  $\times$  Age Group interaction remained significant after specific probing,  $F(3, 84) = 7.72, p < .001$ , with semantic details again the main category difference across age groups,  $t(28) = -3.20, p < .005$  (see Figure 3, lower right). Specific probing also increased the generation of metacognitive and editorial statements (other details) and, to a lesser extent, repetitions, but these did not differ across age groups.

### Recall: Life Period 5

The overall pattern reported above held when the above analyses were repeated for Life Period 5 data alone, although certain effects fell short of significance because of the reduction of number of memories from five to one. The above-reported profile of internal detail categories for recall was qualitatively similar to that observed with all five memories combined, but the Internal Detail Category  $\times$  Age Group interaction was no longer significant. The Ratings Category  $\times$  Age Group interaction was not significant. As in the life span analysis, older adults had nonsignificantly higher time-integration ratings than younger adults. The External Detail Category  $\times$  Age Group interaction for recall was marginally significant,  $F(3, 84) = 2.80, p = .05$ . Follow-up tests indicated a trend toward an age group effect on semantic details,  $t(28) = 1.92, p = .07$ , although this effect was attenuated because of a single young participant with a semantic detail score several standard deviations above the mean. When this participant was excluded from the analysis, the age-group effect was significant  $t(27) = 3.44, p < .005$ .

### Specific Probe: Life Period 5

Neither internal detail nor ratings category significantly interacted with age group. The External Category  $\times$  Age Group interaction was significant after specific probing,  $F(3, 78) = 3.71, p < .05$ , again with semantic details differentiating age groups,  $t(26) = 2.79, p = .01$ .

### Summary

The effect of age group on internal details during recall was due to greater production of event, perceptual, and thought/emotion details in younger adults. Younger and older adults were similarly able to localize events in time and place (although the latter was slightly lower in older adults). Older adults consistently produced more factual details relating to semantic knowledge independent of time-locked episodes, accounting for the external detail effect, and were as good or better than younger adults in integrating events within a life context. Specific probing reduced age-group differences for event details but not for perceptual, thought/emotion, and semantic details. Interpretation of age-group differences in rating categories following specific probing was limited by ceiling effects, but significant differences were noted for ratings of episodic richness and thought/emotion. When Life Period 5 was examined in isolation, this general pattern of findings held, although certain category comparisons fell short of significance.

### The Effects of Life Period (Retention Interval) on Autobiographical Recall for Younger and Older Adults

Because interactions of age group with life period would be confounded with retention interval for all but the fifth life period, analyses involving the effects of life period at encoding were conducted separately for each age group (i.e., this study could not address Age Group  $\times$  Life Period interactions). These mixed-design ANOVAs included the internal/external composites, internal-to-total detail ratios, internal detail categories, external detail categories, and ratings composites and rating categories as effects nested within life period. Post hoc comparisons were corrected using the Bonferroni procedure.

### Younger Adults

For younger adults, there were no statistically significant effects involving life period on any of the measures except for external detail category after specific probing,  $F(12, 108) = 3.53, p < .001$ . Post hoc analyses indicated that other details were greater for the first period as compared to the last period,  $t(12) = 4.18, p \leq .001$ , possibly relating to increased commentary or metacognitive statements related to retrieval of this early childhood memory. Semantic details were significantly greater for the third period as compared to the first period,  $t(13) = -3.62, p < .005$ . We have no explanation for this finding.

### Older Adults

Consistent with the above-reported effects for Period 5, there was a significant effect of period on the internal details composite after specific probing,  $F(4, 52) = 3.34, p < .05$ , with post hoc tests indicating significantly higher internal details in Period 5 as compared to Period 1,  $t(14) = -3.73, p < .005$  (see Figure 4). External detail, ratings, and internal-to-total detail ratios did not significantly differ across life periods.

Turning to specific categories in recall, there were no interactions with internal detail category and period; older adults did not favor any particular internal detail category in Life Period 5. Although the ratings composite as a whole did not vary significantly across life periods, a significant Ratings Category  $\times$  Life Period interaction,  $F(20, 280) = 2.80, p < .001$ , emerged because

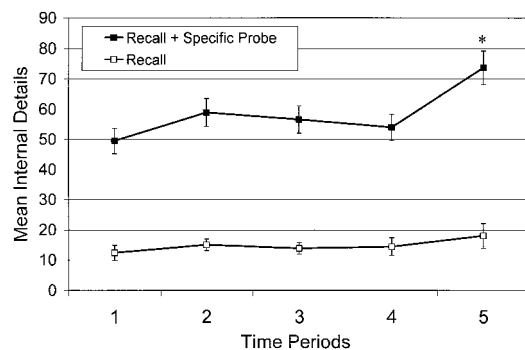


Figure 4. Mean number of internal details retrieved by older adults across five life periods for recall and after specific probing. The asterisk indicates significant difference from Life Period 1.



of significantly higher episodic richness ratings in Life Period 5 as compared with all other periods [vs. Period 1:  $t(14) = 7.90, p < .001$ ; Period 2:  $t(14) = 5.00, p < .001$ ; Period 3:  $t(14) = 4.73, p < .001$ ; Period 4:  $t(14) = 3.59, p < .005$ ]. Ratings category and period did not significantly interact after specific probing. For the time integration rating category, there was a significant effect of time period both for recall,  $F(4, 56) = 3.70, p < .01$ , and after specific probing,  $F(4, 52) = 3.69, p < .01$ . Older adults tended to have higher time integration ratings for later time periods than for earlier periods. The only difference that reached significance after Bonferroni correction was between the first and fourth time periods after specific probing,  $t(14) = 4.03, p < .001$ .

### Discussion

Cognitive aging research indicates age-related deficits for episodic information, such as temporally specific contextual details (e.g., McIntyre & Craik, 1987; Spencer & Raz, 1995; Zacks et al., 2000), whereas semantic information, such as general knowledge and understanding of narrative meaning, is preserved or even facilitated in older adults (e.g., Adams et al., 1997). Little research has examined this pattern within autobiographical memory, a common everyday mnemonic activity. In this study, younger adults produced more episodic details than did older adults in autobiographical recall, whereas production of semantic details was unimpaired or enhanced in older adults, supporting the generalization of prior laboratory findings to real life.

Similar results have been observed in other naturalistic studies of memory and aging (Hashtroudi et al., 1990; Hashtroudi, Johnson, Vnek, & Ferguson, 1994), as well as in studies that have directly addressed age-related changes in the quality of autobiographical memory (Borrini et al., 1989; Cohen & Faulkner, 1988; Holland & Rabbitt, 1990), although each of these used somewhat different methods from our method. Cohen and Faulkner's (1988) findings were restricted to flashbulb memories. Borrini et al. (1989) probed specific predetermined events in adults aged 55 and older. The responses were rated for vividness and fluency, but not for nonepisodic content. Holland and Rabbitt (1990) used several techniques similar to our technique in their study of young-old and old-old adults. Aging was related to reduced specificity as measured both by ratings and thematically relevant details. Further probing with a brief structured interview did not reliably improve specificity ratings. There was no age effect for extraneous or irrelevant details, although these were elevated in those with lower fluid intelligence. To our knowledge, our study is the first of autobiographical memory retrieval to examine indices of episodic and nonepisodic processing (including specific content areas), to manipulate retrieval support, and to analyze retention-interval effects in younger and older adults.

#### *The Retention-Interval Confound*

Extensive research indicates a retention slope in autobiographical memory such that older memories are harder to retrieve than more recent memories (Crovitz & Schiffman, 1974; Rubin & Schulkind, 1997a). By constraining recall in five life periods, we forced older adults to retrieve memories with a longer retention interval, potentially confounding interpretation of age-group effects. Consistent with prior research (Rubin & Schulkind, 1997a),

older adults' production of internal details and ratings was highest for Life Period 5 (the previous year).

With the exception of retrieval support (see below), this confound has little effect on the interpretation of age-related pattern of changes we observed for life span autobiographical memory retrieval. For recall in Life Period 5, when retention interval was equated across groups, there was a double dissociation for composite scores reflecting reduced production of internal details and increased production of external details in older adults relative to younger adults. Ratings and internal-to-total detail ratios for recall were similarly higher for younger adults relative to older adults. Although internal detail production increased from recall to specific probing in both groups, episodic richness (as measured by internal-to-total detail ratios and by ratings) remained higher in the younger adult group.

The age effect for emotions and thoughts reported here is inconsistent with previous research showing attenuation or even reversal of this age effect using laboratory (Carstensen & Turk Charles, 1994) or quasinalistic materials (Hashtroudi et al., 1990). This discrepancy may relate to the solicitation of thoughts and feelings as contextually specific episodic details from very remote events, whereas older adults' affective focus may be constrained to the here-and-now or to very recently studied materials (Isaacowitz et al., 2000).

#### *The Effects of Retrieval Support on Age-Related Differences in Autobiographical Retrieval*

The retrieval support manipulation of probing for specific memory characteristics was highly effective, resulting in an approximate 100% increase in details and raising ratings to near ceiling for many participants. Contrary to expectations from prior research (Craik, 1983; Craik & McDowd, 1987), the retrieval support manipulation was not very effective in reducing age differences for episodic reexperiencing in life span autobiographical memory.

When analyses were restricted to the previous year, however, the effect of retrieval support appeared to be enhanced for older adults; there was no significant age effect for internal details after specific probing. This finding suggests that retrieval support was effective in reducing age differences in episodic richness as measured by internal details when differences in retention interval are controlled. On the other hand, this manipulation was not sufficient to reduce differences in episodic richness as assessed by the ratings.

Laboratory retrieval support manipulations typically compare recognition to free recall (Craik & McDowd, 1987). Our manipulation instead focused on cuing to elicit new internal details. A similar structured interview did not improve ratings of older adults' autobiographical recollections in Holland and Rabbitt's (1990) study (see also Dixon & Gould, 1998). A more effective manipulation might compare recognition of verified autobiographical events to recall or to provide retrieval support at encoding (Hashtroudi et al., 1994). Alternatively, the social and cognitive psychological techniques of the Cognitive Interview (an approach to interviewing designed to enhance recall in eyewitness testimony; Fisher & Geiselman, 1992) could be applied. These techniques, including context reinstatement, guided imagery, and varied retrieval, are generally effective at improving eyewitness

recall, but particularly so for older adults (Mello & Fisher, 1996, but see McMahan, 2000).

Although the specific probe manipulation did not eliminate age differences, it was effective in increasing recall of episodic details across age groups. The presence or absence of this effect could be used to differentiate patients truly amnesic for remote personal information from those with inefficient retrieval operations who are not amnesic. In our ongoing research with the Autobiographical Interview, for example, episodic recall is substantially augmented by probing in patients with self-initiated retrieval deficits due to focal frontal lesions (Svoboda et al., 2002). This benefit from retrieval support contrasts with results from patients with amnesia related to medial temporal and diencephalic damage (Moscovitch et al., 1999).

A final caveat pertains to our use of cumulative scores across conditions, precluding direct statistical evaluation of the retrieval support effect. We hypothesized that retrieval support would reduce age differences in episodic detail recall. This hypothesis was examined with age-group comparisons following solicitation of additional details for each memory by using the specific probe interview, following a natural discursive tendency of participants to augment prior recall without repeating what had already been said. Analyzing these additional details in isolation (i.e., noncumulatively) would not have been meaningful, as it would have penalized participants who provided richly detailed protocols in recall with little to add in specific probe. The same logic would apply to analysis of recall/specific probe condition as a repeated measure in Age Group  $\times$  Recall/Specific Probe Condition interactions; performance attributable to recall in both conditions would be perfectly correlated. The application of different levels of support to separate events would be necessary to produce scores suitable for statistical comparison.

#### *Age-Related Changes in Autobiographical Memory*

##### *Recall: Psychological Growth, Retrieval Deficit, or Both?*

Autobiographical information is considered hierarchical, with semantic information such as lifetime periods and personal facts represented above more specific representations of episodic details (Barsalou, 1998; Conway, 2001; Conway & Pleydell-Pearce, 2000). Our data suggest that older adults excel at the application of broader, time-independent knowledge structures acquired through a lifetime's experience, knowledge that may give rise to wisdom (Labouvie-Vief & Blanchard-Fields, 1982). It is additionally possible that older adults felt obligated to provide extra semantic information to clarify points to the young adult examiner with different life experiences (James et al., 1998).

On the other hand, lower level elements in hierarchical knowledge structures are more difficult to retrieve (Cohen, 2000). Individual differences in retrieval processing efficiency are therefore expected to influence the degree of episodic specificity in autobiographical recall. Age-related reduction in episodic specificity is associated with changes in prefrontal cortical function as measured by functional neuroimaging (Cabeza, Anderson, Houle, Mangels, & Nyberg, 2000), neuropsychological testing ( Craik, Morris, Morris, & Loewen, 1990; Dywan & Jacoby, 1990; Hartman & Hasher, 1991; Parkin, Walter, & Hunkin, 1995), and comparison to simultaneously tested patients with prefrontal damage (Levine, Stuss, & Milberg, 1997; Stuss, Craik, Sayer, Franchi, & Alexander, 1996).

In our ongoing data collection with the Autobiographical Interview, certain patients with prefrontal damage show an exaggeration of the pattern observed in this study, with facilitated production of semantic details in the face of a profound deficit in the retrieval of autobiographical episodic details (McKinnon et al., 2002; Svoboda et al., 2002). Further converging evidence in support of the role of frontal function in autobiographical episodic memory is garnered from functional neuroimaging studies of healthy adults (Levine, Turner, Hevenor, & Graham, 2002; Maguire, 2001; Nyberg, Forkstam, Petersson, Cabeza, & Ingvar, 2002). Although prefrontal function was not assessed in the present participants, the foregoing observations suggest that changes in prefrontal function may reduce older adults' "resolving power" within autobiographical memory, causing retrieval search operations to terminate at the level of nonspecific semantic representations (Craik & Grady, 2002).

The psychological growth and retrieval inefficiency explanations need not be mutually exclusive. The level of autobiographical information selected at retrieval reflects an interaction between characteristics of the rememberer (both social and neurobiological) and the task demands. Relative to older adults, younger adults excel at reconstructing episodic details (see the Appendix). On the other hand, older adults' stories may be more enjoyable (James et al., 1998) and of greater utility in social interchange than those of younger adults (Cohen, 2000; see the Appendix). Accordingly, age-related advantages are maximized when materials and methods do not emphasize episodic detail retrieval (James et al.) or downplay it in favor of abstract interpretations (Adams et al., 1997).

#### *Assessment of Autobiographical Memory*

The AMI (Kopelman et al., 1989, 1990) is the only standardized test of autobiographical memory for quantifying personal semantic and personal episodic autobiographical memory. The robust relationship between Autobiographical Interview recall scores and the AMI supports the construct validity of our instrument. Within personal episodic memory, we have sought to increase the sensitivity of our instrument over the AMI by extending the range of scores beyond a single ordinal measure. Quantifying various phenomenological aspects may prove useful in examining modality-specific deficits within remote personal memory, although this practice should be tempered by the reduced reliabilities of certain detail and ratings categories. Both instruments are time consuming, but our measure requires additional transcription and scoring that entails significant training. The AMI's assessment of autobiographical episodic memory, although subject to ceiling effects, is much easier to apply and was sensitive to age effects in the recall condition. Finally, our measure includes a structured interview with potential for examining the effects of retrieval support.

#### *Conclusion*

The Autobiographical Interview provides reliable and valid indices of episodic and semantic contributions to personal remote memory. We used this instrument to document an age-related bias in favor of semantic details in autobiographical recall; younger adults recalled more details related to happenings, locations, perceptions, and thoughts and feelings specific to the event. This

effect held at all life periods, including the previous year when age-group differences in retention interval were controlled. Retrieval support did not differentially affect older adults' recollections. Although it did reduce age differences when retention interval was controlled, it did not alter the balance between internal (episodic) and external (semantic) details. Older adults likely have different goals when participating in a study of this sort, favoring a more integrative approach to viewing the past that stresses social roles and generativity. Nonetheless, a large body of research suggests that access to contextual episodic details declines with age because of changes in the efficiency of retrieval processes. In contrast, access to semantic and other nonepisodic information is preserved. This study extends these findings to the domain of autobiographical memory.

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## Appendix

## Contrasting Older and Younger Adults' Recollections From the Previous Year

## Older Adults

Well, I only have one sister left now. She's 95 years old and so I'm very close to my youngest sister's family but she died four years ago. And I'm very close to all the kids, the grandchildren, the great-grandchildren. And I've always had Friday night dinners with that branch of the family since my husband and I are no longer together. So after my sister died my brother-in-law kept up the family dinners on Friday and so all his children, grandchildren and now great-grandchildren turn up, and that's always a big do, the family. And it's something I look forward to very, very much. And the winter when he goes away for six months, then two of his daughters take over. So we keep this thing going on the Friday night. I am closer to them actually than I am to my own branch of the family because I only have one married son. They have two children and they don't do it Friday nights. So I see them when I see them. But this is an ongoing thing that is very precious to me.

## Younger Adults

An Italian restaurant. It was on the second floor of this restaurant and it was busy. I was at this little table. It was half the size of this table and this was a good date. The guy I was with was 6'4" and he was a big guy and he just looked really huge for the table. And I remember that looking kind of eye with a bit impatient with the service and I remember talking to him about Italian food and contemplating pasta or pizza and I ordered pizza. He ordered pizza as well. I think his had eggplant on it and I don't like eggplant. I don't remember what mine had on it though. I remember I didn't eat the whole thing, taking home a doggy bag. I think I just had water. He had an espresso as well. He was wearing a blue polo shirt and I was wearing a gray long sleeved t-shirt, blue jeans, black shoes. He was wearing blue jeans and black shoes. I remember the waiters were wearing like white aprons, white shirts with a tie. We were going to order wine but we didn't.

*Note.* The older adult's emphasis is on integrative semantic details and the younger adult's emphasis is on the factual description.

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