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Fighting the Current: Recalling Specific Self-Relevant Memories

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FIGHTING THE CURRENT: RECALLING SPECIFIC SELF-RELEVANT MEMORIES

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Abstract

The present study was designed to address whether recalling specific autobiographical memories is more difficult when they are self-relevant compared to non-relevant. In recent years, a number of experimental studies have indicated that self-relevant memories are more likely to be recalled without a specific time frame or very much detail. Unfortunately, these findings have not been integrated into the popular executive resources theory of autobiographical memory recall or theories of independent semantic and episodic memory stores. This study tested the hypothesis that self-relevant memories will be accessed in the semantic store and therefore will require more executive resources to generate a final specific memory. Contrary to predictions, results demonstrated that participants with low pre-existing executive resources used more executive resources when recalling non-relevant memories compared to self-relevant memories. The unexpected pattern of results suggest that either self-relevance acted much like the self-reference effect and made recall easier or that the instructions in the non-relevant condition may have been differentially difficult.

This dissertation is approved for recommendation
to the Graduate Council.

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Introduction

When asked to recall an example of their "outgoing" behavior, self-proclaimed extroverts will likely recall a category of events. They may tell you that they were involved in the student government, implying that they have outgoing qualities. However, they may have difficulty recalling a specific instance of outgoing behavior (Brunot & Sanitioso, 2004). In fact, research has shown that people spontaneously recall general trait self-knowledge, rather than specific memories, when searching for a self-relevant memory (Klein, Sherman, & Loftus, 1996).

In recent years, a number of experimental studies have indicated that self-relevant memories are more likely to be recalled without a specific time frame or very much detail. There has been a brief flourish of research in that participants with depression recall less specific memories in response to cues relating to self-relevant, depressive themes, or depressive schemas (Barnhofer, Crane, Spinhoven, & Williams, 2007; Crane, Barnhofer, & Williams, 2007; Spinhoven, Bockting, Kremers, Schene, & Williams, 2007). Similarly, social psychologists have shown experimentally a relationship between the self-relevance of autobiographical recall and the specificity of the recalled memory (Brunot & Sanitioso, 2004). Unfortunately, this emerging pattern in autobiographical memory research has not been integrated into the larger body of literature.

Two theoretical approaches could potentially explain these findings and establish a framework to study self-relevant autobiographical memories in the future. First, there is a strong body of literature demonstrating that autobiographical memory is recalled in a hierarchical fashion, which requires cognitive resources to proceed to the desired level of the hierarchy (Conway & Pleydell-Pierce, 2000; Dalgleish et al., 2007; Haque & Conway, 2001;

Willaims, 2006). Second, there is an extensive body of literature that has demonstrated a clear distinction between semantic and episodic self-knowledge (Klein & Sherman, 1997; Klein et al., 1996). The factual based self-knowledge (semantic memory) and the event based self-knowledge (episodic memory) are stored independently of each other. Additionally, the degree of self-relevance often determines whether a memory is retrieved from the semantic or episodic storage (Klein, Babey, & Sherman, 1997; Klein, Robertson, Gangi, & Loftus, 2008). Therefore, I believe the hierarchical nature of autobiographical memory recall, combined with the distinct semantic and episodic memory stores, can account for the lack of specificity found in self-relevant autobiographical memories.

When progressing through a hierarchical retrieval process for a specific autobiographical memory, executive resources are consumed (Dalgleish et al., 2007). Executive resources are cognitive resources that are utilized for the control of attention and working memory (Banich, 2009). While the measurement of executive resources can be somewhat vague, it is a well validated construct that has been studied extensively in cognitive psychology as well as in cognitive neuroscience (Banich, 2009). Researchers have also shown that the specificity of autobiographical recall is predicted by reduced executive resources (Dalgleish et al., 2007, Neshat-Doost, Dalgleish, & Golden, 2008). Although executive resources can account for most instances of reduced specificity in autobiographical memory, its relationship with the self-relevance of those memories is unclear. Given the extensive role of executive resources in everyday cognitive functioning and its relationship with autobiographical memory recall, it is important to integrate research on self-relevance of autobiographical memories into this literature.

In order to understand how executive resources are utilized in the hierarchical search for a specific self-relevant memory, we must understand where the initial memory search begins from. Self-relevant self-knowledge is typically retrieved from a semantic store of memory (Klein et al., 1996). Therefore, the prepotent response when recalling a self-relevant memory is characterized by the broader, factual nature of semantic memory. According to a hierarchical theory of autobiographical memory recall, a memory search starting from this broader storage should require more effort to continue the hierarchical memory search to find a specific episodic memory (Haque & Conway, 2001). Alternately, less-relevant memories tend to originate from the episodic memory store and contain a greater degree of detail. These less-relevant memories should already be sufficiently specific and therefore require less effort in the search process.

The following dissertation will first give a description of autobiographical memory specificity and how it has been explained in the executive resource framework. Second, I will briefly discuss of the two distinct memory stores and their relation to the self-relevance of a memory search. Third, I will explain the small number of studies that have found that self-relevant memories are recalled as less specific. Fourth, I will discuss my hypothesized main effects and interaction. Fifth, I will discuss the methodology I used to test the hypothesis that self-relevant recall requires a relatively large amount of executive resources. Sixth, I will explain the analyses and results, as well as, a series of post hoc analyses. And finally, I will discuss the unexpected pattern of findings and their implications.

Executive Resources and Autobiographical Specificity

Executive resources are used for effortful control of mental tasks and once depleted will often result in failure to complete a complex cognitive task (Banich, 2009). Executive

resources are used for any number of everyday cognitive tasks, including recalling specific autobiographical memories (Dalgleish et al., 2007). Recalling specific autobographical memories can be a difficult cognitive task, consuming cognitive resources to move down a hierarchy from general lifetime periods to specific event memories (Conway & Pleydell-Pearce, 2000). A standardized measure of autobiographical memory specificity was developed to test for problems in generating specific memories among depressives (Williams & Broadbent, 1986). People who have difficulty recalling specific memories on this test have been shown to have significantly worse clinical outcomes (Brittlebank, Scott, & Williams, 1993; Gibbs & Rude, 2004; Mackinger, Loschin, & Leibetseder, 2000; Peeters, Wessel, Merckelbach, & Boon-Vermeeren, 2002; van Minnen, Wessel, Verhaak, & Smeenk, 2005). A broad range of explanations for this overgeneral pattern of autobiographical memory have been proposed. However, the most parsimonious explanation of this overgeneral memory phenomenon in depression is lack of executive resources (Dalgleish et al., 2007).

Executive resources are a broadly defined cluster of cognitive resources used in tasks ranging from inhibiting distractions to switching between task goals (Banich, 2009). All these executive-dependent tasks share in common the need to control attentional resources. As a construct, executive resources emerged out of Baddeley's (1996) research on the subcomponents of working memory. He proposed that the central executive coordinates between the other components of working memory to meet task demands. More recently, neuroimaging data has demonstrated that executive functioning occurs primarily within the dorsolateral prefrontal cortex, but involves additional brain regions as a cascade of activation spreads (Banich, 2009).

Research has shown that the consumption of executive resources by an executive-dependent task can lead to depletion of the executive resource pool (Schmeichel, 2007). Inhibiting distracting text while watching a television show reduced performance on a later working memory task. In a replication of this study, participants inhibited the use of certain letters while writing a story. This effortful inhibition reduced subsequent performance on an executive measure involving the recall of digit spans. In yet another replication, researchers demonstrated how this depletion can affect executive-dependent tasks that are externally valid. Participants who took an initial working memory test showed a reduced ability to inhibit emotional responses to a film clip. Therefore, prior efforts at self-control or completion of tasks requiring attention deplete the pool of executive resources available to perform other, even quite different, tasks.

The exact nature of this pool of resources is poorly specified by extant research and theory, but it appears to be related to attentional control. The resource depletion theory originated in social-cognitive research on self-control. In these early studies, researchers realized that any self-control effort would reduce the effectiveness of later attempts, even when they occur in a separate domain (Muraven, Tice, & Baumeister, 1996). More recently, evidence has suggested that both executive functioning and self-control pull from the same pool of attentional resources (Kaplan & Berman, 2010). Not only does self-control reduce performance on executive tasks, performing an executive task also reduces participants' ability for self-control (Scmeichel, 2007). For instance, participants who had used executive resources to ignore mathematical distractions had more difficulty inhibiting their emotional responses to a distressing film clip. Therefore, prior self-control efforts reduce later executive resources on working memory tasks, and vice versa. However, this shared resource is not

simply another term for intelligence. Depleting these resources via self-control tasks results in reduced performance on open-ended academic and intelligence tests, but has no effect on multiple choice intelligence tests and basic memorization tasks (Schmeichel, Vohs, & Baumeister, 2003).

Simply stated, executive resources are used to direct attention to relevant tasks. Unfortunately, completing an executive-demanding task will deplete the pool of resources and hinder performance on later executive demanding tasks. This is important in terms of self-relevant autobiographical recall because the hierarchical process of recalling autobiographical memories is an executive-demanding task (Haque & Conway, 2001). When recalling an autobiographical memory from scratch (generative retrieval), people begin with a vague memory trace of a lifetime period. In order to progress to a specific memory, people must use strategic inhibition to pick through irrelevant memories. A lack of executive resources may prevent people from successfully progressing down the autobiographical memory hierarchy to a specific memory (Haque & Conway, 2001; Williams, 2006). In a timed memory probe methodology, Haque and Conway (2001) found that participants report general autobiographical memories if recall was interrupted early and specific autobiographical memories if given more time for recall. Furthermore, additional cognitive load during this probe methodology demonstrated that the hierarchical retrieval process is in fact interrupted by competing tasks. Therefore, the present study presumes that a lack of executive resources may prevent the successful progression of a memory search to specific autobiographical memories about the self (Dalgleish et al., 2007; Haque & Conway, 2001; Williams, 2006).

Overgeneral memory is the abnormal inability to recall a specific memory, something that occurred within a single day, rather than a long-lasting memory or category of memories.

Research on overgeneral memory began with clinicians who often reported that their clients who were depressed had difficulty elaborating on autobiographical memories (Williams & Broadbent, 1986). Consequently, overgeneral memory has been studied in relation to depression and independent of psychopathology. In response to clinical reports of overgeneral autobiographical memory, researchers developed a methodology to test for differences in the specificity of recall (Williams & Broadbent, 1986). The cueing methodology from this early research has become the standard for measuring specificity of autobiographical memory.

In order to explore clinical reports of overgeneral memories in patients who were depressed, Williams and Broadbent (1986) created the Autobiographical Memory Test (AMT). This early version consisted of 5 positive and 5 negative cue words. Participants were individually shown each cue on a flashcard and told to recall a specific memory. In response to each cue, they were prompted to think of a specific event that occurred in a single day. Memories were rated by the experimenter as specific if they refer to a specific day (e.g., "eating the cake at my tenth birthday party"). They were rated as general if they refer to an event that lasted longer than a day (e.g., "summer camp") or if they refer to a general class of events (e.g., "being happy"). Therefore, a participant's performance on the AMT can be thought of as a ratio of general to specific memories.

The AMT was first employed in a study involving a group of suicide attempters, a hospital control group, and a healthy, volunteer control group (Williams & Broadbent, 1986). Ratios derived from the AMT performance revealed that suicide attempters recalled more overgeneral memories than either control group. The tendency to recall overgeneral memory has become a well-replicated effect in the depression literature.

A lack of autobiographical specificity may seem like a trivial coincidence in people with depression. However, a great deal of research has demonstrated that this lack of specificity when recalling autobiographical memories is a reliable marker for depressive outcomes (Brittlebank et al., 1993; Gibbs & Rude, 2004; Mackinger et al., 2000; Peeters et al., 2002; van Minnen et al., 2005). Despite this abundance of research on overgeneral memory in depression, no clear causal link has been drawn between overgeneral memory and depressive outcomes. This suggests that a third variable may be responsible for both overgeneral memory and depressive outcomes. It is likely that a lack of executive resources both hinders patients with depression from controlling their emotions and behaviors, and hinders their ability to complete specific autobiographical memory recall.

Individual differences in executive resources have recently been explored as a fundamental explanation for overgeneral memory in depression (Dalgleish et al., 2007; Wessel, Overwijk, Verwoerd, & Vrieze, 2008). Cognitive resource explanations have gradually become more common in depression research. For a number of years depression researchers have recognized a pattern of cognitive deficits in patients with depression (Castaneda et al., 2008). Patients diagnosed with major depression have exhibited deficits in the general domain of executive functioning, as well as numerous subcomponents of executive functioning (i.e., attention and working memory). Only recently has there been a systematic series of studies to determine the role of cognitive resources in the overgeneral memory phenomenon (Dalgleish et al., 2007). This executive resources explanation of overgeneral memory has also been corroborated by converging research from both cognitive psychology and neuropsychology (Banich, 2009; Neshat-Doost, Dalgleish, & Golden, 2008).

In order to show that individual differences in executive resources could account for much of the overgeneral memory effect, researchers tested for relationships between executive resources and the AMT (Dalgleish et al., 2007). In a set of correlational studies they administered a variety of widely accepted executive resource measures (verbal fluency, creative solutions, number generation, and fluid intelligence) in conjunction with the AMT. In every study, measures of executive resources correlated with AMT performance, even after depression had been partialed out. Some of these studies used depressive samples, while others used non-depressed volunteers. Therefore, regardless of depression and clinical diagnosis, individual differences in executive resources are inversely related to autobiographical memory specificity. Furthermore, these individual differences can account for much of the overgeneral memory effect found in depression.

Not only do individual differences in executive resources predict autobiographical memory specificity, temporary fluctuations in available executive resources also cause variation in autobiographical memory specificity on the AMT (Dalgleish et al., 2007, Neshat-Doost et al., 2008). The same researchers have shown that competing demands for executive resources reduce specificity in concurrent autobiographical memory recall and subsequent autobiographical memory recall (Dalgleish et al., 2007). In one study, they tested the effect of cognitive load (holding nine digits in memory) on the limited executive resources of a depressed sample. The results demonstrated that cognitive load caused poorer AMT performance (reduced specificity) for participants who had greater depressive symptoms. This result suggests that the limited executive resources in people with depression are strained by a cognitive load, resulting in overgeneral memory. A similar study also found that prior consumption of executive resources reduced specific autobiographical memory recall in a

subsequent test. Instead of using a cognitive load, like the previous study, these participants completed a Stroop Task (inhibiting interfering colors when reading color words) before completing the AMT (Neshat-Doost, Dalgleish, & Golden, 2008). Participants who completed the Stroop Task recalled less specific memories on the following AMT, compared to no-Stroop controls. These results remained significant, even after controlling for differences in depression level. These findings demonstrate that executive resources act as a pool with limited resources, and can remain depleted for some time after a demanding task.

Therefore, it has been clearly established that people with a limited pool of executive resources have difficulty recalling specific autobiographical memories when prompted to do so (Dalgleish et al., 2007). This is presumed to be due to the inability to continue the hierarchical memory search leading from the initial general memory trace to the final specific memory (Haque & Conway, 2001). I propose that the amount of executive resources consumed is also contingent on where the memory search begins.

Semantic and Episodic Storage

When recalling memories of varying self-relevance, it is possible that the hierarchical search does not always begin in the same place in memory. In fact, there are theoretical reasons to believe the search may begin in distinctly separate memory stores depending on the self-relevance of the initial memory cue (Klein et al., 1996; Klein et al., 2009).

An extensive line of research suggests that personal memories are stored in two distinct systems providing different levels of detail (Klein et al., 2009). This theory holds that people store semantic self-knowledge (broad, factual information) and episodic self-knowledge (detailed, event memories) separately. Both experimental and case studies have supported this theoretical distinction between the two systems of memory (Klein et al., 1997;

Klein et al., 1996). Using priming. researchers have shown that these two systems are functionally independent (Klein, Loftus, & Burton, 1989; Klein et al., 1997). This priming methodology involved two subsequent tasks: First, participants were instructed to either describe themselves with a trait adjective (semantic), to recall a specific instance of exhibiting a trait (episodic), or to define a trait word (control). Next, they were given one of the same three possible tasks. If semantic and episodic self-knowledge is stored in the same network, priming a semantic trait should lead to a speeded response for the following task regardless of whether it is semantic or episodic. On the other hand if semantic and episodic self-knowledge is stored in different networks, priming with the semantic instructions should only affect a subsequent semantic task. Only the latter result has been found, demonstrating that semantic and episodic self-knowledge exist in separate networks (Klein et al., 1997).

This distinction between the two memory stores for self-knowledge has also been demonstrated in a temporary amnesic college student and an autistic child (Klein, Chan, & Loftus, 1999; Klein et al., 1996). In one case, a college student received a concussion during her first semester of college. Researchers capitalized on her temporary amnesic state by testing her semantic and episodic self-knowledge from her first semester (Klein et al., 1996). Consistent with their theory of separate memory stores for semantic and episodic self-knowledge, Klein and colleagues found that this student had severely disrupted episodic knowledge but seemingly intact semantic self-knowledge. However, it was possible that her semantic self-knowledge about college was inferred from pre-accident memories of high-school. In another case study without such a potential confound, these researchers found similar results (Klein et al., 1999). R.J. was a young man who had been diagnosed with autism. Like other autistic children, R. J. had shown developmental delays and intellectual

impairment. He also demonstrated good semantic self-knowledge and very impaired episodic self-knowledge, relative to normal controls.

These researchers have claimed that the semantic store of memory has evolved out of a basic need for fast, efficient evaluations of ourselves and the people around us (Klein et al., 2009). They have also claimed that the episodic store of memory allows us to modify our evaluations based on conflicting details.

According to this theory, episodic information from multiple events is abstracted into trait knowledge about the self-concept (Klein & Loftus, 1993; Klein et al., 1996). Episodic information from multiple similar experiences (i.e., attending parties and going out) is abstracted into semantic self-knowledge with a common theme (i.e., extroversion), while information from distinct experiences remains in a more detailed episodic form. In order to demonstrate that multiple similar experiences form semantic self-knowledge, Klein and colleagues (1996) examined the previously mentioned priming effect in relation to domains of high and low experience. They primed college freshmen by instructing them to describe themselves back home (high experience) or describe themselves in college (low experience). Participants who were given a high experience prime (describe home) showed equivalent reaction times for recalling specific episodic memories from home or college. Participants who were given a low experience prime (describe college) showed faster reaction times when recalling specific episodes from college. In other words, participants relied on semantic self-knowledge to describe themselves in a high-experience context (home) but relied on episodic self-knowledge to describe themselves in a low-experience context (college). This is consistent with their theory that episodic memories are abstracted into semantic self-knowledge once enough of them have accumulated.

Thus when people try to recall a memory that exemplifies their personality, they rely on the more general trait information about themselves stored as semantic self-knowledge. If they had a large number of experiences in that they acted in an extraverted manner, these experiences would have been abstracted into semantic self-knowledge that they were an extrovert. On the other hand, when people try to recall a memory that is inconsistent with their personality, they search for a more specific exemplar that would not fit their trait self-knowledge. If they had very few experiences in that they acted in an introverted manner, these experiences would remain in the episodic store. Regardless of depression, a person who searches their memory for trait knowledge should spontaneously access their semantic store of trait self-knowledge. Therefore, participants who are instructed to recall specific memories to self-relevant cues are likely to begin their search in the more abstract, semantic store. Past research on these separate memory stores, as well as research on executive resources could potentially explain the relatively new findings on self-relevant autobiographical memory specificity.

Self-Relevance and Specificity

A small literature has shown that self-relevant autobiographical memories are often recalled as less specific than non-relevant autobiographical memories. In a few clinical studies, AMT cues relevant to depressive schemas resulted in less specific memories than non-relevant cues (Barnhofer et al., 2007; Spinhoven et al., 2007). Also, a similar pattern has been identified in social-cognitive research (Brunot & Sanitioso, 2004). This research suggests that people tend to recall general memories when searching for information consistent with their self-schemas, but tend to recall specific memories when searching for information inconsistent with their self-schemas.

Within the depression literature, dysfunctional attitudes are self-reported attitudes in depression that are believed to be part of an overarching depressive schema (Clark, Beck, & Alford, 1999). One example of an approval-based dysfunctional attitude is : "I should be able to please everybody". These attitudes are believed to be part of the biased cognitive processing resulting from a depressive self-schema. In a study using only previously patients with depression, the participants' endorsement of dysfunctional attitudes predicted the specificity of their responses to AMT cues related to those attitudes (Spinhoven et al., 2007). High endorsement of these dysfunctional attitudes was related to less specific memories in response to dysfunctional attitude cues. However, this particular study failed to show that the self-relevance of these dysfunctional attitudes was directly related to autobiographical specificity. When biographical variables and depression severity were entered into a hierarchical regression, the effect of self-relevance was no longer significant. Therefore, this study only provides partial support for the relationship between self-relevance and autobiographical memory specificity.

In another study using previously depressed and never depressed participants, experimenters administered the Dysfunctional Attitude Scale (DAS: Weissman, 1979) followed by the AMT a week later (Barnhofer et al., 2007). Half of the AMT cues were given under a dual task condition, in which participants randomly pressed computer keys while verbally responding to the cues. As the executive resources theory would predict, participants generated fewer specific responses when their executive resources were taxed by the dual task demands. The results also revealed a three way interaction among depression, cognitive load, and dysfunctional attitudes (self-relevance) for dysfunctional attitude cues. Previously depressed participants who endorsed high levels of dysfunctional attitudes and who were

under cognitive load recalled less specific memories in response to dysfunctional attitude cues (self-relevant cues). Therefore, self-relevant cues led to the recall of overgeneral autobiographical memories, but only in previously depressed participants whose executive resources were already strained.

In a another study by these researchers, previously depressed and never depressed participants provided self-descriptive words and returned a week later to take an AMT (Crane et al., 2007). The AMT consisted of a variety of personality cues (friendly, thorough, useless), some of that would inevitably overlap with participants' self-descriptions. The results revealed an interaction in that cue self-relevance was negatively correlated with specificity of responses for previously depressed participants, while there was no significant correlation for never-depressed participants. Combined with the previous two studies, there appears to be converging correlational support of the effect of self-relevant cues on the specificity of autobiographical recall. In the first two studies, the authors suggested that dysfunctional attitude cues lead to overgeneral memory. However, the third study demonstrated that a similar effect can be found in previously depressed participants in response to their own self-descriptions. Therefore, this effect appears to exist for any self-relevant cue given to a previously depressed sample.

There is additional evidence that this effect of self-relevance on specificity exists outside of depression. The self-relevance of autobiographical memories has been experimentally manipulated in a non-clinical sample (Brunot & Sanitioso, 2004). Participants were led to believe that either introversion or extraversion was related to success and then asked to think about why this might be true. In what was ostensibly a second study, participants were asked to write down instances in that they behaved in an introverted or

extroverted manner. Participants were not instructed as to how specific their memories should be. Instead, their memories were later coded for specificity. Two blind raters coded each memory according to the same basic criteria used in the AMT. For introverted memories, introversion-success participants recalled more general than specific memories, relative to extraversion-success participants. For extraverted memories, extraversion-success participants recalled more general than specific memories, relative to introversion-success participants. Although extraverted memories mirrored the pattern for introverted memories, the interaction for extraverted memories did not reach significance. Therefore, this study only provides partial evidence that recalling self-relevant memories leads to reduced autobiographical specificity. Participants spontaneously recalled less specific self-relevant, introversion memories, again suggesting that beginning the memory search in the semantic self-knowledge store of general memories is more typical when searching for self-relevant memories. I propose that the tendency for self-relevant memories to be recalled as less specific is the product of the memory store they are recalled from and how many resources are used to shape them into a specific memory.

Integrating Executive Resources and Self-Relevant Recall

When recalling memories related to depressive self-schemas, people with depression are likely to begin with broad, semantic information, just like everyone else (Brunot & Sanitioso, 2004; Klein et al., 2009). Trimming these broad, semantic memories down to specific memories would likely require more executive resources for strategic inhibition than simply beginning with a relatively specific episodic memory. Not only do the low baseline levels of executive resources in participants with depression predict the specificity of their responses on a standard AMT, these individual differences also interact with the self-

relevance of dysfunctional attitude AMT cues to produce less specific responses (Dalgeish et al., 2007; Barnhofer et al., 2007). Unlike participants with depression who recalled overgeneral memories in response to dysfunctional attitude cues, non-depressed participants showed no effect of cue self-relevance (Barnhofer et al., 2007). This would suggest that only previously-depressed participants lacked the necessary executive resources to inhibit the broad, semantic memories that are initially retrieved, while continuing to search for specific memory traces (Klein et al., 2009). However, no prior research has actually tested whether inhibiting the prepotent memory traces during self-relevant recall actually consumes greater amounts of executive resources.

Despite the proposed mechanisms involving hierarchical retrieval that begin at a semantic level, an alternative pattern could also be true. It is possible that self-relevant memories are always easier to recall. Indirect evidence is found in research on the self-reference effect (Rogers, Kuiper, & Kirker, 1977), in which enhanced encoding is found for information that has been evaluated for its self-relevance. Participants have better memory for an item when they consider whether that item is self-relevant or non-relevant.

Current Study

The current study will test the hypothesis that recalling specific self-relevant memories consumes more executive resources than recalling specific non-relevant memories. Although participants may have an abundance of self-relevant information, it is presumably stored in a general semantic self-knowledge system (Klein et al., 2009). When external task demands require a specific self-relevant memory, participants should spontaneously access this semantic store (Klein et al., 1996). In order for this retrieval process to progress to the specific self-relevant memory, participants must employ controlled inhibition of the inappropriate

memories and continue the search (Conway & Pleydell-Pearce, 2000). The volume of executive resources available during this inhibition will vary by individual (Dalgleish et al., 2007). Furthermore, individual pools of executive resources will remain depleted following the effortful inhibition (Schmeichel, 2007). Therefore, I will assess the depletion of executive resources caused by recalling self-relevant memories by measuring remaining executive resources following recall. I hypothesize that participants recalling specific, self-relevant memories will have fewer remaining executive resources than participants recalling specific, non-relevant memories. This prediction is based on prior research in that recalling self-relevant recall spontaneously leads to semantic memories that should theoretically require more executive resources to inhibit (Haque & Conway, 2001; Klein et al., 2009). My second hypothesis predicts an interaction between individual differences in executive resources and self-relevance, such that participants with low pre-existing executive resources will be most affected by the self-relevance of the memory cues. This prediction is consistent with research in which the effect of self-relevance emerged when executive resources were taxed (Crane et al., 2007).

An alternative set of hypotheses is based on a general assumption that self-relevant memories are simply easier to recall. Although no direct evidence has shown that self-relevant autobiographical memories are more accessible, two lines of research provide indirect evidence for this notion. First, participants who encode items by considering its self-relevance remember it better than if they encoded it by considering the items' meaning (Symons & Johnson, 1997). Second, participants are more likely to remember character traits from a story if those character traits are chronically accessible, or used to describe people on a regular basis (Higgins, King, & Mavin, 1982). Therefore, it is possible that self-relevant

autobiographical memories are encoded more effectively and chronically accessible. If this was the case, I would hypothesize a main effect of self-relevance such that participants in the non-relevant condition would exhibit lower remaining executive resources. Next, I would hypothesize an interaction such that participants who began with low levels of executive resources would have especially low levels of remaining executive resources after recalling non-relevant autobiographical memories.

Methodology

Participants

Ninety-one psychology students at the University of Arkansas participated in the experiment as partial fulfillment of a course requirement. The experiment lasted approximately half an hour, for which participants received .5 experimental credits toward their General Psychology class requirement. An a priori power analysis indicated that 77 participants would be needed to identify a medium-sized effect ($f^2 < .15$) in a fixed-factor hierarchical linear regression, using $\alpha = .05$ and $\beta = .2$. This sample was more than adequate for detecting a medium effect size considering that two related studies found significant results with relatively small samples. One study, using an executive task to deplete resources and therefore alter AMT performance, found significant pair-wise effects with a small sample, $F\ (2, 47) = 7.29$, $p < .01$, $\eta^2 = .24$ (Neshat-Doost et al., 2008). Using a very small sample, the second study found a correlation between the autobiographical specificity and the same number generation measure proposed in the current study, $r\ (19) = -.39$, $p < .05$ (Dalgleish et al., 2007).

Design

The experiment employed a two-factor design with self-relevance of memory cue (relevant and non-relevant) and pre-existing executive resources (continuous factor) as between-subjects variables. For analyses, self-relevance was dummy coded (0 = non-relevant, 1 = relevant). Self-relevance, individual differences in executive resources, and their interaction term were entered into a hierarchical linear regression on remaining executive resources. This design allowed me to test the hypothesized interaction in which the effect of self-relevance on remaining executive resources is more pronounced in participants with low pre-existing executive resources.

Materials

Thurstone Verbal Fluency Test. In order to obtain a baseline measure of executive resources, a modified version of the verbal fluency test was used (Lezak, 1995). Participants were instructed to list as many words beginning with the letter *s* as possible in one minute. Participants were warned that repetitions, proper nouns (e.g., Switzerland), and words of the same origin (e.g., swim, swimming) would not count. The total number of acceptable words was used as a final score. Although the original Thurstone Verbal Fluency Test included two tests lasting a total of nine minutes, this abbreviated one-minute version has been successfully used in autobiographical memory research (Dalgleish et al., 2007).

Memory Cueing Methodology. Slightly different cueing methodologies were provided for each condition. Participants in the self-relevant condition were instructed to write three adjectives that they felt described who they are. Participants in the non-relevant condition were instructed to write three adjectives that they felt were poor descriptions of who they are. After choosing three adjectives, participants in both conditions were instructed to recall a specific memory for each adjective. The experimenter checked the specificity of each

memory, reminding the participant what the criteria was for a specific memory if the recalled memory did not meet criteria (a single event occurring within a day). Once participants reached criteria for a specific memory, they proceed to the next adjective. The experimenter was kept blind to the participant's condition. Data collected from this task were only used for the manipulation check.

Number Generation Task. In order to obtain a measure of remaining executive resources, a number generation task followed the autobiographical recall. This task included fifteen items requiring participants to generate numbers that satisfied two or more constrains (e.g., "Could you please give me a sequence of any five numbers within the range one hundred up to five hundred?"). These items required executive functioning in order to generate a sequence of the correct length while remaining within the bounds. As the required sequence become longer, failures to satisfy the constraints increase. Also, when the boundaries are odd numbers, failures to satisfy the constraints also increase. Consistent with past research, these items were presented to participants verbally (Dalgleish et al., 2007; Scott, Barnard, & May, 2001). Three types of errors were entered by a single coder: numbers not in sequence, an incorrect number of digits, and numbers that fall outside the upper or lower bounds. A total error score was computed by summing all three types of errors. This error score was the dependent variable of interest (Dalgleish et al., 2007).

Predictions

The total error scores from the number generation task provided a measure of remaining executive resources. A relatively large number of total errors would indicate low remaining executive resources, while a relatively small number of total errors would indicate high remaining executive resources. Using a hierarchical linear regression, pre-existing

executive resources, self-relevance, and their interaction term were regressed upon the total error score. All three terms were predicted to account for significant portions of variance (see Figure 1). In other words, low levels of pre-existing resources should have led to easy depletion of the executive resource pool. Similarly, the self-relevant condition, which requires inhibition of the prepotent semantic memory trace in order to meet task demands, should have depleted the executive pool to a greater degree. Furthermore, participants who had low pre-existing levels of executive resources should have been depleted more by the difficult self-relevant condition.

Results

After removing the data of 7 participants who did not complete the packets, data from 84 participants were included in the analyses. To assure that participants in both conditions performed equally well on the autobiographical recall task I did a manipulation check of their recall responses. Participants generally recalled specific autobiographical memories in the first attempt for each personality trait listed. The average number of failures to retrieve a specific memory was low, $M = .52$, $SD = .82$. Also, the number of mistakes on the autobiographical recall task did not differ by condition, $F(1, 82) = .59$, *ns*. Therefore, participants in both conditions were equally capable of recalling specific autobiographical memories.

Primary Analyses. The primary analysis was a hierarchical linear regression. In the first step, individual differences in executive resources (centered word generation scores) and experimental condition (dummy coded experimental condition) were regressed on remaining executive resources. In the second step, the interaction between individual differences and experimental condition was added to the model. Remaining executive resources were

computed by summing errors on the number generation task and reversing the sign of this error score. In other words, the more errors participants made on this executive dependent task the fewer executive resources they are presumed to have in their pool (refer to Table 1).

The regression model from the first step accounted for a significant amount of variance in remaining executive resources, F (2, 81) = 4.65, $p < .02$, adjusted $R^2 = .08$. As expected, participants with higher individual levels of executive resources performed marginally better on the final executive measure, $\beta = 1.36$, $p < .10$, $sr^2 = .03$. Contrary to predictions, participants in the self-relevant condition ($M = -2.20$, $SD = 2.23$) performed significantly better on the final executive measure than participants in the non-relevant recall condition ($M = -3.79$, $SD = 3.41$), $\beta = 1.54$, $p < .02$, $sr^2 = .07$.

The regression model from the second step (including the interaction) accounted for significantly more variance than the first step, F (3, 80) = 17.20, $p < .01$, adjusted $R^2 = .26$. Similar to the previous step, pre-existing executive resources also accounted for a significant portion of unique variance, $\beta = .21$, $p < .01$, $sr^2 = .07$. The experimental condition also accounted for a significant portion of variance, $\beta = 1.52$, $p < .01$, $sr^2 = .07$. Most notably, the interaction of individual differences of executive resources and experimental condition accounted for a significant portion of variance, $\beta = -.63$, $p < .01$, $sr^2 = .16$.

This interaction was further examined by regressing pre-existing executive resources on remaining executive resources separately for each experimental condition. For participants recalling self-relevant memories, there was no relationship between pre-existing executive resources and remaining executive resources, $\beta = -1.2$, *ns*. For participants recalling non-relevant memories, there was a positive relationship between pre-existing executive resources and remaining executive resources, $\beta = .52$, $p < .01$, adjusted $R^2 = .27$. Therefore, participants

with low pre-existing levels of executive resources used more resources to recall non-relevant autobiographical memories than to recall self-relevant autobiographical memories (refer to Figure 1).

Secondary Analyses. One possible confound that could not be ruled out by the current methodology was the negativity of the memories being recalled. It was possible that any effects in the primary analysis could be at least partially due to the negativity of the autobiographical memories themselves. It was possible that if one condition may have recalled more negative memoires. Additionally, negative memories could require more executive resources due to their limited accessibility (Bower & Gilligan, 1979; Holmes, 1970). Researchers have known for decades that participants are more likely to recall positive memories. Therefore, if the experimental manipulation of self-relevance is confounded by negativity, one condition may have the advantage of recalling readily accessible positive memories while the other condition must recall less accessible negative memories. Negativity of the autobiographical memories was not addressed in the a priori predictions but was worth further exploration. To address this possible confound each of the three memories were coded as Positive (1), Neutral (2), or Negative (3). Their negativity scores were summed to create an overall negativity composite score for participants' autobiographical recall. Participants typically recalled a neutral mix of memories (M = 6.04, SD = 1.62). Not surprisingly, participants in the self-relevant condition (M = 5.39, SD = 1.32) recalled significantly less negative memories than the non-relevant condition (M = 6.68, SD = 1.65), F (1, 80) = 15.34, p < 01, partial η^2 = .16. However, negativity was not related to the final measure of remaining executive resources, p > .05, and therefore it cannot explain the pattern of results obtained.

Although negativity had been ruled out as a confound, a secondary hierarchical linear regression was conducted to included negativity and the interactions involving negativity. This regression included three steps: The first step was similar to the first step in the primary analyses, except it also included negativity as a predictor. The second step was also similar to the second step in the primary analyses, except it included an interaction term of negativity and condition as well as an interaction term of negativity and individual differences in executive resources (two-way interactions). The third step included a three-way interaction term of negativity, self-relevance condition, and pre-existing executive resources into the model (refer to Table 2).

The regression model from the first step accounted for a significant amount of variance in residual executive resources, F (3, 78) = 3.30, $p < .03$, adjusted $R^2 = .08$. Participants with higher individual levels of executive resources performed marginally better on the final executive measure, $\beta = .15$, $p < .09$, $sr^2 = .03$. Participants in the self-relevant condition performed significantly better on the final executive measure, $\beta = 1.84$, $p < .02$, $sr^2 = .08$. Consistent with the lack of correlation mentioned above, negativity of memories was unrelated to performance on the final executive measure, $\beta = .22$, *ns*.

The regression model from the second step (including the two-way interactions) accounted for significantly more variance than the first step, F (6, 75) = 7.07, $p < .01$, adjusted $R^2 = .25$. Within this model, pre-existing executive resources also accounted for a significant portion of unique variance, $\beta = .21$, $p < .02$, $sr^2 = .06$. Self-relevance condition accounted for a significant portion of unique variance, $\beta = 1.65$, $p < .02$, $sr^2 = .06$. Again, negativity of memories remained unrelated to performance on the remaining executive measure, $\beta = .12$, *ns*. As in the primary analyses, the interaction between individual

differences of executive resources and self-relevance condition accounted for a significant portion of unique variance, β = -.74, $p < .01$, sr^2 = .16. Also, the interaction between negativity of memories and self-relevance condition accounted for a marginally significant portion of unique variance, β = -.79, $p < .06$, sr^2 = .03. Finally, the interaction between negativity and individual differences in executive resources did not account for a significant portion of variance, β = -.04, *p = ns*.

The regression model from the third step (including a three-way interaction) did not account for significantly more variance in residual executive resources than the model from the second step and will not be discussed any further, F (1, 74) = .18, *ns*. It is worth noting that the regression model (second step) from the secondary analyses only accounted for marginally more variance than the regression model from the primary analyses, F (6, 75) = 1.86, $p < .14$, adjusted R^2 = .25.

Interestingly, the relationship between pre-existing executive resources and remaining executive resources, as well as the relationship between self-relevance and remaining executive resources, were similar to those found in the primary analyses. However, the interaction between pre-existing executive resources and self-relevance was opposite in direction to that found in the primary analyses (see Figure 2). Additionally, the secondary analyses revealed a marginally significant interaction between negativity and self-relevance (refer to Figure 3). This interaction was further explored by performing separate regressions of negativity for each experimental condition. For participants recalling self-relevant memories, there was no effect of memory negativity on performance on the final executive measure, β = .47, *ns*. Similarly, participants recalling non-relevant memories did not evidence a relationship between negativity and remaining executive resources, β = .38, *ns*. The results

of the secondary analyses are interesting because they essentially reverse the interaction between self-relevance and pre-existing executive resources. In the primary analyses, self-relevant recall led to more remaining executive resources. However, this simple effect only occurred in participants with low pre-existing executive resources. In the secondary analyses, self-relevant recall led to more remaining executive resources. In this case, the simple effect only occurred in participants with high pre-existing executive resources. These findings are somewhat perplexing and will be discussed below in greater detail.

Conclusion

In the present study I hypothesized that low levels of pre-existing resources should have led to easy depletion of the executive resource pool. Also, the self-relevant condition, which was believed to require inhibition of the prepotent semantic memory trace, should have depleted the executive pool to a greater degree. Finally, participants who had low pre-existing levels of executive resources should have been depleted more by the difficult self-relevant condition. As predicted, participants who had high pre-existing levels of executive resources also had relatively high levels of remaining executive resources following the recall task. This of course was expected since participants with large pools of executive resources would be less affected by any depleting task. Contrary to predictions, participants instructed to recall self-relevant memories had more remaining executive resources than participants instructed to recall non-relevant memories. Therefore, self-relevant memories were easier to recall. Finally, self-relevance and pre-existing executive resources interacted such that participants who began with low pre-existing executive resources had fewer remaining executive resources after recalling memories of low self-relevance. Participants who began with high pre-existing executive resources were not differentially affected by the self-relevance manipulation. There

appeared to be a ceiling effect for remaining executive resources. This was confirmed by a positive skew in errors made on the remaining executive resource measure such that most participants made very few errors, D (85) = .21, $p < .01$.

When secondary analyses were run to include the possible confounding effects of the negativity of memories recalled, the main effect of self-relevance, a marginal effect of pre-existing executive resources, and a two-way interaction between self-relevance and pre-existing executive resources all remained. However, the interaction between pre-existing executive resources and the self-relevance of recall was reversed. When negativity of the memories was statistically controlled for in the secondary analyses, participants who began with high pre-existing executive resources had more remaining executive resources after recalling high self-relevance memories. Participants who began with low pre-existing executive resources were not differentially affected by the self-relevance manipulations. Although it is not entirely clear why statistically controlling for negativity altered the pattern of the interaction between self-relevance and pre-existing executive resources, it is most likely due to the fact that the non-relevant condition recalled significantly more negative memories, F (1, 82) = 16.53, MSE = 2.25, p <.01. However, negativity was unrelated to remaining executive resources, which makes any explanation based on negativity of the recalled memories insufficient. The difference between the high self-relevance and the low self-relevance conditions for participants with low pre-existing executive resources disappeared once negativity was statistically controlled for (refer to Figure 1 and Figure 2). This may have been due to the fact that the low self-relevance condition recalled more negative memories, which were potentially more difficult. Therefore, I might argue that participants with low pre-existing executive resources performed worse due to the difficulty of negative memories, not

due to the difficulty of low self-relevance. Unfortunately, this logic does not help to explain the pattern of results for participants with high pre-existing executive resources. I would have expected that participants with high pre-existing executive resources would have relatively high remaining executive resources regardless of whether they recalled high self-relevance or low self-relevance memories. In fact, this is what the primary analysis showed (refer to Figure 1). However, self-relevant memories were less negative and therefore may be relatively easier. This means that statistically controlling for difficulty should have removed the relative ease of recalling highly self-relevant memories. This increased difficulty of recalling self-relevant memories should have been evidenced by decreased remaining executive resources in the self-relevant condition. However, the results showed that participants with high pre-existing executive resources, who recalled highly self-relevant memories, actually saw an increase in remaining executive resources once difficulty was statistically controlled for (refer to Figure 2). Therefore, an interpretable pattern has not emerged from the secondary analyses, but the negativity of recalled memories will provide an interesting avenue for future research

There are theoretical reasons to believe that recalling self-relevant memories to meet specificity criteria would require more executive resources than recalling non-relevant memories to the meet the same specificity criteria (Dalgleish et al., 2007; Haque & Conway, 2001; Klein et al., 1996). However, the present results do not support this hypothesized pattern. Participants who recalled self-relevant memories made relatively few errors on the final executive resource task, indicating that the self-relevant recall had not depleted their pool of executive resources. Participants who recall non-relevant memories made a greater number of errors on the final executive resource task, indicating that the non-relevant recall had depleted their pool of executive resources. However, this pattern only existed in

participants who had low levels of pre-existing executive resources. Participants who began the experiment with high levels of executive resources appeared to be unaffected by either recall condition. This relative ease with that participants with high executive resources completed the remaining executive resource task was evidenced by a significant skew; that is, they made very few errors.

Although these findings were counter to my original hypotheses, they raise some very intriguing questions. One methodological explanation for the main effect of self-relevance is that executive resources used to recall autobiographical memory may have been unintentionally consumed by the somewhat confusing directions in the non-relevant condition. In order to generate non-relevant cues, the instructions blatantly asked participants to provide three trait adjectives that did not describe them. Immediately after they wrote down these three trait adjectives, they were asked to recall specific instances in which they exhibited these adjectives. This task would be difficult and counterintuitive for reasons other than the hypothesized autobiographical recall process. In contrast, participants in the self-relevant condition were instructed to generate three trait words that did describe themselves and then to generate specific instances in which they exhibited those traits. This task did not appear to confuse the participants and therefore would be easier for reasons other than the hierarchical search process. In fact, a number of participants voiced their confusion about the non-relevant condition. Therefore, the non-relevant condition may have been confounded by an increased difficulty of interpreting the counterintuitive instructions.

Addressing this methodological issue brings up questions about the operationalization of self-relevant memories. Are non-relevant autobiographical memories simply neutral memories that are entirely independent of a person's self-concept or are they memories that

define the boundaries of the self-concept by establishing a rare exception in which a person's behavior did not coincide with their more characteristic behavioral patterns? Empirical evidence suggests that memories that characterize the self are stored and retrieved differently than memories that do not (Klein et al., 1996). Additionally, new memories are assimilated into our semantic self-knowledge if they are consistent with past behavior (Klein et al., 2009). Future research should therefore use the term "less relevant" rather than "non-relevant" to avoid confusion. I am primarily interested in differences in recall between memories that are characteristic of the self and memories that are not characteristic but may none the less be self-relevant because they define the boundaries of the self.

In order to clarify these results, future research must employ a cueing methodology that allows both conditions to be free of unnecessary cognitive dissonance. One way to approach this problem is to use trait adjectives that are self-relevant (or not) while still maintaining a degree of ambiguity. For instance, Brunot and Sanitioso (2004) used introverted and extroverted as trait adjectives to cue autobiographical memory recall. Introversion and extroversion are ambiguous in that they are a bipolar continuum. Everyone is introverted to some degree and extraverted to some degree. Unlike that of other researchers, my methodology required the use of idiosyncratic trait adjectives. However, I could generate a list of more ambiguous trait adjectives that participants could rate for self-relevance. Presumably the degree of self-relevance for each adjective would remain fairly stable over time, during which time participants' memory for their self-reported ratings would fade. The experimenter could bring participants back into the lab after a couple of weeks and ask them to recall memories for either the three most self-relevant or the three least self-relevant traits from their earlier self-reported rankings. By separating the generation of trait adjective cues and the

recall of autobiographical memories for the three most (or least) relevant cues, the cues could remain somewhat ambiguous and would not arouse dissonance.

A second, more literal interpretation of the main effect of self-relevance is that specific, self-relevant memories are easier to recall than specific, non-relevant memories. This explanation is generally consistent with research on the self-reference effect and chronic construct accessibility (Higgins et al., 1982; Rogers et al., 1977). There is substantial experimental evidence that information is encoded much more effectively when their self-relevance is considered (Symons & Johnson, 1997).The self-reference effect is traditionally demonstrated by having participants either make semantic judgments about a list of words (is the target word a synonym to some other word) or make self-reference judgments about the same list of words (does the word describe you). Using this methodology Rogers and colleagues (1977) concluded that the self-concept has special encoding properties. More recently, this effect has been explained by a dual process theory of *elaboration* and *organization* (Klein & Loftus, 1997). Elaboration is the encoding process that occurs when a person encounters a single item and thinks of the various schemas to which it is related. For instance, when an extrovert sees the word outgoing she may think of her self-concept as an extrovert. Organization is the encoding process that occurs when a person sees multiple related items and interprets them as related information. In this case, an extrovert who is thinking about her self-concept may see a group of words that are all related to her. In both *elaboration* and *organization* the information is encoded more effectively. The primary problem with drawing parallels between the self-reference effect and the present set of results is that the self-reference effect occurs regardless of how self-relevant an item is. In other words, if you evaluate the self-relevance of an event only to determine that it is irrelevant to

your self-concept your memory will still be enhanced. However, self-relevance in the present study may still be confounded by self-referent encoding. It is possible that memories that are currently viewed as self-relevant were initially encoded by consciously considering whether they were relevant (self-reference effect). Conversely, memories that are currently viewed as non-relevant were may be less likely to be encoded in reference to the self. It is easy to imagine that most non-relevant memories would be encoded in a more typical, neutral fashion. Therefore, memories recalled in the high self-relevant condition may have disproportionately benefitted from superior self-referent encoding while memories recalled in the low self-relevant condition may have not benefitted from self-referent encoding. Although this is certainly a possibility, the present study provided no evidence to suggest that one condition benefitted from self-referent encoding than another condition.

The chronic accessibility of self-relevant constructs could also help explain why self-relevant memories may be more accessible (Higgins et al., 1982). Constructs have been used to explain the manner in which people perceive one another. More specifically, constructs that people use regularly and are very familiar with are likely to affect their perception of other people (Bargh, Lombardi, & Higgins, 1988; Higgins et al., 1982). Furthermore, peoples' memory of perceptions that are related to their chronically accessible constructs are more resistant to decay than memory of perceptions that are not related to chronically accessible constructs. In two studies Higgins and colleagues (1982) defined chronically accessible constructs based on the primacy and frequency at which character traits regarding these constructs were used to describe people. So participants who often described their acquaintances as lazy were said to have a chronically accessible construct of laziness. In these studies, participants read an essay about characters whose behavior exemplified a number of

traits. Some of these traits overlapped with the chronically accessible constructs while others did not. Then participants were instructed to reconstruct the essay word for word. Results indicated that participants tended to omit the character traits that were not chronically accessible. These results generally suggest that people tend to remember people in a manner that is consistent with their pre-existing, chronically accessible constructs. The same may be true with regards to memories of peoples' own behavior. It is likely that participants in the present study remembered their self-relevant memories in a manner that was consistent with their own self-construct. This may have increased the accessibility self-relevant memories, while decreasing the accessibility of non-relevant memories. Chronically accessible self-constructs are certainly the best explanation for higher levels of remaining executive resources in the self-relevant recall condition.

However, there is a theoretical difference between the initial encoding of an autobiographical memory and the later recall of that memory. The current methodology has no means to distinguish between difficulty of recall due to the quality of encoding (elaboration and organization) and the difficulty of recall due to the hierarchical retrieval process (Conway & Pleydell-Pearce, 2000; Klein & Loftus, 1988). Studies that are concerned with the autobiographical retrieval process tend to hold encoding constant (Conway & Pleydell-Pearce, 2000; Dalgleish et al., 2007; Williams & Broadbent, 1986). On the other hand, studies that are concerned with the encoding of memory tend to hold the retrieval process constant (Klein & Loftus, 1988). The current study did not hold encoding nor retrieval constant. Unfortunately, the dependent variable in this experiment only measured the depletion of executive resources following the entire experiment. Therefore, the higher levels of remaining executive resources in the self-relevant condition could be evidence of superior

encoding of self-relevant memories or evidence that the hierarchical retrieval process is not actually more difficult for self-relevant recall (Conway & Pleydell-Pearce, 2000; Klein & Loftus, 1997).

In order to separate the possible effects of encoding from the effects of hierarchical retrieval of autobiographical memories a new methodology is necessary. The encoding of autobiographical memories must be controlled in a laboratory setting. In order to ensure that participants encode their autobiographical memories in a similar fashion, another follow-up study should include a phase in which participants encode an experience as either self-relevant or non-relevant while trying to maintain a comparable level of *elaboration* and *organization*. Participants would then complete a puzzle task in the laboratory followed by a memory test. In the self-relevant condition, participants would be told that performance on the laboratory task will effectively allow the researchers to assess his or her personality and that they will receive the results when they return to the follow-up session. In the non-relevant condition, participants will be told that they will be tested on the puzzle task when they return to the follow-up session. Next, participants would complete a memory measure about the puzzle task to help address concerns about differences in encoding. Although I could not be entirely sure that participants in both conditions encoded the memory equally effectively, I can use the performance on this initial memory measure to help statistically control for differences.

In a second, follow-up session participants would return to the lab and complete a pre-existing executive resource measure, an autobiographical recall task, and a final measure of remaining executive resources. This portion would closely mimic the present study with the exception of the autobiographical recall task. The autobiographical recall task would ask

participants to verbally recall their experience on the puzzle task in as much detail as possible. Like the present experiment, I would analyze remaining executive resources in order to determine whether self-relevant or non-relevant autobiographical memories require more executive resources to recall in a specific manner.

By addressing the methodological concerns mentioned above I would be able to more directly test my hypothesis and potentially link pre-existing theories of autobiographical memory storage and search. If I could demonstrate that recalling self-relevant memories in specific detail requires more executive resources than recalling non-relevant memories in specific detail (assuming memory encoding is held constant), I would be able to elaborate on hierarchical retrieval models of autobiographical memory (Conway & Pleydell-Pearce, 2000) and on executive resource consumption in autobiographical recall (Dalgleish et al., 2007; Williams, 2006). With respect to Conway and Pleydell-Pearce's (2000) model my hypothesized results would demonstrate that autobiographical memory construction does not always begin at a general level. If participants recalling non-relevant memories find the remaining executive resource task easier, it would suggest that these participants began their memory search with a more specific memory trace. With respect to Dalgleish's (2007) theory of executive resources and overgeneral memory, my hypothesized results would suggest that the self-relevance of autobiographical memories determines how difficult recall is and therefore may result in more overgeneral memory. Furthermore, this pattern of data would suggest that the distinction between episodic and semantic memory systems is not as simple as previously thought (Klein et al., 1989). Despite being separate systems my hypothesized data would provide initial evidence that specific episodic memories may be reached by starting with semantic memory traces. This of course would be a preliminary explanation due

to the fact that my proposed studies have no means to test exactly in which memory store a hierarchical memory search begins.

Building a clearer understanding of the role of executive resources in self-relevant recall is a critical step in the basic cognitive science of autobiographical memory, as well as in clinical research that has found autobiographical specificity to be a robust predictor of negative mental health outcomes (Brittlebank et al., 1993; Gibbs & Rude, 2004; Mackinger et al., 2000; Peeters et al., 2002; van Minnen et al., 2005). In both basic cognitive and clinical literature, self-relevant autobiographical memories are more likely to be recalled in a general form. However, there are some discrepancies in how these two fields view this pattern. Social psychologists have suggested that the tendency to recall self-relevant memories as general may be caused by self-enhancement motives (Brunot & Sanitioso, 2004). Alternately, depression researchers have suggested that the tendency to recall self-relevant memories as general may be due to depressive schemas that cause depressive content to be more difficult to recall (Barnhofer et al., 2007). Understanding the underlying process by which executive resources are allocated to recall self-relevant autobiographical memories would be very beneficial to both fields, potentially giving them a common framework to share theory and data.

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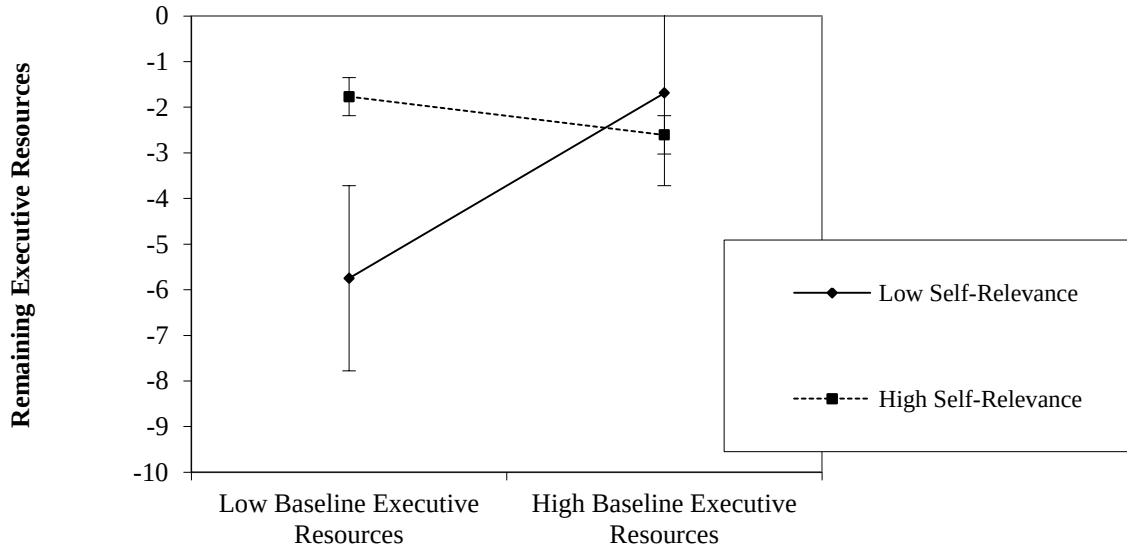
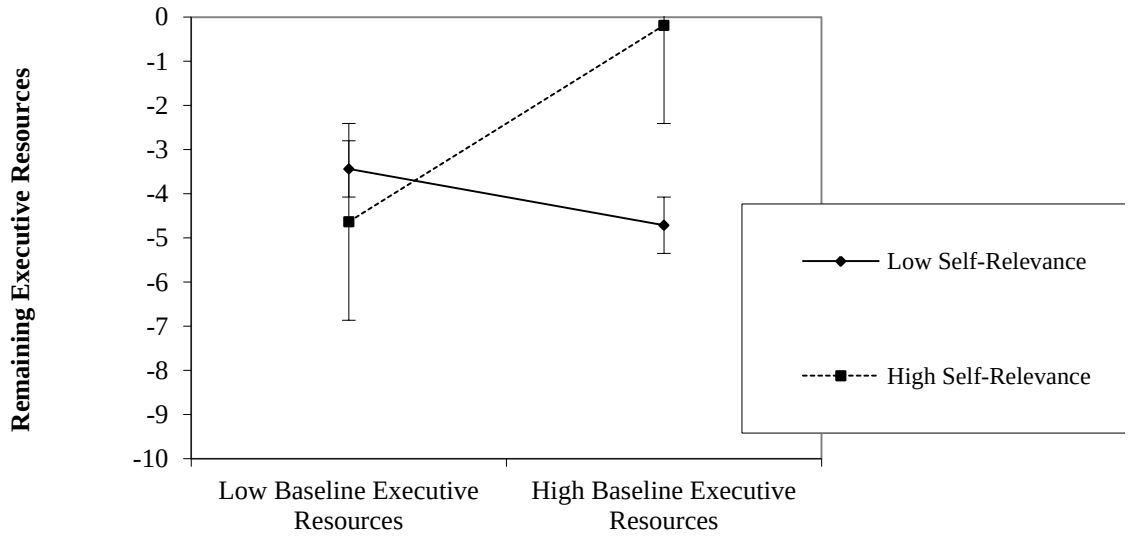
Figure 1
Two-way interaction between baseline resources and self-relevance condition.



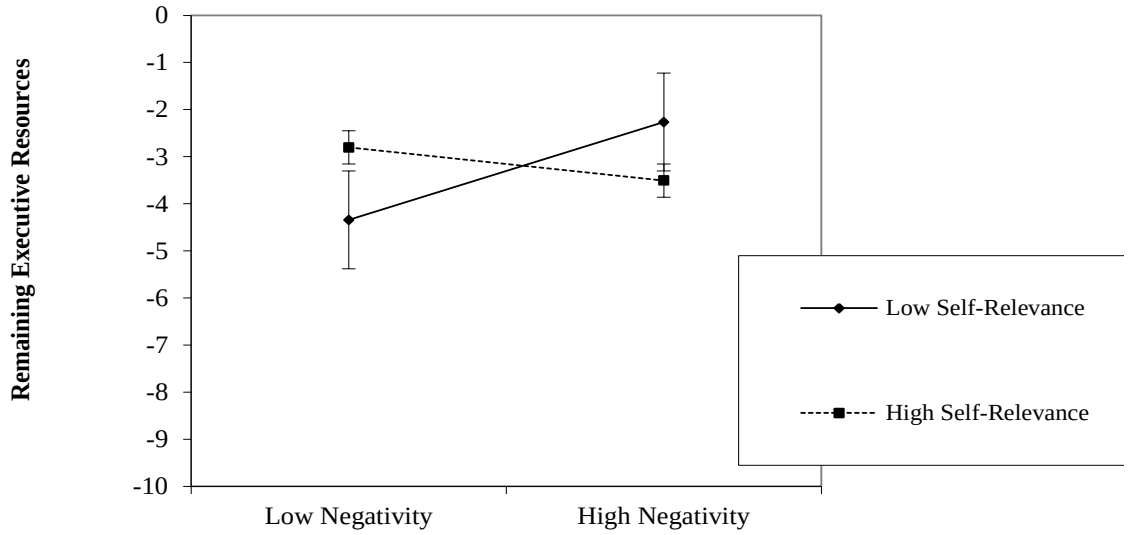
Notes: Baseline executive resources were regressed as a continuous predictor variable.

Figure 2
Two-way interaction between baseline resources and self-relevance condition after statistically controlling for negativity.



Notes: Baseline executive resources were regressed as a continuous predictor variable.

Figure 3
Marginal two-way interaction between the negativity of recalled memories and self-relevance condition after statistically controlling for negativity.



Notes: Negativity of recalled memories was regressed as a continuous predictor variable.

Table 1
Hiearchical Linear Regression with Baseline Executive Resources, Self-Relevance Condition, and Baseline by Self-Relevance Interaction.

	β	SE	t	ΔR^2	F
Step 1				.095	4.29*
Baseline Resources	.14	.08	1.67		
Self-Relevance	1.54	.63	2.47*		
Step 2				1.56	9.03***
Baseline Resources	.21	.08	2.73**		
Self-Relevance	1.52	.57	2.66**		
Baseline X Self-Relevance	.63	.15	-4.15**		

Note: Baseline Executive Resources and Self-Relevance were centered.
* $p<.05$
** $p<.01$
*** $p<.001$

Table 2
Hiearchical Linear Regression with Baseline Executive Resources, Self-Relevance Condition, Memory Negativity, Two-Way Interactions, and a Three-Way Interaction.

		β	SE	t	ΔR^2	F
Step 1					.11	3.23*
	Baseline Resources	.15	.08	1.74		
	Self-Relevance	1.82	.70	2.61*		
	Negativity	.23	.22	1.02		
Step 2					.20	5.61***
	Baseline Resources	.21	.08	2.62*		
	Self-Relevance	1.63	.63	2.60*		
	Negativity	.12	.20	.73		
	Baseline X Self-Relevance	-.74	.18	-4.20***		
	Negativity X Baseline	-.04	.05	-.70		
	Negativity X Self-Relevance	-.84	-.40	-2.09*		
Step 3					.002	4.79***
	Baseline Resources	.19	.09	2.07		
	Self-Relevance	1.62	.64	2.52		
	Negativity	.12	.20	.60		
	Baseline X Self-Relevance	-.75	.18	-4.17*		
	Negativity X Baseline	-.04	.05	-.75		
	Negativity X Self-Relevance	-.80	.41	-1.95		
	Negativity X Self Relevance X Baseline	-.04	.10	-.43		

Note: Baseline Executive Resources and Self-Relevance were centered.
* $p<.05$
** $p<.01$
*** $p<.001$