RETRIEVAL OF EPISODIC AUTOBIOGRAPHICAL MEMORIES IN OLDER ADULTS

A Thesis
by
HEATHER ELIZABETH BURKETT

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Abstract

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In the present study, I examined age-related differences in specificity of autobiographical memories by investigating executive function in young (18 – 25) and older adults (64 – 85) when given low and high imagability word cues (5 low, 5 high in randomized order). Participants provided 10 narratives for the autobiographical interview and completed Matrix Reasoning, Digit Span Backwards, and Verbal Paired Associates to reflect executive function ability. Scores on the Depression Anxiety Stress Scale (DASS-21) were also used as a covariate in the primary analyses. Results for the complete memory data indicated significant effects for Age Group and Imagability, but were qualified by a significant interaction between the two. Young adults produced more specificity than older adults, with high imagability words eliciting the most specificity. Conversely, results for the reduced memory data indicated a significant effect for Imagability and Age Group, with no significant interaction between Age Group and Imagability. High imagability words elicited more specificity in both young and older adults. Significant age differences were also found for the Matrix Reasoning raw scores and Verbal Paired Associates raw scores with young adults providing higher scores than older adults. Unexpectedly, no significant age difference was found for Digit Span Backwards raw scores or DASS-21 scores. Implications for retrieval or encoding differences with age and future research are discussed in terms of the current findings.

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Foreword

This thesis is written in accordance with the style of the *Publication Manual of the American Psychological Association (6th Edition)* as required by the Department of Psychology at Appalachian State University.

Retrieval of Episodic Autobiographical Memories in Older Adults

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Abstract

In the present study, I examined age-related differences in specificity of autobiographical memories by investigating executive function in young (18 – 25) and older adults (64 – 85) when given low and high imagability word cues (5 low, 5 high in randomized order). Participants provided 10 narratives for the autobiographical interview and completed Matrix Reasoning, Digit Span Backwards, and Verbal Paired Associates to reflect executive function ability. Scores on the Depression Anxiety Stress Scale (DASS-21) were also used as a covariate in the primary analyses. Results for the complete memory data indicated significant effects for Age Group and Imagability, but were qualified by a significant interaction between the two. Young adults produced more specificity than older adults, with high imagability words eliciting the most specificity. Conversely, results for the reduced memory data indicated a significant effect for Imagability and Age Group, with no significant interaction between Age Group and Imagability. High imagability words elicited more specificity in both young and older adults. Significant age differences were also found for the Matrix Reasoning raw scores and Verbal Paired Associates raw scores with young adults providing higher scores than older adults. Unexpectedly, no significant age difference was found for Digit Span Backwards raw scores or DASS-21 scores. Implications for retrieval or encoding differences with age and future research are discussed in terms of the current findings.

Retrieval of Episodic Autobiographical Memories in Older Adults

Noticeable changes in the ability to remember are quite prominent as one grows older. Self-initiated retrieval is particularly difficult for older adults (Craik & McDowd, 1987; Rose & Craik, 2012). The majority of research on age deficits in memory retrieval has been conducted using laboratory list-learning procedures (e.g., Craik & Rose, 2012). Similar findings, however, are seen in the autobiographical memory literature, in that older adults have difficulty retrieving pure episodic memories in standardized autobiographical memory (ABM) paradigms in laboratory settings (e.g., Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Piolino et al., 2010; Schlagman, Kliegel, Schulz, & Kvavilashvili, 2009).

Episodic memory is a component of autobiographical memory that involves subjective re-experiencing of the past. Episodic autobiographical memories consist of specific information pertaining to single day events that have occurred within our past (Wheeler, Stuss, & Tulving, 1997). Previous research has found that older adults are less likely to form specific episodic memories and produce fewer episodic details (e.g., specific sensory information) than younger adults in standard laboratory ABM paradigms (Addis, Wong, & Schacter, 2008; Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002).

Older adults' difficulty with episodic autobiographical memory retrieval has been attributed to either executive function deficits (e.g., Piolino et al., 2006) or problems with associative memory (e.g., Addis et al., 2008). Recent research supports the executive function hypothesis, in that age differences in episodic memory retrieval are not found for involuntary autobiographical memories, or memories that come to mind spontaneously (Schlagman et al., 2009).

This thesis will investigate the hypothesis that age differences in retrieval of episodic autobiographical memories are in part due to age-related deficits in memory search processes, which are in turn dependent on executive function. This will be accomplished through both experimental and correlational methods. In the experimental portion of the study, the amount of support available at retrieval will be varied by changing the imagability of the cue used to probe the memory. In the correlational portion of the study, a measure of executive function will be administered to examine the relationship between executive function and episodic memory retrieval.

The following will provide an overview of the literature related to the organization, retrieval, and retention of autobiographical knowledge memories; age differences in autobiographical memory recall; and the role of executive function and working memory in long-term memory retrieval.

Autobiographical Memory

Autobiographical memories represent past events pertaining to one's personal self, and are thought to consist of mental constructions generated from an implicit knowledge base (Conway & Pleydell-Pearce, 2000). Autobiographical memories are pertinent for developing and maintaining one's personal identity across a life span because they contain information from one's personal past (Schlagman et al., 2009). As described by Fivush, Reese, and Haden (2006), "The past is not simply a collection of events that happened; the past is intimately linked to how one thinks and feels, and in this way, the past self becomes linked with the present self" (p. 1580). Remembering past events is critical for self-identity later in life. People often reminiscence about specifics of an event, the event as a whole, and emotions or thoughts they had when the event took place.

For example, people may have memories from their childhood that revolve around a child-sized blue and white art easel. They may recall several occasions when they sat at the easel drawing, coloring or creating projects. As adults they may continue to apply their artistic abilities through paintings and three-dimensional art pieces.

Organization of autobiographical knowledge. One of the best known theories of autobiographical memory organization is from a review by Conway and Pleydell-Pearce (2000). Conway and Pleydell-Pearce suggested that autobiographical memory is organized in a three-level hierarchy. Each level represents an increasing level of specificity when thinking of past events (see Figure 1). The highest level of organization is the lifetime period. A lifetime period represents knowledge about extended periods of time (Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001), and provides general knowledge about ourselves, others, places, actions, activities, and goals (Conway & Pleydell-Pearce, 2000). Lifetime periods are followed by general events, which consist of knowledge pertaining to experiences that are either extended or repeated events (Conway & Pleydell-Pearce, 2000; Haque & Conway, 2001). The highest level of specificity is event-specific knowledge (ESK), which describes autobiographical memories that are full of vivid imagery and generate a single, specific event. When people are presented with a cue to retrieve a memory, the first thoughts that come to mind usually consist of general autobiographical knowledge. Only subsequently do more specific details for the event approach retrieval (Conway & Pleydell-Pearce, 2000).

A second way of describing the organization of autobiographical memory is the memory systems theory of Tulving (1985), which describes the contents of autobiographical memory as containing semantic and episodic components. Semantic memories describe and represent general information and knowledge, without going into depth (Tulving, 1985).

Tulving (1985) described episodic memories as representations of events with personal involvement that extend beyond the current moment of recall, to escape and mentally travel to the precise event. Therefore, episodic memories have greater vividness and detail compared to semantic memories. The operational definitions of the two memory systems may be linked to the hierarchical pathways introduced by Conway and Pleydell-Pearce (2000). Semantic memory corresponds to lifetime period and general events in the Conway and Pleydell-Pearce model. Episodic memory corresponds to event-specific knowledge.

Semantic and episodic memory may also be distinguished by the states of awareness or consciousness that they produce. Theories of Tulving (1985) and Wheeler et al. (1997) have associated the semantic system with noetic consciousness, and the episodic system with autonoetic consciousness. Noetic consciousness is related to more factual knowledge of previous happenings, and autonoetic consciousness is reliving or re-experiencing the event (Tulving, 1985). Autonoetic consciousness allows for conscious recollection of specific happenings from personal events that occurred in the past, or mentally projecting one's self into future events that may occur. The breadth of detail provided by the episodic memory system provides the experience of autonoetic consciousness, heightening the emotional experience of past and possible future events (Rubin & Siegler, 2004; Wheeler et al., 1997). Relatively sparse detail production is more characteristic of the semantic memory system.

There are several objective and subjective qualities of autonoetic consciousness that indicate when a memory is truly episodic. For example, Piolino et al. (2010) described episodic autobiographical memories as entailing affective, perceptual and spatiotemporal contextual details that provides a sense of reliving the event. Additional distinctions between semantic and episodic memory are two distinguishable perspectives when retrieving autobiographical memories: the field perspective for recall of episodic memories, and the observer perspective when retrieving semantic memories. A field perspective places yourself into the event as if viewing through your own eyes, and often allows for experiencing the emotions again (Addis et al., 2008). Observer perspectives capture the overview, or bird's eye view of the event, without placing yourself into the event (Addis et al., 2008).

It is theorized that autonoetic awareness declines as a memory ages (Piolino et al., 2010). With the passage of time, memories converge from autonoetic consciousness to noetic consciousness, or gradually become semanticized (Piolino, Desgranges, & Eustache, 2009). Speculation about why this happens is linked to experiencing similar situations, or simply retelling the story to others. The link between semantization and event repetition is thought to have a larger influence, compared to retelling the story (Piolino et al., 2009).

Retrieval of autobiographical memories. There are two ways to recall specific autobiographical memories, generative retrieval and direct retrieval. Generative retrieval makes use of broader levels of self-knowledge to access event-specific knowledge, producing specific memories from a controlled search process. Direct retrieval activates event-specific knowledge directly by using highly specific cues, without the need for a controlled search process due to the absence of broader information (Conway & Pleydell-Pearce, 2000). Regardless of retrieval direction, both patterns of activation provide support for the hierarchical process (Conway & Pleydell-Pearce, 2000; Piolino et al., 2010).

Past research by Williams, Healy, and Ellis (1999) examined ways to manipulate the ease or difficulty with which specific autobiographical memories may be retrieved. In their study, the degree of word imagability of the word cues was manipulated and used to either disrupt or enhance specificity when recalling past events. Experiment 1 investigated the role of imagability (low vs. high) and frequency (low vs. high) and the impact on retrieval for specific autobiographical memories. To carry out this manipulation, 32 words varying in imagability and word frequency were presented as cues to elicit autobiographical memories from any time period to a group of 24 undergraduate students (21 – 48 years old). Students were read the criteria for a specific memory, described as an event that happened in one particular day and place, and could be easily dated. Students were also told to try and remember a specific event as quickly as possible in response to seeing the cue word. Latency for retrieving a specific event in response to both low and high imagability words served as an exploratory variable. Results for memory specificity revealed a significant main effect of imagability, with high imageable cues producing greater specificity scores than low imageable cues across both conditions of frequency (low vs. high). Moreover, there was a significant main effect of imagability for mean retrieval time for the two imagability groups, with quicker retrieval for high imageable cues than low imageable cues. Interestingly, there were a greater number of autobiographical memory omissions for the low imagability cues (2.06), compared to the high imagability cues (0.38). In summary, results from Williams et al. (1999) showed support that cue words rated high in imagability lead to retrieval of specific autobiographical memories more often and sooner, suggesting a more direct path is used for high imagability words.

Autobiographical memory retention function. The retention function refers to the probability of recalling autobiographical memories from different life periods, and has three main components (see Figure 2). The first is the forgetting curve for events that have taken place within the last 10 to 15 years of our life (Conway & Pleydell-Pearce, 2000). As a memory for an event increases in distance from the present time, knowledge of that event becomes more forgettable and we recall less information (Conway & Pleydell-Pearce, 2000; Levine et al., 2002). The second is a reminiscence bump, or a disproportionately high number of memories from the ages of 10 to 30 (e.g., Rubin & Schulkind, 1997). Finally, a relatively low portion of memories are recalled before the age of five, reflected in the portion of the function as childhood amnesia.

There is evidence that most autobiographical memories begin forming at a universal pace for all humans, meaning that we all have memories from early childhood, yet retrieval of memories from this developmental period is limited. Commonly known as childhood amnesia, people are generally not able to recall events that have occurred before they were three years old (Wheeler et al., 1997). Theories of this phenomenon have suggested that memories from infancy do not transfer "to early childhood [due to] cognitive or neurocognitive transformation [that] makes previously encoded memory traces nonretrievable" (Wheeler et al., 1997, p. 345). As we grow through our teenage years into adulthood, the number of memories we are able to retrieve increases.

Previous research has shown that there tends to be a heightened number of autobiographical memories for adults between adolescence and early- to mid- adulthood. According to Rubin and Schulkind (1997), adults who are 40 years old and older exhibit an increase in memories from this period, known as the reminiscence bump. Specifically, paradigms in which cue word techniques are used for recollection of autobiographical memories show this bump (Jansari & Parkin, 1996). Research that allows free recall from any life period also show an increased representation of events retrieved from the ages of 10 to 30. Such unrestricted autobiographical memory retrieval is important for emphasizing life periods that are heightened due to special occasions and events.

The forgetting portion of the lifespan curve as shown in Figure 2 is of special interest for this thesis, because autobiographical memory retrieval will be restricted to this part of the curve. Memories will be restricted because it creates equality in the age of the memory, apart from the age of the recaller (Levine et al., 2002). Controlling the age of the memory provides opportunity for the evaluation of different age groups on retrieval of episodic autobiographical memories (Levine et al., 2002).

Age Differences in Autobiographical Memory Recall

Healthy older adults are typically more challenged in retrieving episodic components of autobiographical memories, while the ability to generate self-semantic knowledge is well maintained with age (e.g., Piolino et al., 2010). This distinction of age differences in episodic retrieval but not semantic retrieval mimics typical findings in the cognitive aging literature (e.g., Nilsson, 2003). Semantic knowledge that is well-learned does not seem to decline with age.

One of the first studies to examine age differences in episodic specificity of autobiographical memory was that of Levine et al. (2002). In this study, younger and older participants recalled and described events across five life periods and two conditions, general recall and recall + specific probe. The general recall condition was always presented first, and simply asked participants to describe any event from a list of typical life events, without any probing from the examiner. The recall + specific probe condition consisted of a structured interview, in which participants were asked to elaborate on the recalled memories with standardized questions from the examiner. The examiner's interview was designed for additional probing of episodic details, and to extract details that were not self-generated. The questions addressed when and where the event took place, and how long it lasted.

The results of this study found that overall younger adults recalled more episodic details than older adults across most life periods and regardless of probing. However, for memories recalled from the previous year (Lifetime Period 5) the number of episodic autobiographical recollections significantly improved for older adults in the recall + specific probe condition compared to general recall, eliminating the age difference in episodic details in this condition. This suggests that when the age of the memory is the same for older and younger adults, providing retrieval support can significantly reduce the age difference in episodic recall.

Further research by Addis et al. (2008) replicated the finding of age differences in episodic autobiographical recall. In this study, older and younger participants were asked to recall past personal events and to imagine future events in response to single cue words presented on a computer screen. Participants were asked to describe events from two different time periods (within weeks or years of the current time). The two time periods were presented separately, so that all cues oriented for the past few weeks condition were provided together and all cues for the past few years condition were together.

A total of 32 cue words were used to elicit events from participants. For the autobiographical interview, each participant was asked to recall as much detail about the event as possible within a three-minute time frame. Participants were also told that the event generated did not have to pertain specifically to the cue word presented, and that free association was welcomed when memories waned for a cue word. Recalled events had to meet the criteria of being contextually specific or episodic and lasting several minutes or hours, but no longer than one day. Furthermore, participants were instructed to retrieve aspects of the event from a field perspective, as if they had escaped back into that very moment. The scoring procedure for the obtained narratives was borrowed from Levine et al., (2002) and frequency was recorded for number of episodic details and semantic details in each narrative.

Generally speaking, older adults produced fewer episodic details and more semantic details than young adults for both past and future events. In addition, even though both age groups were recalling events from the same time periods, the older participants' memories were slightly older than the memories of the younger participants. The Digit Span Backwards served as a neuropsychological measure of executive function for older participants, and strongly correlated with the number of episodic details produced, though this effect was slightly stronger for future than past narratives. In conclusion, large age differences existed for episodic details in a study designed with very little retrieval support, and Digit Span Backwards correlated with the production of episodic detail in older adults. It should be noted, however, that two other measures of executive function – phonemic fluency and Wisconsin Card Sort performance – did not correlate with episodic detail production in this study. In addition, the Verbal Paired Associates (VPA), a measure of relational memory, showed a significant and positive correlation with production of episodic details in both past and future events.

Among other studies addressing the issues of age-related differences in autobiographical memory recall, several have been led by Piolino, Desgranges, Benali, and Eustache (2002; Piolino et al., 2006; Piolino et al., 2009; Piolino et al., 2010). One of the first (Piolino, Desgranges, Benali, & Eustache, 2002) included individuals who were divided into four age groups, 40 – 49, 50 – 59, 60 – 69, and 70 – 79, who completed an autobiographical interview investigating both semantic and episodic components of recalled events. Events were retrieved within the current year as well as previous decades, with decade dependent upon the participant's age (a range of four to eight decades). The varying time periods provided a unique advantage to examine how the age of the memories influenced production of semantic and episodic information, and allowed comparison of information for memories approximately the same age. Participants recalled four pieces of semantic information and four specific events from each decade they had lived, excluding the most remote decade. Overall, the results indicated that the episodic specificity of the events was negatively affected by both the age of the event and the age of the person. Furthermore, Piolino and colleagues (2002) suggested that recall tasks require additional control and processing in episodic memory, which may be challenging for older adults.

Expanding on these findings, Piolino et al. (2010) formulated a two-task research design considering how executive function and working memory capacity are important for explaining age differences in episodic autobiographical memory retrieval. The first task used a verbal autobiographical fluency task which asked participants to retrieve as many memories as possible from four different levels of detail: lifetime periods, general events, specific events and event details. Detail levels were presented in order of specificity from lifetime period to event details. Participants were encouraged to zoom in on details of the event, step by step from lifetime period to narrowed details. This procedure maintained the hierarchical retrieval process introduced by Conway and Pleydell-Pearce (2000).

The second task was an episodic autobiographical memory free recall test. The purpose of this task was to provide a comparison to the verbal fluency task, and to address the process of retrieving highly specific autobiographical memories without probing. Participants described in detail the first specific memory that came to mind that took place within the past ten years. The criteria included a memory that lasted less than one day and could be localized in time and space. Lastly, all participants completed a series of neuropsychological tests to measure the executive and binding functions of working memory and episodic memory performance (list learning).

Results of the verbal fluency task indicated that older adults recalled fewer items for the specific events and details categories than young adults. Furthermore, results showed that number of episodic details produced by older adults on the free recall task was significantly lower than younger adults, although the age effect was smaller for this task than for the fluency task. Performance on the free recall task was significantly correlated with the specific events and detail levels of the fluency task. Performance on all neuropsychological tests was lower for older adults than younger adults. The autobiographical memory scores and the neuropsychological tests shared 30 - 50% of the variance; once age was partialed out of the correlation matrix, however, these relationships faded. Piolino et al. (2010) further found that performance on the executive function and feature binding components of working memory significantly predicted performance at the specific event and details level of the hierarchical task, and contributed 78 - 91% of the age-related variance. Results supported the authors' executive function/working memory hypothesis.

Consistent across Levine et al. (2002), Addis et al. (2008), and Piolino et al. (2010), there are on average large statistical age differences in episodic retrieval of autobiographical memories in laboratory studies. There are some indications, however, that decreasing the demands on retrieval can reduce this age difference. In particular, age differences were eliminated when event distance was the same for both age groups and specific probes were provided (Levine et al., 2002) and the age effect was reduced when participants were able to describe any single event of their own choosing (Piolino et al., 2010).

It is important to note, however, in cases where some retrieval support was provided, participants were still likely using the *generative* retrieval process to access memories. Both the Levine et al. (2002) and the Piolino et al. (2010) studies used structured processes to guide a memory from general to specific details in an attempt to increase the number of episodic details retrieved. In other words, these two studies guided participants through the process of generative retrieval to access specific details. General cues do not usually lead to episodic details, rather specific cues lead to episodic details. Even though specificity can be accomplished with guided retrieval, the addressed studies are limited for assessing effects of retrieval support because in each instance, responses in the guided retrieval conditions were dependent on the non-guided retrieval condition. Incorporating separate guided and non-guided retrieval conditions within one study may more directly assess the effects of different types of retrieval support.

An effective way of capturing episodic details without guided retrieval is to provide cues that increase the likelihood of direct retrieval. For example, providing a cue that is distinct may trigger an episodic autobiographical memory directly, surpassing the guided pathway. Schlagman et al. (2009) investigated this possibility by examining age differences in involuntary (spontaneous) autobiographical memories. Autobiographical memories can be classified into voluntary or involuntary, according to the means by which they are retrieved (Schlagman et al., 2009). Voluntary autobiographical memories are brought to mind deliberately through a conscious process to retrieve memories, common in laboratory settings (Schlagman et al., 2009). Involuntary autobiographical memories refer to past events that are spontaneously brought to mind, and usually derived from the environment through direct retrieval (Schlagman et al., 2009).

In the Schlagman et al. (2009) study, participants were instructed to record diary entries of all involuntary memories produced by external or internal stimuli for a total of seven days. Participants also completed a timed voluntary memory retrieval task (in the laboratory) where individuals recalled autobiographical memories from 30 word cues that could be either general or specific, recent or remote. The results indicated that age differences in the number of memories retrieved and self-rated specificity of the memories was significant only in the voluntary memory condition. Therefore, it was shown that older adults have more difficulty generating specific voluntary memories in a timed laboratory setting than in daily life. This suggests that conscious effort in memory retrieval is challenging for an older adult, but when memories are retrieved automatically and involuntarily, age differences are minimal.

Age differences in retrieving memories in other laboratory tests. In laboratory list-learning procedures, memory retrieval can be tested through either recall or recognition (Craik & McDowd, 1987). Craik and McDowd suggested that recall requires resources such as “self-initiated” processing, which is quite effortful and relies very little on external stimuli to trigger memories. Recalling memories from the past is a controlled process, similar to generative retrieval in autobiographical memory. In previous studies older adults have shown large decrements of this pathway, resulting in poor performance on recall tasks, relative to younger peers (Craik & McDowd, 1987; Luo & Craik, 2008). Craik and McDowd also proposed that older adults are relatively less impaired on recognition tasks. Recognition uses automatic processing, and is supported by environmental or external stimuli for cueing memory (Craik & Rose, 2012). The automaticity of the recognition pathway is similar to the direct retrieval process in autobiographical memory. Additionally, autonoetic consciousness is present during retrieval mode of both pathways (Conway & Pleydell-Pearce, 2000; Tulving, 1985).

Neuroimaging research suggests that the prefrontal cortex, which shows greater age-related decline than other cortical areas (e.g., Raz & Rodrigue, 2006), may be particularly important in normal age-related changes for memory retrieval (e.g., Buckner & Hughes, 2004). The process of voluntarily retrieving memories uses cognitive processes that must be self-initiated by executive function or working memory capacity (Taconnat, Clary, Vanneste, Bouazzaoui, & Isingrini, 2006). Executive function/working memory capacity provides a theoretical approach to explain how autobiographical memories are retrieved.

Executive Function, Working Memory Capacity, and Retrieval Processes

There are many research studies focusing on the relationship of executive function to other cognitive abilities. Early work in this area developed from neuropsychological studies of patients who had frontal lobe damage (e.g., Miyake, Friedman, Emerson, Witzki & Howerter, 2000). Piolino et al. (2009) further suggested that frontal lobe damage leads to an inability to re-experience episodic autobiographical memories in a sense of mentally traveling to the time the event occurred. Conversely, Piolino et al. (2009) suggest that healthy elderly people are able to experience a sense of mental travel at episodic autobiographical retrieval, compared to people with psychiatric disease like depression or schizophrenia, or persons with neurological disease like Alzheimer’s disease. Neuroimaging results have found that the prefrontal cortex is particularly important for retrieving episodic memories of any age in healthy aging adults. In people with Alzheimer’s disease, however, the hippocampus was activated in retrieval of recent autobiographical memories, and the prefrontal cortex for retrieval of remote memories.

The prefrontal cortex of the brain has long been considered a critical component of the executive function and working memory networks (Craik & Rose, 2012; Myerson, Emery, White, & Hale, 2003; Raz & Rodrigue, 2006; Storandt, 2008; Taconnat et al., 2006; West, 1996). Taconnat and colleagues (2006) referred to executive function as “goal-directed strategic cognitive operations” (p. 1). More specifically, executive functioning pertains to integrating information, handling novel items, executing complex and sequential behavior, attention switching, and inhibiting dominant or pre-potent responses (Miyake et al., 2000; Taconnat et al., 2006).

Because many of these functions are necessary for strategic operations in working memory, for the purpose of this thesis, I will use working memory capacity as a measure of executive function. This is particularly appropriate because of new research suggesting that working memory capacity encompasses strategic retrieval from long-term memory (Unsworth & Engle, 2007), and because the previously reviewed research on autobiographical memory and aging used working memory measures (Addis et al., 2008; Piolino et al., 2010).

Atkinson and Shiffrin (1971) are often cited as the progenitors to modern understanding of working memory. Their research described memory as consisting of two components, primary memory (short-term memory or short-term store) and secondary memory (long-term memory or long-term store). Atkinson and Shiffrin stated that information is maintained in short-term memory, and eventually encoded into long-term memory, through the strategic processes of rehearsal, coding, scheming, and imaging. In this model, strategic processes are also used to retrieve items from long-term memory and bring them back into the short-term store.

In probably the most well-known subsequent formulation of working memory, Baddeley and Hitch (1974) defined working memory as keeping information active over a short period of time in order to be used in other cognitive tasks. The Baddeley and Hitch (1974) model consists of domain-specific short-term stores (the visuospatial sketchpad and phonological loop) that have been joined in recent years by the episodic buffer (Baddeley, 2000), a store that sends and retrieves information from long-term memory. The contents of these buffers are controlled by the central executive, which has been linked to frontal lobe areas. Working memory in this model is distinct from short-term memory in that it encompasses an episodic buffer providing communication between the short-term stores (visuospatial sketchpad and phonological loop) and long-term memory.

Although Baddeley and Hitch's (1974) definition of WM focused on maintenance processes, recent conceptualizations (e.g., Unsworth & Engle, 2007) return to Atkinson and Shiffrin's (1971) idea that WM also involves retrieval from long-term memory. According to Unsworth and Engle (2007), primary memory is limited in capacity, although very active when engaged with task relevant information. When attention is drawn elsewhere, or when primary memory is overloaded, some items in primary memory are displaced into secondary memory. Once items are in secondary memory, they have to be retrieved back into the working memory system to be used. Unsworth and Engle (2007) assume that cue dependent search processes are used to attain relevant information that has been displaced from primary memory. Effective cues may include contextual, categorical or temporal information, which will cap the searching process and retrieve information sooner. Working memory capacity, then, in part reflects strategic retrieval from secondary memory (Unsworth & Engle, 2007).

The Current Study

The primary purpose of this research was to examine the hypothesis that reducing the retrieval demands of autobiographical memory recall will reduce the size of the age difference in specificity. Using a paradigm that was based on the cue imagability manipulation of Williams et al. (1999), I predicted that because low imagability word cues require more self-initiated and generative retrieval for memory recall, age differences in memory specificity should be larger for low imagability words than for high imagability words. Therefore an interaction between age and imagability was expected. It was further predicted that the specificity of the memory produced would be associated with executive function, and that this relationship should be stronger for low imagability words.

Method

Participants

For this study a total of 59 participants were recruited (27 young, 32 older). Participants' data were excluded from analyses if the E-Prime 2.0 apparatus malfunctioned during the autobiographical interview and resulted in a loss of more than one trial from each condition (1 younger, 3 older), or if Short Blessed scores exceeded the suggested cutoff of a score of six (Lezak, Howieson, & Loring, 2004; see below for details; 1 younger, 1 older). The final sample, therefore, consisted of 53 participants, 25 young adults (aged 18 - 25 years) and 28 older adults (aged 64 - 85 years). All procedures were initially approved by the Institutional Review Board at Appalachian State University on September 25, 2013, IRB #

14-0023, and modified on November 4, 2013 by the addition of the Charleston Forge testing location (see Appendices A and B).

The young adults were recruited from Appalachian State University's Psychology Participant Recruitment System using SONA software, and were given course credit for participation. The older adults were local residents of Boone, N.C., recruited through email listservs, mailings and in-person recruiting at community organizations. Older participants were compensated $20.00 for participation. A letter of agreement was obtained from the Lois E. Harrill Senior Center in Boone, N.C. to recruit and test participants at the center (see Appendix C). Prior to running the study, a statistical power analysis using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) indicated that a sample of at least 56 participants would be required to detect a statistically significant relationship found in previous research (α = .05, β = .20, η_p^2 = .05). Although the final sample included 53 participants, as may be seen below the effect sizes for the critical analyses were generally higher than η_p^2 = .05.

Design

A quasi-experimental, repeated measures design was used for this study. Specifically a 2 (Age Group: Young vs. Old) x 2 (Cue Imagability: Low vs. High) between-subjects by within-subjects design was used. The primary dependent variable was the specificity of the memory produced; however other variables (described below) were measured for the purpose of exploratory analyses.

Materials

Background Questionnaire. Once consent to participate was obtained (see Appendix D) each participant was asked to complete a demographics questionnaire for data on date of birth, age, sex, ethnic background, marital status, educational background, current employment status, career background, eyesight, hearing, present medications record, history of chronic illnesses, and six questions addressing frequency of activities (see Appendix E).

Screeners. Two short screening tools were used to assess possible cognitive problems and depressive symptoms.

Short Blessed. The Short Blessed test was used to address cognitive impairments in the areas of memory, orientation and concentration. For example, the test instructs examinees to repeat a name and address provided by the experimenter, which examinees are later asked to recall. Examinees are also asked to count backwards from 20 to 1, and to report the months of the year in reverse order beginning with December. This test served as a screening tool to evaluate possible cognitive problems or impairments associated with dementia (Emery, Hale, & Myerson, 2008; Emery, Heaven, Paxton, & Braver, 2008). The test questions and directions were administered orally by the experimenter to the examinee. Each error is scored as a 1, and the error numbers are multiplied according to the weighted value of each question. After weighing the items, a total sum is calculated from all of the questions ranging from 0 – 28. Scores of 0 – 8 indicate normal to minimum impairment, scores of 9 – 19 indicate minimal to moderate impairment, and scores of 20 – 28 indicate severe impairment (Katzman et al., 1983). Following conventional suggestions (Lezak et al., 2004), participants who scored above 6 on the Short Blessed were excluded from analyses. The Short Blessed was quick, simple to administer, and required no specific training making it an adequate candidate for assessing cognitive impairment by a non-clinician (Katzman et al., 1983).

Depression Anxiety Stress Scale (DASS-21). The short version of the DASS-21 consists of three 7-item self-report scales measuring depression, anxiety, and stress; because depression ratings were of special interest for this study, only the depression scale was considered. The associated seven questions are rated on a four point Likert scale, designed to measure the extent to which depression has been experienced over the past week. Using Cronbach's alpha, prior research has found that the reliability for the depression subscale of the DASS-21 is .88 (95% CI = .87 - .89). Therefore, the depression subscale displays adequate reliability, is shorter in length and time compared to the full version, and more compatible for individuals with limited concentration (Henry & Crawford, 2005). Screening for depression was important for this study because depression can lead to over-general memories or an interruption from reaching event-specific knowledge within episodic memory (Sumner, 2012; Williams et al., 1999). In particular, when voluntarily attempting to retrieve events, depressed individuals respond with generic memories, and fail to reach the specificity level or the context-bound version with the memory's details (Williams et al., 1999). Depression scores, therefore, were used as a covariate in the primary analyses.

Autobiographical Memory Cues. Each participant saw a total of ten cue words (5 high imagability and 5 low imagability) during the autobiographical interview script. The cue words were selected according to five separate ratings: imagability, frequency, emotionality, arousal, and valence (Bradley & Lang, 1999; Clark & Paivio, 2004). Word selection began by choosing words from a rank ordered list of most likely to least likely of eliciting autobiographical memories adopted from Rubin and Wenzel (2005). Higher ranked words from this list were individually selected and paired with the imagability ranking provided by Clark and Paivio (2004). The two imagability word groups were then balanced by frequency and emotionality ratings (Clark & Paivio, 2004) as well as arousal and valence ratings (Bradley & Lang, 1999). The selected words and their ratings can be found in Table 1.

Neuropsychological Tests. Matrix Reasoning (MR; Wechsler Adult Intelligence Scale - Fourth Edition (WAIS-IV); Wechsler, 2008), and Digit Span Backwards (DSB; WAIS-IV; Wechsler, 2008) were used to explore the relationship between executive functioning and memory specificity. In addition, Verbal Paired Associates I (VPA; Wechsler Memory Scale - Fourth Edition (WMS-IV); Wechsler, 2009) was included as a measure of associative memory.

Matrix Reasoning. Matrix Reasoning is a test in which individuals assess and apply rules to visual patterns that consist of various shapes, colors and directional patterns. For this test participants were shown two practice trials that gave assistance and explanation for the general procedure of the task. In the real trials, participants were asked to respond which of the five pictures would appropriately fit in the sequence. Matrix Reasoning assesses logical reasoning skills and ability to sequence patterns by using rules. In prior research, Matrix Reasoning has been highly correlated on average across all variables of the Delis-Kaplan Executive Function System (D-KEFS) that are designed to assist clinicians in the identification of executive dysfunction (r = . 60; Davis, Pierson, & Finch, 2011). Matrix reasoning is also highly correlated with working memory performance in young and older adults (Emery, Hale, et al., 2008).

Digit Span Backwards. In the Digit Span Backwards task, participants are asked to repeat a strand of digits in the reverse order in which they were presented, increasing in length across the task. For this test participants were shown two practice trials, followed by a total of 16 real trials. Item level attainability was dependent upon participant's accuracy in reporting the strands. After two incorrect responses on one item level, the task ended. The use of Digit Span Backwards is supported by Addis et al. (2008) as a measure of executive function ability and for the relationship between performance on this task and specificity in recalling past events.

Verbal Paired Associates. Verbal Paired Associates was used as an exploratory variable because Addis et al. (2008) believed that associative memory, not executive function, is the primary cause of poor episodic retrieval in older adults. For this task, all participants listened to a list of 14 word pairs; some pairs made sense (i.e., sock and shoe), and some pairs did not make sense (i.e., laugh and stand). After reading the whole list of word pairs, the experimenter said the first word of each pair and asked the participant to say the word that was paired with it. By including this variable, the relationship between performance on Verbal Paired Associates I and level of specificity were additionally explored.

Apparatus

E-Prime Professional 2.0 (Schneider, Eschman, & Zuccolotto, 2002) was used to both present the cue words and digitally record audio responses for the autobiographical interview on approximately half of the participants. Because of problems with the E-Prime digital recording, a Sony Digital Voice recorder was used to record the audio responses for the remaining half of the participants.

Procedure

Each participant completed one session lasting approximately two hours. Participants were provided a consent form and given the opportunity to express any concerns or ask questions pertaining to the study. First, participants completed the demographics questionnaire.

Participants were then read a precise autobiographical interview script (see Appendix F). One practice trial was used to familiarize the participants with the general procedure before administering ten experimental trials (see Figure 3). All participants were introduced to the same cue word, *tree*, during the practice trial. The experimental trials were presented in a different randomized order for each participant.

Participants were shown cue words on a computer screen and talked about their memories associated with the cue words from within the past year. Each cue remained on screen up to one minute for participants to recall a specific event. When the participant had retrieved an event they wrote one sentence summarizing the event on the summary event sheet (see Appendix G). The participant was asked to read out loud the summary sentence they had written, which was audio recorded. They were then told that they had two minutes to describe the event in as much detail as they could. They were instructed to press *enter* to begin the audio recording of the elaborate description of the event. Following the two minute description, participants were instructed to provide an approximate date of the event (e.g., MM/DD/YY) and ratings of phenomenological factors on a 5 point Likert scale: (a) the level of detail remembered about the event, (b) emotionality of the event, (c) valence or feeling about the event, (d) significance of the event, and (e) frequency of recall (never - a few times - many times). A 3 point Likert scale was used for memory perspective for which they re-experienced the event; 1 = *As If I Were There*, 2 = *Watching From Above*, 3 = *Neither* (see Figure 4). These questions were adopted and modified from Addis et al. (2008), Rubin and Schulkind (1997), Rubin and Siegler (2004), and Schlagman et al. (2009).

Concluding the autobiographical interview session, Short blessed, Matrix Reasoning, Verbal Paired Associates, and Digit Span Backwards were administered, followed by the

DASS-21 short version and one additional, brief attention questionnaire measure that is not considered herein.

Coding for Level of Specificity

To calculate specificity of events retrieved by participants, the sentence summaries were coded according to the following factors: personal, occurred within one day and contained highly specific information (e.g., images, thoughts, and emotions), using a modified version of the scale used by Piolino et al. (2002). Three separate raters coded the sentence summaries, applying a scale that followed one-half increments, ranging from .50 to 3.00, with higher numbers indicating greater specificity. Agreement among the raters averaged $r = .87$; the raters' scores were averaged to get the final specificity rating. The sentence summary coding scales may be viewed in Appendix H.

Additionally, the audio recordings from each participant were transcribed and will be used in the future to calculate the total number of episodic and semantic components within each event that was retrieved. A standardized coding protocol will be applied for the extensive coding method (Addis et al., 2008; Levine et al., 2002; Piolino et al., 2010).

Results

Participant Characteristics

Means and standard deviations for the participant characteristics, neuropsychological measures, and DASS-21 scores may be seen in Table 2. Years of education for young adults and older adults were statistically different with slightly higher education levels in the older adults, $t(51) = 3.39$, $p = .001$. This was to be expected, as the young adults were still in college. Among the neuropsychological measures, significant age differences in the expected direction were found for the Matrix Reasoning raw scores, $t(51) = 3.80$, $p < .001$, and Verbal

Paired Associates, $t(46) = 3.32$, $p = .03$. Unexpectedly, no significant age difference was found for Digit Span Backwards, $t(49) = 1.46$, $p = .15$. Finally, there were no age differences in DASS-21 depression scores, $t(51) = 0.93$, $p = .36$. It should be noted that the sample size for Verbal Paired Associates and Digit Span Backwards are smaller than the total final sample size. This is because some older adults refused to complete these tasks, and expressed frustration.

Age of Memories

Before analyzing the primary data, I first checked to see how well participants followed the instruction to recall memories from within the past year. The age of the memories were calculated in days by subtracting the reported date the event took place from the date of retrieval (i.e., testing date). As may be seen in Table 3, for both age groups there was large variability around the average event date, indicating that there were a number of memories that fell outside the one year mark. Based on the averages, it also appeared that the older adults were more likely to recall memories from outside one year.

To further investigate this issue, the number of times a participant recalled a memory that was outside the one year mark was calculated for each person. Overall, the average number of memories each person recalled that were "too old" was less than 1. It was true, however, that older adults ($M = 0.75$, $SD = 0.87$) were more likely than young adults ($M = 0.25$, $SD = 0.56$) to recall memories that were "too old," $F(1,51) = 5.84$, $p = .03$, $\eta_p^2 = .10$. When the memories that were "too old" were excluded from the analysis, there were no longer differences in "memory age" between the young and the old, $F(1,50) = 0.01$, $p = .92$, as may be seen in Table 4. This analysis resulted in the loss of one participant, for whom all of the low imagability trials were either too old or missing a date.

Because of the problems with memory age, all of the following analyses were conducted in two parts. First, each analysis was done on the complete memory data, including memories that were outside the one year mark or were missing a date. Then, this analysis was repeated on *only* the memories for which the reported date was within the last year. This meant that trials were excluded if the number of days since the memory was greater than 365, or if the participant did not enter a date for the memory. These two analyses will be referred to as the "complete memory data" and "reduced memory data," respectively.

Age Group Differences in Episodic Specificity

To test the hypothesis that age differences in episodic specificity would be reduced for the high imagability cue words, a 2 (Age Group: Young vs. Old) x 2 (Cue Imagability: Low vs. High) Analysis of Covariance (ANCOVA) was conducted on the specificity scores, with the DASS-21 scores included as a covariate. As described above, this analysis was conducted twice: once with the complete memory data, and once with the old/missing date memories excluded. The data for these analyses are presented in Figure 5.

Results for the complete memory data indicated main effects of Imagability, $F(1,50) = 11.86$, $p = .001$, $\eta_p^2 = .19$, with High Imagability words producing more specific memories than Low Imagability words, and for Age Group, $F(1,50) = 20.71$, $p < .001$, $\eta_p^2 = .29$, with Young Adults producing more specific memories than Older Adults. As may be seen in Figure 5, however, these main effects were qualified by a significant interaction between Imagability and Age Group, $F(1,50) = 6.34$, $p = .02$, $\eta_p^2 = .11$. Separate ANCOVAs within each age group indicated that there was no effect of Imagability for the older adults, $F(1,26) = 1.69$, $p = .21$, $\eta_p^2 = .06$, but there was for young adults, $F(1,23) = 13.49$, $p = .001$, $\eta_p^2 = .37$. As a result, and contrary to predictions, there was a smaller age difference in specificity for *low imagability* words than for *high imagability* words: Highly imageable words elicited specificity in young adults that was approximately two times higher than the specificity produced by older adults.

Results for the reduced memory data, conversely, indicate only main effects of Imagability, $F(1,49) = 11.22$, $p = .002$, $\eta_p^2 = .19$, and Age Group, $F(1,49) = 18.30$, $p < .001$, $\eta_p^2 = .27$, and no significant interaction, $F(1,48) = 1.55$, $p = .24$, $\eta_p^2 = .03$. Examination of Figure 5 suggests that this is due to cue imagability now having a small effect in older adults. Direct comparison of the imagability conditions in each age group finds that the effect in young adults is similar to the prior analysis, $F(1,23) = 11.58$, $p = .002$, $\eta_p^2 = .34$. The effect in older adults is larger than in the previous analysis, but still just below statistical significance, $F(1,25) = 3.77$, $p = .06$, $\eta_p^2 = .13$.

Age Differences in Phenomenological Factors

In order to evaluate the extent of re-experiencing, or autonoetic consciousness in recalling autobiographical memories, each participant was instructed to self-report on various phenomenological factors of the event recalled. For the purpose of measuring autonoetic consciousness, level of subjective detail and memory perspective was most relevant, although the remaining factors are analyzed as well. Each phenomenological variable was analyzed using a 2 (Age Group: Young vs. Old) x 2 (Cue Imagability: Low vs. High) Analysis of Covariance (ANCOVA), with the DASS-21 scores included as a covariate. Means and standard deviations for both the full memory data and the reduced memory data are presented in Tables 3 and 4, respectively.

For the full memory data, four of the phenomenological variables indicated significant age differences, with older adults’ ratings higher than younger adults’: subjective detail, $F(1,50) = 16.29$, $p < .001$, $\eta_p^2 = .25$; emotionality, $F(1,50) = 12.58$, $p = .001$, $\eta_p^2 = .20$; valence, $F(1,50) = 6.30$, $p = .02$, $\eta_p^2 = .11$; and frequency of recall $F(1,50) = 24.25$, $p < .001$, $\eta_p^2 = .33$. Two variables, valence, $F(1,50) = 10.42$, $p = .002$, $\eta_p^2 = .17$, and frequency of recall, $F(1,50) = 7.03$, $p = .01$, $\eta_p^2 = .12$, also indicated statistically significant effects of imagability, with the memories recalled to low imagability cues rated as less positive and more frequently rehearsed than memories recalled to high imagability cues. No other effects were significant, including any of the Age x Imagability interactions. In addition, the only small change in these findings when the reduced memory data was analyzed was that the effect of Imagability on frequency of recall dropped slightly below significance, $F(1,49) = 3.54$, $p = .07$, $\eta_p^2 = .07$.

Relationships Between Episodic Specificity and Cognitive Measures

To investigate how executive function/working memory ability influences episodic specificity, performance on the neuropsychological tests were incorporated into analyses. Pearson's *r* correlation coefficients were calculated to explore the relationship between performance on these tests and specificity for events triggered by both types of imagability cues. As may be seen in Table 5, only MR was consistently correlated with memory specificity for both the full and reduced memory data. VPA was only correlated with specificity in the reduced memory data, and DSB was only correlated with specificity for high imagability cue words, across both sets of memory data. In no instance were the neuropsychological measures more highly correlated with specificity to low imagability cues than to high imagability cues, contrary to predictions.

Because prior research has found that working memory capacity was not correlated with autobiographical memory specificity in young adults (Hill & Emery, 2013), but was in older adults (Addis et al., 2008), correlations between DSB and memory specificity were also examined separately in young and old. For this exploratory analysis, data was collapsed over cue type. This analysis found that DSB was not significantly correlated with specificity in the young (r = -.12 for full data; r = .09 for reduced data), but was significantly correlated with memory specificity in the old (r = .52 for full data; r = .49 for reduced data).

Exploratory Analyses

Memory Retrieval Times. To further explore possible reasons that the cue imagability manipulation did not substantially help older adults, retrieval times for the memories were examined as an exploratory variable. It should be noted, however, that the current reaction time data may be somewhat unreliable. In particular, the instructions for this study emphasized memory specificity, not reaction time. As a result, participants likely traded speed for accuracy, which would lead to less valid RTs. In addition, because speed was not emphasized, many participants (including nearly all of the young adults) either forgot to press the response button before they started writing their sentence, or simply waited for the entire 60 seconds to begin writing. As a result, the young adult data was not analyzable (only four participants had complete RT data), and several older adults had missing RT data.

Nevertheless, in the 20 older adults with complete reaction time data, participants were faster to respond to High Imagability cue words (M = 26.87 sec, SD = 9.17 sec) than Low Imagability cue words (M = 33.67 sec, SD = 12.21 sec), $t(19) = 2.26$, $p = .04$. This effect did not change substantially in the reduced dataset, $t(18) = 2.43$, $p = .03$. This suggests that older adults’ memory search was aided by the high imagability cues, but it did not necessarily lead to a production of more specific memories.

***Relationships between Phenomenology and Specificity*.** Finally, because four of the phenomenological variables (Subjective Detail, Emotionality, Valence, and Frequency of Recall) showed significant age differences, exploratory analyses were conducted to determine if age differences in specificity were related to age difference in phenomenology. To simplify the analyses, data were collapsed over cue imagability.

In the full dataset, memory specificity was significantly (p's $< .05$) negatively correlated with all four phenomenological variables ($r = -.44$ for subjective detail; $r = -.36$ for emotionality; $r = -.45$ for valence; $r = -.54$ for frequency of recall). Only frequency of recall, however, appears to account for a substantial portion of the age-related variance in memory specificity. That is, age group alone accounts for 29% of the variance in specificity ($R^2 = .29$; $F[1, 51] = 20.39$, $p < .001$). After controlling for frequency of recall, age only accounted for 8% of the variance in specificity ($\Delta R^2 = .08$, $F[1, 50] = 6.11$, $p = .01$). This suggests that approximately 72% of the age-related variance in memory specificity can be accounted for by age differences in frequency of recall. For the reduced dataset, the bivariate correlations remained relatively unchanged, and frequency of recall accounted for a smaller, but still substantial portion of the age-related variance in specificity (63%; $\Delta R^2 = .11$, $F[1, 49] = 7.63$, $p = .008$).

Discussion

For this study, I incorporated an age-related differences approach towards examining the impact of executive function and working memory ability on eliciting episodic specificity in recalled autobiographical memories. Participants voluntarily retrieved memories associated with a cue word during the autobiographical interview. The stimuli used for triggering autobiographical memories were directly manipulated by how imageable the word was to investigate the differences between generative retrieval processes (e.g., low imagability words) and directive retrieval process (e.g., high imagability words). Participants then completed multiple measures of executive functioning and working memory ability. I had hypothesized that high imagability cue words would produce smaller age differences in autobiographical memory specificity than low imagability cue words, due to increased support for memory retrieval (Williams et al., 1999). After coding the autobiographical memories and comparing the relationship with performances on the executive function tasks, I was also able to examine the extent to which these neuropsychological processes influence an older adult's ability to remember personal memories from their past.

With respect to the first hypothesis, there were overall large age group differences in episodic specificity which is consistent with prior research (Addis et al., 2008; Levine et al., 2002; Piolino et al., 2010; Schlagman et al., 2009). The imagability manipulation had the expected effect on the young adults (Williams et al., 1999), with high imagability cues resulting in more specific memories. Somewhat surprisingly, cue imagability did not have an impact on older adults in specificity retrieved, resulting in larger age differences for the *high* imagability cues than the low imagability cues. Additionally, I found that older adults were more likely to ignore the instruction to recall events within the last year, and when I analyzed only the events from the last year, there was no longer a significant interaction between age group and age of memory. Regardless of the way the data were analyzed, the prediction of minimizing the age difference in specificity by using highly imageable words was not supported.

Secondly, I hypothesized that autobiographical memory specificity would correlate with measures of executive function, with the strongest relationship for responses to low imagability words. MR, VPA and the DSB were used to measure executive function ability, and were then correlated with scores of memory specificity. With respect to this hypothesis, MR was consistently correlated with specificity for the full and reduced memory data, and VPA was correlated with specificity in the reduced memory data only. The significant correlation for VPA and memory specificity is consistent with Addis et al. (2008), and reflective of the role of associative memory processes in memory specificity.

DSB was highly correlated with specificity for high imagability words across both full and reduced memory data, but only in the older adults. These findings supported the hypothesis in part, and have been more directly supported in prior research on working memory capacity and autobiographical memory specificity (Addis et al., 2008; Hill & Emery, 2013).

Furthermore, there were several age differences in the phenomenological characteristics of the memories. First, older adults were self-rating their memories as higher in detail than the objective ratings indicated. Secondly, older adults rated their memories as more emotional and more positive compared to young adults. This suggests that older adults were either recalling more positive events, or remembering past events more positively, than young adults. This positivity effect has been found in prior research where older adults showed a larger distortion of autobiographical memories in a positive direction, compared to young adults (see Mather & Carstensen, 2005).

Lastly, older adults reported recalling or re-thinking about the events more often, and this was shown to be negatively related to their ability to retrieve specific memories. Frequency of retrieval was most negatively related to memory specificity in the exploratory analysis, meaning the more often an event was recalled the less specificity at the autobiographical interview. This exploratory finding supports the theory of semanticization, where memories converge from autonoetic consciousness (episodic memory) to noetic consciousness (semantic memory) as the memories age, when considering frequency of retrieval (Piolino et al., 2009; Tulving, 1985). The relationship between memory specificity and experience of similar situations was not investigated in the exploratory analysis.

Theoretical Explanations of Findings

Overall, the findings indicate that executive function is related to older adults' ability to produce specific autobiographical memories within the past year, but may not be related to memory search during retrieval of these types of memories. That is, providing retrieval support did not reduce the age difference in memory specificity, and EF measures were roughly equally correlated with retrieval to high and low imagability cues. This suggests that whatever process is causing age differences in memory specificity within a short duration is operating similarly across conditions.

Processes Operating at Retrieval. To further explore factors influencing autobiographical memory specificity at retrieval, imagability cue type and executive function are reviewed below.

Impact of Cue Type. First, to address why the imagability manipulation did not reduce the age difference in memory specificity, I want to consider the reaction times and the phenomenological factor of valence. My experimental paradigm was based on the one used by Williams et al. (1999), in which they manipulated retrieval type (direct vs. generative) by varying the imagability of the retrieval cue words (low vs. high). The major difference between that study and the current one is that Williams et al. (1999) emphasized specificity *and* speed of retrieval. Williams et al. (1999) asked their participants to remember a specific event as quickly as possible, whereas the current autobiographical interview emphasized only memory specificity. In the prior study, reaction times for event retrieval were quicker in their high imagability condition for the young adult participants; this was also found in the current study in the older adults. Although older adults' memory search was faster with high imagability cues, this did not substantially increase memory specificity. Reaction times for high imagability cue words in the current study (26.9 seconds), however, were substantially slower compared to the reaction times of Williams et al. (1999) (6.8 seconds). It is possible, therefore, that the current study exhibited use of mostly *generative retrieval* pathways.

It is also of note that the memories recalled to low and high imagability cues differ in valence. This is despite the fact that the word cues themselves were balanced for valence and arousal, and replicates the findings by Williams et al. (1999). To speculate why people reported events as more negative when retrieved by low imagability words, it is possible that the cues were associated with events that were more distressing or related to hardship. Anecdotally, people did seem to talk about events that were more serious, and were related to more ethical or moral personal standards, when responding to the low imagability cue words. For example, in response to the cue word "Opinion," many people reported instances when they had a *difference* of opinion with someone. Perhaps people reported events as more positive when retrieved by high imagability words due to associations with events that were more superficial and less serious. In addition, I further speculate that this effect of valence may have influenced how quickly, and thus easily, associated events were retrieved, as evidenced by slower reaction times for the low imagability cues (33.7 seconds) and faster reaction times for the high imagability cues (26.9 seconds). Therefore, older adults' faster reaction times to high imagability cue words may be a manifestation of the age-related positivity effect, rather than a result of more direct retrieval.

Impact of Executive Function. Both MR and DSB were correlated with memory specificity, but were not more highly correlated with memories retrieved to low imagability cues. This suggests that better executive function is associated with better memory specificity for the past year, but not for reasons related to memory search. Cognitive resources used for executive function tasks involve a number of different skills, including sustained attention, monitoring, inhibition, and mental set shifting (Miyake et al., 2000). Each of these becomes overly demanding and often decline in the older population (Craik & McDowd, 1987; Luo & Craik, 2008; Piolino et al., 2010). It is possible that an age-related decrease in sustained attentional resources resulted in difficulty maintaining the instruction to discuss a personal event occurring within one day with specificity. This is supported by the greater number of times older adults' retrieved autobiographical events outside of the requested one year mark.

In addition, DSB was not significantly correlated with specificity in the young adults, but was in the older adults. This may be because the older adults were relying on alternative neural networks to compensate for declines in cognitive resources impacting memory specificity (e.g., declines in associative memory). For example, prior research has suggested that older adults engage bilateral prefrontal regions more than younger adults during working memory performance, even when performance on the task is equivalent (Emery, Heaven, et al., 2008).

In addition, measuring executive function only once may not portray a participant's full potential. To counter this, two measures of executive function were included. There has also been debate of how accurate DSB measures working memory capacity in the young adult population (Engle, Tuholski, Laughlin, & Conway, 1999). The results of the current study do show that performance on MR is highly correlated with performance on DSB in the full sample (Table 5). Looking at the correlation within each age group, however, finds that the MR-DSB correlation is much larger in the old (r = .50) than in the young (r = .16)

Processes Operating at Encoding and Consolidation. The current study aimed to address age-related differences in retrieval of autobiographical memory within the last year, and not age-related differences in encoding and consolidation processes. The exploratory findings, however, suggest that age differences in processes related to rehearsal and consolidation may be in part responsible for the age difference in memory specificity. That is, older adults' higher frequency of retrieval negatively impacted their memory specificity. This suggests that repeated retrieval in the past year can cause interference over time, which is linked to semanticizing (Piolino et al., 2009). I suspect that the older adults are using rehearsal as a technique to be able to remember past events; however my findings suggest that this is actually harming memory specificity.

In addition, I attempted to equate the age of the memories for both age groups by limiting retrieval to the past year, which would have reflected similar time periods for encoding and consolidating the events. Regardless, the events that participants chose to discuss were occasionally beyond one year, more so in older adults, as evidenced by the memories' ages. Excluding those particularly old memories, however, did not substantially reduce the age difference in memory specificity.

Finally, Addis et al. (2008) proposed that VPA, a measure of associative memory that is related to hippocampal function, is strongly associated with memory specificity. Although there is some debate about whether hippocampal function is involved in retrieval, there is broad consensus that it is involved in memory consolidation (e.g., Alvarez & Squire, 1994). The fact that VPA only correlated with memory specificity in the reduced data set of the current study supports this theory. That is, the memories retrieved within the last year are perhaps still in the consolidation phase, and function as a part of associative memory.

Future Research and Conclusions

One limitation of the current study is that it used an extreme groups comparison design by excluding middle-aged people from data collection and investigating people at opposite ends of the life spectrum. The decision to exclude a middle-aged group was used to show more distinguishable differences between two age groups that are at opposite ends of a life period (Conway & Pleydell-Pearce, 2000). Excluding middle-aged people is common in the cognitive aging literature (Addis et al., 2008; Levine et al., 2002; Piolino et al., 2010; Schlagman et al., 2009), but using two extreme age groups assumes that middle-aged adults' autobiographical memory characteristics fall midway between young and older adults. This may not always be the case. For example, recent research in our laboratory suggests that middle-aged adults' memory specificity is more similar to young adults, whereas the phenomenological characteristics of middle-aged adults' memories look more like the old (Emery & Burkett, 2013; Emery, Hale, & Booze, 2014). Future research should include middle-aged adults to further understand the trajectories of memory change across adulthood. Future studies may also want to incorporate either verbal or paper and pencil responses for phenomenological questions of an autobiographical interview to avoid loss of data, notably for an older sample. The results of the current study are also limited in generalizability to other older adults because my sample had on average 16 years of education.

Additionally, future directions for autobiographical memory research should focus on memory consolidation processes in order to identify mechanisms that are altered or relied upon more in an older brain. Consolidation processes are often difficult to address behaviorally, but are more commonly studied in the neuropsychological literature. To address the consolidation dilemma, a paradigm could be designed so that all participants are individually exposed to the same stimuli, administered a surprise recall test, and examined by functional magnetic resonance imaging (fMRI) at each stage of the memory process. This would allow researchers to determine whether older and younger adults differ in the anatomical regions of the brain that are used to encode the event, consolidate the experience, and to then retrieve the information.

Preserving autobiographical memories. It is greatly important for individuals of the aged population to maintain salient information from events in their lives for several reasons. Reminiscing about events in the near past has been shown to lead to semanticized or vague memories, not allowing older adults to re-experience previous emotions, and conflicting connections with loved ones. Ultimately, being able to recall specifics of our past, may prepare us for things yet to be experienced.

Past research has applied a discrete cognitive, developmental, or neuroimaging prospective to investigate the phenomenon of age-related degradation of episodic autobiographical memories. Importantly, future research approaches are encouraged to interrelate these approaches to thoroughly explore the questions raised in the current study, and assess development for preserving life’s most memorable and cherished events.

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Table 1

List of Low and High Imagability Cue Words

Word	Imagability	Frequency	Arousal	Valence
		Low Imagability Words		
Advantage	2.37	1.71	4.76	6.95
Chance	2.50	2.00	5.38	6.02
Idea	2.20	2.00	5.86	7.00
Opinion	3.23	2.00	4.89	6.28
Truth	2.73	2.00	5.00	7.80
		High Imagability Words		
Candy	6.63	1.52	4.58	6.54
Friend	6.37	2.00	5.74	7.74
Rock	6.37	2.00	4.52	5.56
Toy	6.17	1.70	5.11	7.00
Truck	6.60	1.38	4.84	5.47

Table 2

Means and Standard Deviations by Age Group for Demographics and Measures

	Age Group	
	Young *M (SD)*	Old *M (SD)*
Age**	19.32 (1.75)	72.57 (6.63)
Education**	13.12 (1.27)	16.11 (4.24)
DSB_{Raw}	9.28 (1.77)	8.54 (1.86)
MR_{Raw}**	19.60 (2.43)	15.93 (4.25)
MR_{Scaled}	10.44 (1.58)	11.89 (3.39)
VPA I_{Raw}	38.00 (9.23)	31.30 (10.80)
DASS-21	3.84 (3.38)	2.93 (3.71)

Note. The table provides the means and standard deviations for demographics and neuropsychological measures, according to age group.
*$p < .05$. ** $p < .01$.

Table 3

Means and Standard Deviations of Phenomenological Factors, By Age Group: Full Memory Data

	Young		*Older*	
Factors	Low (SD)	High (SD)	Low (SD)	High (SD)
Age of Memory[a]	209.61 (494.38)	197.84 (329.84)	1319.52 (3039.74)	2112.73 (5925.22)
Subjective Detail[a]	3.56 (.68)	3.62 (.76)	4.22 (.58)	4.30 (.60)
Memory Perspective	1.34 (.50)	1.33 (.49)	1.22 (.33)	1.21 (.29)
Emotionality[a]	3.09 (.82)	3.01 (.73)	3.75 (.73)	3.59 (.64)
Valence[a,b]	3.11 (.67)	3.69 (.62)	3.56 (.83)	4.04 (.60)
Significance	2.66 (.86)	2.43 (.69)	3.06 (.91)	2.79 (.98)
Frequency of Recall[a,b]	2.65 (.87)	2.40 (.83)	3.56 (.74)	3.25 (.66)

Note. The table provides the means and standard deviations for the full memory data.
[a]Significant Age Effect, $p < .05$; [b]Significant Imagability Effect, $p < .05$.

Table 4

Means and Standard Deviations of Phenomenological Factors, By Age Group: Reduced Memory Data

	Young		*Older*	
Factors	Low (SD)	High (SD)	Low (SD)	High (SD)
Age of Memory	95.03 (60.15)	85.23 (48.69)	81.30 (74.47)	95.70 (68.14)
Subjective Detail[a]	3.63 (.66)	3.66 (.75)	4.50 (.56)	4.25 (.76)
Memory Perspective	1.27 (.49)	1.33 (.48)	1.20 (.33)	1.21 (.34)
Emotionality[a]	3.10 (.73)	2.97 (.79)	3.69 (.70)	3.51 (.77)
Valence[a,b]	3.10 (.43)	3.70 (.58)	3.50 (.82)	3.98 (.70)
Significance	2.64 (.79)	2.43 (.72)	2.88 (.90)	2.61 (1.13)
Frequency of Recall[a]	2.66 (.84)	2.35 (.85)	3.36 (.68)	3.20 (.85)

Note. The table provides the means and standard deviations for the reduced memory data.
[a]Significant Age Effect, $p < .05$; [b]Significant Imagability Effect, $p < .05$.

Table 5

Correlations for Performance on Measures and Specificity by Imagability Type

	1.	2.	3.	4.	5.	6.	7.
1. Specificity – Low, Full	-						
2. Specificity – High, Full	.58**	-					
3. Specificity – Low, Reduced	.92**	.49**	-				
4. Specificity – High, Reduced	.57**	.95**	.47**	-			
5. MR	.40**	.52**	.34*	.48**	-		
6. VPA	.26	.27	.35*	.29*	.23	-	
7. DSB	.23	.31*	.20	.29*	.42**	.28	-

Note. DSB = Digit Span Backwards; MR = Matrix Reasoning; VPA = Verbal Paired Associates.
*$p < .05$. ** $p < .01$.

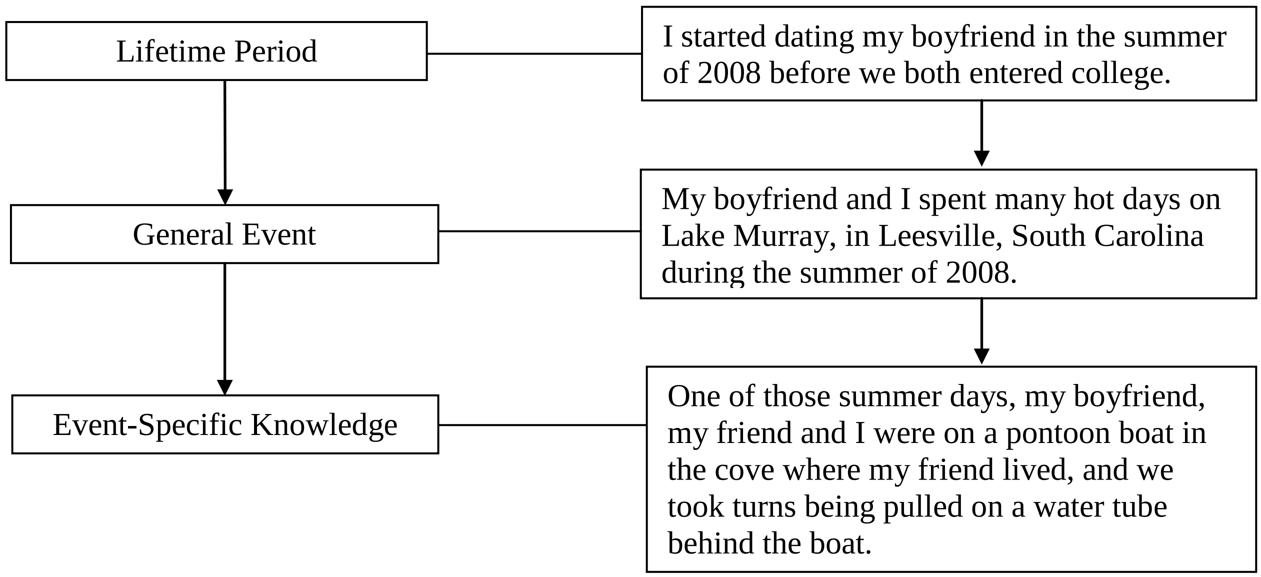

Figure 1. Illustration of the hierarchy for autobiographical knowledge.

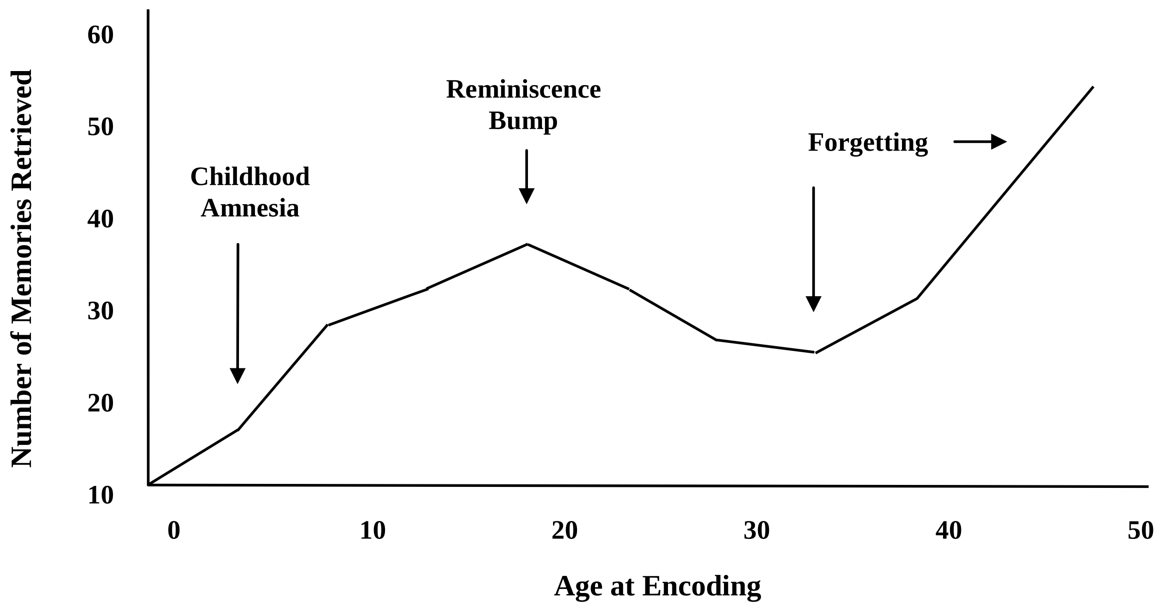

Figure 2. Age ranges for childhood amnesia, reminiscence bump, and forgetting curve.

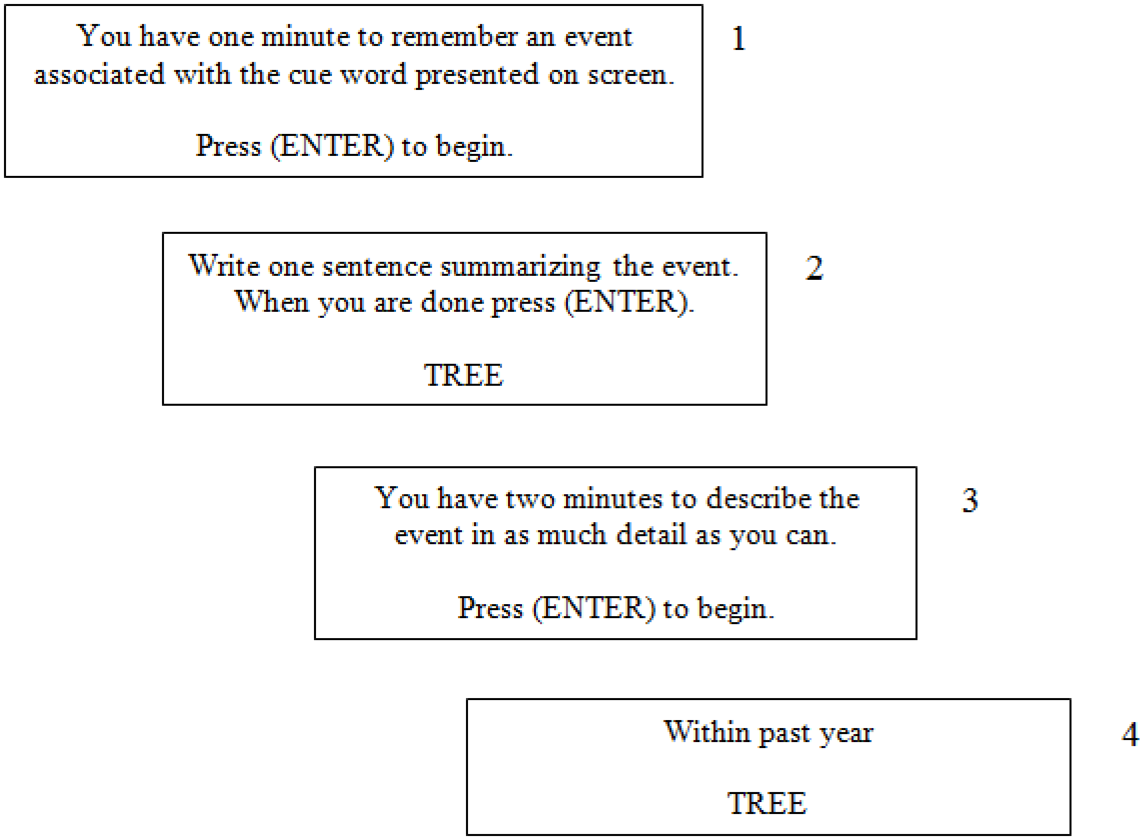

Figure 3. Autobiographical interview instructions.

1

Please provide the approximate date this event took place.

(MM/DD/YYYY)

Press (ENTER) for the next question.

2

As I remember this event, the level of detail is:

1 2 3 4 5

Vague with few ----------------------------Vivid

3

The emotional intensity I experience as I remember this event is:

1 2 3 4 5

Non-Emotional ------------Highly-Emotional

4

As I am remembering now, my feelings about this event are:

1 2 3 4 5

Negative --------------------------------Positive

5

How significant/life-changing was this event:

1 2 3 4 5

Insignificant--------------------Life-Changing

6

From what memory perspective did you recall the event:

1 2 3

As If I Were There–Watching From Above--Neither

7

How frequently have you recalled this event:

1 2 3 4 5

Never ------- A Few Times ------ Many Times

Figure 4. Phenomenological factors.

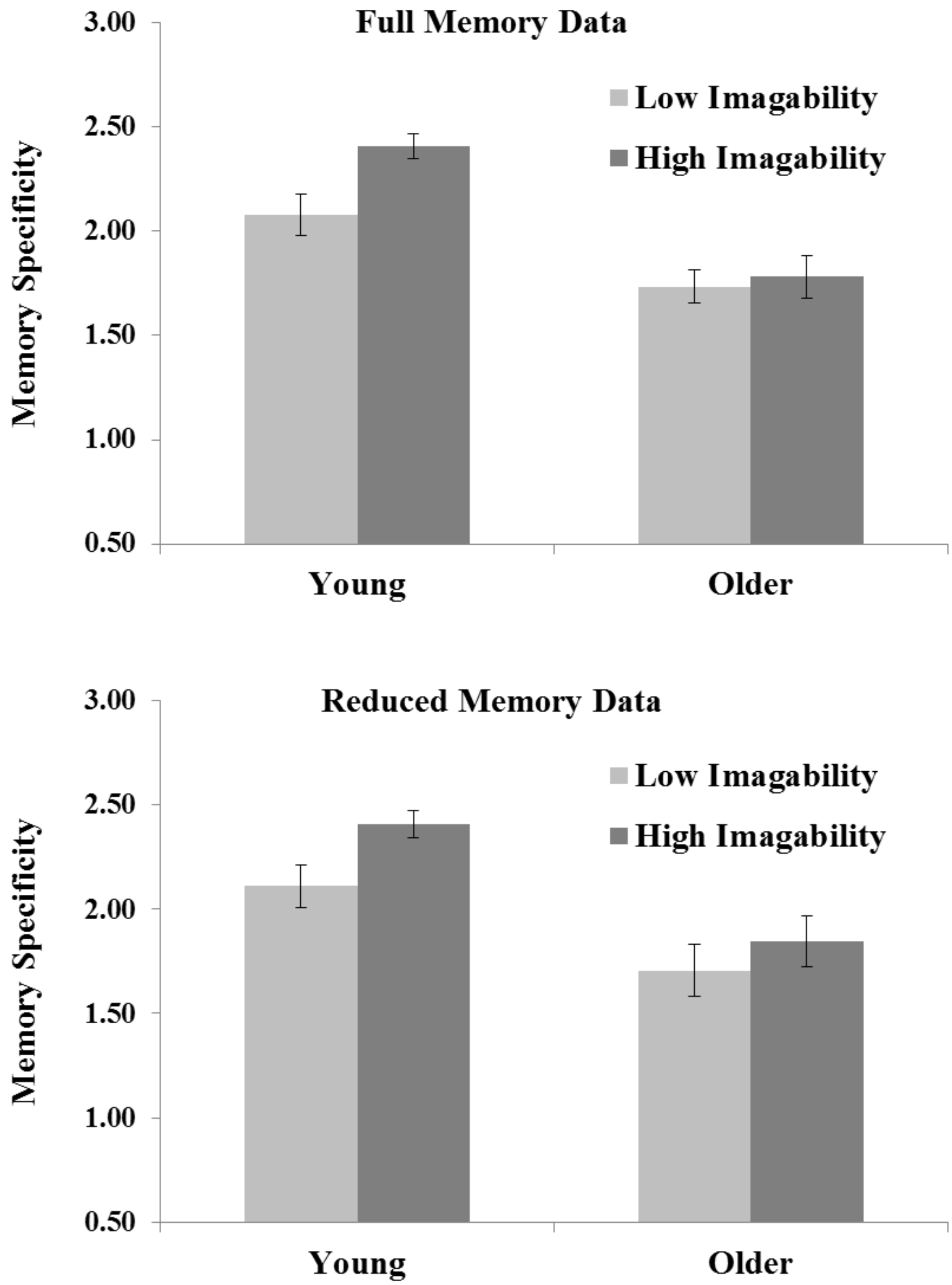

Figure 5. Level of specificity elicited from low and high imagability words across both age groups. The top panel includes the full dataset; the bottom panel includes only memories that were from the last year. Error bars represent standard errors.

Appendix A

Notice of IRB Approval: Initial

To: Heather Burkett

EMAIL

From: Dr. Stan Aeschleman, Institutional Review Board Chairperson
Date: 9/26/2013
RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Study #: 14-0023
Study Title: Retrieval of Episodic Autobiographical Memories in Older Adults
Submission Type: Initial
Expedited Category: (6) Collection of Data from Recordings made for Research Purposes,(7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.
Approval Date: 9/26/2013
Expiration Date of Approval:9/25/2014

The Institutional Review Board (IRB) approved this study for the period indicated above. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approval materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

Appendix B

Notice of IRB Approval: Modification

To: Heather Burkett

EMAIL

From: Dr. Stan Aeschleman, Institutional Review Board Chairperson
Date: 11/04/2013
RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Study #: 14-0023

Study Title: Retrieval of Episodic Autobiographical Memories in Older Adults
Submission Type: Modification
Expedited Category: (6) Collection of Data from Recordings made for Research Purposes,(7) Research on Group Characteristics or Behavior, or Surveys, Interviews, etc.
Approval Date: 11/04/2013
Expiration Date of Approval:9/25/2014

The Institutional Review Board (IRB) approved the modification for this study. The IRB found that the research procedures meet the expedited category cited above. IRB approval is limited to the activities described in the IRB approved materials, and extends to the performance of the described activities in the sites identified in the IRB application. In accordance with this approval, IRB findings and approval conditions for the conduct of this research are listed below.

Appendix C

Letter of Agreement

9/26/2013

To the Appalachian Institutional Review Board (IRB):

I am familiar with Heather Burkett's research study entitled Episodic Autobiographical Memories: Retrieval in Older Adults. I understand Lois E. Harrill Senior Center's involvement with this study is to assist with recruiting older adults for participation in the study and potentially holding sessions at the center, if space allows.

As the research team conducts this research study I understand and agree that:

- This research will be carried out following sound ethical principles and that it has been approved by the IRB at Appalachian State University.
- Older adults' participation in this project is strictly voluntary.
- To the extent confidentiality may be protected under State or Federal law, any data collected will remain confidential, as described in the protocol. The name of our agency or institution will be reported in the results of the study, to identify how participants were recruited.

Therefore, as a representative of the Lois E. Harrill Senior Center, I agree that Heather Burkett's research project may be conducted at our agency, and that the research team may assure participants that they may participate in this study as a volunteer and provide responsive information without adverse consequences.

Sincerely,

Jennifer Teague, Lois E. Harrill Senior Center Director

Appendix D

Consent to Participate in Research

Information to Consider About this Research

Recalling Past Events

Principal Investigator: Heather Burkett, B.A.
Department: Psychology
Contact Information:
Email: burketthe@email.appstate.edu
Mailing Address: Appalachian State University, P.O. Box 32109, Boone, N. C., 28608
Street Address: 222 Joyce Lawrence Lane, Boone, N.C., 28608
Phone: (828) 262-2272

Faculty Advisor: Lisa Emery, Ph. D.
Email: emerylj@appstate.edu

What is the purpose of this research?

You are invited to participate in a research study about how memories are recalled pertaining to one's past. By participating in this study you will add additional information to this area of research. By conducting this study we hope to learn how much information can be recalled from one's own past. Results from this study will help to either confirm or disconfirm already existing information in this field of research.

Why am I being invited to take part in this research? Are there reasons I should not take part in this research?

You are being invited to participate because you are a healthy volunteer at least 18 years old with no history of memory impairment. For this study we are very interested in the memories that you will be asked to recall. If you have experienced occasional memory loss or interference in recalling past events please notify the researcher.

What will I be asked to do?

- This research study will be conducted at the University Psychology Clinic, designated space at Charleston Forge (251 Industrial Park Drive, Boone) or Smith-Wright Hall where the Psychology Department is located. The location for the study will be disclosed when scheduling a session. You will need to come here 1 time during the study for approximately 2 hours.
- During this session you will be asked to describe past events that you have been directly involved in. You will be prompted to recall these events from words presented on the computer screen.
- You will have three minutes to discuss each memory, and descriptions of these memories will be audio recorded.

- In addition, you will also be asked to complete a few cognitive tests and a number of questionnaires.
- To participate in this study, you must be between **18-25** or **65-85 years old.**

What are possible harms or discomforts that I might experience during the research?

There are minimal risks with this study; however there is a possibility that you may be bored or frustrated with your performance on a few tasks. Furthermore, there is a possibility that you may recall an emotional event that may be upsetting when describing past personal events or when completing the questionnaires. Please note that you can withdraw from the session at any time.

As a student, if you experience discomfort or distress resulting from the study, services may be sought by contacting Appalachian State University Counseling and Psychological Services Center at (828)-262-3180. As a community participant, if you experience discomfort or distress resulting from the study, services may be sought by contacting Appalachian State University Psychology Clinic at (828)-262-6639.

What are possible benefits of this research?

Having the opportunity to share stories or memories from your past may be considered a benefit for you in this study.

Furthermore, information that is gained from this session may help confirm or disconfirm previous research that has been conducted in this field.

Will I be paid for taking part in the research?

Community participants in this study will receive $20.00 for attending the study. Furthermore, you can discontinue participation at any time, and you will not be penalized. You will still receive the full compensation of $20.00.

If you are a student enrolled at Appalachian State University, you will receive 4 Experiential Learning Credits (ELCs) for completing the full study. For any student who does not complete the full study, the ELCs will be pro-rated according to the amount of time (1 credit per every 30 minutes) that student participated in the study.

What will it cost me to take part in this research?

You will not be charged to partake in this research study. We are asking for participation on a volunteer basis only.

How will you keep my private information confidential?

You will be tested individually in a private room where you will be asked to elaborate on personal memories. Please only provide information that you will be comfortable discussing.

In addition, your information will be combined with other participants in this study. Your information will not be discussed on an individual basis. Furthermore, your information will be linked to a code, to insure confidentiality.
.
All information will be stored in a locked filing cabinet, within a locked laboratory, where only the Principal Investigator and Faculty Advisor have access. Paper materials will be shredded and audio recordings will be destroyed from the computer after 5 years.

Whom can I contact if I have a question?

The researchers of this study are available to answer any questions. You may contact the Principal Investigator at 828-262-2272. If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2130 or via email at irb@appstate.edu.

Do I have to participate?

Your participation in this study is completely voluntary. If you choose not to volunteer, there will be no penalty or consequence. If you decide to take part in the study you may choose to discontinue at any time during the duration of the study and still receive compensation.

This research project has been approved on 9/26/2013 by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on 9/25/2014 unless the IRB renews the approval of this research.

I have decided I want to take part in this research. What should I do now?

If you have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then sign the consent form and keep a copy for your records.

____

Participant's Name (PRINT) Signature Date

Appendix E

Background Information

Birth Date _____/_____/_____

1. Age _____

2. Female _____ Male _____

3. Ethnic Background (This information is required by our funding agency). Circle the most appropriate letter:

   a. American Indian or Alaskan Native
   b. Asian or Pacific Islander
   c. African-American, Black (not Hispanic origin)
   d. Hispanic
   e. Caucasian, White (not Hispanic origin)
   f. Other

4. Marital Status (check one):

   Single ____ Married _____ Divorced ____ Separated ____ Widowed ____

5. Education (circle the <u>highest</u> grade/year <u>completed</u>)

1 2 3 4 5 6 7 8	9 10 11 12	13 14 15 16	17 18 19 20 20+
(grade school)	(high school)	(college)	(graduate training)

6. Are you presently: (circle all that apply)

   a. Employed full-time
   b. Employed part-time
   c. Retired
   d. Retired on disability
   e. Not employed and seeking work
   f. Not employed and not seeking work
   g. Full-time student
   h. Part-time student

7. What kind of work have you done most of your life? (circle one)

   a. Never employed
   b. Housewife
   c. Other (state the specific occupation in detail)

   ____

8. Compared to other people my age, I believe my **eyesight** is (circle one):

1	2	3	4	5
Excellent				Poor

9. Compared to other people my age, I believe my **hearing** is (circle one):

1	2	3	4	5
Excellent				Poor

10. What prescription medicines have you taken in the past six months? **Please place an asterisk (*) by any medication you are currently taking.**

____
____
____

11. What illnesses and/or disorders, if any, do you have at the present time? Please be sure to include any chronic conditions (e.g., migraines, diabetes, hypertension)

____
____
____

12. How many people do you know well enough to visit with in their homes? (circle one)

a. 0
b. 1-2
c. 3-4
d. 5-6
e. 7 or more

13. About how many times did you talk to someone – friends, relatives, or others – on the telephone, in the past week (either you called them or they called you)? (circle one; if you have no phone, circle a.)

a. 0
b. 1-2 times
c. 3-4 times
d. 5-6 times
e. 1 time a day or more

14. About how many times during the past week did you spend some time with someone who does not live with you; that is, you went to see them or they came to visit you, or you went out to do things together? (circle one)

a. 0
b. 1-2 times
c. 3-4 times
d. 5-6 times
e. 1 time a day or more

15. In the past six months, how frequently have you participated in arts and crafts classes, planned and organized social or recreational programs, or in any group activities? (circle one)

a. 0
b. 1 time every two weeks
c. 1 time a week
d. 2 times a week
e. More than 2 times a week

16. In a typical day, how many hours do you spend reading and writing at work, school, and/or home? (circle one)

a. Less than 1
b. 1
c. 2
d. 3
e. 4 or more

17. In a typical day, how many hours do you spend watching television? (circle one)

a. Less than 1
b. 1
c. 2
d. 3
e. 4 or more

Appendix F

Autobiographical Interview Script

Bolded items to be read to participant

For this portion of the study, you will be prompted to remember events within the *past* year. You will see a cue word on the screen, which will be your cue to remember an event from the *past* year. You can choose any events you wish, the cue word is simply to help you remember an event. Our interest is not so much in which events you choose, but rather how you describe them. Do not feel pressure to pick any particular event, and be sure to only choose events that you feel comfortable discussing in detail.

The event you describe 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, lasting a few minutes or hours, but less than 1 day. For example, playing basketball in school would not be sufficient. However, an event involving a specific basketball game would be good. As you elaborate on the details, try to remember each event from a first-person perspective, as if you are re-experiencing the events now through your own eyes.

You will first be shown a practice trial of the procedure, followed by 10 real trials. In these trials you will be given 1 minute to recall an event. You will be asked to write one sentence summarizing the event, and then you will be asked to read out loud your sentence which will be audio recorded. Then you will be given 2 minutes to describe the event in as much detail as possible, which will also be audio recorded. After elaborating you will be asked some questions about the event you recalled.

Do you have any questions?
You may now press {ENTER} to begin the practice trial.

When necessary, general probes can be given to clarify instructions and encourage further description of details:

- If they can't think of an event from a specific cue, give the participant the option of selecting a different event. Remind them that they can describe any event; it doesn't have to be directly related to the cue word. If that doesn't work, instruct them to pick any event from the specified time period.
- If the participant can't recall a specific event:
  "Can you tell me a specific instance of…?"
- When participant is give 2 minutes to elaborate, and their response is less than 2 minutes, prompt them *TWICE* before allowing them to continue:
  "I want to know all the details that come to mind."
  "Is that everything you can say about it?"

ENTER key to exit out of a cue word early

Appendix G

One Sentence Summary of Event

Practice Event:

Event 1:

Event 2:

Event 3:

Event 4:

Event 5:

Event 6:

Event 7:

Event 8:

Event 9:

Event 10:

Appendix H

Sentence Summary Coding Scales

3.0 = 1 personal event that occurred within one day

Very detailed: images, thoughts, and emotions of event

2.5 = 1 personal event that occurred within one day

Not detailed: no images, thoughts, or emotions of event

2.0 = Personal event is repeated or is longer than one day

Very detailed: images, thoughts, and emotions of event

1.5 = Personal event is repeated or is longer than one day

Not detailed: no images, thoughts or emotions of event

1.0 = Does not pertain to an event

Expresses subjective information (e.g., likes, dislikes, opinions)

Content is general knowledge

Content is abstract

0.5 = Expresses information about others, and not themselves

Family, friend, acquaintance, stranger, etc.

Vita

Heather E. Burkett was born in 1989 to Steve and Deborah Burkett. Heather attended the Gilbert school system, graduating with honors from Gilbert High School in June of 2008. Later that year she enrolled at Midlands Technical College in Columbia, SC, and graduated with honors in 2010 with an Associate of Arts. Continuing her education she later graduated magna cum laude from the University of South Carolina, Columbia, with a Bachelor of Arts in Experimental Psychology, and a minor in Neuroscience in May of 2012. Furthering her education she moved to Boone, NC to begin her pursuit of the Master of Arts in the General Experimental Psychology program at Appalachian State University. Upon receiving her degree in 2014, Heather began her career as the Director of Life Enrichment at HarborChase of Columbia, in South Carolina.