AUTOBIOGRAPHICAL INTERVIEW: AGE-RELATED DIFFERENCES IN EPISODIC RETRIEVAL

by

Eva-Maria Svoboda

A thesis submitted in conformity with the requirements for the degree of Master of Arts

Graduate Department of Psychology

University of Toronto

© Copyright by Eva-Maria Svoboda, 2001
The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author’s permission.

L’auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L’auteur conserve la propriété du droit d’auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.
AUTOBIOGRAPHICAL INTERVIEW: AGE-RELATED DIFFERENCES IN EPISODIC RETRIEVAL

Eva-Maria Svoboda

Department of Psychology, University of Toronto

Masters of Arts, 2001

Abstract

Apart from observational findings, little is known about age-related changes in autobiographical remembering. This study investigated these changes using a new measure of autobiographical memory: The Autobiographical Interview. Younger and older adults recalled events from 5 lifetime periods. Memories were broken down into internal (event-related) and external (semantic, or off-target information) details. Internal details also received rating scores. We found that younger adults received higher internal detail and rating scores in contrast to older adults who received higher external detail scores. Detail groups were further broken down into detail categories to examine which ones accounted for these age differences. Younger adults recalled more perceptual and thought internal details, and older adults recalled more semantic information. Memories from the last year were examined to control for memory age, and a similar pattern of recollection was evinced. Our findings support theories of selective frontal degeneration, and inefficient inhibitory processes in older adults.
Acknowledgements

I would like to thank Brian Levine and Gus Craik for their insightful feedback throughout the preparation of this thesis. I would also like to thank Rosemary Waxman for recruiting and testing several of the participants in this study, as well as Lisa Cauchi and Paula Matthews for transcribing the majority of the protocols. I thank the members of the Levine lab for their assistance, support and stimulating discussions about scoring procedures, and Malcolm Binns for his helpful comments on the analysis of the data. I also thank Brian Levine, Janine Hay, Morris Moscovitch, Gordon Winocur, Tania Yaschyshyn and Rosemary Waxman for their invaluable work on the development of the scoring criteria utilized in this study. Last but not least, I would like to thank my family for their continued and unconditional support in my endeavors. This thesis is especially dedicated to my mother.
Table of Contents

List of Tables vi
List of Figures vii
List of Appendices ix

Introduction 1

Relevant Definitions and Theories 3
Autobiographical Remembering and the Prefrontal Cortex 7
Autobiographical Memory in Patients with Brain Damage 8
Functional Imaging of Autobiographical Memory Processes 11
Age-Related Memory Decrement 11
The Role of the Prefrontal Cortex in Age-Related Memory Decrement 17
Autobiographical Memory in Older Adults 21
Autobiographical Memory Across the Life-Span 26
Autobiographical Memory Measures and Related Research 27
Overall Summary 34
The Present Study 37

Method 39

Participants 39
Materials 40
Procedure 40
Protocol Preparation 44
Protocol Scoring 44
### Results

- **Internal and External Autobiographical Memory Details** 51
- **Autobiographical Memory Ratings** 53
- **Internal to Total Detail Ratios** 53
- **Time Periods** 54
- **Individual Internal and External Categories** 57
- **Autobiographical Memory After a One Year or Less Delay Period** 62
- **Comparison with the Autobiographical Memory Interview** 71

### Discussion

- **Aging and Autobiographical Retrieval of Event-Specific and External Information** 73
- **Age-Related Differences in Autobiographical Remembering Across the Life-Span** 77
- **Components of Event-Specific and Off-Target Information** 78
- **Recollection of Events from the Past Year** 82
- **Construct Validity** 83
- **Conclusions** 85
- **References** 91
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Subject Characteristics</td>
<td>39</td>
</tr>
<tr>
<td>Table 2</td>
<td>Time Periods for Young and Older Adults</td>
<td>41</td>
</tr>
<tr>
<td>Table 3</td>
<td>Internal and External Groups and their Categories</td>
<td>46</td>
</tr>
<tr>
<td>Table 4</td>
<td>Text Details</td>
<td>47</td>
</tr>
<tr>
<td>Table 5</td>
<td>Comparison of Internal to Total Detail Ratios in Younger and Older Adults</td>
<td>54</td>
</tr>
<tr>
<td>Table 6</td>
<td>Comparison of Internal to Total Detail Ratios in Younger and Older Adults</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>for Events from the Last Year</td>
<td></td>
</tr>
</tbody>
</table>
List of Figures

Figure 1. Mean number of internal and external details given during recall and after specific probing by younger and older adults. 52

Figure 2. Mean number of internal details given by younger and older adults, across time periods 1 to 5, during recall (a) and after specific probing (b). 55

Figure 3. Mean rating scores of younger and older adults, across time periods 1 to 5, during recall (a) and after specific probing (b). 57

Figure 4. Mean number of internal details given by younger and older adults for each internal detail category, during recall (a) and after specific probing (b). 59

Figure 5. Mean rating scores of younger and older adults for each internal detail category, during recall (a) and after specific probing (b). 61

Figure 6. Mean number of external details given by younger and older adults for each external detail category, during recall (a) and after specific probing (b). 63

Figure 7. Mean number of internal and external details given during recall and after specific probing by younger and older adults, for the last time period. 64

Figure 8. Mean number of internal details given by younger and older adults for each internal detail category, during recall (a) and after specific probing (b), for the last time period. 67
Figure 9. Mean rating scores of younger and older adults for each internal detail category, during recall (a) and after specific probing (b), for the last time period.

Figure 10. Mean number of external details given by younger and older adults for each external detail category, during recall (a) and after specific probing (b), for the last time period.

Figure 11. Continuum of episodicity in episodic details.
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A</td>
<td>Event list</td>
<td>87</td>
</tr>
<tr>
<td>Appendix B</td>
<td>General probes</td>
<td>88</td>
</tr>
<tr>
<td>Appendix C</td>
<td>Specific probes</td>
<td>89</td>
</tr>
</tbody>
</table>
AUTOBIOGRAPHICAL INTERVIEW: AGE-RELATED DIFFERENCES IN EPISODIC RETRIEVAL

Autobiographical memory - memory for information about oneself (Brewer, 1986) - is one of the least understood areas in the study of memory (Rubin, 1986). Although autobiographical memory is in many respects similar to other memory processes studied in the laboratory, it is the personal relevance associated with remembering that sets it apart. It is also this personal aspect that has made the study of autobiographical memory particularly more difficult and complex. In contrast to studying recall of wordlists that are presented and recalled in the laboratory, autobiographical memories are difficult to verify, experimental control in the testing environment is hard to achieve (Brewer, 1986), and the variability of the resulting data presents numerous quantitative challenges. Considering these tribulations, it is not surprising that in comparison to other memory processes few studies have investigated the effects of aging on autobiographical remembering.

Although many older adults claim that their memory is best for earlier life events, there is no empirical evidence to support this (Warrington & Sanders, 1971). It has been postulated that autobiographical memory is prone to the same cognitive and neuroanatomical changes that affect other memory processes (Holland, 1992). Older adults show decrements in laboratory memory tasks that involve strategic or conscious recollection; such as free recall, prospective memory and working memory tasks. These tasks, as well as self-reference tasks, have all been shown to rely heavily on the frontal lobes, which are thought to undergo selective degeneration with advancing age. Several studies of autobiographical memory in patients with frontal damage and older adults, combined with imaging findings, suggest frontal responsibility for age-related declines. However, apart from observational
findings, little is known about the nature of these age-related changes in autobiographical remembering. Part of the difficulty lies in quantifying these changes. There are few valid and reliable measures available with which to investigate autobiographical memory. New methods and measures are needed to further our present knowledge of age effects on autobiographical recollections. Furthermore, the study of real-life memory phenomena such as autobiographical remembering, in conjunction with laboratory-based investigations, will provide a fuller and more accurate depiction of overall memory changes that accompany aging.

The primary objective of the present study was to investigate age-related differences in autobiographical recollection. Of particular interest was the recollection of episodic details – do younger and older adults differ in the quantity and quality of event details recalled? Of further interest were the effects of structured probing and of the time period when the memory was first encoded (recent or remote), on younger and older adults’ recollections. A new measure of autobiographical memory was utilized to investigate these objectives. The results were also meant to provide useful data for validating the new measure. The role of the frontal lobes in autobiographical memory retrieval was also considered.

We begin with a definition of relevant memory terms and theories. Evidence of frontal contribution to autobiographical recollection in selected patient studies, as well as in functional imaging studies will be addressed. Next, age-associated decrements in episodic memory, and the role of frontal involvement in these decrements will be considered. Finally, what is known about the effects of aging on autobiographical memory will be discussed, followed by a review of the existing measures.
Relevant Definitions and Theories

Autobiographical memory is one of the components of remote memory. What distinguishes autobiographical memory from other types of remote memory is the relationship to the self. The term autobiographical memory can be separated into several parts, all of which are unified by the reference to the self. To begin with, autobiography refers to a personal account of one’s life story. The incidents and facts contained in this account may or may not be committed to memory. For the purposes of this study, autobiographical memory is referred to as the information from the personal account that is accessible to remembering. The act of autobiographical remembering can be thought of as the recollection or retrieval of personal episodes and their details from autobiographical memory.

The information successfully retrieved from autobiographical memory can be broken down into several levels of knowledge specificity. In the self-memory system model, Conway and Pleydell-Pearce (2000) describe 3 levels of knowledge specificity evident in autobiographical memory: Lifetime periods, General Events and Event Specific Knowledge (ESK). Lifetime periods, the broadest knowledge base of the three, represent personal eras (e.g., time at university, living in city X), and general knowledge of others, locations, activities, and goals. General Events constitute repeated events (e.g., going to the cottage), extended single events (e.g., vacation in France), and sets of associated events or “mini-histories” (e.g., learning to drive a car) (see Robinson, 1992). ESK is essential to vivid remembering. It comprises specific event, imagery and sensory details of a memory. These knowledge systems are hierarchically organized such that ESK is contextualized by general
events, which in turn are contextualized by Lifetime Periods. All three levels represent knowledge in relation to the self (see also, Brewer, 1986).

Consistent with the above model, autobiographical memory has been suggested to comprise episodic and semantic memory components (see Cermak, 1985; Hodges & McCarthy, 1995; Kihlstrom et al., 1988; Klein, Loftus, & Kihlstrom, 1996; Kopelman, Wilson, & Baddeley, 1989; Moscovitch, Yashchyn, Ziegler, & Nadel, 1999; Reiser, Black, & Abelson, 1985). The episodic component is the retrieval of spatio-temporally specific episodes from one’s personal past, which will be referred to as episodic retrieval. Episodic retrieval or memory has also been related to re-experiencing in which the rememberer undergoes mental time travel and re-experiences an event as it was originally encountered. William James (1890) captured the essence of re-experiencing when he suggested that, “remembrance is like a direct feeling; its object is suffused with a warmth and intimacy to which no object of mere conception ever attains.” (p.239). Although re-experiencing is difficult to test and we do not propose that our measure can directly tap this phenomenon, it has been suggested that the ability to recollect numerous contextual or phenomenal details (e.g., location, perception, emotions, thoughts) intrinsic to an episode, is reflective of experiencing versus imaging an incident (Johnson, Foley, Suengas, & Raye, 1988). Moreover, an incident is not remembered in a vacuum, but rather fits into a broader context of ongoing events and self-schemas, comprising the personal-semantic component of autobiographical memory.

Tulving (1972), proposed that episodic and semantic memory are two functionally and neuroanatomically independent memory systems. In contrast to episodic memory, semantic memory is the retrieval of general, undated, third person knowledge that we have
about the world and ourselves. The majority of this knowledge is about ourselves (Tulving, 1993). This self-knowledge component has been referred to as "personal semantic" memory (Cermak & O'Connor, 1983). Moreover, semantic memory is accessed through "noetic consciousness", which enables an individual to be aware of and apply a summary or generalized knowledge of the world and oneself to ongoing activities. In contrast, episodic memory is accessed through "autonoetic consciousness", which is an awareness of an "event as a veridical part of his [sic] own past existence." (Tulving, 1985, p.3). Once information is stored it can be retrieved at a later time via the episodic system, the semantic system or both.

The functional and neuroanatomical distinctness of these two memory systems is evident in the case of K.C. (Tulving, 1989). After acquiring a severe closed head injury during a motorcycle accident at the age of 30, K.C. became densely amnesic. While he was unable to consciously recall a single event that had ever happened to him, his intelligence and semantic knowledge remained intact. For instance, prior to the accident, K.C. had enjoyed playing chess. Although K.C. retained the rules of the game post-injury, he could not recall a single instance of playing chess. Similarly, he could quite accurately describe his personality, but had no personal recollections from which this knowledge could be inferred (Tulving, 1993). Moreover, K.C. had access to his semantic but not his episodic memory store. He could only experience the present moment and was incapable of re-experiencing the past or projecting himself mentally into the future. Although he could intelligently discuss the concept of time, K.C. remained consciously unaware of the past and the future (see also Vargha-Khadem et al., 1997).

Tulving’s episodic/semantic distinction has recently gained further support with the development of functional imaging. Several recent imaging studies have provided evidence
of differential prefrontal cortex activation during episodic versus semantic encoding and retrieval (for review see, Buckner, 1996; Nyberg, Cabeza, & Tulving, 1996; Tulving, 1998). On the basis of such data, Tulving et al. (1994) proposed the hemispheric encoding/retrieval asymmetry (HERA) model. The HERA model asserts that episodic encoding and semantic memory retrieval processes differentially engage the left hemisphere, while episodic memory retrieval and semantic encoding processes differentially engage the right hemisphere, including the right prefrontal cortex.

In line with Conway and Pleydell-Pearce's (2000) self-memory system model and the theoretical persuasions of several other aforementioned authors, it has been postulated that autobiographical memory comprises both episodic and personal-semantic memory components. In the present context, the term personal semantic is primarily derived from Tulving's depiction of semantic memory. However as suggested by the word "personal", it refers to general knowledge about oneself, which is also in agreement with Conway and Pleydell-Pearce's definition of life time periods and general events. K.C.'s predicament, a man who could recite general knowledge about the world and himself, but could not retrieve a single specific incident from his past, suggests that semantic and personal semantic memory may be part of the same preserved memory system. Furthermore, evidence from functional imaging studies depicts these episodic and semantic components as two functionally and neuroanatomically distinct memory systems. Taken together, it appears that these memory systems can be differentially disrupted and have differential contributions to autobiographical remembering. In the next section, the role of the prefrontal cortex as the retrieval system of autobiographical memories is discussed.
Autobiographical Remembering and the Prefrontal Cortex

The prefrontal cortex mediates such memory processes as the organization, storage, search, retrieval and construction of events. These functions are monitored by a central executive or supervisory attentional system that operates through a self concept (Norman & Shallice, 1980, c.f. Cohen, 1998). Autobiographical remembering or retrieval of personally experienced events is mediated by these executive processes (Cohen, 1998). Executive functions are implemented during the strategic search of distinct events and their details from a vast cumulative record of semantic and episodic components (Squire, 1987). Moreover, several lines of evidence that will be reviewed shortly, suggest that the prefrontal cortex is critical during these retrieval processes. Age-associated selective deterioration of or damage to the prefrontal cortex results in generalized recollections and fewer details. Although autobiographical retrieval of episodes may spontaneously occur to a specific cue (e.g., odor, sound), they are more commonly accessed through generative retrieval strategies (see Conway, 1992; Conway & Pleydell-Pearce, 2000) which place higher demands on the frontal lobes. According to Wheeler, Stuss and Tulving (1997), episodic retrieval is more closely associated with higher-order processes such as executive functions and autonoetic awareness, than semantic memory processes.

Several broadly compatible models of autobiographical memory retrieval processes have been suggested over the last two decades (for initial model see Norman & Bobrow, 1979; see also Burgess & Shallice, 1996; Conway, 1992; Conway, 1996; Conway & Pleydell-Pearce, 2000; Williams & Hollan, 1981). Current models, such as those by Conway, and Burgess and Shallice, suggest that episodic memories are not discrete memory records or packets, as previously believed, but rather an amalgam of sensory and phenomenal
details that are represented as traces over a wide variety of separable cortical systems. These traces are re-activated in a complex cyclic multi-stage retrieval process. According to Burgess and Shallice (1996) such retrieval engages a Supervisory System. It is assumed that episodic elements and networks in what is referred to as the long term storage system are experienced or brought to awareness when they are activated by the Supervisory System. This conception of awareness also corresponds with Tulving’s (1989) autonoetic consciousness.

Autonoetic consciousness is a unique human capacity that allows an individual to mentally travel into the past or future of subjective time. In a recent reformulation of the episodic memory theory, Wheeler, Stuss, and Tulving (1997) suggest that although the personal past can be accessed through the semantic memory system, also referred to as semanticized or generalized recall, only episodic retrieval is “infused” with autonoetic consciousness.

Autobiographical Memory in Patients with Brain Damage

The study of patients with frontal lobe damage has given us a better understanding of this region’s involvement in autobiographical memory processes. As a result it also provides helpful information for interpreting age-related decrements in autobiographical recollection. Although most studies of brain damage and memory have focused on patients with medial temporal lobe insult, it is important to distinguish between the effects of hippocampal and frontal damage. Damage to the hippocampal complex disrupts the binding of information into memory traces, while damage to the prefrontal cortex disrupts the capacity to activate existing memory traces or retrieve mnemonic information (Baddeley & Wilson, 1986).
There are several lines of evidence that suggest frontal damage can evoke retrieval deficits in autobiographical memory as well as deficits in self-awareness or the ability to re-experience previous episodes. These areas will only be touched on for the purposes of better understanding the effects of the aging process on autobiographical memory.

In a study on autobiographical memory and brain injury, Baddeley and Wilson (1986) found that bilateral frontal patients encountered varying levels of retrieval difficulty ranging from non-fluent or "clouded" recollections to unintentional and even fantastic confabulation. Deficits were evinced in initiating memory searches, and in the case of the confabulators, differentiating past experiences from other implausible associations. In another study, Della Sala et al. (1993) studied autobiographical remembering in unilateral (left and right) and bilateral frontal patients. All 4 of the bilateral frontals showed impoverished performance, while only 2 unilateral frontals (1L, 1R) were impaired. However, the structure of the measure utilized suggests that it was not designed to distinguish between episodic and semantic retrieval abilities. In other words, the test may have encouraged compensatory mechanisms in unilateral frontal patients, in that answers could be retrieved through either an intact episodic or an intact semantic memory system. Thus, patients with bilateral frontal insult were unable to access either one of the memory retrieval systems (see section on autobiographical memory measures).

Several studies suggest that placing less demands on frontal functions through structured cueing, aids in episodic retrieval. Eslinger (1999) compared autobiographical remembering of several cases of unilateral and bilateral temporal amnesics to a patient with bilateral prefrontal cortical damage. While medial temporal lobe amnesics showed severely impoverished autobiographical remembering, both personal-semantic and episodic, the
patient with bilateral prefrontal damage could recall further details when probed. Thus, the bilateral frontal patient had an intact autobiographical memory store, but he could not spontaneous access it. Similarly, Crovitz (1986) found that with the help of rigorous cueing an amnesic patient could retrieve events that had occurred up till a few seconds prior to his traumatic car accident.

Frontal damage appears to be requisite to amnesic syndromes in which self-awareness is clearly disrupted, most notably in bizarre confabulation. For instance, Baddeley and Wilson (1986) discussed a patient with bizarre confabulation who had no conception of the link between his past and present. On one occasion he was said to be at home with his family when he asked his wife, “Why do you keep telling people we are married?” After a few exchanges in which he could not be convinced of their status, she showed him their wedding photographs. At this, the patient admitted that he resembled the groom, but denied that the photograph was of himself (see p. 241). This duplication of the self has also been termed reduplicative paramnesia or Capgras syndrome, in which there is a delusional belief that one or more persons close to the patient have been substituted for by one or more imposters. In another similar case, Alexander, Stuss and Benson (1979, c.f. Stuss, Picton, & Alexander, 1998) reported a frontal patient who believed he had a second family which was identical to his first. Although he was unaware that his personal situation was unlikely, as an outside judge he agreed that such a scenario was impossible. Overall, there appears to be an inverse relationship between severity of confabulation and self-awareness (Feinberg, 1997).
Functional Imaging of Autobiographical Memory Processes

To date, only four imaging studies of autobiographical remembering have been published (Andreasen et al., 1995; Conway et al., 1999; Fink et al., 1996; Maguire & Mummery, 1999). The results unanimously show prefrontal cortical activation in response to autobiographical remembering. In line with Tulving et al.'s HERA model of episodic retrieval, Andreasen et al. and Fink et al. reported bilateral right greater than left prefrontal, and right prefrontal cortex activations, respectively. Conway et al., and Maguire and Mummery evinced left and medial prefrontal cortex activations, respectively. In an unpublished EEG study, Conway (in press) examined three stages of autobiographical remembering: retrieval of a personal memory, holding it in mind, and releasing it. Results showed that the first two stages were associated with activation in the left frontal area, and right frontal area, respectively. Clearly the lateralization of frontal activations still needs to be resolved. The latter imaging findings appear to be in contrast to Tulving et al.'s (1994) HERA model. However too few imaging studies in autobiographical memory have been conducted to draw any meaningful conclusions on lateralization in the prefrontal cortex. What these findings do show is that autobiographical memory consistently engages the frontal lobes.

Age-Related Memory Decrement

There is good agreement that older adults demonstrate poorer memory performance on tasks that are explicit, effortful, unstructured, and require conscious control. For instance, age related-decrements are evinced in free recall of word lists and text, memory for source or contextual details, working memory and prospective remembering (for reviews see, Craik,
Anderson, Kerr, & Li, 1995; Craik & Jennings, 1992; Light, 1991; Zacks, Hasher, & Li, 2000). Age-associated declines are present during both deliberate encoding and retrieval processes. Nonetheless, it has recently been suggested that retrieval processes play a key role in age-related memory decline (Craik, 2000). As we are primarily interested in age-differences in the retrieval of contextual or phenomenal details during autobiographical remembering, the following section will focus on findings related to age-associated decrements in memory for source and contextual information. Research on older adults’ memory for source and contextual features of an event is of particular interest because it provides corollary evidence to the nature of age-related decrements in autobiographical remembering.

Source memory refers to remembering the context or environment in which a given fact or item was acquired. Schacter, Harbluk, and McLachlan (1984) distinguished between two types of source memory deficits: Source amnesia (a term coined by Evans & Thorn, 1966, c.f., Schacter et al., 1984) refers to correctly recalling an experimentally acquired term, but attributing its source to an extraexperimental learning episode (e.g., television, radio, newspaper); and source forgetting refers to correctly recalling or recognizing an item and that it was acquired earlier in the experimental session, but incorrectly selecting one of several intraexperimental sources (e.g., visual or auditory presentation). Source forgetting appears to increase with age (see Spencer & Raz, 1995 for meta-analysis). For instance, older adults are less accurate than the young in remembering the modality in which information was presented (Light, La Voie, Valencia-Laver, Albertson-Owens, & Mead, 1992; McIntyre & Craik, 1987), the color (Park & Puglisi, 1985) location (Chalfonte & Johnson, 1996; Park, Puglisi, & Lutz, 1982), case format (Kausler & Puckett, 1980), and temporal sequence
(Kausler, Salthouse, & Saults, 1988) of the stimulus, whether the words were read or mentally generated (Rabinowitz, 1989), as well as identifying the presenter (Hashtroudi, Johnson, & Chrosniak, 1989) or whether the presenter was male or female (Kausler & Puckett, 1981; see also, Schacter, Osowiecki, Kaszniak, Kihlstrom, & Valdiserri, 1994).

Source amnesia is also evident in older adults. In a paradigm modeled after Schacter, Harbluk, and McLachlan's (1984) source memory study in amnesic patients, McIntyre and Craik (1987) presented younger and older adults with trivia questions and answers which were either read or heard. Memory for old and new trivia information was tested one week later. They found that older adults were more likely to attribute knowledge for facts learned intraexperimentally to extraexperimental sources than were younger adults. Age-related decrements in intraexperimental attributions were also observed for modality. While source forgetting can be expected in healthy adults, additional source amnesia may be indicative of underlying neuroanatomical changes that predispose older adults to source memory decrements. In the original paradigm, Schacter et al. found that amnesics made numerous extraexperimental errors for correctly retrieved items, while normal subjects rarely made extraexperimental errors but often forgot the intraexperimental source of the fact.

Source attribution was initially addressed in Johnson and Raye's (1981) framework of reality monitoring. Reality monitoring refers to discriminating memories for events that were experienced or perceived from those that were imagined or thought about (see Johnson, 1988; Johnson & Raye, 1981). Memories for experienced events are postulated to be richer in sensory details and in temporal, spatial and contextual attributes. In contrast, memories for imagined events are richer in cognitive aspects such as thoughts or feelings. Several studies support this idea (Anderson, 1984; Johnson et al., 1988; Johnson, Raye, Wang, &
Taylor, 1979; McGinnis & Roberts, 1996). These somewhat segregated groups of characteristics are thought to be used to determine whether a particular memory represents a real or imagined event.

In a study on reality monitoring, Johnson, Foley, Suengas et al. (1988) asked participants to rate memories for perceived events and imagined events on several characteristics. Common events were assigned for the retrieval of a perceived occurrence (e.g., trip to the dentist), and participants selected their own dream, fantasy or unfulfilled intention as the imagined event. Overall, experienced events received higher ratings on visual detail, sound, smell, taste, realism, location, setting, spatial arrangement of objects and people, and temporality (e.g., time, year, season, day and hour) than imagined events. Although the perceived event cues may have biased the ratings of certain characteristics that are not commonly associated with episodic retrieval (i.e., trips to the dentist are often associated with awful tastes, smells, and drilling sounds), the findings suggest that sensory stimuli may play an important role in episodic recollections. Similarly, Brewer (1988) reported that accurate recollections were more likely to be associated with a greater number of sensory details than less accurate recollections (see also, Hyman, Gilstrap, Decker, & Wilkinson, 1998; McGinnis & Roberts, 1996). If older adults show decrements in identifying contextual details of events, which would make real events less distinguishable from imagined events, perhaps they are more likely to misattribute an imagined event as something that happened. Several findings show that this is the case (Cohen & Faulkner, 1989; Guttentag & Hunt, 1988; Hashtroudi et al., 1989; Hashtroudi, Johnson, & Chrosniak, 1990).
The MCQ (Memory Characteristics Questionnaire), was developed by Johnson et al. (1988) to study memory for features of recollected items or events. The selection of attributes comprises those that capture the qualitative experience of remembering an event (e.g., perceptual and contextual details, thoughts and emotions). Variants of this questionnaire have been utilized to further investigate reality monitoring and source memory in young and older adults. Overall, these studies have shown that both young and older adults recall more features (e.g., color, sound, temporal order) for items correctly recognized as “old” than for items incorrectly recognized or lures (see, Zacks et al., 2000). However, older adults’ true and false memories show fewer sensory and contextual differences than young adults (Hashtroudi et al., 1990; Norman & Schacter, 1997). In addition, older adults appear to base their recollective decision on associative or semanticized information (emotions/thoughts associated with the target word) rather than character attributions. This may in part explain older adults’ vulnerability to the “false-recognition effect”. Similarly, older adults are also more susceptible to the “false-fame effect”. In one such study, Dywan and Jacoby (1990) presented young and older adults with a list of fictitious names. At test, they were given a fame judgement task in which the same fictitious names were mixed with additional fictitious names and moderately famous names. Dywan and Jacoby found that older adults were more likely to judge a previously learned fictitious name as famous, presumably because they misinterpreted familiarity as fame.

Familiarity- or semantically-based recollection has also been evinced in older adults by utilizing the remember/know technique (Gardiner, 1988; Tulving, 1985). In this variant of a recognition test, subjects are asked to state whether a recognized item is a “remember” (conscious recollection of an item) or “know” (familiarity of an item that lacks conscious
recollection) response (see also Gardiner & Richardson-Klavehn, 2000). Studies that have employed this technique to compare recollective experience in young and older adults have found that older subjects show fewer “remember” responses and the same or a greater number of “know” responses (Java, 1996; Mäntylä, 1993; Parkin & Walter, 1992; Perfect & Dasgupta, 1997). These findings suggest an age-related decrement in recollecting phenomenal details or re-experiencing, and an increased reliance on compensatory familiarity-based recognition. Moreover, in a study of autobiographical memory in young adults, Hyman et al. found that “remembered” events were rated higher on phenomenal re-experiencing than “known” events. These findings fit nicely with the idea that the weakening of retrieval mechanisms in older adults result in familiarity-driven recollection and hence a paucity of recollected phenomenal or contextual details. Furthermore, “remember” responses have also been associated with frontal lobe functions (Düzel, Yonelinas, Mangun, Heinze, & Tulving, 1997; Levine et al., 1998; Parkin & Walter, 1992).

Parkin and Walter (1992) found that the lower proportion of remember to know responses in older adults was related to poorer performance on the Wisconsin Card Sorting Task (WCST), a measure of frontal lobe dysfunction. This study suggests that older adults’ difficulty in “remembering” or retrieving phenomenal details may be related to the selective deterioration of the prefrontal cortex, presuming that the WCST is an accurate measure of neuroanatomical frontal status.

In summary, age-associated changes have been found in memory tasks that reflect episodic retrieval or a certain degree of re-experiencing. Older adults demonstrate poorer performance in memory for source and contextual details that may be related to their difficulty in distinguishing experienced from imagined events. Interestingly, these findings
vaguely mirror memory processes evinced in confabulating patients with frontal damage (Borroni, Dall'Ora, Dalla Sala, Marinelli, & Spinnler, 1989). Patient studies reviewed earlier suggest that confabulating individuals experience difficulty distinguishing past experiences from those imagined or thought about. Retrieval deficits in older adults for specific contextual or phenomenal details may also be responsible for the increased reliance on familiarity-based recognition, and hence fewer "remember" responses during remember/know recognition tests. These findings lay the ground work for understanding age-related decrements in autobiographical memory. First of all, in line with the above findings, older adults should recall fewer contextual or phenomenal details than younger adults. It would also seem plausible that older adults would rely more on semantic information during recall than episodic information, which would be more difficult to retrieve.

The Role of the Prefrontal Cortex in Age-Related Memory Decrements

It is well established that with increasing age selective degeneration occurs in the prefrontal cortex. Between young adulthood and old age, 15-20% of the total neurons are lost (Squire, 1987). According to the frontal lobe hypothesis of aging, malfunction begins significantly earlier in the prefrontal cortex than in any other cortical region, or structure (see West, 1996). Tasks that require self-initiated, organizational, or executive processes are thought to be both sensitive to age-effects and engage the prefrontal cortex (see, Moscovitch & Winocur, 1992; Moscovitch & Winocur, 1995; West, 1996 for reviews).

Many studies have implicated the frontal lobes in age-related deficits in source recall. For instance, Craik et al. (1990) showed that source memory performance in older subjects
was related to several measures of frontal dysfunction. There was also evidence suggesting that the relationship between frontal dysfunction and source amnesia increased with age (see Spencer & Raz, 1994 for different findings). Moreover, Janowsky, Shimamura, and Squire (1989) demonstrated that both non-amnesic patients with frontal lesions and their age-matched controls committed significantly more source errors than younger subjects.

Several lines of evidence suggest that memory for source or contextual details and memory for facts may be cognitively as well as neuroanatomically dissociable. In a large meta-analysis, Spencer and Raz (1995) found that age differences in context memory were significantly greater than in memory for facts. In Janowsky, Shimamura, and Squire's (1989) study, frontal patients performed equally well on fact recall as their age-matched controls and younger subjects. Schacter (1984) demonstrated that when amnesic patients' fact memory was equated to normal individuals by means of brief delays, source attribution errors were reflective of the degree of frontal dysfunction and not severity of amnesia. Moreover, Glisky, Polster and Routhieaux (1995) showed a double dissociation between fact and source memory in a group of older adults. Older subjects with high-frontal functions (as determined by a composite of frontal tests) outperformed those with low-frontal functions on memory for source, regardless of temporal lobe functioning, while subjects with high-medial temporal functions (as determined by a composite of medial temporal tests) outperformed those with low-medial temporal functions on fact recall, regardless of frontal lobe functioning.

The experimental manipulation of structural support has also shed some light on frontal processes in memory performance. When a structural framework is provided, young and older adults as well as patients with frontal damage (see earlier section) show benefits in memory performance. Presumably shifting reliance from internally derived retrieval
strategies or structure during recollection to externally provided structure reduces the demands made on the frontal lobes. Craik (1986) postulated that various memory tasks provide differential structural support, and thus a differential need to rely on these internal strategies which he called "self-initiated processes". Aging is hypothesized to disrupt these self-initiated processes, which are presumably caused by age-related selective deterioration of the prefrontal cortex. For instance, it is well established that age differences are greater for free recall tasks, which provide little external structure, than for recognition tasks, which provide a greater degree of structural support (for reviews see Craik, 1977; Craik et al., 1995; Poon, 1985).

Other studies that have directly compared older adults to frontal patients' performance on structurally manipulated tasks have found parallel deficits. For instance, in an experiment utilizing a conditional associative learning task (CAL; e.g., learning arbitrarily paired stimuli through trial and error), Levine, Stuss, and Milberg (1997) found performance decrements in older adults and to a greater extent in patients with focal frontal lesions. When the task was modified to include structural support, which would alleviate dependence on inefficient frontal processes, older adults achieved near perfect performance, and the frontal patients significantly improved their performance. Furthermore, in another study, the same authors found that age-decrements were also attenuated in a concept generation task (e.g., grouping stimuli according to verbal or graphic concepts) when structure was introduced through cueing (Levine, Stuss, & Milberg, 1995).

Imaging studies suggest that differential networks engaging the prefrontal cortex are activated during memory task performance in young and older adults. For instance, while Cabeza et al.'s (1997) findings in young adults were consistent with the HERA model,
namely, left lateralized activation during encoding, and right lateralized activation during retrieval (for reviews see, Buckner, 1996; Nyberg et al., 1996; Tulving, 1998), older adults showed little frontal activity during encoding and more bilateral frontal activation during retrieval. The young subjects in Schacter et al.’s (1996) study showed bilateral activation in the anterior frontal regions during episodic recall, while the older subjects showed activation in the posterior regions of the frontal lobes. In a study of rCBF during encoding and recognition of faces, Grady et al. (1995) found that during encoding young subjects showed activations in the left prefrontal and right hippocampal regions while older subjects showed no reliable activations in these areas. During face recognition, both subject groups showed similar right prefrontal activation. One exception to the above findings was reported by Mark and Rugg (1998), who were not able to find any topographical differences between young and older adults in an item and source recognition test using EEG.

Although the nature of frontal activity in older adults needs further study, these imaging studies show that aging does alter activation networks engaging the prefrontal cortex. Cabeza et al. (1997) postulated that age-related reductions in activation may reflect altered memory networks, while increases in activation may suggest reliance on inefficient processing strategies. Further investigation is also needed to clarify whether age differences are more prominent during encoding or retrieval. In addition, the inability to find age differences using EEG may suggest that results in this area are still somewhat reliant on the imaging technique employed.

Overall, the above studies suggest a relationship between deficits in the retrieval of contextual details and frontal functions. Memory deficits in older adults appear to be more prominent for phenomenal details related to facts than for the facts themselves. Differences
in performance between young and older adults as well as patients on memory tasks thought to engage the frontal lobes, can be attenuated under structured conditions. However, older adults appear to have parallel performance decrements to frontal patients. This would make sense considering imaging studies provide evidence for altered activation networks involving the frontal lobes in older adults. Given that frontal patients are able to retrieve more details during autobiographical recollection with structured probing (see autobiographical memory in patients with brain damage) it would seem logical that older adults should reap similar benefits.

**Autobiographical Memory in Older Adults**

Older adults are more likely to give generalized accounts of personal events with fewer specific details than younger adults. Over-generality is especially pronounced when recollections are drawn outside the pool of well rehearsed and frequently told events (Cohen, 1998). There is some evidence that open-ended queries of autobiographical memory produce fewer episodic recollections (Pillemer, Rhinehart, & White, 1986). In a study of psychologists' autobiographical accounts of early consequential experiences, Mackavey, Malley and Stewart (1991) found that only 31% of recollections were episodic or had an episodic component. However, most autobiographical studies discourage generality when probing for events, and instructions alone can not account for the reported age differences. For instance, Borrini et al. (1989) found that even though generality was discouraged, older adults received lower autobiographical memory scores comprising ratings of vividness, amount of detail, and fluency in retrieving events, than younger adults.
Similar age-related deficits have been reported in the flashbulb memory literature.

Cohen, Conway and Maylor (1994) found that older adults had significantly fewer flashbulb memories than younger adults, and remembered fewer details about the events. Furthermore, both older and younger adults reported similar phenomenal experiences during encoding (Margaret Thatcher’s resignation), which would indicate an age-related difference in the retrieval of phenomenal details.

Retrieval failures for other specific information such as names have also been evinced in older adults (Cohen & Burke, 1994). Burke et al. (1991) suggested that such retrieval failures are more frequent with increasing age because nodes containing specific information are not sufficiently activated. In the transmission deficit hypothesis, Mackay and Burke (1990) proposed that retrieval occurs when activation of a node reaches threshold level, which is governed by linkage strength. Linkage strength is influenced by recency and frequency of activation, and the age of the information. Although activation strength is thought to decline with age, information can still be maintained with frequent activation.

Several studies in autobiographical memory have demonstrated that rehearsal is among the strongest predictors of memory vividness in older adults (Cohen & Faulkner, 1988; Rabbitt & Winthorpe, 1988). As suggested by the aging literature previously reviewed, older adults’ increasing reliance on generalized recollections may be because many specific details are no longer retrievable (see also Cohen, 1998).

The generalization evinced in older adults’ recollections are characterized by emotionally laden, reflective and evaluative statements (Labouvie-Vief & Blanchard-Fields, 1998).

*Classic flashbulb memory theory emphasizes the preservation of vivid memories through a unique encoding process. This process is mediated by high levels of emotion, surprise and consequentiality presented by an event. Brown and Kulik (1977) initially suggested that flashbulb memories were recollections with a “live” quality in which perceptual details came to mind with great vividness. More recently it has been suggested that
1982; Obler & Albert, 1981; Randall, 1999). In text recall, older adults exhibit a more interpretive style than younger adults, who give more detailed text based recollections (Adams, 1991; Adams, Labouvie-Vief, Hobart, & Dorosz, 1990; Hashtroudi, Johnson, Vnek, & Ferguson, 1994). Direct comparisons of text and autobiographical memory recollection scores show that older adults recall fewer details across both measures (Borrini et al., 1989; Holland & Rabbitt, 1990). It is not clear whether similar retrieval mechanisms are activated, as the relationship between the two measures appears to be dependent on the way autobiographical memory is tested. Holland and Rabbit found a relationship between text and autobiographical memory scores when subjects were asked for details about events they had already recalled a few months earlier. However, definitive conclusions can not be drawn about the relationship between these measures as they gauge inherently different memories. In contrast to autobiographical memories, it is unlikely someone could recall an equivalent number of details from prose that were presented in the laboratory 40 years ago.

There appears to be a trade off between older adults' affinity to filtering recollections through an accumulating life story, and focusing on discrete facts or details. Hashtroudi, Johnson, Vnek, and Ferguson (1994) found that age differences in source monitoring scores were eliminated when older adults were told to focus on the factual aspects of a script. Moreover, older adults’ source monitoring scores did not differ when given direction to focus on affective qualities and when no particular focus was suggested. An affective focus was shown to be disruptive to recall in both age groups. Despite this, older adults were found to produce more non-script related elaborations than younger adults. Similarly, Bluck, Levine, and Laulhere (1999) found no age differences in gist recall of autobiographical events, but

*flashbulb memories, like ordinary memories, are not immune to decay and subjective reconstruction (Neisser, 1982).*
younger adults remembered the dates of the events more accurately than older adults. Hasher and Zacks (1988) proposed that the abundance of thought and emotion driven recollections in older adults could be due to a breakdown in inhibitory mechanisms that in normal functioning restrict non-goal oriented subjective reflections.

The inability to inhibit competing responses has also been linked to verbosity in older adults (Arbuckle & Gold, 1993). Early studies on verbosity and aging showed a larger amount of wordiness in older adults' speech (Obler & Albert, 1981). More recent reports suggest instead that older adults are more likely to engage in “off-target” verbosity rather than general talkativeness (Arbuckle & Gold, 1993; Gold, Arbuckle, & Andres, 1994). Measurements of number and length of utterances, and number of words per clause are not indicative of a general age-related increase in speech production (Cooper, 1990; c.f. Arbuckle & Gold, 1993). The key feature of off-target verbosity is the inability to maintain focus. Speech is initially associated with the stimulus but transgresses into disjointed verbalizations that become less and less related to the original target. Thus while the overall quantity of spoken information remains the same between age groups, older adults are proportionately more off-topic than younger adults (Glosser & Deser, 1992). It is plausible that verbosity is a sign of inefficient frontal lobe functioning in older adults. Arbuckle and Gold (1993) demonstrated that several neuropsychological measures of inhibition, traditionally used to assess frontal functions, predicted verbosity. Older adults' performance on other non-frontal neuropsychological measures was not related to verbosity, indicating that verbosity was specifically related to reduced efficiency in frontal functions rather than general cognitive decline.
Overall, studies suggest that older adults recall fewer specific or phenomenal details from their past than their younger counterparts. Clearly, more research is needed to determine the exact nature of this decline. For instance are specific factual details, such as time and place, more accessible than phenomenal details, such as perception and thoughts/emotions, in older adults? In studies of age-related differences in text recall, language and interviews, older adults have shown a higher proportion of generalized or off-target speech. To date there have not been any studies in autobiographical memory that have investigated the nature or contents of verbosity in older adults during personal recollections, or the proportion of specific details to generalized information recalled. The few studies that have examined the contents of autobiographical recollections have focused on event details, and have only noted older adults' tendency to give generalized accounts. What are these generalized statements that older folks make during autobiographical recollections? Are they repetitions? Semantic information about their pasts? Evaluative or interpretive commentary? Although some of these questions have been answered in studies of text recall, the nature of verbosity may be quite different for recollections of real-life events. It has also been proposed that verbosity may be related to inefficient inhibition mechanisms and frontal lobe functions. Whether structured probing would attenuate age differences in detail recollection and reduce verbosity in older adults, is also yet to be investigated. Clearly there are more questions to be answered with respect to the mechanisms of autobiographical memory than have been answered in the studies published to date.
**Autobiographical Memory Across the Life-Span**

The Galton technique (discussed in the next section) has been one of the most popular methods of studying autobiographical memory across the life-span (see Rubin, Rahhal, & Poon, 1998; Rubin & Schulkind, 1997a; Rubin & Schulkind, 1997b; Rubin, Wetzler, & Nebes, 1986). Participants are given a list of cue words and asked to recollect and date events from any time period that are associated with each word. On the basis of its methodological and theoretical underpinnings, this approach has been termed the Galton/Crovitz/Rubin paradigm (Rabbitt & Winthorpe, 1988). Three theoretically independent components, based on empirical evidence, underscore this paradigm: 1) Adults show the same retention slope for the past 20 years of their lives regardless of their age; 2) There is a reduction of memories during early childhood years; and 3) There is a tendency for adults over 50 years of age to recall a disproportionate number of memories from the time that they were 10 to 30 years old, referred to as the “bump”.

In a review by Rubin, Rahhal and Poon (1998), numerous studies were reported that demonstrate the unique predisposition of events that occurred between the ages of 10 to 30, both semantic and episodic, to be the most important, and vividly remembered. One of the earlier studies reviewed (Rubin et al., 1986) combined the data of 4 different laboratories that had employed the Galton technique, and found a robust reminiscence effect for adults over 50 years of age. The reminiscence effect was specific to the 10 to 30 years of age time period rather than the age of the memories. Relative to the first and last decades in the life span, the middle decades comprise more stereotypical events (Cohen & Faulkner, 1988), which may contribute to their accessibility, considering their remoteness. Adults under 30
years of age did not show a reminiscence effect. Additionally, between one and two thirds of all the memories recalled by young and older adults were within the last year.

Although for the most part the literature has supported the Galton/Crovitz/Rubin paradigm, several studies that did not employ the cue word technique could not replicate the reported time gradient. For instance, Rabbitt and Winthorpe (1988) demonstrated that the “bump” could not be replicated when recall was restricted to 3 counterbalanced time periods, each with a 10 minute time limit for recollection. In fact no linear functions were found. Most memories were dated from the mid-points of each time period, thus the data produced 3 inverted U’s specific to each time period. Older adults were especially inclined to use forward search or temporal associations to retrieve memories which may also produce high incidence of earlier memories (see also Cohen & Faulkner, 1988). Other studies that employed an autobiographical interview technique in which older adults were asked standard questions across three time periods have also failed to find a time gradient (Borrini et al., 1989). It is plausible that sampling memories from only three time periods is not a sensitive measure of time gradient. Nonetheless, Kopelman, Wilson and Baddeley (1989) did find a significant time gradient in amnesic subjects, also using 3 time periods. Clearly, further consideration of the “bump” using various testing techniques would be useful in gaining a fuller understanding of its causal circumstances.

Autobiographical Memory Measures and Related Research

The dearth of reliable and valid testing tools has made it difficult to study autobiographical memory processes. Galton (1879) created the first measure of autobiographical memory. Despite the early start, nearly a century passed before memory
scientists picked up the pieces left by Galton*. Testing methodology has not progressed much further than this initial start. As suggested in the previous section, Galton’s methodology is presently the most popular means for studying autobiographical memory (Brewer, 1986).

I selected a list of suitable words, and wrote them on different small sheets of paper...

I laid one of these sheets with all due precautions under a book, but not wholly covered by it, so that when I leaned forward I could see one of the words, being previously quite ignorant of what the word would be. Also I held a small chronograph, which I started by pressing a spring the moment the word caught my eye, and which stopped of itself the instant I released the spring; and this I did so soon as about a couple of ideas in direct association with the word had arisen in my mind. (Galton, 1907, p. 135).

At the time of his self-as-case study, Galton was 57 years old. He reported that 39% of his associations were initially formed during “boyhood and youth”, 46% in “subsequent manhood”, and 15% came from “quite recent events”. However, Galton’s findings may have been confounded by his use of unusual words, and the time periods were somewhat arbitrarily selected (Kopelman, 1992).

Crovitz and Schiffman (1974) renewed the interest in Galton’s technique by modifying it into what has become known as the “Crovitz test”. In their initial study, Crovitz and Schiffman presented 98 undergraduate students with 20 picturable nouns (Paivio, 1971) of A or AA word frequency (Thorndike & Lorge, 1944). Participants were required to write

---

*Ebbinghaus had explicitly rejected the study of personal memory or consciousness on the grounds that it was bad methodology. His approach to studying certain aspects of memory (e.g., rote memory) was popularized because it offered verifiable results and a controlled experimental environment. It was only after behavioral
down a few words about the memories that came to mind, and to date them. From the resulting data, Crovitz and Schiffman derived a regression curve such that the frequency of episodic memories decreased as a function of their age. Numerous variants of this initial Crovitz test followed in subsequent studies of autobiographical memory. For instance, Robinson (1976) separated the list of words into 3 different categories: common objects, common activities, and various affective states. Chew (1979; Chew & Kihlstrom, 1986; c.f. Kihlstrom et al., 1988) added to Robinson’s methodology by utilizing common high and low imagery nouns and verbs, and controlling the epochs from which memories were retrieved.

Although the Crovitz test was not originally conceived with a method for scoring recall, some authors have devised rating schemes for differentiating retrieval ability. For instance, in a study of amnesics, Moscovitch and Melo (1997) applied a 0-3 rating scale similar to that utilized by Kopelman, Wilson, and Baddeley (1989, see below). These variants of the Crovitz test are not standardized. Rather, the basic testing procedure that has persisted comprises recalling events in response to a list of words, and then localizing these recollections in place and time.

Although the Crovitz test provided a basic tool with which to prod autobiographical memory, in its original form it disregards the importance of sampling equally across time periods as is done in many semantic tests for remote memory (i.e., famous faces, news events). In allowing subjects to search their memory unconstrained, the inability to access specific time periods is overlooked (Kopelman, 1992). This limitation also makes it difficult to draw meaningful comparisons between autobiographical memory and semantic memory abilities across time periods. There is also no standard scheme for converting episodic methodology was relaxed that psychologists re-established their interest in memory of the self or autobiographical remembering (see. Brewer, 1986).
recollections into standard quantitative scores. Overall, the degree and precision with which recollections can be sampled and analyzed remains variable, preventing meaningful comparisons between studies conducted in different laboratories.

Kopelman, Wilson and Baddeley addressed these limitations in part in the Autobiographical Memory Inventory (AMI, Kopelman, Wilson, & Baddeley, 1990; Kopelman, 1994; Kopelman et al., 1989). The AMI is the most recently accepted measure of autobiographical memory. It is a semi-structured interview that separately assesses episodic and personal-semantic memory across three broad lifetime periods: “childhood”, “early adult life”, and “recent”. For the episodic portion, subjects are required to recall one episode for each of three sub-periods nested within each lifetime period. Overall, a total of nine events are recalled. Each episode is given a qualitative rating (0–3) on the basis of descriptive richness, and ability to recall the time and place of the incident. The personal-semantic portion samples memory for information specific to each lifetime period (e.g., date of birth, home address, names of teachers, etc.). In an initial validating study of the AMI, Kopelman and colleagues (1989) were able to reliably differentiate amnesic patients from healthy controls. In contrast to the control subjects’ gradual recency effect, the amnesic patients demonstrated a steep drop in the temporal gradient, reflective of their impoverished recall of events, and personal information from the recent past (for further studies see, Kopelman, 1991; Kopelman, 1994; Kopelman, Stanhope, & Kingsley, 1999).

In contrast to the Crovitz test, the AMI provides experimenter-controlled sampling of memories across the life span, and a standardized 0-3 rating scheme for scoring recollections. While the strength of the AMI’s 0-3 rating scheme lies in the simplicity with which it can be administered and scored, it also provides simple results. In other words, it is up to the
examiner to figure out, on an observational basis, why the scores are low. There is reason to believe that a detailed quantitative scoring scheme would be more sensitive to and provide more information about deficits in autobiographical memory (see, Moscovitch et al., 1999, discussed later). Thus, while it may be informative that older adults receive lower autobiographical memory ratings, why this is the case can not be answered by the present administration and scoring methods of the AMI. Furthermore, the AMI is simply not designed to measure the existing variation in older adults’ retrieval ability, especially differential ability to activate specific sensory or phenomenal experiences.

The Autobiographical Memory Enquiry (AME, Borrini et al., 1989; Della Sala et al., 1993) was designed to assess episodic retrieval across three broad time periods. For each time period, subjects are asked specific questions relating to their activities (e.g., Can you remember what steps you had to take to get your pension?), and receive a rating out of 15. The greater range of possible scores would suggest a scoring scheme that is better equipped to deal with more subtle differences in recollection than the AMI. However, the interview is somewhat crude in that it does not specifically tap episodic retrieval, but rather confounds episodic and semantic memory. For instance, recounting the steps toward getting a pension does not necessarily involve episodic retrieval. For the purposes of studying episodic recollection, more work is needed to differentiate episodic retrieval from semantic knowledge. For instance, in a study of autobiographical memory in frontal patients, Della Sala et al. (1993) found that only 6 of the 16 patients tested showed impaired performance on the AME. It is possible that the AME cues are too structured to tap deficits in retrieval capacity, even in frontal patients.
In an attempt to produce a more sensitive quantitative measure that better captured the range of episodic retrieval abilities, Moscovitch et al. (1999) devised a scoring scheme that took the most salient items of the MCQ (previously discussed, see Johnson et al., 1988) and divided them into 7 categories of details: Event, temporal, perceptual, spatial, emotion, implication and other details. Event details, comprised actions, what others said, did or thought, the next 5 categories are self-explanatory, and the last category, other details, comprised responses that were not captured by the other 6 categories. This scoring method was utilized in a study of autobiographical memory in amnesic and control subjects (Moscovitch et al., 1999). Subjects were asked to recall 2 memories for each of 5 time periods. Each recollection was further probed for phenomenal details. Recollections were scored by assigning 1 point to each detail, which was classified within one of the 7 categories. Generalized or semantic information recalled by subjects was not quantified or included in analyses. Moscovitch et al. found that while controls demonstrated a temporal gradient, in which recollection of older episodes was poorer than more recent episodes, amnesics showed a flat gradient. By re-scoring data using this new method, that had previously been scored on a 3-point rating scale (see Moscovitch & Melo, 1997), Moscovitch et al. (1999) found a much greater difference in recollection of details than was initially observed between amnesics and controls. This difference was reduced with structured probing, as amnesics benefited significantly more than controls. Although this method of scoring autobiographical recollections is in its initial stages of development, it appears to be a promising new approach in capturing the richness of episodic retrieval. This approach may also be applicable, with some modifications, to the analysis of older adults’ generalized or semantic recollections.
In summary, there are only two standardized and widely used measures of autobiographical memory, the Crovitz test and the AMI. While the Crovitz test has provided us with a means of investigating the distribution of memories across the life span, the time periods from which memories are sampled are not experimentally controlled. The method by which memories are sampled, within specified time periods or free selection, appears to influence the time gradient (see previous section for discussion). Furthermore, there is no standard method of scoring recollections by which different laboratories can compare their findings. The AMI (Kopelman et al., 1989) addresses some of these issues by sampling events from three broad time periods, and supplying a 3-point rating scale for each episode. In addition, it is designed to assess both episodic and semantic retrieval. However, the limited range of the 3-point rating scale significantly reduces information given by the AMI. While the AMI may be informative as to whether two cohorts differ, very little information is given as to why or how they differ.

A few laboratories have devised their own measures for studying autobiographical memory. Della Sala et al.'s (Borrini et al., 1989; Della Sala et al., 1993) AME offers a wider range of ratings than the AMI which could potentially increase its sensitivity. Nonetheless, because the interview probes are not specific to episodic recollection, the validity of the resulting ratings as measures of episodic retrieval is questionable. Scoring phenomenal characteristics is a new method of gauging episodic richness and possibly investigating why and how certain cohorts differ in their episodic retrieval ability (see Johnson et al., 1988; Moscovitch et al., 1999). By utilizing this method to re-score data from a previous study, Moscovitch et al. demonstrated an additional 20-40% advantage of control over amnesic subjects in episodic detail recollection. Clearly, attending to the various phenomenal details
given during recollection provides perhaps a more powerful method of investigating episodic retrieval in autobiographical memory.

**Overall Summary**

Autobiographical memory is different from other forms of long term memory in that it is memory for information related to oneself. Although age-related decrements have been established in other types of declarative memory, comparatively little is known about the effects of aging on autobiographical memory. Several authors have suggested that autobiographical memory is multi-layered and comprised of both episodic and personal-semantic components. Thus an incident does not happen in a vacuum, but rather occurs in the context of other ongoing events or a personal history. The episodic component of autobiographical memory has been further fractionated into multiple phenomenal or sensory experiences. This division of episodic components has proven to be informative in differentiating experienced from imagined events. In a similar vein, these components may also prove to be informative in understanding not only that there are age differences in autobiographical memory, but how young and older adults differ.

The prefrontal cortex is thought to mediate retrieval processes and autonoetic awareness, both of which have been implicated in the episodic component of autobiographical remembering. Evidence from studies of autobiographical memory in frontal patients as well as imaging studies attest to this. Patients with damage to the prefrontal cortex demonstrated retrieval deficits in autobiographical remembering, that were ameliorated with structured probing. Frontal damage was also shown to be associated with distinct deficits in autonoetic awareness as demonstrated in patients with bizarre
conflation or Capgras syndrome. Imaging studies provided further evidence for prefrontal cortical involvement during the retrieval of episodes from the personal past.

Age-related deficits have been consistently evinced in tasks of episodic retrieval, which are demanding of frontal functions. Older adults have greater difficulty remembering source or contextual details, distinguishing real from imagined events, and as a result may be more dependent on familiarity or semantic-based recognition than young adults. Selective deterioration of the prefrontal cortex is thought to occur with advancing age, and mediate the increased difficulty in retrieving episodic and especially specific phenomenal information. Several studies have shown a relationship between contextual or source memory performance and neuropsychological measures of frontal functions in older adults. Moreover, parallel deficits between older adults and frontal patients were found on these measures. Older adults have also shown parallel deficits with frontal patients in performance on tasks in which structural or environmental support was manipulated. Taken together, these findings present behavioral evidence for age-related deficits in the retrieval of phenomenal information, as well the possible contribution of selective deterioration of the prefrontal cortex to these deficits. Whether deficits in phenomenal detail retrieval are uniform in autobiographical remains to be explored. Moreover, imaging studies have substantiated the behavioral findings by demonstrating age-related alterations in frontal functioning during episodic retrieval.

Older adults have been reported to receive lower scores on autobiographical recollections than younger adults, and recall fewer vivid memories. They also have difficulty recalling other specific information such as names. These age-related deficits in the retrieval of specific information appear to be offset by an increase in off-target speech. Off-target
speech or general verbosity in older adults has been associated with inefficient inhibition mechanisms, and the result of aging processes on the frontal lobes. However, age-related off-target speech in autobiographical recollections has not been investigated formally. For the most part, the bulk of aging studies in autobiographical memory have concentrated on the number of memories retrieved across the life span, more so than the content of information retrieved. Several of these studies show evidence of a reminiscence effect or an increase in number of memories recalled by older adults for the adolescence/early adulthood years. Young adults do not show this pattern of retrieval. A few studies that have not employed the Galton technique have failed to replicate these findings.

Other than the Crovitz test (derived from the Galton technique) and the AMI, there are no other standardized measures of autobiographical memory. Of the two, only the AMI has a standard method of scoring recollections. This method, however, comprises a 3 point rating scale that is not sensitive to the wide range of episodic retrieval abilities. A few other laboratories have developed their own methods of testing autobiographical memory. One of these methods has proven to be particularly promising with respect to scoring episodic richness. When this method was used to re-score data that had originally been scored using the AMI’s 3 point method, scoring sensitivity to amnesic and control subjects’ differences in episodic recollections were significantly increased. This led us to incorporate this scoring scheme into our new measure of autobiographical memory.
The Present Study

The purpose of this study was to examine age differences in autobiographical remembering using the Autobiographical Interview, a new measure of autobiographical memory. The data collected was used in part to validate this new measure. The Autobiographical Interview drew from the Crovitz test, AMI, and Moscovitch et al.'s (1999) methodologies to access recollections, and a modification of Moscovitch et al.'s scoring criteria was used to score recollections. Subjects were given an event list to cue their memory, and asked to recall an event for each of 5 time periods. Recollections were then further probed for phenomenal details with structured questions. Moscovitch et al.'s quantitative scoring criteria for episodic retrieval were improved in the Autobiographical Interview, and separate quantitative scoring criteria were developed for off-target or semantic information. The quantitative scoring system provided the necessary information to calculate episodic to total detail proportion scores. A qualitative account of episodic retrieval was also given with a 3-point rating system for each of the phenomenal categories. A separate 6-point rating of overall episodic richness was also added.

Hypotheses

1) Older adults will recall fewer episodic details and receive lower episodic ratings than younger adults during autobiographical recollection without probing.

2) Older adults will also have lower episodic to total detail score ratios than younger adults during autobiographical recollection without probing. Thus, age-related declines in episodic retrieval will be accompanied by an increase in off-target or semantic output.
3 ) Age differences, in hypotheses one and two, will be greatest during autobiographical recall without specific probing, and attenuated after probing.

4 ) In accordance with the Galton/Crovitz/Rubin paradigm, it is hypothesized that older adults will show an increase in episodic scores for the middle time periods, while both groups will show an increase in scores for the last time period.

5 ) To assess construct validity, data were also scored using the AMI episodic rating scheme. These ratings will be compared with the episodic detail and rating scores.
Method

Participants

Participants were 12 younger (ages 19-34 years) and 12 older (ages 66-89 years) healthy adults recruited from University of Toronto undergraduate classes, and the Rotman Research Institute volunteer database. Potential participants were screened for incomplete secondary school education, evidence of learning disability (i.e., childhood diagnosis or failure of a grade), history of neurological, psychiatric, or medical disorders known to affect memory, and prolonged alcohol or substance abuse. Older adults were additionally screened for dementia with the Mini Mental State Exam (MMSE, Folstein, Folstein, & McHugh, 1975). The mean MMSE score was 27.9. The vocabulary sub-test of the Wechsler Adult Intelligence Scale – Revised (WAIS-R, Wechsler, 1985) was administered to both younger and older groups as a measure of verbal intelligence (see table 1).

Table 1
Subject Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Age</th>
<th>Yrs. of Ed.</th>
<th>MMSE</th>
<th>WAIS-R Vocab</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Younger</td>
<td>3</td>
<td>9</td>
<td>23.33</td>
<td>4.19</td>
<td>14.42</td>
</tr>
<tr>
<td>Older</td>
<td>7</td>
<td>5</td>
<td>74.08</td>
<td>6.24</td>
<td>14.42</td>
</tr>
</tbody>
</table>

Note: Vocabulary means for younger adults are based on 7 of 12 scores. Five of the younger subjects were drawn from a separate study in which the Mill Hill Vocabulary Scale (Raven, 1965) was administered.
**Materials**

The Autobiographical Interview comprised lists of time periods, typical life events, and a booklet of standard instructions and probes administered by the examiner.

**Procedure**

The Autobiographical Interview was administered within the context of a larger testing battery that included other measures of memory, as well as executive and cognitive functions tests. Prior to the commencement of testing, informed consent was obtained for the interview and its audiotaping. Interviews were audiotaped for the purpose of transcription and scoring.

**Recall.** Participants were given a list of typical life events (see Appendix A), and asked to select 1 event for each of 5 time periods listed on a separate sheet of paper (for overview see table 2). For the purposes of later reference, participants responded by writing the number of the corresponding time period next to each selected event. Subjects were given unlimited time to think about and select the 5 episodes. The time periods were meant to span from childhood to the past year, and were accordingly adjusted for age differences between the younger and older groups. Younger adults described 1 event for each of primary school (to age 11) and high school (ages 11 to 18) periods, 2 events that occurred during post-secondary education or early adulthood (ages 18 to 30), and 1 event from the past year. Similarly, older adults described 1 event from each of primary school and high school periods, but only 1 event from post-secondary education or early adulthood, and 1 event for each of middle adulthood, and the past year periods (see table 2). The event list was meant to aid in memory retrieval and was organized into various categories (i.e., job related, romance).
However, participants were able to describe any event they wished, even if it was not included on the event list.

Table 2

**Time Periods for Young and Older Adults**

<table>
<thead>
<tr>
<th>Time Periods</th>
<th>Younger Adults</th>
<th>Ages</th>
<th>Older Adults</th>
<th>Ages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Primary School</td>
<td>up to 11</td>
<td>Primary School</td>
<td>up to 11</td>
</tr>
<tr>
<td>2</td>
<td>High School</td>
<td>11 to 18</td>
<td>High School</td>
<td>11 to 18</td>
</tr>
<tr>
<td>4</td>
<td>Post-Secondary School/Early Adulthood</td>
<td>18 - 30</td>
<td>Middle Adulthood</td>
<td>30 - 55</td>
</tr>
<tr>
<td>5</td>
<td>The Past Year</td>
<td>The Past Year</td>
<td>The Past Year</td>
<td>The Past Year</td>
</tr>
</tbody>
</table>

Subjects were asked to provide recollections that were specific to time and place. They were also encouraged to provide as much detail as possible.

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.

Subjects were reminded to select events that they were comfortable discussing in detail, as they were required to answer specific questions about these events later on. Participants were informed that it was not the events they chose that were of interest, but rather how they were described. After the instructions were administered subjects had the opportunity to ask any questions pertaining to what was required of them. The examiner then asked the
participant to begin by recounting the event from the childhood period. The participants responded by recalling the entire event without any interruptions from the examiner. Only after the subject had finished recalling an event in its entirety could the examiner proceed to the next event or give further instructions through general probing.

**General probing.** On occasion subjects produced vague recollections with no identifiable event. The following is one such case, which has been edited for ramblings and repetitions:

When Hitler came to power in 1933, I was very happily ensconced in a Montessori school, which was the first Montessori School for normal so called normal children. I was living in Berlin. I was born in 1922, so I was 10. As soon as Hitler came to power the school was summarily closed, and my parents had to find a new school for me. The reason this was significant was because up to that time I did not even know what being Jewish meant, since my family was not at all religious and I realized clearly that I belonged to the Jewish race. But I was suddenly faced with the designation of Jew and therefore I had to find a new school and my parents, as the pendulum swings, usually put me into a very Orthodox Jewish school where I felt totally like a fish out of water, I didn’t know about the food, I didn’t know about the holidays, I didn’t know any Hebrew and I was desperately trying to catch up.

The above recollection is problematic because in order to probe for phenomenological characteristics later on, there must be a clearly defined event with a beginning and an end. Such responses usually occurred due to a misunderstanding, on the participant’s part, of the test requirements. For the majority of these cases, the examiner was able to clarify the instructions with general probing and receive a recollection of a distinct
incident (i.e., Can you tell me a specific instance of...?; That's not quite what I was looking for. I need a memory for a single event or instance that happened to you.). General probing was also administered if a recollection was specific but overly terse (i.e., Is that everything you can say about it? I want to know all the details that come to mind.). In some cases two to three probes were required (see Appendix B for list of probes). Both age groups were administered general probing for half the memories recalled. General probing was not necessary for those descriptions that had sufficient detail and were specific in time and place. The examiner was instructed not to influence the participant's responses with leading questions or suggestions, when administering general probing. If probing did not elicit a specific event, the participant was given the option of selecting a different episode that was more likely to result in successful recall. Although subjects were encouraged to stick with the event presented during recall, a new event emerged in a few cases during general probing. Overall, recall and general probing of events was meant to be unstructured in that subjects were required to provide a detailed description of an episode specific in time and place without the aid of structured questions pertaining to phenomenal details.

Specific probing. Specific probing was administered after all 5 of the selected events were recounted. This process ensured that recall was not influenced by the anticipation of specific questions. Specific probing was the structured part of the Autobiographical Interview. These standardized questions were meant to examine whether additional event details that were not spontaneously recalled could be retrieved. The examiner returned to the childhood event, and began with the first question. The participant responded to all the probes for the first event, and then specific probing was started for the next event.
Specific probes were organized into 5 separate categories: Time, time integration, place, other contextual information, and thought/emotion (see Appendix C for list of specific probes). The same questions were asked for each of the 5 events. Some flexibility was allowed in adjusting the probes to address idiosyncrasies across various events. For instance, if someone described an incident that occurred at a park, instead of asking, "what part of the room were you in?" the examiner might ask, "where were you in the park?".

**Protocol Preparation**

After transcription, each subject’s protocol was separated into 5 memories (1 for each time period), comprising recall, general probing and specific probing components. Protocols were then edited for examiner errors, such as questions that strayed from the interview, or referred to information already supplied by the subject and hence scored. An effort was made not to score protocols by the same subject in succession as to not be influenced by previous scores.

**Protocol Scoring**

Scoring a protocol comprised identifying the event, and evaluating the recollection by assigning quantitative and qualitative scores. The Autobiographical Interview Scoring Manual (Levine et al., 2000) was utilized as a reference guide, and will only be summarized in the following paragraphs.

**Defining the event.** The first step in scoring a protocol was to define the event. This was important for the next stage of scoring in which information bits were segregated into internal and external categories. Although participants were asked to recall an event specific
to time and place, multiple events were occasionally provided, or a vague recollection with no distinct beginning and end. The primary criterion for isolating an event was the event duration. Events had to fit within a time frame of a few hours, rather than an entire day, over a span of days or even weeks. If the subject recalled more than one event, the episode that gleaned the most points was selected, and the other events were treated as external or contextual information.

**Scoring system.** All protocols received quantitative and qualitative scores. Quantitative scores comprised an internal detail score and an external detail score. These detail scores were based on text segmentation and their categorization, discussed below. An internal/total detail ratio was derived from the detail scores. Qualitative scores comprised ratings based on the internal details recalled.

**Text segmentation and categorization.** Scoring began by segmenting the narrative into informational bits or details. A detail was defined as a unique occurrence, observation, or thought. There were 2 broad groups of details: internal and external (see table 3 for score sheet). Internal details were directly related to the specified event, and external details were outside of or not directly related to the specified event. Internal details were thought to be reflective of the episodicity of the event, while external details were an amalgamation of semantic and other information. Both internal and external groups were broken down further into 5 mutually exclusive categories: event, place, time, perceptual, and emotion/thought details. Each detail could only be assigned to one of the 5 detail categories, within either the internal or external detail group. There were also 3 additional categories that were exclusive to external details: semantic, repetition, and other details (see table 4). After counting up all the information bits for each detail category, all the scores were summed across detail
categories to form internal and external composites, which were the main variables of interest in the present study.

Table 3

<table>
<thead>
<tr>
<th>Internal and External Groups and their Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recall</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Event detail</td>
</tr>
<tr>
<td>Place</td>
</tr>
<tr>
<td>Time</td>
</tr>
<tr>
<td>Perceptual</td>
</tr>
<tr>
<td>Emotion/Thoughts</td>
</tr>
<tr>
<td>Semantic detail</td>
</tr>
<tr>
<td>Repetitions</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>AMI rating</td>
</tr>
<tr>
<td>Time integration</td>
</tr>
<tr>
<td>Episodic richness</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
</tr>
</tbody>
</table>

There were two composites, one for recall and general probe (hereafter referred to as recall), and the other for specific probe. These composites composed the total number of scores across all 5 events or periods. Each event or period also had its own composite scores. All scores were cumulative. In other words, although there were separate scores for recall and specific probing, specific probing was a composite of recall and specific probing scores. The internal and external composites were also transformed into internal to total detail ratios, which provided a third quantitative score.
Table 4

<table>
<thead>
<tr>
<th>Details</th>
<th>Internal</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
<td>Happenings (e.g., I sneezed), individuals present, the weather,</td>
<td>Same as Internal</td>
</tr>
<tr>
<td></td>
<td>physical/emotional actions or reactions in others, etc.</td>
<td></td>
</tr>
<tr>
<td>Place</td>
<td>Localization of an event including the city, street, building, room,</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>part of room, etc.</td>
<td>&quot;</td>
</tr>
<tr>
<td>Time</td>
<td>Year, season, month, day of week, time of day, etc.</td>
<td>&quot;</td>
</tr>
<tr>
<td>Perception</td>
<td>Auditory, olfactory, physical texture, taste, visual, body position,</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>duration, etc.</td>
<td>&quot;</td>
</tr>
<tr>
<td>Emotion/Thought</td>
<td>Emotional state, thoughts, implications, etc.</td>
<td>&quot;</td>
</tr>
<tr>
<td>Semantic</td>
<td>X</td>
<td>General knowledge or facts, ongoing events, extended states of being.</td>
</tr>
<tr>
<td>Repetition</td>
<td>X</td>
<td>Unsolicited repetition of details</td>
</tr>
<tr>
<td>Other</td>
<td>X</td>
<td>Details that do not fit into any category, such as meta-cognitive</td>
</tr>
</tbody>
</table>
Rating assignment. Each category of details, with the exception of event details, was assigned a rating, on a scale of 0 to 3. Ratings were based only on internal detail information. The following were the general requirements for each level of ratings:

3 points: A rich, highly specific, evocative, and/or vivid description that appears to emerge from a feeling of re-experiencing.

2 points: A detailed description that falls short of a 3 in the degree of richness.

1 point: A description that is limited to general, non-specific information but is still episodic in nature.

0 points: No mention of information pertaining to the specified category, or a response based on semantic knowledge rather than episodic memory.

Qualitative scoring was also done for two additional categories: time integration and episodic richness. These categories were not mutually exclusive, but were based on an overall assessment of recall. Time integration, which employed the same 3 point rating scale as internal details, was based on the overall ability of the participant to integrate the episode into a larger context by giving information before and after the incident. However, this rating was not included in the analyses of the present study. Episodic richness, a qualitative estimate of re-experiencing, was based on a 6 point rating scale. The 6 point scale was used in order to increase this ratings’ sensitivity to the large variation in ability to retrieve episodically rich recollections. Only information within the episode was assessed. The rating was based on the subject’s ability to give an impression of re-experiencing by recreating an incident with perceptual, cognitive or emotional elaborations specific to a time and place. Additionally, each event was also given a separate rating based on the episodic
rating criteria of the Autobiographical Memory Interview (AMI, Kopelman, 1994), which is a currently accepted measure of autobiographical memory. The AMI rating was used only as a comparison measure to validate the Autobiographical Interview scoring criteria. All the above categorical ratings were assigned to each level of recollection, recall and specific probing, producing 2 separate scores. Each score was an accumulation of categorical ratings. However, the AMI rating was not included in these total scores.

Overview

After transcription, the Autobiographical Interview was separated into 5 memories. Each memory, which comprised recall and specific probing, was edited for possible examiner errors. To begin the scoring procedure an event had to be defined. The narrative was then segmented into information bits or details falling into 2 groups, details that were internal, or details that were external to the specified event. Within each group, internal or external, details were further broken down into specific categorical segments. Ratings were then assigned to categories pertaining to the specified event. Detail segmentation and assignment of ratings was carried out for both recall, which was meant to be the unstructured part of the interview, and specific probe, which was meant to be the structured part. Each level of recollection produced 3 total scores, number of internal and external details summed across detail categories, and the sum of the ratings based on the specified event. Ratios were also calculated to produce internal to total detail scores. Overall there were 3 quantitative and 1 qualitative measure. Text segmentation and rating was done individually for each memory.
Design and Statistical Analyses

Several variables were of interest in the present study: The influence of Age Group, Time Periods and Structural Support; and measures of performance including, internal and external details, and ratings. Age group was the only between-subjects variable. The analyses of these variables were conducted as follows. The effect of Age Group (younger and older adults) on number of internal and external details recalled was examined with 2(Age Group) X 2(Detail Type: internal vs. external) mixed-factor ANOVA’s. The effect of Age Group on internal detail and rating scores across Time Periods was investigated separately for the first 3 time periods, 2(Age Group) X 3(Time Periods) mixed-factor ANOVA’s, and the last time period, one-way ANOVA’s. This method of analysis was chosen for the purposes of comparing older and younger adults’ performance on time periods in which one time factor was shared between groups (i.e., age at encoding, or retention interval). One-way ANOVA’s or t-tests were used to analyze significant effects. The Bonferroni multiple comparison procedure was employed in post-hoc between-group comparisons of internal and external detail categories. Analyses were conducted separately for recall and specific probing due to the high correlation and dependency of specific probing to recall. Information retrieved during recall influenced what specific probes were administered by the examiner, as well as the information retrieved and scored. Non-parametric statistics (Spearman rank-order correlations, Mann-Whitney U tests) were used to compare AMI ratings to internal detail and rating scores. Results were interpreted as significant at p < .05, unless indicated otherwise.
Results

Three younger participants did not have specific probing recorded for one event each due to equipment failure. The missing specific probe responses were from different time periods. To avoid listwise deletion in repeated measures analyses, missing data were replaced with the average scores from the other 4 recorded events. The younger group also had one outlying subject that demonstrated a tremendous amount of repetitiveness (3.1 SD's above young group mean). All other categories scored for this subject were within normal limits relative to other younger subjects. His repetition scores were replaced with the next highest scores in the younger group. The other scored categories remained unchanged.

Internal and External Autobiographical Memory Details

In line with other research findings, younger and older adults recalled an equivalent number of total details (internal and external details combined) during recall (Younger M = 217.17, SD = 87.88; Older M = 203.83, SD = 62.36), t(22) = .429, p = .67, and specific probing (Younger M = 460.75, SD = 121.50; Older M = 479.25, SD = 115.34), t(22) = -.383, p = .71. Thus both age groups had the same speech output. These non-significant age effects across details will not be considered further. The age differences in each of internal and external detail categories reported below are therefore not based on overall verbosity or greater speech output by one of the two groups.

For autobiographical memory recall, a 2(Age Group) X 2(Detail Type: internal vs. external) ANOVA showed no main effect of Detail Type, F(1, 22) = .100, p = .76, but a significant Age Group X Detail Type interaction, F(1, 22) = 10.78, p < .005. As seen in Figure 1 (hatched section), younger adults gave more internal details than older adults, F(1,
22) = 9, \( p < .001 \), while older adults gave more external details than younger adults, however the latter comparison did not reach significance, \( F(1, 22) = 2.5, p = .13 \).

![Figure 1](image)

**Figure 1.** Mean number of internal and external details given during recall and after specific probing by younger and older adults.

A 2(Age Group) X 2(Detail Type: internal vs. external) ANOVA showed that after specific probing there was a marginal main effect of Detail Type, \( F(1, 22) = 3.67, p = .07 \), and a significant Age Group X Detail Type interaction \( F(1, 22) = 14.74, p \leq .001 \). Younger adults still recalled more internal details than older adults, \( F(1, 22) = 6.12, p < .05 \), and older adults recalled significantly more external details than younger adults \( F(1, 22) = 6.32, p < .05 \). These findings suggest that specific probing by the examiner failed to attenuate age differences in internal and external detail recollection.
Further analyses were conducted to explore the reason behind our failure to attenuate age differences with specific probing. For these purposes, specific probing was analyzed as a non-cumulative variable, or without the inclusion of recall details. In response to specific probing alone, both age groups recalled an equivalent number of internal details, \( t(22) = 1.04, p = .31 \). This would suggest that the overall age difference sustained after specific probing was primarily driven by performance during recall (refer to Figure 1). In other words, older adults never caught up to the number of internal details given by younger adults. For the age difference to be attenuated, older adults would have to give more internal details than younger adults during specific probing. Older adults did however show a greater increase in the number of internal details recalled during specific probing relative to younger adults, 283% and 225%, respectively. Nonetheless, this could also be because younger adults did not have as much information to add in proportion to their already rich autobiographical recollections.

**Autobiographical Memory Ratings**

The autobiographical memory ratings, which are based on the content of internal details given, reflect the above findings. Younger adults outperformed older adults during recall, \( t(22) = 3.02, p < .01 \), and older adults failed to attenuate the age difference in ratings during specific probing, \( t(22) = 3.02, p < .01 \).

**Internal to Total Detail Ratios**

As expected, older adults had lower internal to total detail ratios than younger adults, for autobiographical memory recall, \( t(22) = 3.57, p < .005 \), and after specific probing, \( t(22) = \).
4.30, p < .001 (see table 5). Interestingly, these age effects were not driven by an initial difference during recall. Older adults also demonstrated lower internal to total detail ratios when specific probing was examined alone, t(22) = 3.13, p = .005.

Table 5
Comparison of Internal to Total Detail Ratios in Younger and Older Adults

<table>
<thead>
<tr>
<th></th>
<th>Recall</th>
<th>After Specific Probe</th>
<th>Specific Probe (alone)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Older</td>
<td>0.38</td>
<td>0.14</td>
<td>0.46</td>
</tr>
<tr>
<td>Younger</td>
<td>0.59</td>
<td>0.16</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Time Periods

Younger and older adults' internal detail and rating scores were compared across the first three time periods and the last period. Memories recalled across these periods were equivalent for age at encoding, and retention interval, respectively. Due to the large difference in life span between our subjects, the fourth time period shared no factor in common between the two groups (see table 2), thus it was excluded from group comparisons. In addition, period three for younger adults comprised the average of 2 events recalled for the early adulthood period.

A 2(Age Group) X 3(Time Periods) ANOVA for recall, showed the expected younger group superiority over older adults in number of internal details recalled, F(1, 22) = 9.43, p < .01, no main effect of Time Periods, F(2, 44) = .31, p = .74, and no Age Group X Time Periods interaction, F(2, 44) = .72, p = .49 (see Figure 2, a). There was no age difference for the last time period, F(1,22) = 1.18, p = .29.
Figure 2. Mean number of internal details given by younger and older adults, across time periods 1 to 5, during recall (a) and after specific probing (b). Note that time period 3 for younger adults is the average of the 2 events selected for the early adulthood period. Period 4 (middle adulthood) for older adults, was excluded due to a lack of a comparable time period in the younger adult group (see table 2).

Similar results were found after specific probing, namely younger adults recalled more internal details than older adults, $F(1, 22) = 5.31$, $p < .05$, there was no main effect of
Time Periods, $F(2, 44) = .90, p = .41$, and no interaction between the two factors, $F(2, 44) = .57, p = .57$ (see Figure 2, b). There was also no age difference for the last time period, $F(1, 22) = .62, p = .44$.

Although there were no Age Group X Time Periods interactions for recall or after specific probing, inspection of data suggested a possible Time Periods effect for older adults after specific probing (see Figure 2, b). A one-way analysis across all five time periods confirmed that there was at least a marginal effect of Time Periods, $F(4,44) = 2.50, p = .056$. A planned comparison between the first and last time period, showed an increase in number of internal details recalled for the last year, $F(1,11) = 8.93, p < .01$.

The effect of Age Group and Time Periods was also examined in autobiographical memory ratings (see Figures 3, a & b). Two 2(Age Group) X 3(Time Periods) ANOVA's for the first three time periods, and 2 one-way ANOVA's for the last period, were conducted separately for recall and specific probe ratings. Younger adults received higher rating scores than older adults during recall, $F(1,22) = 9.0, p < .01$, and there was no main effect of Time Periods, $F(2, 44) = .17, p = .85$, and no interaction, $F(2, 44) = .72 p = .49$ (see Figure 3, a.). Younger adults also received higher rating scores than older adults for the last year, $F(1, 22) = 4.69, p < .05$.

After specific probing, younger adults sustained their higher ratings scores, $F(1, 22) = 8.27, p < .01$, and there was no main effect of Time Periods, $F(2,44) = .65, p = .53$, and no interaction, $F(2, 44) = .33, p = .72$. Younger adults also sustained higher rating scores for the last time period $F(1, 22) = 6.13, p < .05$. Both groups showed a trend toward performing at ceiling (ratings were out of 18) after specific probing (see Figure 3, b).
Figure 3. Mean rating scores of younger and older adults, across time periods 1 to 5, during recall (a) and after specific probing (b).

**Individual Internal and External Categories**

Age differences in the number of internal and external details given by subjects were investigated in more depth by breaking down each group of details into its individual
categories or components. Rating components were also analyzed. We were primarily interested in whether there was one or more specific detail categories that accounted for the age differences in internal and external details recalled, or ratings given. The alpha level after the Bonferroni correction for multiple comparisons procedure was $p < .01$. However, results were considered at both the corrected .01 and uncorrected .05 levels.

**Internal detail and rating categories.** The internal detail group comprised event, place, time, perceptual, and thought/emotion detail categories (see Figures 4, a & b). During recall, significant age differences were demonstrated for event, $t(22) = 2.43, p = .02$, place, $t(22) = 2.46, p = .02$, perceptual, $t(22) = 2.78, p \leq .01$, and thought/emotion details, $t(22) = 3.33, p < .005$. Age differences did not reach significance for time details, $t(22) = 1.55, p = .14$ (see Figure 4, a).

After specific probing, age differences were found for perceptual, $t(22) = 2.50, p = .02$, and thought/emotion details, $t(22) = 2.63, p = .015$. Age differences for the other internal categorical details were not significant, namely, event, $t(22) = 1.70, p = .10$, place, $t(22) = .49, p = .35$, and time details, $t(22) = 1.14, p = .27$ (see Figure 4, b). These findings suggest that while specific probing was successful in attenuating age differences for event, place and time details, it did not attenuate age differences in perceptual and thought/emotion details. This may be largely because younger adults retrieved on average double the number of perceptual (Young $M = 17.25, SD = 8.48$; Older $M = 8.42, SD = 7.05$) and thought/emotion details (Young $M = 17.08, SD = 7.09$; Older $M = 8.58, SD = 5.30$) than older adults during recall. While there were age differences for event (Young $M = 75.33, SD = 32.53$; Older $M = 48.33, SD = 20.60$) and place details (Young $M = 10.58, SD = 4.78$; Older $M = 6.17, SD = 3.97$) during recall, it would appear that perceptual and
Figure 4. Mean number of internal details given by younger and older adults for each internal detail category, during recall (a) and after specific probing (b). Note: * $p \leq .05$; ** $p \leq .01$. 
thought/emotion details were largely accountable for the significant age differences after specific probing, with a smaller contribution by the age difference in event details (see above means).

Analyses of rating scores in recall showed age differences in place, $t(22) = 2.73$, $p \leq .01$, and thought/emotion categories, $t(22) = 3.07$, $p < .005$, but not in time, $t(22) = 1.58$, $p = .13$, and perceptual categories, $t(22) = 1.72$, $p = .10$. There was also an age difference in the episodic richness rating category, $t(22) = 2.79$, $p \leq .01$ (see Figure 5, a). The age differences in the perceptual detail and rating categories was increased when an outlier in the older group (+2.5 detail SD's; +2.37 rating SD's) was excluded from analyses. The exclusion of this case from perceptual analyses resulted in a significant age difference in perceptual ratings $t(21) = 2.53$, $p = .019$, as well as an increase in statistical significance for perceptual details, $t(21) = 3.62$, $p < .005$.

Ratings after specific probing showed age differences in perceptual, $t(22) = 2.23$, $p = .037$, and emotion/thought ratings, $t(22) = 2.62$, $p < .016$, and a trend toward significant in place, $t(22) = 2.00$, $p = .058$, and time categories, $t(22) = 1.96$, $p = .063$. The age difference in episodic richness was sustained after specific probing, $t(22) = 2.86$, $p < .01$ (see Figure 5, b).
Figure 5. Mean rating scores of younger and older adults for each internal detail category, during recall (a) and after specific probing (b). Note that while other ratings had a 0-3 scale, episodic richness ratings had a 0-6 scale. For comparison purposes the mean episodic richness ratings were divided by 2.
External detail categories. External detail categories comprised, event, semantic, repetition and other details (see Figure 6, a & b). The age difference for external details in recall and after specific probing reported earlier, although not statistically significant, appeared to be driven primarily by a large between-group discrepancy in semantic detail scores. At the corrected significance level $p < .01$, younger and older adults differed in the number of semantic details given during recall, $t(22) = -2.7, p \leq .01$, but not in event, $t(22) = -1.18, p = .86$, repetition, $t(22) = 1.24, p = .23$, or other details $t(22) = -2.23, p = .81$ (see Figure 6, a). The age difference in the number of semantic details was sustained even after specific probing, $t(22) = -3.33, p < .005$. Age differences for the other detail categories remained insignificant, namely, event, $t(22) = -1.72, p = .48$, repetition, $t(22) = -1.19, p = .85$, and other details, $t(22) = -1.23, p = .23$ (see Figure 6, b).

Autobiographical Memory After a One Year or Less Delay Period

By examining only the last time period it was possible to equate the retention interval of autobiographical memories between age groups. It was of interest whether older adults recalled recent events in the same way that they did older ones. As reported previously for the total events recalled, younger and older adults recalled equivalent numbers of total details (internal and external combined) for recall (Younger $M = 41.75, SD = 13.68$; Older $M = 46.92, SD = 26.30$), $t(22) = -1.60, p = .55$, and specific probing (Younger $M = 88, SD = 23.35$; Older $M = 108.67, SD = 49$), $t(22) = -1.3, p = .20$, in period 5. These non-significant age effects across details will not be considered below.
Figure 6. Mean number of external details given by younger and older adults for each external detail category, during recall (a) and after specific probing (b).
Internal and External Autobiographical Memory Details. A 2(Age Group) X 2(Detail Type: internal vs. external) ANOVA showed no main effect of Detail Type, $F(1, 22) = .31, p = .58$, and a marginal Age Group X Detail Type interaction, $F(1,22) = 4.33, p = .05$, during recall (see Figure 7). While age differences were not significant for the number of internal details given during recall, $F(1,22) = 1.78, p = .29$, they were marginally significant for external details, $F(1,22) = 3.44, p = .077$.

![Figure 7](image_url)

Figure 7. Mean number of internal and external details given during recall and after specific probing by younger and older adults, for the last time period.

After specific probing, a 2(Age Group) X 2(Detail Type: internal vs. external) ANOVA showed a main effect of Detail Type, $F(1,22) = 10.63, p < .005$, with internal details greater than external details (see Figure 7). There was also an Age X Detail Type interaction.
interaction, $F(1,22) = 11.29, p < .005$. Age differences for number of internal details recalled after specific probing did not reach significance, $F(1,22) = .62, p = .44$, but older adults recalled more external details than younger adults, $F(1,22) = 7.07, p < .01$. From the above findings, it would appear that now age groups did not differ in internal detail scores, but differences in external detail scores were maintained for the last year.

**Autobiographical Memory Ratings.** In contrast to the internal detail findings, younger adults had higher rating scores for recall than older adults, $t(22) = 2.17, p < .05$. As with the earlier findings, specific probing also failed to attenuate age differences in rating scores, $t(22) = 2.48, p < .05$.

Table 6

**Comparison of Internal to Total Detail Ratios in Younger and Older Adults for Events from the Last Year**

<table>
<thead>
<tr>
<th></th>
<th>Recall</th>
<th>After Specific Probing</th>
<th>Specific Probing (alone)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Older</td>
<td>0.46</td>
<td>0.20</td>
<td>0.52</td>
</tr>
<tr>
<td>Younger</td>
<td>0.65</td>
<td>0.21</td>
<td>0.70</td>
</tr>
</tbody>
</table>

**Internal to total detail ratios.** Ratios of internal to total details for events from the last year were similar to those from all the time periods combined. Older adults had lower ratios than younger adults for autobiographical memory recall, $t(22) = 2.32, p < .05$, and after specific probing, $t(22) = 2.49, p < .005$ (see table 6). Furthermore, these age effects were not driven by an initial difference during recall. Older adults also demonstrated lower internal to total detail ratios when specific probing was examined non-cumulatively, $t(22) = 2.84, p = .01$. 

.01. That is, even in response to specific probing, older adults gave more external information when recalling an event from the last year.

**Internal detail categories and ratings.** The Bonferroni multiple comparison correction level was $p < .01$. Results at .05 significance level are also reported below.

During recall, there were no age differences in event, $t(22) = .25, p = .80$, place, $t(22) = 1.57, p = .13$, time, $t(22) = 1.15, p = .26$, and perceptual details, $t(22) = 1.08, p = .29$, and only a marginal difference was found for thought/emotion details, $t(22) = 1.90, p = .07$ (see Figure 8, a). After specific probing, younger adults recalled more place, $t(22) = 2.92, p < .01$, and thought/emotion details, $t(22) = 2.25, p = .035$, than older adults. There were no age differences for event, $t(22) = -.23, p = .82$, time, $t(22) = .73, p = .47$, and perceptual details, $t(22) = .29, p = .78$ (see Figure 8, b).

Younger adults received higher ratings for thought/emotion, $t(22) = 2.42, p = .02$, and episodic richness categories, $t(22) = 2.60, p = .016$, during recall. There were no age differences for place, $t(22) = 1.63, p = .12$, time, $t(22) = .76, p = .45$, or perceptual categories, $t(22) = .61, p = .55$ (see Figure 9, a). After specific probing, younger adults still received higher ratings for thought/emotion, $t(22) = 2.09, p = .05$, and episodic richness categories, $t(22) = 2.28, p = .03$. There were no age differences in ratings for place, $t(22) = 1.08, p = .29$, time, $t(22) = 0, p = 1$, and perceptual categories, $t(22) = .69, p = .50$ (see Figure 9, b).
Figure 8. Mean number of internal details given by younger and older adults for each internal detail category, during recall (a) and after specific probing (b), for the last time period. Note that significance is marked at the $p \leq .05$, and $p \leq .01$ levels for internal categories, however, only the latter was considered statistically significant after the Bonferroni correction procedure.
Figure 9. Mean rating scores of younger and older adults for each internal detail category, during recall (a) and after specific probing (b), for the last time period.
External detail categories. As with the above internal detail category comparisons, the Bonferroni correction level was $p < .01$, results were considered both at this level and at $p < .05$.

During recall, older adults gave more external event details than younger adults, $t(22) = -2.27, p = .03$. Age differences were not significant for semantic, $t(22) = -1.57, p = .13$, repetition, $t(22) = .45, p = .66$, and other details, $t(22) = -.48, p = .64$. After specific probing, age differences were evinced for event $t(22) = -2.36, p = .027$, and semantic details, $t(22) = -2.26, p = .037$, in which older adults recalled more details than younger adults. There were no age differences for repetition, $t(22) = -.18, p = .86$, and other details, $t(22) = -1.62, p = .12$.

Due to the nature of external details and fewer observations for the last time period, there was a large distribution of scores within each category. In order to decrease the influence of several extreme scores in both age groups, non-parametric analyses were conducted for recall and specific probe using the Mann-Whitney U test. For recall, older adults recalled marginally more event, $z = -1.8, p = .07$, and semantic details, $z = -1.97, p = .05$, and no age differences were evident for repetition, $z = -.39, p = .70$, and other details, $z = -.09, p = .93$ (see Figure 10, a). For specific probe, older adults recalled more event, $z = -2.56, p \leq .01$, and semantic details, $z = -2.23, p = .02$, than younger adults. No age differences were evident for repetition, $z = -.90, p = .37$, and other details, $z = -1.23, p = .22$, as reported above (see Figure 10, b).
Figure 10. Mean number of external details given by younger and older adults for each external detail category, during recall (a) and after specific probing (b), for the last time period. Note that significance in this figure was determined after non-parametric tests were conducted.
Comparison with AMI

In order to assess our measure's construct validity, internal detail and rating scores were compared to AMI ratings for recall and specific probe. In recall, Spearman rank order correlations showed a significant relationship between the AMI and our detail and rating scores, $r's = .61, .79$, $p's < .005, .001$, respectively. There was no relationship for these comparisons in specific probe. This was due to a ceiling effect in the AMI ratings, which only ranged from 0-3 points. In line with the above findings, Mann-Whitney U tests showed that the AMI was capable of detecting age differences in recall, $z = -2.58$, $p < .01$, but not overall age effects after specific probing. On the basis of AMI ratings alone, it would appear that age differences in autobiographical memory can be attenuated with specific probing. However, the attenuation is based on at ceiling performance by both age groups after specific probing. Our measure also showed internal construct validity. Internal detail scores were highly correlated with rating scores, both during recall, $r = .90$, and after specific probing, $r = .88$ ($p's < .001$).
Discussion

The purpose of the present study was to investigate age-related differences in autobiographical remembering. A new measure of autobiographical memory was utilized, and the findings provided useful information in the validation of this measure. The Autobiographical Interview was developed on the basis of experimental evidence and already established measures and theories of memory. On these grounds, we thought it was important to differentiate between episodic and semantic or off-target information components within autobiographical retrieval. The quantity of contextual or phenomenal information retrieved was interpreted as an indication of episodic retrieval ability. Several studies that have utilized young and older adults, as well as patient groups, further suggest that the fractionation of episodic recollections into time, place, perceptual and thought components is a more informative and sensitive means of differentiating episodic retrieval ability. In the present study, it was assumed that episodic retrieval of specific details placed higher demands on frontal functions relative to other cortical functions. Thus it was hypothesized that older adults, who are thought to be prone to selective prefrontal cortical degeneration, would retrieve fewer specific details, and more semantic or off-target information. The fractionation of off-target or general verbosity into external information categories was also informative in examining the nature of this age-related phenomenon. Structural support was manipulated to investigate to what extent group differences in episodic retrieval ability and quantity of external information retrieved could be attenuated. Episodic retrieval ability was also examined separately for each of 5 time periods for the purposes of examining time gradients.
Aging and Autobiographical Retrieval of Event-Specific and External Information

During autobiographical recall, younger adults retrieved a greater number of internal details, and older adults retrieved a greater number of semantic or off-target details, resulting in a significant Age Group (younger, older) by Detail Type (internal vs. external) interaction. Younger adults also received higher episodic rating scores than older adults. These findings are significant in that the general consensus in the memory and aging literature, that older adults show impoverished recollection of specific contextual or phenomenal details relative to younger adults, was replicated within the real-life context of autobiographical remembering. Laboratory studies of memory have shown that older adults have an increased incidence of source forgetting (e.g., forgetting perceptual details such as colour of text, sound of the speaker’s voice), and even source amnesia (e.g., forgetting the place or location in which the material was acquired). Memory for these and other details, such as visual, sound, smell, taste, location, and setting details, has also been associated with differentiating real from imagined events (Johnson, Foley, Suengas, & Raye, 1988). Moreover, older adults’ memory for correctly and falsely recognized items show fewer sensory and contextual differences than younger adults (Hashtroudi, Johnson, & Chrosniak, 1990; Norman & Schacter, 1997), suggesting that older adults retain fewer specific details. As shown in our study, older adults rely instead on semanticized or general information, rather than contextual details, to remember items or episodic events.

Structural support in the laboratory setting has been shown to attenuate age related differences in memory (see Craik, 1986) and learning tasks (Levine, Stuss, & Milberg, 1995; Levine, Stuss, & Milberg, 1997). Interestingly, we found that although both groups recalled more information after specific probing, age differences were not attenuated in the number of
episodic details retrieved (young greater than older), or in the number of semantic or external
details given (older greater than young). Further analyses showed that in response to specific
probing alone, age differences in the number of internal details given were not statistically
significant. In other words, on a question-answer basis, both age groups retrieved an
equivalent amount of event-specific information. It appears that the sustained age difference
after specific probing was a carry-over effect from recall. It is possible that younger adults
had less information to add to an already detailed recollection, while older adults were unable
to outperform younger adults during specific probing to make up for their relative episodic
retrieval deficit during recall.

It is noteworthy that responses to probing were not independent from initial recall in
that information already given was not probed or probed less extensively by the examiner.
While this approach worked against younger adults in that they may have received fewer
probes, older adults were more likely to get extensive probing. Despite this, our method of
specific probing did not attenuate age differences. One of the reasons for this may be due to
the sensitivity of the scoring criteria employed. The rating scores and especially the detail
scores were constructed to quantify the wide range of episodic retrieval ability in healthy
adult and patient populations. As such, age differences could not be attenuated by at ceiling
performance, especially in the case of detail scores (see AMI results in Construct validity
section). Moreover, although older and younger adults recalled an equivalent number of total
details during recall, and after specific probing, the proportion of internal to total details was
significantly higher for younger adults. However while our scoring procedure was less likely
to project ceiling effects on recollected details than that of the AMI, which provides 0-3
ratings, our method of specific probing may not have provided sufficient or the right type of structural support to attenuate age differences.

Older adults also retrieved much older memories than did younger adults. Thus, it is not clear whether the retrieval difficulty for older adults was age-related or age-of-memory-related. Presumably, retrieving details about events after a significantly longer delay period is more difficult than for more recent events. In contrast to the latter argument, Holland and Rabbitt (1990) reported that age of encoding had no effect on episodic retrieval ability of autobiographical events, suggesting that the effect size may be larger for age at retrieval rather than retention interval or age at encoding. This issue was addressed in the present study by analyzing recollections for the last time period alone, in which memory age and thus task difficulty was equated between groups (discussed later).

Generalized or interpretive verbosity has been noted to increase with age (Adams, 1991). This has been reported in studies that have examined interviews with older adults, their linguistic style, and recall of prose. Apart from casual observation, verbosity has not been systematically investigated in older adults’ autobiographical recollections. Through a quantitative breakdown of recollections into internal and external information bits, we found significant evidence of generalized retrieval and off-target statements in older adults in comparison to their younger counterparts. This was the case even after specific probing, and for events recalled from the last year.

There are several existing cognitive interpretations of this increase in generality and loquaciousness in older adults that appear to fall into three main categories: the limited resources interpretation, the inefficient inhibition processes theory, and the life-span developmental perspective. The limited resources interpretation posits that with increasing
age, processing or working memory capacity declines (Craik, 1986), and older adults must rely on compensatory strategies. Processing resources can be aided by the use of environmental support and internal strategies that reduce demand on self-initiated processes (Craik, 1986). For instance, several studies have found that younger adults provide more detailed text-based recollections, while older adults are more likely to provide the gist, or an interpretational account of the text (Adams, 1991; Adams et al., 1990). Studies that have directly compared younger and older adults’ ability to summarize or recall main points of the text have found no age differences (Hultsch & Dixon, 1984) (see Byrd, 1985 for alternative findings). These findings suggest that reliance on gist or summary statements may provide an efficient means of compensating for a decrease in ability to recollect specific details.

However, our findings also show that even after specific probing (environmental support) older adults still provided a greater amount of external information than younger adults. Thus despite structural aids in the form of specific prompts, they continued to provide a greater amount of external or general information than younger adults. It would appear that there are additional factors involved in this phenomenon then are addressed by the limited resources interpretation. For instance, older adults have been reported to have intrusions of irrelevant information during discourse, and to give less substantive information related to the topic under discussion (see Gold et al., 1994). Gold et al. even state that specific questions during discourse prompt off-target verbosity. Irrelevant intrusions and the inability to stay on track has been linked to an age-related decline in inhibitory processes (Hasher & Zacks, 1988; Zacks et al., 2000), that is hypothesized to be reflective of selective deterioration in the prefrontal cortex (Arbuckle & Gold, 1993; Gold et al., 1994; West, 1996; see also Greenwood, 2000 for alternative view). Thus, although structural support enabled
older adults in our study to recall more specific details, but not enough to attenuate age differences, it did not eliminate the effects of inefficient inhibitory processes. Thus as suggested by the above reports and by our own findings, it appears that structural support may not be effective in reducing older adults' loquacious retrieval style.

Advocates of the alternative life-span perspective propose that these age-related changes in retrieval style are part of a progressive developmental reorganization, rather than a regression or decline in functioning. Labouvie-Vief and colleagues (Adams et al., 1990; Labouvie-Vief & Blanchard-Fields, 1982) posit that older adults are more concerned with the social, psychological and moral implications of text, stories or events, and that their recollections are influenced by prior experience and wealthy composites of knowledge. This change from verbatim and detail-oriented recall to more integrative and interpretative recollections is suggested to be a progressive transition that may or may not be a consequence of processing deficits. The ability to integrate, interpret and summarize events has also been put forward as a change in how narrative intelligence is exercised (Randall, 1999).

**Age-Related Differences in Autobiographical Remembering Across the Life-Span**

Younger adults recalled more internal details and received higher ratings than older adults before and after specific probing across all comparable time periods, with the exception of the last year. After specific probing the number of internal details recalled by older adults across time periods followed a similar pattern to that proposed in the Galton/Crovitz/Rubin theory of event retrieval across the life span (see Figure 2). Fewer
details were recalled during the childhood period in comparison to periods 2, 3, and the last year. The highest number of details was recalled during the last year.

Scientists of autobiographical memory have for some time been plagued by the problem of equating age at encoding, time since encoding, and age at retrieval. This problem has also been brought to light in studies of news events and famous faces (Warrington & Sanders, 1971). In comparing younger and older adults across time periods, we found that these factors were interchanged depending on the period. For instance, periods one and two were equated for age at encoding, period three was marginally so, period four could not be equated on any of these factors, and events retrieved from the last year were equated for time since encoding. Thus, by studying age differences in autobiographical memory retrieval across several time periods results may be influenced not only by confounding variables such as memory age and subject age, but also by the inconsistent influence of these variables across time. However, these factors may only be a problem when comparing group characteristics that are expected to have a very small effect size. A few studies have taken the approach of holding the retention interval constant (e.g., Hashtroudi et al., 1990). As discussed below, we examined the last period alone, in which the retention interval was also held constant between groups.

Components of Event-Specific and Off-Target Information

Episodic details are necessary to differentiate memory for a specific target event from similar repeated or ongoing events (Holland & Rabbitt, 1990). The latter type of recollection, which has been termed overgeneral memory (Cohen, 1998), lacks detail. Several studies, including the present one, show that older adults retrieve fewer details during
autobiographical recollection and are more likely to have overgeneral memory (see Cohen, 1998; Holland & Rabbitt, 1990). In addition to replicating and quantifying these age differences, the present study further decomposed the internal and external factors comprising autobiographical remembering, and analyzed the contributions of their individual detail categories to the observed age effects.

We found that during autobiographical recall, the age difference in number of episodic details retrieved was driven by younger adults recalling more place, event, perceptual and thought/emotion details than older adults. The number of time details retrieved was equivalent between groups. Of particular interest is that specific probing attenuated previous age differences for place and event details, but not for perceptual and thought/emotion details. Episodic rating scores mirrored these findings.

These results suggest that details associated with a specific occurrence may vary in their representation of episodicity, or re-experiencing. In other words some details may be better indicators of re-experiencing (e.g., perceptual, thought/emotion details) than others (time, place details). This variation can be thought of on a continuum (see Figure 11).

![Figure 11](image-url)
For instance, although temporal details are episodic in that they refer to a particular point in time, they are not intrinsic to the unfolding of the event. Robinson (1986) argues this point well by stating that, “Although we use clocks and calendars to mark time, we do not experience time as a succession of uniform units of duration. Rather, we experience time as action, and succession as either repetition of an action or a change from one activity to another.” (p. 159) He further describes the cognitive representations of time as “temporal references systems”. Thus certain events may be semantically anchored to particular calendar dates, or scripts representing months or seasons. Similarly, we may have semantic scripts for places, event actions, perceptions and thoughts/emotions (this was accounted for by our scoring criteria by categorizing such representations as external to the incident). However, these details are also more integral to the event than time details, respectively. Identification of a particular location, especially if it is unusual, infrequently visited or significantly contributes to the unfolding of the event, may give one an impression that the event can be re-experienced. However, as with time details, even place details that are integral to an incident are easily accessible through semantic representations and scripts. As demonstrated by the attenuation of age differences after specific probing, these details can be accessed through cueing, reasoning or strategic retrieval processes. Actions or event details are assumed to be more specific to individual incidents, although some action sequences may be scripted (i.e., riding a bike, driving a car). Finally, the specific colors, smells, textures, or physical sensations (perceptual category), and subjective feelings of angst, turmoil, rage, or the mental monologue unfolding along side the incident (thought/emotions category), appear to be most indicative of an individual’s ability to re-experience an incident. This information
may be less accessible to strategic retrieval in that it is more difficult to reconstruct on the basis of logistics.

Our findings showed that the difficulty experienced by older adults in retrieving episodic details was related to the degree of episodocity those details represented. This was especially true after specific probing in which age differences in perceptual and thought/emotion details were more resistant to attenuation through structural aid. In line with these findings, Tulving (1985) proposed that spontaneously recalled material is episodically richer and more likely to be “remembered” than material retrieved upon cueing, which is more likely to be “known”. Similarly, if aging reduces the richness of episodic recollections, then age differences should be evinced for details that are higher on the episodic continuum.

One caveat to consider is the possible ceiling effects in time and place details. Although descriptive information such as perceptual and thought details can be unlimited (both during encoding and retrieval), only a limited number of time and place details exist per event. One method of equating the detail categories in terms of at ceiling performance is by considering the rating scores. Overall, younger adults received higher rating scores in episodic richness during recall and after specific probing. During recall, age differences were evinced in the place, perceptual and thought/emotion categories, but not in the time category. After specific probing, age differences were only statistically significant for perceptual and thought/emotion details. Thus, although ratings are generally less sensitive to large variation in performance and more prone to ceiling effects, these findings are consistent with those of the detail categories.

Older adults retrieved significantly more external information details than younger adults before and after specific probing. These age differences were driven by the
recolIection of more semantic details by older adults. Older and younger adults retrieved an equivalent number of external event, repetition, and other details. These findings fit nicely with the existing memory and aging literature. Several studies that have investigated recollective experience using the remember/known technique show that older adults give fewer “remember” responses and the same or a greater number of “know” responses than younger adults (Java, 1996; Mäntylä, 1993; Parkin & Walter, 1992; Perfect & Dasgupta, 1997).

**Recollection of Events from the Past Year**

The last time period equated retention interval between younger and older adults. Age differences were not evinced for number of internal details recalled, but older adults still recalled more external details during recall and after specific probing. Interestingly, rating scores for internal details showed a significant age difference before and after specific probing. Thus there is a question of whether individual subject variability contributed to the insignificant age difference for number of internal details given, or whether older adults really had fewer episodic retrieval deficits for recent information. The difference in rating scores would suggest the former postulation to be more likely.

With respect to internal detail categories, younger adults recalled more place and thought/emotion details after specific probing but not during recall. Younger adults also received higher rating scores for the thought/emotion category as well as for episodic richness, before and after specific probing. Although younger adults recalled more details across most detail categories (many did not reach significance; see Figure 8) the episodic richness rating, which is based on consideration of all the internal detail categories, appeared to capture these differences. These findings provide some support for the episodicity
continuum presented earlier in that age differences were found for the thought/emotion category. However due to sample size and many statistically insignificant age differences for individual components it is difficult to draw any meaningful conclusions for episodes from only the last year.

Warrington and Sanders (1971) observed that memory for recent and remote public events were highly correlated across subject groups, suggesting that semantic retrieval appears to be more or less intact for events across the life-span. As reported for overall memory scores, older adults showed higher semantic detail scores before and after probing, they also retrieved more external event details for each level of recall. This may suggest that older adults had more off-target verbosity about events external to the main event retrieved. However, the most conclusive finding for the last time period was that younger adults still had a higher proportion of internal to total details than older adults during recall and after specific probing.

Construct Validity

The Autobiographical Interview rating and detail scores were highly correlated with the AMI rating scores during recall. Both measures reliability differentiated performance in younger and older adults. However after specific probing, younger and older adults’ AMI scores hit ceiling, thus showing attenuated age differences. The relationship between both measures, and consistency in differentiating age groups during recall, suggests the construct validity of the Autobiographical Interview. However, the ability of our measure to tap into variability in retrieval ability after specific probing, in light of a ceiling effect in AMI scores, further suggests that the Autobiographical Interview is overall a more sensitive measure.
Nonetheless, although our rating scores showed a significant age difference across recall levels, there was a trend toward ceiling performance after specific probing (see Figure 3). In cases where expected group differences are small, there may be an advantage in using the detail-based scoring system.
Conclusions

Autobiographical memory is a challenging memory phenomenon to investigate. The relationship to the self contributes to the variability between individuals and across the life-span in what and how information is encoded and retrieved. The currently accepted measures of autobiographical memory were not designed to consider this variability, or what factors are responsible for it. The present study utilized a measure that was shown to be highly sensitive to differences in episodic retrieval ability in older and younger adults, as well as what factors were responsible for these differences. Both detail and rating scores were shown to be effective in gauging differences, and consideration of episodic and off-target information provided an additional perspective into the workings of age-related changes in autobiographical remembering.

Limitations of the Autobiographical Interview include the lengthy scoring process. Although this measure takes approximately the same amount of time to administer as the AMI, scoring the results can take several hours. While this may be worthwhile for research studies, such depth of analysis is probably not necessary for clinical assessments. For clinical purposes the rating scale may provide enough information. However, with the use of ratings alone, off-target or external information is not considered beyond an observational basis. In addition, ratings are only useful when the expected effect size of the assessed condition or disposition is moderate. It is debatable whether structural support or specific probing is required, provided that recall performance alone gives all the necessary information. Examination of patient populations will be helpful in determining this.

Further research is needed to investigate the construct validity of the Autobiographical Interview in patient groups. Given that we were able to differentiate older
adults' retrieval performance from that of younger adults, it is highly probable that
differences between healthy and patient populations will be detected easily. Of interest then,
is whether the Autobiographical Interview would be sensitive to differences across various
patient groups. In addition, the comparison of older adults to patients with frontal lobe
pathology, may provide further information into the involvement of the frontal lobes in
autobiographical remembering.
**Early memories**
- First memory
- Buying a pet
- Birthday party
- A sibling's birth
- Playing a game during childhood

**Emotional**
- Losing something important
- Being humiliated
- An argument
- Being fired
- Pet dying
- Being disciplined at school
- Being very frightened
- Performance failure
- A bad play (sports)
- Being robbed/burglarized
- Injury or illness in a friend
- Being lost
- Witnessing an accident

**Family events**
- Someone's death
- A Wedding
- Birth - own children
- Birth - family/friend
- A holiday celebration
- Injury or illness in a family member
- First day of school for child
- Spousal argument
- A celebration from childhood
- A family reunion

**Job Related**
- A job interview
- Speaking in public
- Being promoted/given a raise
- Making a mistake on the job
- First job
- First paycheck
- Retirement
- Military service

**Leisure**
- Shooting a gun
- Going to a sporting event
- Going to a performance
- A significant movie or play
- A memorable meal

**Romance**
- First kiss
- First date
- Falling in love
- Holding hands/romantic touching

**Misbehavior**
- Catching someone doing something
- Being arrested, stopped by police
- Using drugs
- Stealing something
- Doing something dangerous
- Breaking something valuable
- Telling a lie
- Cheating on a test
- Being caught doing something wrong
- Trying a cigarette for the first time

**Physical**
- A hospitalization/operation
- Being hurt or injured
- A fight
- Being sick
- Being disciplined
- Car accident
- Getting sick on alcohol
- Pregnancy
- Getting food poisoning
- A doctor or dentist appointment

**Public**
- Seeing someone famous
- Being on TV, radio, or newspaper
- Disaster (natural or man-made)

**Religious**
- 1st holy communion
- 1st Confirmation
- Confirmation/bar mitzvah

**School**
- Taking a test (school or standardized)
- High school graduation
- Last day of elementary school
- Last day of middle school
- Staying home sick

**Social**
- A party
- Giving a gift
- Receiving a gift
- Saying goodbye to someone
- Feeling angry at someone
- Going to a dance/prom
- Buying an expensive dress
- Surprise party
- Being visited by someone

**Transition**
- Buying a car
- Moving out of parents house
- First bicycle
- Buying a house
- Moving
- First time driving a car

**Travels**
- A Vacation
- Camping outdoors
- Going away on your first trip
- Seeing the ocean
- Seeing mountains
- Being in a boat
- Being on a ship
- First plane flight
- First train trip
- Going to summer camp
- 1st long journey/overseas
- A long drive

**Triumphs**
- Voting
- Performance success
- An award
- Winning something
- Building/constructing something
- A great play (sports)
- Giving assistance to someone
- Making a large purchase
APPENDIX B

General Probes

Probes given to clarify the test instructions and requirements.

- Can you tell me a specific instance of?
- I need an event specific to a time and place.
- That’s not quite what I was looking for. I need a memory for a single event or instance that happened to you.

Probes given to elicit more contextual information without specifically asking for it.

- Is there anything else you can tell me?
- Tell me more about it.
- Tell me more details about…
- What do you remember about…?
- Is that everything you can say about it? I want to know all the details that come to mind.

The participant is also given the option to select another event for which recollection may be better.

- Would you like to look at the list for another event?
APPENDIX C

Specific Probes

Probes targeted at specific contextual information. Probes that address content already covered by the participant are omitted. If the information is covered in a partial or vague way, these probes are used to improve the specificity of the information. The phrasing of the questions are subject to change according to the content of the memory being probed.

TIME

1) When did this event take place?
   Be as specific as possible. For recent memories, a date and time should be given. For older memories, month and year will be sufficient.
2) What day of the week was it?
3) What time of day was it? Was it light or dark?
4) What season was it?

TIME INTEGRATION

1) What were you doing before/after?
2) What happened next? What was going on before?
3) How long did it last?

PLACE

1) Where did this take place?
   Depending on the event, obtain either a city, street, address, or building.
2) What room were you in? What part of the room were you in?
3) What sort of things were around?
   Phrase this according to where the event took place. For example, if it was outside, were there a lot of cars?
4) Where were you in relation to the main things (or people)?
OTHER CONTEXTUAL INFORMATION
Ask as many of these that apply to the situation.

1) What was the weather like?
2) Who were you with? Who else was around? (get names)
3) What were you wearing?
4) What color was it?
5) Were you sitting/standing/walking...?
6) What did it sound like?
7) What did it smell like?
8) What did it taste like?
9) What was the texture like? Were there any textures or feelings on your skin?
10) What was the temperature like?

EMOTION

1) How did you feel about it?
   Frame the question according to the event. “Were you happy/sad/angry/surprised/afraid/excited/anxious?” “What made you feel that way?”
   If there is more than one component of the event, elicit feelings for each component (e.g., “How did you feel at the beginning/end?”). Be sure the subject is recollecting his emotional experience, rather than giving you his reactions in the present.

2) How did you react? How was this feeling expressed at the time?
   Separate affect (expressed) from emotion (felt). “Did you laugh/cry? Did your heart beat faster?”

3) (If others were present). How did the others react?
   How do you think they felt? What kinds of emotions did they express?

4) What were the implications of this for you at the time? How did you think it would affect you? How did you feel about that possibility?
   Be sure to discuss the implications felt at the time by the subject, which may not be the actual implications that came to pass.
References


