On the Relationship Between Conscious and Unconscious Death Reminders,

Self-esteem, and Self-control

by

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Abstract

When thoughts of death become conscious individuals attempt to suppress them, which consumes self-control resources. Once consumed, performance on subsequent tasks requiring self-control tends to suffer. However, terror management theory would predict the exact opposite pattern of performance when a self-control task has relevance for self-esteem. To test this prediction, I conducted a study that exposed participants to mortality salience (MS; vs. control salience) and after a delay had them engage in a self-control task. Prior to completing the self-control task participants were given information that framed the task as self-esteem relevant or not. Results showed that following MS participants performed better on the self-control task when it had implications for self-esteem compared to when it did not. I conducted two subsequent studies to examine whether a subliminal death (SD; or a death reminder below conscious awareness) prime affects self-control in the same fashion as MS (a death reminder that is conscious). I exposed participants in Studies 2 and 3 to a SD prime (vs. a neutral prime) and had them engage in two separate self-control tasks. Consistent with Study 1, prior to completing the self-control tasks participants were given information that framed the tasks as self-esteem relevant or not. Both Studies 2 and 3 showed a main effect of SD on self-control performance. The results from all three studies are interpreted from a self-control resource conservation perspective. Specifically, MS (vs. SD) activates suppression, which depletes self-control resources. Once depleted, individuals conserve their remaining resources for tasks that have implications for self-esteem. However SD keeps resources stocked and leads to greater self-esteem striving. As such, SD can increase self-control when self-control exertion is a means to attain self-esteem. Discussion focuses on the relationship between self-esteem and self-control, and the distinction between a conscious death reminder and a SD reminder.

Preface

This thesis is an original work by Erik H. Faucher. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, The role of self-esteem relevance on self-control performance following mortality salience, <u>Pro00025317</u>, 9/7/2011.

Dedication

I dedicate this thesis to Peanut, who is, among many things (e.g., my "ultimate buffer"), a true exemplar of self-control and self-esteem.

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Introduction

From the perspective of terror management theory (TMT; Greenberg, Solomon, & Pyszczynski, 1997), when thoughts of death enter consciousness people engage in a variety of techniques to ultimately fend off such thoughts because thoughts of death are terrifying. These techniques are commonly referred to as proximal defenses, which include suppression, or mentally trying to push death thoughts out of awareness (Pyszczynski, Greenberg, & Solomon, 1999). According to the limited strength model of self-control the process of thought-suppression consumes mental resources (Muraven, Collins, & Nienhaus, 2002). Self-control resources are suggested to draw from a common pool of energy, which then leads to a state of ego-depletion when this pool has been overtaxed (Muraven & Baumeister, 2000). In other words, consuming large amounts of self-control resources limits the availability of these resources for future tasks that require self-control, thereby hindering performance. In support of this reasoning, Gailliot, Schmeichel and Baumeister (2006) found that after a conscious reminder of death participants performed worse on self-control tasks relative to participants who were not reminded of death. These findings are consistent with the notion that self-control is more difficult when in a state of relative ego-depletion (e.g., Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven, Tice, & Baumeister, 1998; Vohs, Baumeister, & Ciarocco, 2005).

However, according to TMT, thoughts of death also instigate a process aimed at buffering the potential for anxiety associated with such thoughts, which consists of promoting faith in a cultural worldview and fostering a sense of personal significance (i.e., self-esteem). As such, reminders of death should increase the amount of effort that an individual devotes toward activities that have the potential to provide meaning and self-esteem. The purpose of the present research was to integrate research from the limited strength model of self-control (see Muraven,

2012 for a review) with self-esteem bolstering research from TMT (see Pyszczynski, Greenberg, Solomon, Arndt, & Schimel, 2004 for a review). I hypothesized that if a self-control task has little relevance for self-worth, conscious thoughts of death should decrease performance in this activity, whereas if a self-control task has high relevance for self-worth, conscious thoughts of death should increase performance in this activity despite being depleted. I tested this hypothesis in Study 1. In Studies 2 and 3, I sought to build on the findings from Study 1, via investigating how a subliminal death reminder (i.e., below conscious awareness), which precludes effortful suppression, might affect self-control. I begin my thesis with a detailed description of TMT and the appropriate research the theory has generated. I then do the same with the limited strength model of self-control, before delving into the integration of the two theories.

Terror Management Theory and Self-esteem

Human beings, just like any other animal species on the planet, want to live and survive for as long as they can. In other words, due to evolutionary forces, all creatures are built to want to survive and reproduce; all creatures are predisposed toward continued life (Darwin, 1859). However, the human animal is also a very special type of animal. Compared to other animals and even our closest living relative the chimpanzee, our brain is much larger relative to our bodies, specifically our cerebral cortex (Gazzaniga, 2008). In addition, the human brain continues to develop after birth more so than any other mammal. This process allows our brains to be shaped by our experiences and sets the stage for our sophisticated cognitive abilities (Schimel & Greenberg, 2013). For instance, human beings have what Becker (Pyszczynski, Solomon, & Greenberg, 2003) referred to as high freedom of reactivity, which is greater behavioral flexibility in response to environmental stimuli. Other animals however, are more hardwired in their responses to environmental stimuli compared to human beings. In fact, the more developed the

mind of an animal, the greater the freedom of reactivity (Becker, 1962/71). At the most basic level there is the direct reflex, such as when moths gravitate toward a light, even if it means their demise. With more developed animal minds, such as those of mammals and non-human primates, more advanced levels are observed; for instance conditioned responses and even higher yet, insightful problem solving. Freedom of reactivity becomes yet even more complex with human beings because we have more developed minds. We are capable of making conscious choices and engaging in self-regulation more so than other animals (Baumeister, 2005). Moreover, we are capable of temporal thought (e.g., we can think about the past and wonder about the future), symbolic thought (e.g., we can communicate with arbitrary symbols) and have self-consciousness (e.g., we can think about ourselves as objects of attention). These abilities when juxtaposed with language (an advanced form of symbolic thought), make us fully self-aware and truly unique as a species. However, and much to our dismay, these sophisticated cognitive abilities carry a significant byproduct, in that we can ponder our eventual death.

Our sophisticated cognitive abilities makes us aware that we are alive, which in turn makes us aware that one day we will not be alive. On the one hand, we can imagine ourselves as standing apart from nature and as transcending physical limits, but at the same time we know that we are hopelessly trapped in a body that is finite. As Becker (1973) stated rather crudely, but accurately, "we are gods with anuses". Moreover as human beings we know that death could occur unexpectedly from a variety of different circumstances that we can never fully anticipate or control. Given this cumbersome reality of a human animal that desires eternal life, but knows of an inevitable death, there should be the potential for substantial anxiety. However the average human being functions day-to-day without being worried about death. How is this possible?

From a TMT perspective death anxiety is "managed" with cultural constructions. Ironically, these cultural constructions come from the same advanced cognitive abilities that gave rise to the knowledge of mortality in the first place. According to TMT, cultural worldviews offer purpose, permanence, and a feeling of security to life. Culture helps answer existential questions such as what will happen to me when I die, and what am I suppose to do while I'm alive? In addition, cultural worldviews can offer a sense of immortality, which is manifested in two distinct forms, literal or symbolic. Literal immortality refers to a form of afterlife promised by every known religion, in at least one form or another (e.g., Heaven or Nirvana). In contrast, symbolic immortality refers to being part of something that will endure beyond one's lifetime (e.g., an important cause), or by creating something tangible that will endure beyond one's lifetime (e.g., publishing a book or having children).

With cultural worldviews, human beings now get to belong to something bigger and more enduring than themselves. They get a chance to feel significant, that their lives really count for something and are meaningful (e.g., Becker, 1973). Cultural worldviews offer rules and standards to live up to, and meeting those standards allows one to feel significant, or from a TMT perspective have self-esteem. Thus, the primary function of self-esteem is to quell the potential for existential anxiety.

If the function of self-esteem is to manage the potential for anxiety inherent in the knowledge of death, then the need for self-esteem should be universal (e.g., Pyszczynski et al., 2004). In other words, all cultural constructions and practices across the globe are aimed at managing existential fear; however there is tremendous diversity in how that fear is managed (i.e., how individuals derive self-worth). From a TMT perspective then, what an individual

deems to be an important aspect of their self-esteem is due primarily to the environment and culture into which they are socialized.

Mortality Salience and the Dual Defenses of Terror Management

The bulk of terror management research has been examined with the mortality salience (MS) hypothesis (Burke, Martens, & Faucher, 2010). This hypothesis states that if a psychological structure (e.g., a cultural worldview or self-esteem) functions to protects people from thoughts and concerns about death, then reminders of death should temporarily increase the need for that psychological structure (e.g., worldview defense or self-esteem striving). MS has been manipulated in a variety of ways, such as having participants write two open-ended questions about their own death, completing a fear of death scale (e.g., Boyar, 1964), and subliminally priming the word *dead* or *death*. The two aforementioned manipulations that involve reading and writing are suggested to be conscious manipulations of death thoughts compared to the subliminal death priming manipulation, which is suggested to be unconscious because words presented subliminally are below the threshold of conscious awareness (e.g., Arndt, Greenberg, Pyszczynski, & Solomon, 1997). Accordingly, when thoughts of death enter immediate consciousness TMT suggests proximal defenses become activated (Pyszczynski et al., 1999), which consists of strategies such as suppression (e.g., actively trying to push thoughts of death out of immediate consciousness), rationalization (e.g., someone thinking death is in the distant future because they eat healthy) or distraction (e.g., someone coping with death thoughts via drinking alcohol, gambling or using other avoidant coping strategies). Importantly, these proximal defenses become activated immediately following a conscious manipulation of death-thoughts (MS) and serve to remove thoughts of death from immediate consciousness.

Once proximal defenses have materialized, thoughts of death are suggested to dissipate from immediate consciousness and reside outside of awareness in an area of the mind similar to Freud's preconscious (Pyszczynski, Greenberg, & Solomon, 1997). Even though thoughts of death are outside of current focal attention they continue to exert an influence on behavior, in the form of distal defenses (Pyszczynski et al., 1999). These defenses are symbolic, and as a result are aimed at cultural worldview affirmation and self-esteem striving. Whereas proximal defenses are generally used to get thoughts of death out of immediate attention, distal defenses are generally used to alleviate the potential for anxiety due to the conscious realization of the inevitability of death. Moreover, distal defenses become activated following a conscious MS manipulation, but only after some time has elapsed (i.e., after proximal defenses have subsided). However, if the death manipulation is subliminal then proximal defenses are bypassed because death is not consciously perceived, which subsequently leads directly to distal defenses (Arndt, Cook, & Routledge, 2004). The proximal and distal defenses in response to death reminders have been labeled the dual-process model of defense in terror management research (Pyszczynski et al., 1999).

Research supporting the dual process model has shown that immediately following MS participants denied vulnerability to a short life expectancy, but not after a delay (Greenberg, Arndt, Simon, Pyszczynski, & Solomon, 2000). Other research has demonstrated that proximal defenses do not always entail defensive responses such as denial, but can include more beneficial and adaptive responses for the individual as well. For instance immediately following MS (vs. control) participants expressed increased interest in fitness and exercise. However after a delay, MS led to increased fitness intentions only among participants who reported fitness as being relevant for their self-esteem (Arndt, Schimel, & Goldenberg, 2003). This research suggests

proximal and distal defenses become activated when thoughts of death are conscious or accessible to consciousness, respectively.

Other empirical evidence for the dual process model comes from studies measuring death-thought accessibility (DTA) following different manipulations of MS. The most common way DTA is measured in terror management research is through a word fragment completion task (Hayes, Schimel, Arndt, & Faucher, 2010). This task instructs participants to complete each word fragment with the first word that comes to mind. There are a total of 20 word fragments, six of which can be completed with a death related word, and the remaining 14 words can only be completed with neutral words. For example a word fragment such as COFF _ _ or DE _ _ leaves ambiguity as to the remaining letters that would complete the word. COFF _ _ could be completed as a neutral word (e.g., coffee) or as a death related word (e.g., coffin), and DE _ _ could be completed as a neutral word (e.g., deck) or as a death related word (e.g., dead). However the fragment PLA _ _ can only be completed in a non-death related manner (e.g., place or plate). The rationale behind this cognitive measure is the more fragments completed with death related words, the more death is posited to be cognitively accessible (Arndt et al., 2004). For instance immediately following MS, DTA is low, presumably because proximal defenses such as suppression are activated (Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994). That is, thoughts of death are not in immediate awareness following a conscious manipulation of MS. However after a delay, DTA is suggested to be highly accessible despite being out of immediate consciousness (Pyszczynski et al., 1999); a process akin to deep activation (Wegner & Smart, 1997). Consequently, when DTA is high distal defenses become activated (e.g., increased self-esteem striving). For this reason, terror management research investigating distal defenses (e.g., self-enhancement) requires some type of delay between a conscious manipulation

of MS and the dependent measure of interest. However, as previously mentioned when the concept of death is activated subliminally, DTA is high without the need for a delay because thoughts of death are never in immediate focal attention. In this case, proximal defenses are bypassed and distal defenses become activated immediately (Arndt et al., 1997). Figure 1 depicts the dual defenses and cognitive architecture of TMT (Arndt, Cook, et al., 2004).

Mortality Salience and Self-esteem Striving: Empirical Evidence

TMT has generated a large empirical literature in support of its primary hypotheses (for recent reviews see, Burke et al., 2010; Greenberg, Solomon, & Arndt, 2008; Kesebir & Pyszczynski, 2012), but for the purpose of this paper I will solely focus on the terror management findings directly related to MS and self-esteem striving. Several different studies have examined the effect of MS on self-esteem striving within a variety of different self-esteem domains. For instance, studies have shown that participants who derive self-esteem from tanning (i.e., having a tanned body compared to a paler body) reported more interest in tanning products after MS (Routldege, Arndt, & Goldenberg, 2004). In a similar fashion, MS can influence physical health related domains if those domains are pertinent to one's self-esteem. In one study participants who derive self-esteem from physical strength squeezed a hand dynamometer harder after MS (Peters, Greenberg, Williams, & Schneider, 2005) and in another study participants who derive self-esteem from exercise indicated greater exercise intentions after MS (Arndt et al., 2003). Other terror management research has shown that male Israeli soldiers who derive self-esteem from their driving ability drove more reckless and faster after MS, presumably to show off their driving skills (Taubman, Florian, & Mikulincer, 1999).

Other research testing the MS hypothesis has examined financial successes and aspirations as self-esteem domains. Participants whose self-esteem was based on materialistic

values overestimated their future financial success after MS (Study 1) and participants reported more greed after MS (Study 2) (Kasser & Sheldon, 2000). Likewise Mandel and Heine (1999) manipulated MS via a fear of death scale (Boyar, 1964) or a similar scale related to depression. Participants then viewed advertisements for high and low status products. After viewing the products participants rated their intentions for purchasing those products. Given that high status products are more likely to boost self-esteem than low status products, MS should increase purchasing intentions only for those products. The results confirmed these predictions. However, reminders of death do not always lead to greed, but can also lead to generosity, since giving to others is a socially acceptable behavior that can confer self-esteem. For example, research conducted by Jonas, Schimel, Greenberg, and Pyszczynski (2002) found that after a death reminder participants became more favorable toward personally relevant charities and donated more money to an ingroup (vs. outgroup) charity compared to control conditions.

Death reminders can also motivate positive behaviors if individuals report more positive traits (e.g., empathy and tolerance) as important to their self-esteem. In one study highly conservative or highly liberal participants were given MS or a control topic, and then evaluated two target participants who were described as conservative or liberal. Given that a liberal worldview espouses tolerance on its members as an important value, liberal participants should derive self-esteem from being tolerant. Accordingly, following MS (vs. control) there were no significant differences between evaluations of the targets for liberal participants, but conservative participants rated the conservative target more favorably (Greenberg, Simon, Pyszczynski, Solomon, & Chatel, 1992). Finally, Schimel, Wohl, and Williams (2006, Study 2) found that after a death reminder participants showed more forgiveness toward a worldview violating

individual, but only if participants scored high on empathy, and thus based their self-esteem on being compassionate and kind.

An individual's self-esteem is also affected by the groups to which they belong. Indeed, this is the premise of social identity theory, which suggests that individuals derive meaning and self-esteem from the groups to which they belong (e.g., Tajfel & Turner, 1979). TMT makes the same claim, but takes it one step further by suggesting self-esteem is needed for quelling fears about death. If this is true then MS should increase identification with a group when they are successful and decrease identification with a group when they fail. Research from Dechesne, Greenberg, Arndt and Schimel (2000) supports this idea. In one study Dutch participants thought their local soccer team would score more goals and win more future games after MS compared to a control condition. A subsequent study found that University of Arizona students were more likely to identify with the school's football team after MS compared to a control condition. However after the football team lost an important game, MS led participants to shift their identification to the (historically more successful) school basketball team, just as basketball season was about to commence. These findings lend support to the idea that people like to identify with groups that confer self-esteem (i.e., winning teams) more so than groups that confer less self-esteem (i.e., losing teams).

Gender and ethnicity are also potential groups that affect self-esteem. Just as winning teams increase identification towards a group and losing teams decrease identification towards a group, negative gender and ethnic stereotypes about groups can also lead to decreased identification. Studies conducted by Arndt, Greenberg, Schimel, Pyszczynski and Solomon (2002) provide direct evidence for this claim. In one study female participants were reminded of the negative stereotype facing women and math abilities or not, and then were reminded of their

death or a control topic. All participants then completed a measure of how similar they believed they are to other women. Women primed with the negative stereotype under MS saw themselves as being more distinct than participants under MS who were not primed with the negative stereotype. Two subsequent studies found similar results, but for a negative ethnic stereotype; Hispanics as drug dealers. Anglo and Hispanic participants were primed with either a negative stereotype or a positive stereotype, given MS or dental pain salience, and then evaluated works of art done by a Hispanic artist or an Anglo artist. When both Anglo and Hispanic participants were given MS and primed with the negative stereotype they evaluated the Hispanic paintings more negatively than any other conditions (Arndt et al., 2002, Study 2). This work suggests that individuals will disassociate from their gender or ethnic group in order to preserve self-esteem.

If self-esteem is a defense mechanism against the knowledge of inevitable death, then providing information of an afterlife or some form of literal immortality should attenuate the need for self-esteem. This research question was addressed in three studies (Dechesne et al., 2003). In the first study, participants were given an article that suggested near death experiences are a side effect of biological processes or that biological processes cannot explain near death experiences and there is likely some form of life after life. After reading the articles participants were given MS or dental pain salience, and were then given positive personality feedback. All participants were asked to rate the feedback according to accuracy and credibility. Higher ratings of accuracy and credibility concerning the personality feedback were construed as an indication of enhanced self-esteem striving. Whereas participants who read the article arguing against an afterlife saw the feedback to be more accurate following MS, participants who read the article in favor of an afterlife saw the feedback to be as accurate as control conditions. Study two replicated this finding, but included a neutral article condition. A third study demonstrated the

same pattern of results, but for two different dependent variables, a measure of greed and a measure of punishment toward worldview violators. Taken together, this research lends strong credibility to the notion that self-esteem striving serves a terror management function because participants not given information in favor of life after death exhibited higher self-esteem striving after MS.

In sum, a large body of work supports TMT's proposition that self-esteem functions to buffer individuals from thoughts of death. Reminding individuals of their mortality increased self-esteem striving in personal domains such as driving ability, physical appearance and strength, and led to behaviors in line with personal values such as tolerance, compassion, and charitable giving. Studies further showed that MS increased people's tendency to identify with groups that reflected favorable on them and to disidentify with groups that reflected negatively on them. Moreover, if people's need for existential security was previously bolstered through evidence of an afterlife or worldview affirmation, the effect of MS on self-esteem striving was eliminated. Interestingly, many of these previously documented forms of self-esteem striving require that individuals exert willpower, or self-control. For example, showing one's physical strength by squeezing a hand-dynamometer longer than others (Peters et al., 2005), or maintaining an attractive physique via sticking to a fitness regimen requires that self-control resources be spent. Thus, it would seem that when people are highly motivated to pursue self-esteem, they should be more willing to expend self-control resources when certain activities have relevance for their self-worth. With this notion in mind, I now turn to a discussion of theory and research on self-control. I begin by highlighting some important behavioral outcomes that are affected by individual differences in self-control before operationally defining self-control. I then discuss the nature of self-control along with its supporting empirical evidence.

The Importance and Definition of Self-control

Human beings are able to regulate their behavior in more elaborate and complex ways than perhaps any other animal on the planet (Baumeister, 2005). Typically this is referred to as self-regulation, which can be broadly defined as any type of occurrence whereby an individual overrides the self's natural response in order to achieve some other desired state or outcome that would not have occurred on its own; that is, without regulating the self (Bauer & Baumeister, 2011). Effective self-regulation is an invaluable asset at the individual level as well as the group or societal level. Intrapersonally, those who are able to self-regulate more effectively do better in school, demonstrate less psychopathology, and have higher self-esteem (Tangney, Baumeister, & Boone, 2004). Moreover, effective self-regulation is an important component for successful dieting (Heatherton, Striepe, & Wittenberg, 1998) and less substance and alcohol abuse (Tangney et al., 2004; Wills, Sandy, & Yaeger, 2002). At a more cultural and group level, poorer self-regulation is related to crime (Gottfredson & Hirschi, 1990), violence (Stucke & Baumeister, 2006), and dysfunctional relationships (Finkel & Campbell, 2001; Tangney et al., 2004).

Given the profound importance of self-regulation in a variety of intrapersonal and interpersonal domains, some researchers have even suggested that promoting self-esteem is less important than promoting better self-regulation (Baumeister, Campbell, Krueger, & Vohs, 2003). What is more, many personality theorists and researchers have been interested in effective vs. defective self-regulation from a variety of different perspectives. Some examples include the trait conscientiousness (Digman & Inouye, 1986), trait self-control (Tangney et al., 2004), the temperament effortful control (Kochanska & Knaack, 2003), the ability to delay gratification (Mischel, 1974), the psychoanalytic term ego strength (Barron, 1953), and the neo-analytic term ego-resiliency (Block & Block, 1980). Ultimately, the vast variety of interest and research on

this topic seems to suggest that self-regulation is an especially important construct that promotes psychological equanimity, achievement, and interpersonal harmony.

Thus far I have used the term self-regulation to refer to the process of overriding a more natural response in order to achieve some other means to an end. This definition, as well as the aforementioned research, is also given the label self-control. Indeed, self-regulation and self-control are often used interchangeably (Bauer & Baumeister, 2011). However despite many psychologists treating self-control and self-regulation interchangeably, there is an important distinction. Self-control is more accurately described as a subset of self-regulation (Muraven, 2012). Self-regulation is related to both short term goals as well as long term goals, whereas self-control is related more towards long term goals. For example, self-control is a process akin to delaying gratification. In other words, consider an individual who is given a choice between two rewards. One reward is smaller and less desired, but the individual can receive this reward immediately. The other reward is larger and more desired, but the individual receives this reward sometime in the future. Self-control is the process that allows one to forgo the immediate reward and thus delay gratification for the larger and more desired reward. Moreover, self-regulation deals with both conscious and unconscious processes, whereas self-control is predominately conscious, which is to say self-control is a more deliberate and effortful process. In other words, self-control is used for volition, to deter the self from its automatic processes and engage in more deliberate and conscious behavior (Muraven, 2012).

The Nature of Self-control and Empirical Evidence

Volitional behaviors that require self-control can include self-presentation, decision making, delaying gratification, and problem solving, to name but a few. These behaviors require self-control because they often require some aspect of willpower, or inhibition of a more natural

response. For example, self-presentation can be a conscious process whereby one is actively trying to present oneself favorably to others (Schlenker, 2003), which often involves following social norms such as being polite (e.g., Debono, Shmueli, & Muraven, 2011). If an individual has a desire to express a rude comment regarding their boss then they must deliberately squash that desire. In addition, anything that beckons the exercise of self-control is suggested to draw from a common pool of energy or resources. This pool of energy (i.e., self-control strength) is finite, thus exercising self-control will become progressively more difficult until self-control resources are replenished.

This perspective treats self-control and its corresponding strength with the metaphor of a muscle (Muraven & Baumeister, 2000). Exercising a muscle causes it to become fatigued momentarily. For instance, an individual will have a better chance of winning an arm wrestling match if their bicep muscle is well rested. In contrast, if an individual had just lifted heavy boxes prior to an arm wrestling match they will be less likely to be victorious because their muscles are fatigued. Self-control is posited to operate in a similar manner. Exercising self-control will tax an individual's limited self-control resources, or that common pool of self-control energy. When an individual's self-control strength has been taxed they are said to be in a state of ego-depletion, or more simply depleted, which in turn will make future attempts at self-control (and strictly self-control) more difficult. This model is called the limited strength model of self-control, and has received a bountiful amount of empirical support (For recent reviews see Bauer & Baumeister, 2011; Muraven, 2012).

If self-control is a limited resource that can become depleted, then having participants use up some of this resource should hinder performance on a subsequent self-control task. Early research testing the limited strength model and its corresponding hypothesis came from Glass,

Singer, and Friedman (1969), though this research did not specifically mean to test the tenets of the model. Participants were initially exposed to random (i.e., unpredictable) noise recordings or fixed (i.e., predictable, every minute for a total of nine seconds) noise recordings. Importantly, all participants were exposed to the same duration of total noise. Subsequently, all participants were moved to the same quiet room and worked on a line-tracing task. Unbeknownst to participants this task was unsolvable, thus the primary dependent measure was persistence, which is an aspect of self-control. In other words, the individual has to forgo the urge to quit, and muster self-control resources to press on in order to be successful. The results demonstrated that participants who were exposed to the unpredictable noise became more frustrated and quit sooner than participants exposed to the predictable noise. Glass et al. (1969) suggested that participants exposed to the unpredictable noise spent more energy to concentrate on filtering out the noise, which in turn left them depleted for the subsequent tasks.

Similar results of self-control exertion leading to self-control failure have been replicated numerous times in a variety of domains. In a typical set of research findings, participants are instructed to inhibit some type of natural and automatic response, which requires self-control and depletes resources. Then self-control is measured in some unrelated domain. For instance, some research had participants sit at a table, which contained a bowl of freshly baked chocolate chip cookies as well as red and white radishes (Baumeister et al., 1998, Study 1). Participants were instructed to merely sample either the cookies or the radishes, but not both. Presumably inhibiting the urge to eat cookies requires self-control, but inhibiting the urge to eat radishes does not. After the food sampling, all participants completed the line-tracing task described earlier from Glass et al. (1969), which served as the measure of self-control. Participants instructed to eat radishes quit sooner at the task than participants instructed to sample cookies or participants

not presented with food (i.e., a control condition). A follow-up study replicated these results, but rather than use tempting food to deplete participants, the researchers had participants actively make a meaningful choice regarding their opinion on a certain issue vs. not having participants make a choice. Apparently exercising responsibility and actively choosing something taxes the same pool of self-control resources as resisting temptation (Baumeister et al., 1998, Study 2).

Another process that requires self-control and yields depletion patterns is the act of thought suppression. As discussed previously regarding TMT and proximal defenses, suppression is the act of trying to deliberately dispel some thought from one's immediate consciousness (Wenzlaff & Wegner, 2000). Muraven et al. (2002) examined the effects of suppression on self-control. Participants who indicated they were social drinkers were recruited for the study and were randomly assigned to either a depletion condition or a non-depletion condition. The depletion condition involved the suppression of an unwanted thought; participants were specifically instructed to not think of a white bear. The suppression of an unwanted thought requires self-control because of the persistence involved in pushing those thoughts out of immediate consciousness. In the non-depletion condition participants were instructed to do somewhat difficult arithmetic problems (e.g., 235 + 908 = 1143). Arithmetic is a procedural exercise that although can be as frustrating as actively suppressing something it does not require the overriding of impulses, and therefore is not deemed self-control depleting. Following the depletion phase, participants were instructed to sample beer, but were also told they would be partaking in a driving test on a simulator following the beer sampling and the participant with the best performance on the driving test would win a prize. This was to add incentive to exercise self-control of restraining one's amount of alcohol intake so as to not impair one's performance on the driving task. The results demonstrated that participants who had been in the depletion

condition drank more alcohol and had higher blood alcohol content than participants in the non-depletion condition.

Suppression also involves actively trying to inhibit emotions, which in turn can deplete self-control resources (Baumeister et al., 1998; Muraven et al., 1998). This basic research strategy has participants watch a segment of a film that is emotionally evocative, and instructs participants to engage in affect regulation. More simply, participants are told to not feel or express any emotions during the film. Importantly, it is the suppression of emotions in general that is the depleting mechanism and not the suppression of strictly negative emotions, as participants instructed to suppress positive emotions during a humorous clip also become more depleted. For example, participants who had suppressed negative emotions in response to a sad clip as well as suppressed positive emotions in response to a funny clip subsequently performed worse on anagrams (i.e., a measure of self-control) than participants who had watched the same clips but told to let their emotions flow (Baumeister et al., 1998).

In a similar vein, Muraven et al. (1998) instructed participants to either amplify or inhibit their emotional reactions in response to an upsetting film. Amplifying one's mood is deemed an effortful and deliberate process, thus it can lead to depletion. Participants in the control condition also watched the upsetting film, but were given no instructions in regards to their emotion regulation. Self-control was measured via squeezing a handgrip. The type of exertion involved with this measure is less related to physical strength, but instead is related to persistence to overcome physical discomfort, and takes self-control to continue to squeeze the handgrip despite physical fatigue. The results supported the limited strength model such that participants who had inhibited or amplified their emotions squeezed the handgrip for a shorter duration relative to participants who watched the film naturally (Muraven et al., 1998). It is also worth noting that

these decrements in self-control performance seem to be unique to exerting self-control and not a product of mood or arousal as depleted conditions do not significantly differ from non depleted conditions on mood measures (Baumeister et al., 1998; Muraven et al., 1998; Wallace & Baumeister, 2002).

Interpersonally, regulating and monitoring one's behavior can deplete self-control resources. Self-presentation and monitoring behavior can take effort, particularly in situations that are novel or a situation in which it is important to make a desired impression (Vohs, Baumeister, & Ciarocco, 2005). For example, regulating and monitoring one's behavior in front of a group of undergraduates during a seminar is likely going to require more self-control than regulating and monitoring one's behavior in front of one's spouse at home. If more strategic self-presentation requires self-control, then future acts of self-control will be hindered. Vohs and colleagues (2005) demonstrated this depletion pattern in a series of studies. If participants engaged in self-presentation that was atypical (e.g., male participants touting their interpersonal skills) then they showed decrements in self-control tasks (e.g., ability to stifle emotional reactions to an upsetting film) relative to participants who engaged in more typical self-presentation. Moreover, in an additional set of studies Vohs and colleagues demonstrated the opposite pattern; that depleted individuals would be less competent in self-presentation. If self-presentation requires self-control resources in order to be successful then depleted participants should demonstrate impairments in self-presentation. As expected, depleted participants (e.g., via Stroop color naming) were less successful in interpersonal contexts that required self-presentation (e.g., expressing a greater desire to talk and less of a desire to listen) relative to non-depleted participants.

Interpersonal relationships are also heavily influenced by one's interaction partner or partners. Most simply, interacting with a more socially inept individual will require greater self-control. For example, participants that worked on a task with an uncooperative confederate subsequently performed worse on anagrams than participants that worked on a task with a cooperative confederate (Finkel et al., 2006). In a similar vein, interpersonal interactions and self-control can be affected by race. When white participants were led to believe they were prejudiced, via false feedback on an implicit associations test (Greenwald, McGhee, & Shwartz, 1998), they performed more poorly on a self-control task if they had previously interacted with a black confederate relative to a white confederate (Richeson & Trawalter, 2005). Presumably these participants were expending self-control resources during the interaction so as to not look prejudiced, which in turn left them depleted. However, if the self-control demands of the interaction were attenuated, via giving participants a script of questions in which to ask the confederate, then self-control performance remained unaltered. It is also noteworthy that these results generalize to both white and black participants (Richeson, Trawalter, & Shelton, 2005).

Finally, being depleted leads to more detrimental interpersonal behaviors. For one, research suggests that when self-control is lacking individuals are less truthful (Mead, Baumeister, Gino, Schweitzer, & Ariely, 2009). Being honest is, at least in part, related to inhibiting selfish desires in favor of more prosocial desires, and therefore related to self-control. Mead and others (2009) found that depleted participants were more tempted to cheat than non-depleted participants. Specifically, participants completed a 25-question quiz and were told they would receive ten cents per correct answer. They would mark their answers on the actual test booklet, and later transfer those answers onto a bubble sheet. Participants could choose between two bubble sheets, one had the correct answers lightly bubbled in whereas the other was blank.

Depleted participants were more likely to choose the bubble sheet with the correct answers than non depleted participants. Moreover, depleted participants who had taken the bubble sheet with the answers already bubbled in scored higher on the test than their non-depleted counterparts, which is even more direct evidence of actually being dishonest (Mead et al., 2009). In other words, being tempted to cheat actually led to more cheating for those depleted participants.

Other detrimental behaviors that result from depletion include being less helpful (DeWall, Baumeister, Gailliot, & Maner, 2008) and being more aggressive (DeWall, Baumeister, Stillman, & Gailliot, 2007). I discuss these two behaviors and their relationship to self-control in turn. Helping behaviors are much like what was said about honesty in the preceding paragraph, such that there is often a conflict of two competing motivations, the desire to be selfless (i.e., help another individual) and the desire to be selfish (i.e., not help another individual). Given the fact that many urges and inclinations are selfish by nature, it takes self-control to override those urges and inclinations. Therefore, depleted participants should be less helpful. Research from DeWall and colleagues (2008) demonstrated that depleted participants expressed less willingness to help in hypothetical scenarios (Study 1) as well as reported volunteering fewer hours to help an individual in need compared to their non-depleted counterparts (Study 2). In regards to aggression, self-control is often vital for inhibiting aggressive impulses. Resources are required to stifle the desire to retaliate to an insult or some other provocation, thus depleted individuals may be more likely to act aggressively in response to threat. Empirical evidence supports this notion (DeWall et al., 2007). Across a series of studies depleted participants acted more aggressively than non-depleted participants, but only under conditions of provocation (e.g., negative feedback on an essay relative to neutral feedback).

The benefits of self-control do not end with persistence, inhibition of motives, suppression, and improved social functioning. Self-control resources are also highly involved with intelligent thought. Thinking that is more effortful, deliberate, or logical is suggested to require more cognitive resources and thus be more depleting than more automatic and simple ways of thinking (Schmeichel, Vohs, & Baumeister, 2003). For instance, solving logical reasoning problems that use central executive functioning (Baddeley, 1996) should be more taxing of self-control resources than solving problems that use rote memory. Indeed, participants who had been depleted of self-control resources vs. not depleted subsequently performed more poorly on a cognitive estimation task, which is a task that requires extrapolating prior knowledge structures from memory to solve novel problems (Schmeichel et al., 2003). Importantly, there was no difference between the depleted and non-depleted participants on questions related to general knowledge or pre-existing vocabulary (e.g., "which city is known as the windy city").

Other research conducted by Schmeichel (2007) converges on the idea that self-control depletion negatively affects higher order cognitive functioning as well as executive control (Norman & Shalice, 1986). Executive control is very much like self-control since it relates to actively modifying thoughts and behaviors. Moreover, executive control corresponds to memory updating, which is deemed an act of self-control since one has to keep a piece of knowledge in their working memory and then transform it, usually several times. Thus, prior self-control exertion should negatively affect memory updating. This hypothesis was supported. Depleted participants exhibited impairments in working memory performance on a variety of different tasks (e.g., the operation span task) compared to non-depleted participants (Schmeichel, 2007).

Furthermore, self-control depletion leads to decrements in cognitive functioning in the realm of decision making. Research has documented that depleted individuals take more risks

than non-depleted individuals (Freeman & Muraven, 2010). What is more, when depleted participants make decisions they are more likely to rely on simpler cognitive shortcuts such as heuristics (Masicampo & Baumeister, 2008). Depleted individuals are also more likely to prefer information consistent with their viewpoints, since cognitively inconsistent information is more cumbersome to process than consistent information. Research conducted by Fischer, Greitemeyer and Frey (2008) supported this notion. Participants were more likely to request additional information that was consistent with their preexisting political attitudes as opposed to inconsistent information if they were depleted whereas non-depleted participants showed no difference.

Recent research also seems to suggest that self-control is an influential factor in overly positive self views. A large literature in social psychology suggests that individuals have unrealistically positive views of themselves and their abilities, and they tend to be unrealistically optimistic about their futures (e.g., Leary, 2004; Taylor & Brown, 1988). These cognitions are self-serving for the individual (e.g., they enhance one's self-esteem) and appear to foster mental health. An interesting question however is whether these cognitions are relatively automatic, or instead do they need to be conjured up by the individual, which in turn might require some cognitive effort? Amber Debono and Mark Muraven (2013) sought to answer this question with empirical research. If self-serving cognitions are automatic then depleted individuals should be just as biased as non-depleted individuals, but if self-serving cognitions require effort and self-control then depleted individuals should demonstrate more realistic self views than non-depleted individuals. The data supported the latter hypothesis and not the former. Participants who were not depleted were overly optimistic about their performance on an upcoming task relative to participants who were depleted. This research suggests that self-control may be an influential

variable as to whether or not one can maintain positive illusions (Debono & Muraven, 2013; Muraven, 2012).

To summarize, self-control seems to be a very important adaptation for human beings and an important personality trait. When human beings engage in active and effortful control over their emotions, thoughts, and behaviors, they draw from a finite pool of self-control resources. Once self-control has been exerted, the limited strength model suggests momentary depletion until resources are replenished. Once in that state of depletion subsequent acts of self-control will be hindered. Empirical evidence for the limited strength model is robust. A wide variety of different manipulations of self-control depletion as well as dependent measures of self-control performance have been utilized by researchers.

Mortality Salience, Self-control and Self-esteem Relevance

According to the dual process model of TMT, when thoughts of death enter consciousness proximal defenses such as suppression become activated (Arndt et al., 1997). Presumably thoughts of death are anxiety provoking and to be blunt rather scary. As such, people actively try to dispel those thoughts from consciousness. From a limited strength model perspective, suppression leads to depletion since suppression consumes self-control resources (e.g., Muraven et al., 2002). With these considerations in mind, Gailliot and others (2006) tested the hypothesis that MS would decrease performance on subsequent tasks of self-control compared to a control salience condition (e.g., dental pain). This prediction was supported across four studies utilizing different measures of self-control. In the first test of their hypothesis, Gailliot et al. (2006; Study 6) reminded people of either death or dental pain using two open-ended questions used in prior TMT research. Following both salience conditions participants completed two tasks to serve as the necessary delay for the suppression process to take effect

(Pyszczynski et al., 1999). The subsequent self-control task was the Stroop task. This task shows participants a series of words of colors (e.g., red, green, and so on) on a computer screen, but the words are presented in a color different from the word. For example the word blue would be presented in red font. Participants are instructed to indicate what color the font of the word is, thus self-control is required in so far as one has to override the natural response of reading the word to identify it and instead respond based on the font color. The results supported the limited strength model; participants given MS made more errors on the Stroop task relative to participants given dental pain.

Subsequent studies further demonstrated this pattern of results (Gailliot et al., 2006). Participants were exposed to the same MS manipulation or two corresponding open ended questions about uncertainty, and following a delay completed analytical reasoning problems as well as problems related to rote memory (Study 7). Consistent with prior self-control research (e.g., Schmeichel et al., 2003), MS decreased performance on the analytical reasoning problems, but not the rote memory problems. Additional findings demonstrated the same pattern of results but with anagrams as the self-control measure (Gailliot et al., 2006; Study 8). Anagrams require self-control due to the constant attention, persistence, and the extrapolating of different letters to form words in order to come up with the correct solution. Participants given MS solved fewer anagrams relative to participants given dental pain. Finally, participants given MS quit sooner at a word fragment task as evidenced by fewer completions compared to their dental pain counterparts (Gailliot et al., 2006; Study 9).

The notion that conscious thoughts of death can be threatening and that people likely work to suppress such thoughts is well-supported and consistent with current articulations of TMT. Indeed, past research has shown that immediately following a conscious death reminder

DTA is low, presumably because those thoughts are being suppressed (Greenberg et al., 1994).

Moreover, suppressing unwanted thoughts requires mental effort, which depletes resources that

could be directed toward self-regulation (Muraven et al., 2002). Therefore, the research from

Gailliot et al. (2006) is also consistent with past research on the limited strength model of self-

control showing that when self-control resources are depleted performance on future self-control

tasks will suffer (e.g., Vohs & Heatherton, 2000). Despite this evidence, a growing number of

additional studies have demonstrated the opposite effect, that MS (vs. control salience) increased

performance on a task requiring self-control. In one such study, Peters and others (2005) found

that participants given MS squeezed a hand dynamometer (HD) harder relative to participants

given dental pain salience. Importantly, this effect occurred only for participants who previously

reported deriving self-esteem from physical strength. Moreover all the participants squeezed the

HD at Time 1, which was before the death or dental pain salience manipulation and again at

Time 2, after the salience manipulation. At time 2, participants' self-control resources should

have been quite depleted, because 1) they had been reminded of death and had presumably been

suppressing thoughts of death, and 2) they had already squeezed the HD once. Indeed, squeezing

this apparatus has been shown to require persistence and self-control resources (Muraven et al.,

1998). However, these participants actually performed better on the task, despite the previous

exertions.

More recent research also supports the idea that MS can sometimes increase self-control,

but with regard to worldview relevance rather than self-esteem relevance (Williams, Schimel,

Hayes, & Faucher, 2012). For example, in one study participants with a pro-evolution (vs. pro-

creation) worldview read an essay that clearly supported an evolutionary account of the origin of

life, and then took a test of reading comprehension. If the pro-evolution participants had been

reminded of death (vs. pain) prior to reading the essay, they scored better on the reading comprehension test. Notably, these effects were found for questions related to abstract and analytical reasoning, but not for questions assessing rote memory. As previously indicated, past research has demonstrated that when participants are depleted (e.g., from MS), performance on analytical reasoning problems suffer, but not performance on rote memory problems (Gailliot et al., 2006; Schmeichel et al., 2003). Therefore, after MS, pro-evolution participants should have been depleted, which in turn should have affected their performance negatively. But again, in this case MS actually increased reading comprehension performance for questions that require self-control resources. The same effect was observed for pro-creation (vs. pro-evolution) participants who read a pro-creation essay and then completed a test of reading comprehension: participants reminded of their own death performed significantly better on the more difficult abstract reasoning items relative to control participants.

The research evidence clearly suggests that MS can increase or decrease performance on self-control tasks. What is less clear is under what boundary conditions will MS accentuate or attenuate performance? I suspect that the self-esteem and worldview affirming implications of the self-control task is the primary difference between the studies conducted by Gailliot et al. (2006) and the research of Peters et al. (2005) and Williams et al. (2012). My argument is that MS slightly depletes self-control resources via suppression, which in turn will make future attempts at self-control less likely. In other words, following MS individuals will be motivated to use their remaining self-control resources on activities that confer self-esteem or reaffirm the cultural worldview. If the self-control task does not meet these conditions, then individuals will be less likely to expend self-control resources. This line of reasoning suggests that MS actually leads to a state of resource conservation (i.e., self-control becomes less likely) rather than a state

of absolute resource depletion (i.e., self-control becomes difficult to impossible). It is important to mention that self-control conservation is still compatible with the limited strength model because conservation is most pronounced following depletion of finite resources, or that limited pool of self-control energy (Muraven, Shmueli, & Burkley, 2006). That is, self-control conservation and self-control depletion are two distinct processes that both seek to explain the nature of self-control, but both stem from the same limited strength model of self-control. Research evidence supports both the idea of self-control conservation, as well as self-control exertion despite prior depletion on tasks that are related to self-esteem and cultural significance. I review this research in turn.

According to the alternative account of resource conservation, when self-control resources are depleted people go into a state of ego-conservation in which they become more selective about where they allocate self-control resources. For example, Muraven and colleagues (2006) found that when ego-depleted (vs. non-depleted) participants were forewarned that they would be completing a task that required self-control resources in the near future, they conserved some of their resources by devoting less effort toward a present self-control task compared to participants that were not forewarned. A subsequent study demonstrated that depleted participants who had conserved resources on an intermediate self-control task actually performed better on a final self-control task. In fact, there was a significant negative correlation between performance on the second self-control task and performance on the final self-control task (i.e., the final task was the task that participants were forewarned would require substantial self-control; Muraven et al., 2006). Thus, MS may deplete self-control resources just enough to place participants in a state of ego-conservation. However, even if MS does not deplete self-control resources via thought suppression (e.g., if non-effortful proximal defenses are utilized), it still

increases people's need for meaning and self-worth. Consequently, self-control tasks that have no clear link to self-esteem goals may be deemed as mundane or trivial. In this way, MS may cause research participants to withdraw precious self-control resources from any task they perceive as relatively unimportant and resource intensive. To be sure, conservation most often arises from prior depletion, but conservation can occur sans prior depletion. For instance, a less depleted individual can still conserve self-control resources for an anticipated and resource intensive act of self-control (Muraven et al., 2006).

Motivation is a powerful variable that can combat depletion, or said differently, can lead an individual to tap into those conserved self-control resources. Research from the self-control literature has demonstrated circumstances where depleted individuals do not show decrements in self-control performance when individuals are motivated to affirm their self-esteem or beliefs related to their cultural worldview. For example, Muraven and Slessareva (2003) found that although depleted participants quit sooner at an unsolvable task, they persisted if they thought it would benefit Alzheimer's research. In other words even though participants were depleted, they continued to exercise self-control when they thought the task was worthwhile. Given that contributing effort to improving the lives of the less fortunate (such as people with Alzheimer's disease) is a culturally valued activity, pushing oneself to try harder in the name of this value is a means of attaining self-esteem. It is as if depleted participants said to themselves, "I know I'm tired, but if I can push myself to be successful at this task I can help an individual with an awful disease."

A follow up study exhibited a similar pattern of depleted participants exerting self-control if they were offered monetary rewards (Muraven & Slessareva, 2003). In fact, merely mentioning money has been shown to counteract depletion effects (Boucher & Kofos, 2012).

Moreover, socially excluded participants were equal to their non-socially excluded counterparts regarding performance on a self-control task, but only if they had been offered a cash incentive (Baumeister, DeWall, Ciarocco, & Twenge, 2005). Besides the obvious economic implications, money is often valued by one's culture and viewed as a cultural symbol of success and power. Even more simply, many individuals derive self-esteem from the size of their bank accounts (Solomon, 2006). Indeed research from TMT has documented a variety of different studies demonstrating MS increases materialism and the pursuit of wealth (Arndt, Solomon, Kasser, & Sheldon, 2004). For instance following MS (vs. control salience) participants were more likely to get excited about finding unexpected cash (Solomon & Arndt, 1993, as cited in Arndt, Solomon et al., 2004), were more attracted to high status products (Mandel & Heine, 1999), and were more willing to buy high status products (Kasser & Sheldon, 2000).

Helping others and wealth are not the only factors that can offset depletion effects. On the contrary, another way to attenuate depletion is via self-affirmation (Schmeichel & Vohs, 2009). Self-affirmation is about restoring one's overall self-integrity (Steele, 1988), particularly after some aspect of oneself has recently been psychologically threatened. In laboratory studies self-affirmation is most commonly manipulated by having participants write about a value that is personally important to them, whereas participants in the non-affirmation condition write about their least important value or a value that might be important to someone else (e.g., Hayes, Schimel, Faucher, & Williams, 2008). Schmeichel and Vohs (2009) reasoned that defensive responses are often an automatic knee jerk reaction to threat, and are thus due to a loss of self-control. Given that self-affirmation is robust in reducing defensive reactions (Sherman & Cohen, 2006), it is tenable that self-affirmation also boosts self-control. Depleted participants performed poorly at a subsequent self-control task (i.e., holding one's hand in very cold water), but only

when they had not affirmed an important value (Schmeichel & Vohs, 2009). This research compliments the idea that depleted individuals are capable of self-control under conditions that promote one's cultural worldview or have implications for self-esteem. In addition, it is noteworthy that self-affirmation has also been shown to reduce worldview defense following MS (Schmeichel & Martens, 2005).

Based on these considerations, I formulated a general hypothesis about how MS will affect performance on a self-control task by combining ideas from the research on self-control motivation, ego-conservation (Muraven et al., 2006) and TMT. Based on research from self-control theory and TMT's dual-process model (Pyszczynski et al., 1999), MS should trigger death-thought suppression, which should consume self-control resources. Following the depletion of self-control resources, participants should perform worse on tasks that require a sufficient amount of self-control, but only if the task has little or no relevance for managing death-anxiety by increasing self-esteem or faith in the cultural worldview. To reiterate, participants under MS should be more judicious in regards to their self-control resources, and will forgo utilizing those resources on insignificant tasks. However, when the self-control task does have worldview or self-esteem relevance, MS should increase performance because participants will be highly motivated to spend their resources on that more meaningful task. In other words, MS should motivate individuals to allocate self-control resources toward tasks that have the potential to buffer individuals from death-related anxiety by providing meaning and self-worth. In the current research I focused on the self-esteem component of the cultural anxiety-buffer and conducted a study to test the aforementioned hypothesis.

Study 1

In Study 1, following the manipulation of MS participants engaged in a serial subtraction task (SST), which served as the measure of self-control. This task involves making rapid subtractions (e.g., in intervals of seven) from a relatively large number (e.g., 1674), and trying to be as accurate as possible. Prior research has shown that participants view this task as challenging and difficult (Arndt, Schimel, Greenberg, & Pyszczynski, 2002; Schimel, Arndt, Banko, & Cook, 2004; Tomaka, Blascovich, Kibler, & Ernst, 1997). One potential explanation for the difficult nature of this task is that it requires a substantial amount of self-control resources for successful performance. The type of mental arithmetic involved with serial subtraction relies on the executive self-system, since it requires higher-order controlled processing of information and hence active self-regulation. Two processes in particular contribute to the self-control involved in serial subtraction; persistence and monitoring. An individual must be persistent insofar as they need to continue making subtractions in rapid succession until the allotted time elapses. Along these lines, perpetual attention and vigilance are needed to monitor going from one number to the next number. In other words, rather than doing simple subtraction, an individual has to hold each number in their working memory, constantly monitoring the previous number in order to get to the next number. This vigilance should require self-control resources. Indeed, updating working memory is suggested to be a demanding process requiring executive control (Schmeichel, 2007). It is important to note that past research has used math problems as control conditions to compare to depletion conditions (e.g., Muraven et al., 1998). For instance participants complete multiplication problems (e.g., three digit by three digit multiplication) using paper and pencil. However this math is more procedural and is especially less taxing of

self-control resources because it is completed on paper. Therefore, it requires less self-control than serial subtraction.

Before participants attempted the SST they were given background information, which framed performance on the task as self-esteem relevant or irrelevant. University students are immersed in a social context in which intelligence and academic performance is highly valued, making success in these domains a potential source of self-esteem. To frame the SST as relevant for self-esteem I therefore told participants in the self-esteem relevant condition that better performance on the SST was associated with higher undergraduate GPA, better scores on tests related to academic achievement (e.g., the graduate record examination; GRE) as well as career achievement. Participants in the self-esteem irrelevant condition were told solely that they would engage in serial subtraction but were given no additional information linking better performance to academic success or career achievement. Directly manipulating the self-esteem relevance of the task allowed me to go beyond the work of Peters et al. (2005) to assess the causal hypothesis that MS will increase (vs. decrease) self-control expenditure on a self-esteem relevant (vs. irrelevant) activity. As in prior research (Gailliot et al., 2006), I expected MS to decrease performance compared to a non-MS condition when the SST is unrelated to self-esteem goals. However, if the SST is linked to self-esteem goals then I expected MS to increase performance.

Method

Participants and Design

One hundred and thirteen introductory psychology students at the University of Alberta participated in the study as partial fulfillment of a course requirement and were tested in groups ranging from two to four. Five participants were excluded for not following instructions or suspicions. This left 108 participants (25 men, 80 women, and 3 unreported) for the data

analysis. Participants were randomly assigned to both the salience condition and self-esteem relevant condition, yielding a 2 (salience: mortality vs. uncertainty) X 2 (self-esteem relevant: yes vs. no) between-subjects factorial design.

Procedure and Materials

When participants arrived at the laboratory, they were greeted by a female experimenter who was blind to conditions. She explained the purpose of the study as an examination of personality characteristics and attitudes with different cognitive tasks. She further explained that participants would first complete some personality measures followed by a few cognitive tasks; some of those tasks would be completed orally whereas others would be completed with paper and pencil. Upon hearing these general instructions, each participant was ushered into a separate cubicle for the remaining duration of the study. After participants provided consent, the experimenter entered the cubicle with a packet of personality measures. The packet began with a filler questionnaire, followed by the salience manipulation. Participants given the MS manipulation were instructed to "Briefly describe the emotions that the thought of your own death arouses in you" and "Jot down, as specifically as you can, what you think will happen to you as you physically die and once you are physically dead." This manipulation of MS is the most common in the terror management literature (Burke et al., 2010). Participants in the control condition were asked parallel questions related to uncertainty. I used uncertainty salience as the control condition to demonstrate the results as being unique to a reminder of death, and not just any aversive topic. Indeed, past research has suggested that thoughts of uncertainty can also be threatening and aversive (van den Bos, Poortvliet, Maas, Miedema, & van den Ham, 2005), but thoughts of uncertainty have no direct relationship to death. Following the salience manipulation, two measures were included to provide the required delay for the suppression process, and also

since distal MS effects (e.g., self-esteem striving) are most pronounced when death thoughts are beneath consciousness but remain highly accessible (Hayes et al., 2010). The first measure was a personality measure, which was the self-monitoring scale (Snyder & Gangestad, 1986), and the second measure was the positive and negative affect schedule (PANAS; Watson, Clark, & Tellegen, 1988). This state measure consists of 20 items related to one's current mood. Responses were given based on a 6-point scale with 1 being (*not at all*) and 6 being (*very much*). Including this measure allowed me to examine the potential effects of mood on serial subtraction performance.

When participants completed the personality packet, the experimenter told each participant that other participants were still working on the personality measures, and in the meantime asked them to read over some background information about the first cognitive task. This background information contained the self-esteem relevance manipulation. All participants read that they would be engaging in a serial subtraction task, and were told they would subtract numbers out loud in a designated interval (i.e., the number 1978 in intervals of 7) as quickly and accurately as possible. However, for participants assigned to the self-esteem relevant condition they read the following additional information:

> Successful performance on this serial subtraction task involves completing many serial subtractions with few errors. Interestingly, better performance on the serial subtraction task you will engage in momentarily is associated with higher undergraduate GPA, better scores on tests of intelligence and academic achievement (e.g., the GRE & LSAT), and higher levels of career achievement and satisfaction over the lifespan. The study today will continue this line of research with your participation.

After reading the background information, participants proceeded to the serial subtraction task. They were instructed to make rapid subtractions from the number 1978. The experimenter gave them an example using intervals of three to ensure they understood the task. She then told participants they would be making subtractions in intervals of seven for a period of two minutes, and instructed them to work as quickly and as accurately as possible within that designated timeframe. They were instructed to say their answers out loud into a tape recorder. Once the experimenter began recording, she started a timer for two minutes and left the cubicle. Participants then engaged in the serial subtraction task for two minutes. When the time had elapsed, the experimenter reentered the cubicle and had participants complete several paper and pencil cognitive measures (e.g., a word search puzzle). These were only included to bolster the cover story. When participants were finished with those measures the study was concluded, and participants were probed for suspicion and thoroughly debriefed.

Results

Self-control Performance

To construct a measure of self-control performance, I first counted the number of subtractions attempted by each participant as well as the number of correct subtractions. If an error was made during one of the serial subtractions, then the next serial subtraction was deemed correct if it was correctly computed from the previous total (Schimel et al., 2004). Next I submitted the ratio of correct-subtractions/subtractions-attempted to a 2(salience: mortality vs. uncertainty) × 2(self-esteem relevant: yes vs. no) ANOVA, which yielded only the predicted interaction, $F(1, 104) = 5.52$, $p = .02$, $\eta^2 = .05$. The means are presented in Figure 2. To examine the central hypothesis of this research, I first looked at self-control performance within the MS conditions. Participants had significantly higher scores when the task was framed as self-esteem

relevant (vs. irrelevant), $F(1, 104) = 4.01$, $p = .05$, $\eta^2 = .04$. No such effect emerged in the uncertainty conditions, $F(1, 104) = 1.69$, $p = .20$, $\eta^2 = .02$. To examine whether these results are consistent with the limited strength model of self-control and the findings of Gailliot et al. (2006), I compared the means within the self-esteem irrelevant conditions. Consistent with the limited strength model, there was a marginal effect such that MS participants had lower scores compared to uncertainty salience participants, $F(1, 104) = 2.95$, $p = .08$, $\eta^2 = .03$. Finally, looking within the self-esteem relevant conditions yielded no significant results, $F(1, 104) = 2.57$, $p = .11$, $\eta^2 = .02$.

I also examined gender as a potential covariate. There was no effect of gender on the ratio performance measure, $F < 1$, and the salience X relevance interaction remained significant $F(1, 100) = 4.99$, $p = .03$, $\eta^2 = .05$, when gender was included.

Affect

I also examined if mood had any effect on participants' serial subtraction performance. I first took the mean of the ten positive mood items and ten negative mood items of the PANAS (Watson et al., 1988), which gave me a score of positive affect and negative affect respectively. There was no significant effect of either mood construct on the serial subtraction ratio performance measure, both Fs < 1, and the salience X relevance interaction remained significant after controlling for both positive affect $F(1, 101) = 5.02$, $p = .03$, $\eta^2 = .05$, and negative affect $F(1, 101) = 4.85$, $p = .03$, $\eta^2 = .05$. These findings are consistent with both TMT research and research from the limited strength model of self-control demonstrating mood and arousal do not affect dependent measures (Muraven, 2012; Pyszczynski et al., 1997).

Discussion

Study 1 demonstrated that MS can increase or decrease self-control depending on how the self-control task is framed. Participants in the MS condition who were led to believe that the task was self-esteem relevant performed better on the task than those who were not. This finding directly supports the prediction that MS can lead to better performance on a measure of self-control if the self-control task is relevant to one's self-worth. The potential depletion felt as a result of MS likely lead participants to be more selective with their self-control resources. Importantly, this study also qualifies the work of Gailliot and colleagues (2006). Across four studies these researchers found that MS undermined performance on self-control tasks. The present data suggests this is not always the case, and that MS can enhance self-control on tasks that have relevance for self-esteem. Again, this pattern of results implies that ego-depletion following MS is not a state of absolute depletion such that participants are unable to self-regulate at all, but are in a state of relative depletion, or conservation, such that they are able to muster the remaining resources needed for meaningful self-relevant activities despite being somewhat depleted.

Moreover, the present data also complements the research from Gailliot et al. (2006). Although the comparison between the self-esteem irrelevant conditions was marginal, the pattern of MS undermining self-control compared to uncertainty salience is consistent with that research. One potential explanation for the comparison being only marginally significant could have to do with the self-control task that was administered. Gailliot et al. (2006) did not use a SST as one of their self-control measures. Nevertheless the evidence is still rather compelling in supporting the tenets of both TMT and the limited strength model of self-control. The work from Gailliot et al. (2006) is also still consistent with the notion that MS leads to conservation. Though not entirely

unequivocal, the results from Gailliot and colleagues could be interpreted such that following MS participants were relatively depleted. Once these participants were depleted, they conserved self-control resources, and thus performed more poorly compared to control salience participants because the self-control tasks offered no clear or direct self-enhancement or worldview affirmation.

Study 1 provided support for the notion that MS leads to self-control conservation and qualified the findings from Gailliot and colleagues (2006). Naturally however, there are still lingering issues. One particular issue concerns the salience manipulation utilized. Prior TMT research has shown that a subliminal death (SD) reminder leads to self-esteem striving and worldview defense in the same fashion as MS (Arndt et al., 1997; Burke et al., 2010). The primary difference between the two manipulations however, is that conscious reminders of death (i.e., MS), lead to proximal defenses, such as suppression, which then leads to heightened DTA (and distal defenses) after a delay. In contrast, SD should not activate proximal defenses such as suppression because thoughts of death are never in immediate consciousness. As such, SD leads participants to have an immediate increase in DTA, which is the specific variable posited to activate self-esteem striving or worldview defense (Arndt, Cook, et al., 2004; Pyszczynski et al., 1999).

It is precisely this unconscious, albeit accessible, increase in death related cognition that might lead to conservation of self-control resources for tasks that confer self-esteem. Stated differently, if elevated DTA triggers the motive to pursue self-esteem and thus led participants in the previous study to perform better on the SST when it was framed as self-esteem relevant, as well as perform worse on the SST when it was not framed as relevant, then the same pattern of results could emerge following a SD prime even without prior depletion. The inference that self-

control conservation can occur even without prior depletion has been suggested elsewhere. For instance, Muraven (2012) suggested that the desire for an individual to conserve self-control resources is likely not a conscious process, as individuals are often naïve of their self-control states. To be sure, prior research has demonstrated that when people are depleted they conserve resources for the future if they are aware that future tasks require self-control (e.g., Muraven et al., 2006; Tyler & Burns, 2009), but this prior depletion only heightens this need. Therefore it is plausible that a SD reminder could lead individuals into a state of ego-conservation despite having a full stash of self-control resources. If so, I would expect to observe the same pattern of results that emerged for Study 1.

However, if suppression is required to lead to conservation, then a SD reminder will likely not yield a similar pattern of results as Study 1 because the suppression process will be bypassed. With the suppression process bypassed, participants should be less depleted under SD, and less likely to conserve self-control resources. Thus, the same decrement in self-control performance observed in the self-esteem irrelevant conditions of Study 1, and by Gailliot et al. (2006) when participants were primed with MS should not be observed when participants are primed with SD. Without a state of ego-conservation at work under SD, framing the task as relevant vs. irrelevant for self-esteem may have less influence for SD than it did for MS, yielding only a main effect of SD, such that SD will lead to better self-control performance than control. The following two studies were designed to assess these possibilities.

Study 2

Study 2 was an exploratory effort to determine if MS and SD affect self-control similarly or differently. Since I am trying to expand on the data from the previous study, it seemed the best approach was to keep much of the materials and procedure from Study 2 identical to that of

Study 1. Specifically, I used the same self-control measure (i.e., the SST), and also used the same self-esteem relevance manipulation. Apart from these two consistencies, in the current study I made appropriate modifications. For one, rather than manipulate the death reminder with the two open ended questions I manipulated the death reminder subliminally (i.e., below one's conscious level of awareness). In addition, I included two manipulation check items at the conclusion of the study session. The first item pertained to the cover page instructions (i.e., the self-esteem relevance of the SST) and the second item pertained to the amount of effort exerted on the SST.

Method

Participants and Design

Ninety four introductory psychology students at the University of Alberta participated in the study as partial fulfillment of a course requirement and were tested in groups ranging from two to four. Participants were eligible to participate if they answered "English" or "English and another language other than English" to the question "what is your native (first) language(s)?", which was included in a mass testing session earlier in the semester. This recruitment procedure has been used in prior TMT research (e.g., Arndt et al., 2001).

A total of five participants were excluded for suspicions or not following instructions. This left 89 participants (28 men, 59 women, and 2 unreported) for the data analysis. Participants were randomly assigned to both the subliminal prime condition and self-esteem relevant condition, yielding a 2 (subliminal prime: death vs. field) X 2 (self-esteem relevant: yes vs. no) between-subjects factorial design.

Materials and Procedure

Upon arriving at the study session, participants were greeted by a female experimenter, who was blind to conditions. The experimenter explained the purpose of the study as an investigation of personality characteristics and attitudes with different cognitive tasks. Moreover, she explained that one of the cognitive tasks would be completed on the computer whereas the other cognitive task would be completed orally, and the reason for this was to ostensibly examine whether there is a different relationship between personality and cognition if cognitive tasks are completed on the computer vs. orally. This information was provided to bolster the cover story and to mask the true intentions of the research. In reality, the supposed cognitive task on the computer was a word relation task (i.e., the subliminal priming manipulation) and the oral cognitive task was the SST (i.e., measure of self-control).

Upon hearing these general instructions, each participant was ushered into a separate cubicle for the remaining duration of the study. After participants provided consent, the experimenter entered the cubicle with a packet of personality measures intended to bolster the cover story. These measures consisted of the need for cognition scale (Haugtvedt & Petty, 1992) and an abbreviated version of the social desirability scale (Crowne & Marlowe, 1964) as well as the self-monitoring scale (Snyder & Gangestad, 1986). Participants were instructed to go through the packet as honestly and accurately as possible and answer with their first natural response.

Upon completion of the personality portion of the study, the experimenter entered the cubicle and explained the cognitive task on the computer. Participants were told they would see two words presented one after the other in the middle of the computer screen, and that these words would be presented relatively quickly. The purpose of the task is to establish whether or not the two words are related. To further explain the task, the experimenter provided an example

to the participant: "If you see the word *tree* followed by the word *bark* then you would indicate those words are related." At that point she turned on the computer monitor and indicated to the participant that these instructions explained the task in more detail, and they should read those carefully before starting the task.

The instructions read as follows:

In the following task, a fixation point will appear on the screen, followed by two words presented one after the other. Your task is to indicate whether or not the words are related by pressing "R" when they are related and "U" when they are unrelated. The goal of this task is to identify the relationship between word pairs as quickly and as accurately as possible. Press spacebar to begin.

After participants had read the instructions and pressed the spacebar they saw another screen of instructions. These instructions indicated to participants that they would complete a few practice trials before doing the actual cognitive task:

To get ready, place your right index finger over the "U" key and place your left index finger over the "R" key. You may adjust the keyboard to a position that is comfortable. To start the practice trials press spacebar.

Participants then completed the three practice trials, in order to get them accustomed to the task. Following those trials, participants engaged in the actual task, which consisted of 30 total trials. For each trial, participants saw a fixation point, which then flashed a word for approximately 350 milliseconds (e.g., "sneaker") followed by another word for 350 milliseconds (e.g., "fajita"). Between the flashing of these two words, a word was flashed subliminally for 30 milliseconds, which is below conscious awareness. For the first 20 trials, all participants were exposed to the subliminal flashing of the word *table*. For the last 10 trials, half of the participants

were exposed to the subliminal flashing of the word *death* and the other half of participants were exposed to the subliminal flashing of the word *field*. Field was used as the control condition because it has the same number of letters as the word death and roughly the same type of frequency in the English language. This procedure is consistent with past research administering a SD manipulation (Arndt et al., 2001; Landau et al., 2004). Participants were instructed by the computer when the program was finished to open their cubicle door, which alerted the experimenter they had finished the first cognitive task.

After participants had completed the cognitive task on the computer (i.e., the word relation task) the experimenter reentered the cubicle. She told each participant that other participants were still working on the first cognitive task, and in the meantime they should read over this background information pertaining to the oral cognitive task. As with Study 1, this allowed for the manipulation of the self-esteem relevance of the task. The information for the self-esteem relevant condition and self-esteem irrelevant condition was the same as Study 1. In addition, the procedure for the SST was identical to that of Study 1.

When participants had finished the SST the experimenter entered the cubicle for a final time and administered a post study questionnaire. Participants were instructed to complete it with their first natural response. The questionnaire was divided into two sections; a first cognitive task section and a second cognitive task section. In the first section the questions pertained to the word relation task. These items consisted of "during the trials, did you ever see more than two words flashed at a time?" The response options were *yes*, *no*, or *I'm not sure*. If participants answered *yes* then they were asked a subsequent question, "was it the same word or a different word from the others you saw?", with the response options of *same*, *different*, or *I'm not sure*. If participants answered *different*, they were instructed to list what word they thought it might have

been. Finally, on a separate page from the previous questions all participants were asked; "assuming that there was a word flashed in between the two target words, what do you think that word might have been?" participants were instructed to circle all that apply from a response list that contained the words *table, death, pain, field, fail,* and *love* (e.g., Arndt et al., 1997).

The remaining questions in the post study questionnaire were concerned with the SST. These items, which were predominately manipulation check items, consisted of the following two items: "Based on the information from the *cover page instructions*, many serial subtractions with few errors is a strong predictor of performance on standardized tests and undergraduate GPA", and "I felt I exerted a lot of effort on the serial subtraction task". These two items were answered on a nine-point scale with anchors of 1 = *Strongly Disagree* and 9 = *Strongly Agree*. The post study questionnaire is in Appendix A. When participants finished the post study questionnaire the study was concluded and at that point all participants were probed for suspicion and debriefed.

Results

Self-control Performance

Consistent with Study 1, I first counted the number of subtractions attempted by each participant as well as the number of correct subtractions. I then submitted the ratio of correct subtractions/subtractions attempted to a 2(subliminal prime: death vs. field) × 2(self-esteem relevant: yes vs. no) ANOVA. This analysis yielded a significant main effect of subliminal prime $F(1, 85) = 4.58, p = .04, \eta^2 = .05$. Participants exposed to subliminal *death* performed significantly better ($M = .89, SD = .09$) than participants exposed to subliminal *field* ($M = .84, SD = .12$). No significant interaction or main effect of relevance condition emerged, both $Fs < 1$. The mean ratio scores by condition are presented in Figure 3. In addition, I examined gender as a

covariate on the ratio dependent measure. This analysis revealed no significant effect of gender $F(1, 82) = 2.49$, $p = .12$, and did not eliminate the main effect of subliminal prime on performance $F(1, 82) = 3.64$, $p = .06$, $\eta^2 = .04$. Similarly, there was no significant effect of need for cognition, $F < 1$, and the main effect remained significant when need for cognition was included $F(1, 85) = 4.43$, $p = .04$, $\eta^2 = .04$.

Manipulation Check Items

As with prior terror management research administering subliminal stimuli (e.g., Arndt et al., 2001), I wanted to be certain that the subliminal stimuli was indeed below conscious awareness. Therefore, I examined the responses to the items pertaining to the subliminal stimuli in the post study questionnaire. In regards to the item, "During the trials, did you ever see more than two words flashed at a time?", 12 participants indicated *yes* (13.5%), 64 participants indicated *no* (71.9%), and 12 participants indicated *I'm not sure* (13.5%). A Pearson chi-square test demonstrated these responses did not significantly vary by subliminal prime condition, χ^2 (2, $N = 88$) = 4.72, $p = .10$. Of the twelve participants who indicated *yes*, they were asked if they had seen the same word or a different word from the others that were flashed. Four participants indicated they had seen the same word, five participants indicated they had seen a different word, and three participants indicated they were not sure. When asked what word they thought it might have been, no participant correctly identified the word. Finally, I conducted a Pearson chi-square test on the multiple choice question, "Assuming that there was a word flashed in between the two target words, what do you think that word may have been?", which revealed no difference between the salience conditions, χ^2 (22, $N = 89$) = 21.42, $p = .49$.

I also submitted each of the manipulation check items pertaining to the SST to a 2(subliminal prime: death vs. field) × 2(self-esteem relevant: yes vs. no) ANOVA. The item

"Based on the information from the *cover page instructions*, many serial subtractions with few errors is a strong predictor of performance on standardized tests and undergraduate GPA" revealed a significant main effect of self-esteem relevance, $F(1, 85) = 26.10$, $p < .001$, $\eta^2 = .24$, such that participants given the self-esteem relevant information indicated significantly more agreement ($M = 6.16$, $SD = 2.54$) than participants not given the self-esteem relevant information ($M = 3.59$, $SD = 2.29$). This suggests participants read and understood the additional information given in the self-esteem relevant condition. There were no significant effects on the effort item. The means of the manipulation check items by condition are presented in Tables 1 and 2.

Discussion

The results of Study 2 showed a main effect of SD. Participants subliminally primed with the word *death* performed better at the SST than participants subliminally primed with the word *field*, irrespective of the self-esteem relevance conditions. Importantly, this result did not mimic the result of Study 1. Since the primary difference between the two studies was MS vs. SD, it seems fair to conclude that manipulating the death reminder consciously vs. unconsciously led to the two divergent results. The main effect found in Study 2 could be interpreted most simply from a TMT perspective, that a SD prime increased self-esteem striving. It is viable that since the death reminder was manipulated subliminally participants did not become depleted and therefore exercised self-control in order to perform better, since MS leads participants to strive more for self-esteem (Pyszczynski et al., 2004). Participants who were subliminally primed with the word *field* were not depleted either, but they did not perform as well as participants primed with the word *death* presumably because they were not as hungry for self-esteem. It is also viable that SD participants exerted self-control in the self-esteem irrelevant condition because they saw the SST as meaningful in and of itself without prior mention of what a good performance indicates.

Recall that the self-esteem irrelevant condition did not downplay the importance of the task, but instead just told participants what they would be doing (i.e., engaging in serial subtraction). Quick and accurate subtraction can be an indicator of intelligence, which many university students indicate as a domain of self-worth (Crocker & Wolfe, 2001).

With that said however, there was no significant difference regarding the manipulation check item pertaining to effort between the subliminal prime conditions. Presumably if participants given SD performed better overall than participants not given SD, and this effect stemmed from an increase in self-control (i.e., more effort and persistence exerted) as a means to attain self-esteem, then there should have been a main effect of SD for that item. In order to help address this concern, as well as further investigate the relationship between SD reminders, self-esteem relevance, and self-control, I conducted a third study.

Study 3

Thus far I have administered the same self-control measure, namely the SST. It seems pertinent to see if the previous results are also exhibited in a self-control task other than serial subtraction. For the measure of self-control in Study 3, I used analytical reasoning problems adopted from a GRE booklet. Dependent measures of self-control incorporating analytical reasoning was used in the research showing MS leads to decrements in self-control (Gailliot et al., 2006, Study 7) and has been used by other self-control researchers (e.g., Schmeichel et al., 2003). Analytical and logical reasoning questions use cognitive processes that require a substantial amount of self-control resources. For instance, questions testing reading comprehension of a short literary passage require logical reasoning, whereby one extrapolates knowledge and thinks critically with that information, which is a highly controlled and less automatic way of thinking.

I also altered the self-esteem relevance manipulation in Study 3. Recall that in the previous two studies participants in the self-esteem irrelevant condition were told they would be doing serial subtraction without any mention of what a good performance indicates. As I alluded to previously, perhaps the self-esteem irrelevant condition was still somehow self-esteem relevant to participants given the nature of the task. In other words, maybe participants believed that serial subtraction is already an implicit indicator of intelligence and mental abilities, and assumed this to be true even without additional information to suggest such an idea. To address this potential issue, rather than having a more neutral self-esteem irrelevant condition, I gave participants information indicating the self-control task (i.e., the GRE problems) is unrelated to intelligence and abilities. Participants given the self-esteem relevant condition received the opposite information. This modification should make the self-esteem relevant (vs. irrelevant) manipulation more black and white. If participants previously given SD increased their self-control in order to fortify their self-esteem, then a self-control task that downplays implications for self-esteem may be deemed as trivial and performance in turn will suffer.

Method

Participants and Design

One hundred and twelve introductory psychology students at the University of Alberta participated in the study as partial fulfillment of a course requirement and were tested in groups ranging from two to four. Three participants were excluded for expressing suspicions in regards to the study materials. This left 109 participants (31 men, 75 women, and 3 unreported) for the data analysis. Participants were randomly assigned to both the subliminal prime condition and self-esteem relevant condition, yielding a 2 (subliminal prime: death vs. field) X 2 (self-esteem relevant: yes vs. no) between-subjects factorial design.

Materials and Procedure

Upon arriving at the laboratory, participants were greeted by a female experimenter (blind to conditions) who explained the study as an investigation of personality and cognition. Similar to study 2, participants were told the study was interested in the relationship between various personality characteristics and attitudes with different cognitive tasks. The experimenter further explained that upon completion of some personality measures, there would be two different cognitive tasks: One of those tasks would be completed on the computer whereas the other would be completed with pencil and paper. As with the prior research, this information was given to bolster the cover story. In reality, the computer cognitive task was the word relation task (i.e., subliminal prime manipulation) and the paper and pencil cognitive task was the GRE problems (i.e., the measure of self-control).

Participants then moved to a private cubicle, signed and dated their consent form, and received a packet of personality measures. As before, these measures were included to bolster the cover story as an investigation of personality. However in this study, only two personality measures were included, the need for cognition scale (Haugtvedt & Petty, 1992) and an abbreviated version of the social desirability scale (Crowne & Marlowe, 1964) as opposed to the three measures used in the prior studies. I only included the two measures in this study because the GRE questions take significantly longer than the SST. Participants were instructed to answer each item in the packet as accurately and honestly as possible with their first natural response.

Once participants completed the personality measures, they were given the same instructions and completed the same word relation task used in Study 2. Thus, participants were either subliminally exposed to the word *death* or the word *field*. Following that task, the experimenter reentered the cubicle and administered the supposed second cognitive task, which

was the one done with paper and pencil. She explained to participants that there is a cover page

to this task and that before beginning they should read over that cover page carefully. The cover

page contained the title "Cognitive Assessment" at the top of the page. The instructions and

information on the cover page was where I manipulated the self-esteem relevance of the self-

control task. The instructions for the self-esteem irrelevant condition read as follows [wording of

the self-esteem relevant condition is presented within brackets]:

> The following questions in this packet are designed to assess your cognitive ability. The
>
> remarkable thing about this assessment technique is that research consistently shows that
>
> performance on this test is completely unrelated to mental abilities [highly related to
>
> mental abilities] in real life settings. In other words, how smart you are has no impact on
>
> how well you'll do on this test [only really smart people tend to do really well on this
>
> test].
>
> The remaining instructions would read the same for all participants:
>
> Directions: There are many questions on the following pages. The pages are double-
>
> sided. Please feel free to answer as many or as little as you like. For each page, read the
>
> instructions at the top of the page and answer the questions by circling the letter that
>
> corresponds to your answer. When you are finished, please open your door to the let the
>
> research assistant know you are done.

The questions consisted of 30 multiple choice items that assessed reading comprehension, verbal

ability, and mathematical ability. The questions are presented in Appendix B. They are

moderately difficult and require sufficient self-control resources to process and identify the

correct option. Participants had as long as they wished to complete the GRE problems; however

participants who were still working with fifteen minutes left in the study session were stopped by

the experimenter in order to allow sufficient time to complete the post study questionnaire, be

probed for suspicion and debriefed. The experimenter recorded how long each participant

worked on the problems by starting a timer when she had left the cubicle and stopping that timer

when the participant had indicated they were done working. Once participants were finished with

the self-control measure they were given the same post study questionnaire as Study 2. When all

participants completed the post study questionnaire the experimenter ushered them back into the

main room. They were then probed for suspicion and fully debriefed.

Results

Self-control Performance

In order to examine self-control performance, I first counted the number of questions

attempted by each participant. Next, I computed the correct response for each individual item of

the GRE problems. I then computed a sum score of the number correct and divided this by the

number attempted to get a ratio score of performance and submitted this to a 2(subliminal prime:

death vs. field) × 2(self-esteem relevant: yes vs. no) ANOVA. This analysis yielded no

significant interaction or main effect of self-esteem relevance, both Fs < 1, however a main

effect emerged on the subliminal prime condition $F(1, 105) = 4.23$, $p = .04$, $\eta^2 = .04$. Participants

exposed to subliminal *death* performed significantly better ($M = .584$, $SD = .156$) than

participants exposed to subliminal *field* ($M = .512$, $SD = .171$). This finding is consistent with

Study 2. The mean ratio scores by condition are presented in Figure 4.

In addition, I submitted the amount of time participants spent working on the GRE

problems to a 2 X 2 ANOVA. This analysis showed a significant effect of subliminal prime

condition, $F(1, 105) = 4.07$, $p = .05$, $\eta^2 = .05$. Subliminally primed *death* participants spent

significantly longer working on the problems ($M = 19.11$ minutes, $SD = 5.07$ minutes) than their

subliminally primed *field* counterparts (*M* = 16.91 minutes, *SD* = 5.78 minutes). Neither the interaction nor main effect of relevance condition was significant. The time spent working longer on the GRE problems also correlated with the ratio measure of performance, $r(109) = .49$, p (one-tailed) = .01. This correlation suggests that greater persistence, as measured by the amount of time working on the problems, was positively related to a better performance.

As with the previous two studies I also examined gender as a potential covariate. This analysis showed no effect of gender $F<1$, and the main effect of subliminal prime remained significant, $F(1, 101) = 4.06$, $p = .04$, $\eta^2 = .04$. In addition, there was a significant effect of need for cognition $F(1, 104) = 6.19$, $p = .01$, $\eta^2 = .06$, but importantly, controlling for this individual difference in an ANCOVA did not eliminate the main effect of SD prime $F(1, 104) = 4.20$, $p = .04$, $\eta^2 = .04$.

Manipulation Check Items

As with Study 2, I wanted to be certain that the subliminal stimuli remained below conscious awareness. In regards to the item, "During the trials, did you ever see more than two words flashed at a time?", 25 participants indicated *yes* (22.9%), 67 participants indicated *no* (61.5%), and 16 participants indicated *I'm not sure* (14.7%). A Pearson chi-square test demonstrated these responses did not significantly vary by subliminal salience condition, χ^2 (2, *N* = 108) = 3.13, $p = .21$. Of the 25 participants who indicated *yes*, they were asked if they had seen the same word or a different word from the others that were flashed. Two participants indicated they had seen the same word, 15 participants indicated they had seen a different word, and eight participants indicated they were not sure. When asked what word they thought it might have been, no participant correctly identified the word. Finally, I conducted a Pearson chi-square test on the multiple choice question, "Assuming that there was a word flashed in between the two

target words, what do you think that word may have been?", revealed no differences between the subliminal prime conditions, χ^2 (30, $N = 109$) = 36.41, $p = .20$.

I also submitted the two manipulation check items to a 2(subliminal prime: death vs. field) × 2(self-esteem relevant: yes vs. no) ANOVA. The item "Based on the information from the *cover page instructions*, smarter people perform better on the cognitive assessment test" revealed a significant main effect of self-esteem relevance, $F(1, 104) = 101.58$, $p < .001$, $\eta^2 = .49$, such that participants given the self-esteem relevant information indicated significantly more agreement ($M = 6.41$, $SD = 2.67$) than participants given the self-esteem irrelevant information ($M = 1.93$, $SD = 1.87$). This suggests participants read and comprehended the self-esteem relevant frame as well as the self-esteem irrelevant frame (see Table 3 for cell means and standard deviations). The item "I felt I exerted a lot of effort on the cognitive assessment test" revealed a significant main effect of subliminal prime condition, $F(1, 104) = 11.39$, $p = .001$, $\eta^2 = .09$. Participants subliminally exposed to the word *death* reported exerting significantly more effort ($M = 6.83$, $SD = 1.73$) than participants subliminally exposed to the word *field* ($M = 5.62$, $SD = 1.98$). The means are presented in Table 4. This finding suggests effort as being a potential variable responsible for the increased performance following a SD reminder. Indeed, effort was significantly correlated with performance, $r(108) = .32$, p (one-tailed) = .01, as well as the time spent working on the GRE problems, $r(108) = .47$, p (one-tailed) = .01.

Discussion

The results of study 3 demonstrated a main effect of subliminal prime on self-control performance. Participants primed with *death* scored better on the analytical reasoning problems, spent more time working on the analytical reasoning problems, and also exerted more effort on the analytical reasoning problems than participants primed with *field*. The main effect on

performance is consistent with the previous study. Taken together, these findings suggest that a SD prime does not put individuals into a state of resource conservation. Instead, these results suggest that a SD prime did not deplete participants and because participants had self-control resources to spare they used them to perform better on the self-control task, most likely as a means to attain self-esteem. This claim is, however, somewhat equivocal given the fact that in Study 3 the self-esteem irrelevant condition was designed to explicitly indicate that the task was unimportant. However with that said it is tenable that once participants in the self-esteem irrelevant condition started to solve the analytical reasoning problems they recognized them as traditional GRE style questions, and attempted to solve the problems because they personally felt those problems indicated greater intelligence. And since these participants were previously reminded of death they were more inclined to view those problems as an indicator of intelligence, which is a common domain on which undergraduate students stake their self-esteem. I return to this issue in the general discussion.

General Discussion

Summary of Main Findings

The current research began by trying to qualify findings showing MS decreases performance on self-control tasks. Consistent with the limited strength model of self-control (Muraven & Baumeister, 2000), suppression of death thoughts consumes self-control resources, which then undermines subsequent efforts at self-control (Gailliot et al., 2006). I suggested that although MS can be depleting due to the suppression process (i.e., proximal defenses), it also can be motivating, because MS leads to greater self-esteem striving (Pyszczynski et al., 2004). Therefore, I suggested that if a self-control task has implications for self-esteem then performance will not be hindered by MS but rather intensified, because according to TMT, death

reminders first and foremost motivate the need to defend against existential anxiety. I found support for this hypothesis. In Study 1, participants who were reminded of death performed worse on a self-control task if they did not receive additional information as to what a good performance indicates (i.e., the self-esteem irrelevant condition) compared to participants who did receive that information (i.e., the self-esteem relevant condition). It seems individuals will conserve self-control for tasks that offer self-esteem following MS.

I then sought to expand on the results of Study 1 and the relationship between death reminders and self-control. Instead of using a conscious and salient manipulation of death I administered a death manipulation subliminally in an exploratory effort to investigate a potential distinction between the two manipulations. Though I did not make specific apriori predictions, I suggested that a SD prime would be a good candidate to help determine if increasing DTA directly using the SD prime makes an individual more selective in allocating self-control resources, or in contrast, if increased DTA resulting from suppression is what makes an individual more selective. The results from both Studies 2 and 3 found main effects of SD primes on self-control performance. This increased performance effect suggests that SD led individuals to strive more for self-esteem. The results from the participants primed with death given self-esteem relevant information follows logically from the tenets of TMT, but the results from participants primed with death given self-esteem irrelevant information are less intuitive. Most simply, it seems without prior self-control exertion participants given self-esteem irrelevant information still were able to perform well. This issue deserves further discussion. Before tackling this conundrum, however, I first discuss the implications of Study 1 and the relationship between self-control and self-esteem. Following this section, I articulate the relationship between SD primes, self-esteem and self-control.

Implications for the Relationship between Self-esteem and Self-control

The results of Study 1 are important for two reasons. First, they qualify the research from Gailliot et al. (2006) and secondly they make an important contribution to the limited strength model of self-control. This research joins an increasingly growing list of self-control studies that demonstrate depleted individuals will exercise self-control under certain conditions (e.g., Muraven & Slessareva, 2003; Schmeichel & Vohs, 2009; Williams et al., 2012). Moreover, the data from Study 1 can speak to self-control exertion outside of a laboratory setting. In human beings' day to day activities, effective self-control is a must in order to keep meeting deadlines, staying physically healthy, having a successful romantic relationship, or otherwise attaining an infinite amount of long term goals via forgoing more short term desires. One important element that likely helps people stay on track with their self-control endeavors is the pursuit of self-esteem, or the psychological need to feel significant in a larger sociocultural context (Pyszczynski et al., 2004). The need for self-esteem offers an explanation as to why an individual will continue to exercise self-control toward a pertinent and meaningful activity even after being quite depleted. As one example, the popular "reality" television show *Survivor* requires an abundance of self-control, and as the show progresses individuals participating become exponentially more depleted. Many of the depletion patterns exhibited on *Survivor* stem from the same depletion patterns found in laboratory studies such as strategic self-presentation (Vohs et al., 2005), inhibiting emotions (Baumeister et al., 1998), problem solving (Schmeichel, 2007), being socially excluded (Baumeister et al., 2005), overcoming physical discomfort (Muraven et al., 1998), and having low blood glucose levels as a result of a restricted diet, which negatively affects self-control as well (Gailliot & Baumeister, 2007). How is it that these individuals persevere? I would suggest the need for self-esteem is, at least in part, what keeps them going.

The will to win carries an obvious self-esteem boost, as does winning a lot of money. Indeed as indicated earlier, money is a counterpunch to depletion effects (e.g., Muraven & Slessareva, 2003). There is also fame attached to winning *Survivor*, and a sense of symbolic immortality, which are two things inextricably tied to self-esteem (Greenberg, Kosloff, Solomon, Cohen, & Landau, 2010).

More mundane examples could be an athlete who continues to train despite the temptation to give up or a student who continues to study despite mental exhaustion. Regarding the latter example, research evidence has shown that self-control is a significant variable in predicting GPA among college students (Wolfe & Johnson, 1995) and is a better predictor of academic success among adolescents than even IQ (Duckworth & Seligman, 2005). According to TMT the self-esteem boost that comes from successes such as receiving an A in a course is psychologically essential because ultimately existential anxiety remains repressed. Consequently then, it could also be said that self-control is a major component to managing death anxiety as well, because it is invaluable for attaining self-esteem. Indeed trait self-control and trait self-esteem are positively correlated (Tangney et al., 2004).

On Subliminal Death, Self-control, and Self-esteem Relevance

In an attempt to further explore the relationship between death-thoughts and self-control I manipulated the death reminder subliminally in Studies 2 and 3. According to TMT, MS and SD both lead to greater self-enhancement so long as DTA is high when self-enhancement is measured (Arndt, Cook et al., 2004). What was less clear was whether high DTA alone led to self-control conservation, or alternatively high DTA as a result of suppression is what led to conservation. Comparing the results of Study 1 with Study 2, it seems suppression leading to elevated DTA is required for self-control conservation because participants in Study 2 who were

told solely they would be engaging in serial subtraction exercised as much self-control as participants given the self-esteem relevance information. Study 3 replicated this result using a different measure of self-control, and a slightly different manipulation of self-esteem relevance.

The findings from Studies 2 and 3 are consistent with prior work demonstrating that it is the suppression of death-thoughts following MS that leads to impairments in self-control, rather than DTA per se (Gailliot et al., 2006). Specifically, in Study 9 reported by Gailliot et al. participants were placed under MS (vs. control salience), and after a delay were given an opportunity to defend their cultural worldview. Following the worldview defense measure, participants were given a self-control task. The results showed that MS participants' self-control suffered even after defending their worldview. Because terror management research has shown cultural worldview defense lowers DTA (e.g., Greenberg et al., 1994), these results suggest that it is the conscious suppression of death-thoughts that impairs subsequent self-control, not the presence of DTA.

Ultimately the data from the three studies suggest that a MS manipulation and a SD manipulation are not the same, at least as they pertain to self-control. Prior TMT research suggests a conscious MS manipulation will lead to distal defenses following a delay between the manipulation and dependent measure of interest, whereas a SD manipulation requires no delay (Arndt, Cook, et al., 2004). The delay task is utilized with a conscious MS manipulation because death thoughts need time to be suppressed, whereas with a SD manipulation death thoughts never enter immediate consciousness and therefore become accessible outside of awareness directly following the manipulation (i.e., high DTA). It is precisely the salience and subsequent act of suppression that distinguishes these two manipulations. A conscious MS manipulation seems to deplete self-control resources whereas a SD manipulation does not. The evidence from

Studies 2 and 3 support this notion. Subliminally primed death participants exhibited better self-control performance even without self-esteem relevant information, which suggests these individuals had resources to spare.

Taken together, the full pattern of results across the three studies implies that MS leads to a rather dynamic set of psychological processes. On the one hand, when participants are under MS they are somewhat ego-depleted due to efforts at death-thought suppression, but on the other hand are motivated to pursue meaning and self-worth. Because MS participants are slightly depleted, they are in a state of ego-conservation, and are thus more selective about how to spend their remaining self-control resources. This effect explains the decrements in performance observed for MS participants when the self-control task had no clear relevance for self-esteem, observed in Study 1 and the work of Gailliot et al. (2006). It is as if participants say to themselves, "Why should I spend my precious self-control resources on a silly task in a psychology study? I'm not going to put any extra effort into this task". However, if the task has some clear relevance for increasing a sense of meaning and self-worth, participants seem very willing to expend their remaining resources on a self-control task, despite being somewhat depleted. The polarized reactions exhibited by MS participants in Study 1, showing the best performance when the task was framed as relevant for self-esteem, and the worst performance when the task was not framed as such, is consistent with this analysis. Interestingly, these polarized reactions to MS depending of the self-esteem relevance of the task disappeared when death-thoughts were primed subliminally. Because SD precludes the need for death-thought suppression, participants under SD were not in a state of resource conservation. As such, decrements in self-control performance for SD primed participants were not observed when the task had no clear relevance for self-esteem (Study 2), or when the task was framed as irrelevant

(Study 3). Thus, in Studies 2 and 3, only a main effect of death-prime was observed, showing better self-control performance for SD vs. control participants.

What is somewhat puzzling about the findings in Studies 2 and 3 is that the SD prime increased self-control performance even when the task had no relevance for self-esteem. One way of interpreting this finding may have to do with the nature of the self-control tasks that were utilized, and how these tasks were approached for participants under SD, specifically. As previously discussed, a large literature supports the notion that DTA heightens the motive to pursue meaning and self-worth. Given that participants were not in a state of ego-conservation, and thus had self-control resources to spare, SD may have motivated participants to go after success or meaningful experiences more generally. Even though the tasks were not framed as self-esteem relevant, participants had nothing to lose in terms of self-control resources by trying to perform well.

One other puzzling question pertains to the inconsistent finding on the effort item across studies 2 and 3. In Study 3 there was a main effect of SD prime on this item, in which SD primed participants reported higher effort on the task. This effect however did not emerge in Study 2. One possibility for the different findings has to do with the duration of the two different self-control tasks. The SST only lasted two minutes, whereas with the analytical reasoning problems participants were not given a set time limit. Instead, they were instructed to answer as many or as little of the problems as they wished. These instructions likely created more variability in regards to how much effort an individual could put into the task. An individual who worked longer on the GRE problems presumably tried harder and thus exerted more effort. Indeed, the amount of effort correlated with the amount of time participants spent in their cubicle working on the analytical reasoning problems, which taken together strongly suggests self-control exertion since

prior research has often operationally defined self-control as the duration one works on a task, rather than actual performance (Baumeister et al., 1998; Muraven & Slessareva, 2003).

In contrast, during the SST all participants subtracted for the same amount of time (only 2 minutes), which likely reduced the amount of variability regarding effort in the task. In other words, it is reasonable to assume that two minutes does not offer enough time to observe significant differences in effort. In fact the mean scores on the effort item demonstrated somewhat of a ceiling effect, with no condition being lower than 6.5 on a 9-point scale. Therefore, it is conceivable that if participants were not given a set time as to how long they could subtract, or on the other hand if participants were given a set time that was a longer duration than two minutes, then significant differences between the subliminal prime conditions on the effort item may have emerged in Study 2 as it did in Study 3.

Conclusion

Three studies investigated the relationship between death reminders, self-esteem, and self-control. In Study 1, a conscious death reminder decreased performance on a self-control task unless that task conveyed self-esteem. In Studies 2 and 3, a SD reminder increased performance on two separate self-control tasks, irrespective of how those tasks were conveyed. These findings have important implications and are illuminative for integrating TMT and self-control theory, which are two influential theories in social and personality psychology. Study 1 demonstrated that MS does not always lead to impairments in self-control performance (cf. Gailliot et al., 2006); so long as the self-control task is deemed worthwhile then MS will actually increase performance. Considering the findings from Study 1 with Studies 2 and 3, a conscious death reminder is not analogous to a SD reminder, at least as they pertain to self-control. A conscious MS manipulation leads to suppression of death thoughts, which consumes self-control resources,

whereas a subliminal manipulation bypasses the suppression process, keeping self-control resources stocked. Therefore, it seems a conscious death reminder is indeed a mechanism that leads to self-control depletion via suppression, which in turn triggers self-control conservation. Perhaps MS and its effects on self-control are comparable to other self-control findings concerning self-control as a limited resource, such that self-control conservation (vs. depletion) cannot be completely ruled out (Baumeister & Alquist, 2009). In all likelihood, depletion and conservation probably operate in tandem.

In conclusion self-esteem and self-control are invaluable qualities for psychological equanimity. According to TMT self-esteem buffers individuals from the potential for existential anxiety. Self-control is a crucial factor in attaining self-esteem. Death reminders momentarily increase the need for self-esteem, and under certain conditions can increase self-control. Perhaps it is no coincidence then, that great thinkers throughout history have touted the importance of self-control as well as being cognizant of one's mortality in order to lead a fuller life. As one example, Cicero condemned procrastination (Baumeister & Tierney, 2011) and commended embracing one's mortality (Yalom, 2008). All together, the best recipe for mental health might include the following ingredients: strong willpower (i.e., high self-control), as well as contemplations every now and again of one's mortality (i.e., death reminders), which should in turn lead to healthy and stable self-esteem (i.e., abated anxiety, meaning, and a life worth living).

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Appendix A

Post Study Questionnaire

The questions below pertain to the two cognitive tasks you completed during the study. Please indicate your response to each question using your first, natural response.

The following questions pertain to the <u>first cognitive task</u>, which was completed on the computer.

1. Indicating whether two words were related or not made up one trial. Excluding the three practice trials, how many trials do you think you completed: _____

2. During the trials, did you ever see more than two words flashed at a time?

       YES   NO   I'M NOT SURE

3. If you answered YES to the previous question, was it the same word or a different word from the others you saw?

       SAME   DIFFERENT   I'M NOT SURE

4. If you answered DIFFERENT, list what you think the word may have been:

      _____

5. Assuming that there was a word flashed in between the two target words, what do you think that word may have been? Circle all that apply.

TABLE   DEATH   PAIN   FIELD   FAIL   LOVE

The following two questions pertain to the <u>second cognitive task</u>, which was the serial subtraction task.

6. Based on the information from the *cover page instructions,* many serial subtractions with few errors is a strong predictor of better performance on standardized tests and undergraduate GPA:

1   2   3   4   5   6   7   8   9
Strongly   Strongly
Disagree   Agree

7. I felt I exerted a lot of effort on the serial subtraction task:

1   2   3   4   5   6   7   8   9
Strongly   Strongly
Disagree   Agree

Thank you. Please crack open the door to let the research assistant know you are finished.

Appendix B

<u>Directions</u>: The questions on this page refer to the passage below. Read the passage and then answer the questions.

The common belief of some linguists that each language is a perfect vehicle for the thoughts of the nation speaking it is in some ways the exact counterpart of the conviction of the Manchester school of economics that supply and demand will regulate everything for the best. Just as economists were blind to the numerous cases in which the law of supply and demand left actual wants unsatisfied, so also many linguists are deaf to those instances in which the nature of a language calls forth misunderstandings in everyday conversation, and in which, consequently, a word has to be modified or defined in order to present the idea intended by the speaker: "He took his stick – no, not John's, but <u>his own</u>." No language is perfect, and it we admit this truth, we must also admit that it is not unreasonable to investigate the relative merits of different languages or of different details in languages.

1. The primary purpose of the passage is to
    a) analyze an interesting feature of the English language.
    b) refute a belief held by some linguists.
    c) show that economic theory is relevant to linguistic study.
    d) illustrate the confusion that can result form the improper use of language.
    e) suggest a way in which languages can be made more nearly perfect.

2. The misunderstanding presented by the author in lines 6-7 is similar to which of the following?
    I.   X uses the word "you" to refer to a group, but Y thinks that X is referring to one person only.
    II.   X mistakenly uses the word "anomaly" to refer to a typical example, but Y knows that "anomaly" means "exception"
    III. X uses the word "bachelor" to mean "unmarried man," but Y mistakenly thinks that bachelor means "unmarried woman."
    a) I only
    b) II only
    c) III only
    d) I and II only
    e) II and III only

3. In presenting the argument, the author does all of the following EXCEPT
    a) give an example.
    b) draw a conclusion.
    c) make a generalization.
    d) make a comparison.
    e) present a paradox.

4. Which of the following contributes to the misunderstanding described by the author in lines 6-7?
    a) It is unclear whom the speaker of the sentence is addressing.
    b) It is unclear to whom the word "his" refers the first time it is used.
    c) It is unclear to whom the word "his" refers the second time it is used.
    d) The meaning of "took" is ambiguous.
   e) It is unclear to whom "He" refers.

Directions: Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered words or sets of words. Choose the word or set of words for each blank that best fits the meaning of the sentence as a whole.

5. The senator's reputation, though --------- by false allegations of misconduct, emerged from the ordeal ---------.
    a) shaken…unscathed
    b) destroyed…intact
    c) damaged…impaired
    d) impugned…unclear
    e) tarnished…sullied

6. The poetry is no --------- it is more likely to appeal to an international audience than is poetry with strictly regional themes.
    a) familiar
    b) democratic
    c) technical
    d) complex
    e) provincial

7. Experienced employers recognize that business students who can --------- different points of view are ultimately more effective as managers than are the brilliant and original students who --------- dogmatically to their own formulations.
    a) discredit…revert
    b) assimilate…adhere
    c) impose…refer
    d) disregard…incline
    e) advocate…relate

8. Poe's --------- reviews of contemporary fiction, which often find great merit in otherwise --------- literary gems, must make us respect his critical judgment in addition to his well-known literary talent.
    a) thorough…completed
    b) petulant…unpopular
    c) insightful…unappreciated
    d) enthusiastic…acclaimed
    e) harsh…undeserving

9. The significance of the Magna Carta lies not in its --------- provisions, but in its broader impact: it made the king subject to the law.
    a) specific
    b) revolutionary
    c) implicit
   d) controversial
    e) finite

10. The theory of cosmic evolution states that the universe, having begun in a state of simplicity and --------- has --------- into great variety.
   - b) equilibrium…modulated
   - c) homogeneity…differentiated
   - d) contrast…metamorphosed
   - e) proportion…accelerated
   - f) intelligibility…developed

11. Not wishing to appear --------- the junior member of the research group refrained from --------- any criticism of the senior members' plan for dividing up responsibility for the entire project.
   - a) reluctant…evaluating
   - b) inquisitive…offering
   - c) presumptuous…venturing
   - d) censorious…undercutting
   - e) moralistic…observing

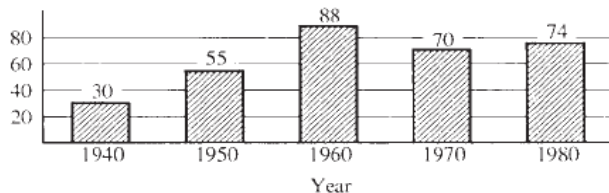The questions on this page pertain to the following graph:

AVERAGE DAILY CIRCULATION FOR NEWSPAPER X
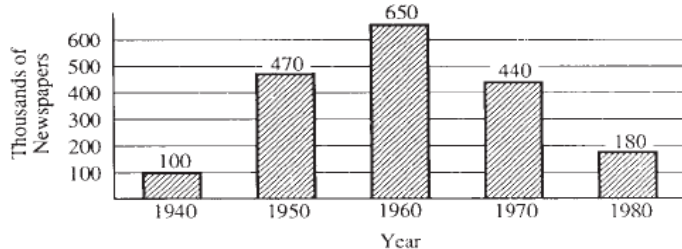
TOTAL YEARLY ADVERTISING REVENUE FOR NEWSPAPER X
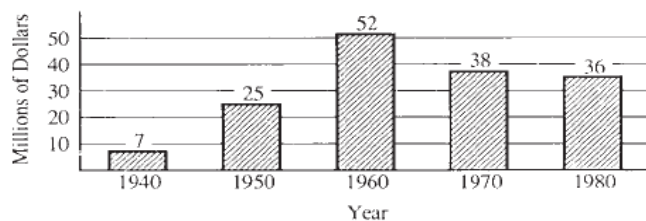
AVERAGE NUMBER OF PAGES PER NEWSPAPER FOR NEWSPAPER X

----

12. In how many of the years shown was the average number of pages per newspaper at least twice as much as the average in 1940?
   a) Four
   b) Three
   c) Two
   d) One
   e) None

13. In 1950, if the printing cost per newspaper was $0.05, what would have been the total cost of printing the average daily circulation?
   a) $32,500
   b) $26,000
   c) $23,500
   d) $22,000
   e) $2,600

14. In 1980 the number of dollars of advertizing revenue was how many times as great as the average daily circulation?
   a) 500
   b) 200
   c) 100
   d) 50
   e) 20

15. The percent decrease in average daily circulation from 1960 to 1970 was approximately
   a) 10%
   b) 12%
   c) 20%
   d) 26%
   e) 32%

16. Which of the following statements can be inferred from the data?
   I. The greatest increase in total yearly advertising revenue over any 10-year period shown was $27 million.
   II. In each of the 10-year periods shown in which yearly advertising revenue decreased, average daily circulation also decreased.
   III. From 1970 to 1980 the average number of pages per newspaper increased by 10.
   a) I only
   b) II only
   c) III only
   d) I and II
   e) II and III

Directions: In each of the following questions, a related pair of words or phrases is followed by five lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.

17. SEDATIVE : DROWSINESS
    a) epidemic : contagiousness
    b) vaccine : virus
    c) laxative : drug
    d) anesthetic : numbness
    e) therapy : psychosis

18. LAWYER : COURTROOM
    a) participant : team
    b) commuter : train
    c) gladiator : arena
    d) senator : caucus
    e) patient : ward

19. CURIOSITY : KNOW
    a) temptation : conquer
    b) starvation : eat
    c) wanderlust : travel
    d) humor : laugh
    e) survival : live

20. ANTIDOTE : POISON
    a) cure : recovery
    b) narcotic : sleep
    c) stimulant : relapse
    d) tonic : lethargy
    e) resuscitation : breathing

21. FRAGILE : BREAK
    a) invisible : see
    b) erratic : control
    c) flammable : burn
    d) noxious : escape
    e) industrial : manufacture

22. EXPAND : VOLUME
    a) ascend : flight
    b) proliferate : number
    c) bend : flexibility
    d) cool : temperature
    e) deflect : heading

23. SUITCASE : LUGGAGE
    a) gift : package
    b) necklace : garment
    c) room : house
    d) hat : millinery
    e) faucet : sink

Directions: Each question below consists of a word printed in capital letters, followed by five lettered words or phrases. Choose the lettered word or phrase that is most nearly opposite in meaning to the word in capital letters.

Since some of the questions require you to distinguish fine shades of meaning, be sure to consider all the choices before deciding which one is best.

24. FALLACY
    a) personal philosophy
    b) imaginative idea
    c) unconfirmed theory
    d) tentative opinion
    e) valid argument

25. BOYCOTT
    a) extort
    b) underwrite
    c) underbid
    d) stipulate
    e) patronize

26. ADULTERATION
    a) consternation
    b) purification
    c) normalization
    d) approximation
    e) rejuvenation

27. UNDERMINE
    a) submerge
    b) supersede
    c) overhaul
    d) reinforce
    e) intersperse

28. FREQUENCY
    a) unity
    b) rarity
    c) gradualness
    d) persistency
    e) moderation

29. DIVULGE
    a) keep secret
    b) evaluate by oneself
    c) refine
    d) restore
    e) copy

30. VERITABLE
    a) impetuous
    b) malicious
    c) inefficacious
    d) disastrous
    e) fallacious

Table 1

Means of the item "Based on the information from the cover page instructions, many serial subtractions with few errors is a strong predictor of better performance on standardized tests and undergraduate GPA" as a function of subliminal prime and relevance conditions.

| | Subliminal Prime | | | |
| | Death | | Field | |
Self-esteem Relevant	*M*	*SD*	*M*	*SD*
Yes	5.45	2.70	6.74	2.28
No	3.00	2.58	4.13	2.71

Note. Higher scores reflect more agreement with the item.

Table 2

Means of the item "I felt I exerted a lot of effort on the serial subtraction task" as a function of

subliminal prime and relevance conditions.

	Subliminal Prime			
	Death		Field	
Self-esteem Relevant	*M*	*SD*	*M*	*SD*
Yes	6.63	1.64	6.82	1.55
No	6.76	1.48	6.25	2.27

Note. Higher scores reflect more agreement with the item.

Table 3

Means of the item "Based on the information from the cover page instructions, smarter people perform better on the cognitive assessment test" as a function of subliminal prime and relevance conditions.

	Subliminal Prime			
	Death		Field	
Self-esteem Relevant	*M*	*SD*	*M*	*SD*
Yes	6.73	2.35	6.12	2.94
No	1.74	2.55	2.11	2.15

Note. Higher scores reflect more agreement with the item.

Table 4

Means of the item "I felt I exerted a lot of effort on the cognitive assessment test" as a function

of subliminal prime and relevance conditions.

| | Subliminal Prime | | | |
| | Death | | Field | |
Self-esteem Relevant	*M*	*SD*	*M*	*SD*
Yes	7.15	1.43	5.46	1.91
No	6.52	1.95	5.78	2.10

Note. Higher scores reflect more agreement with the item.
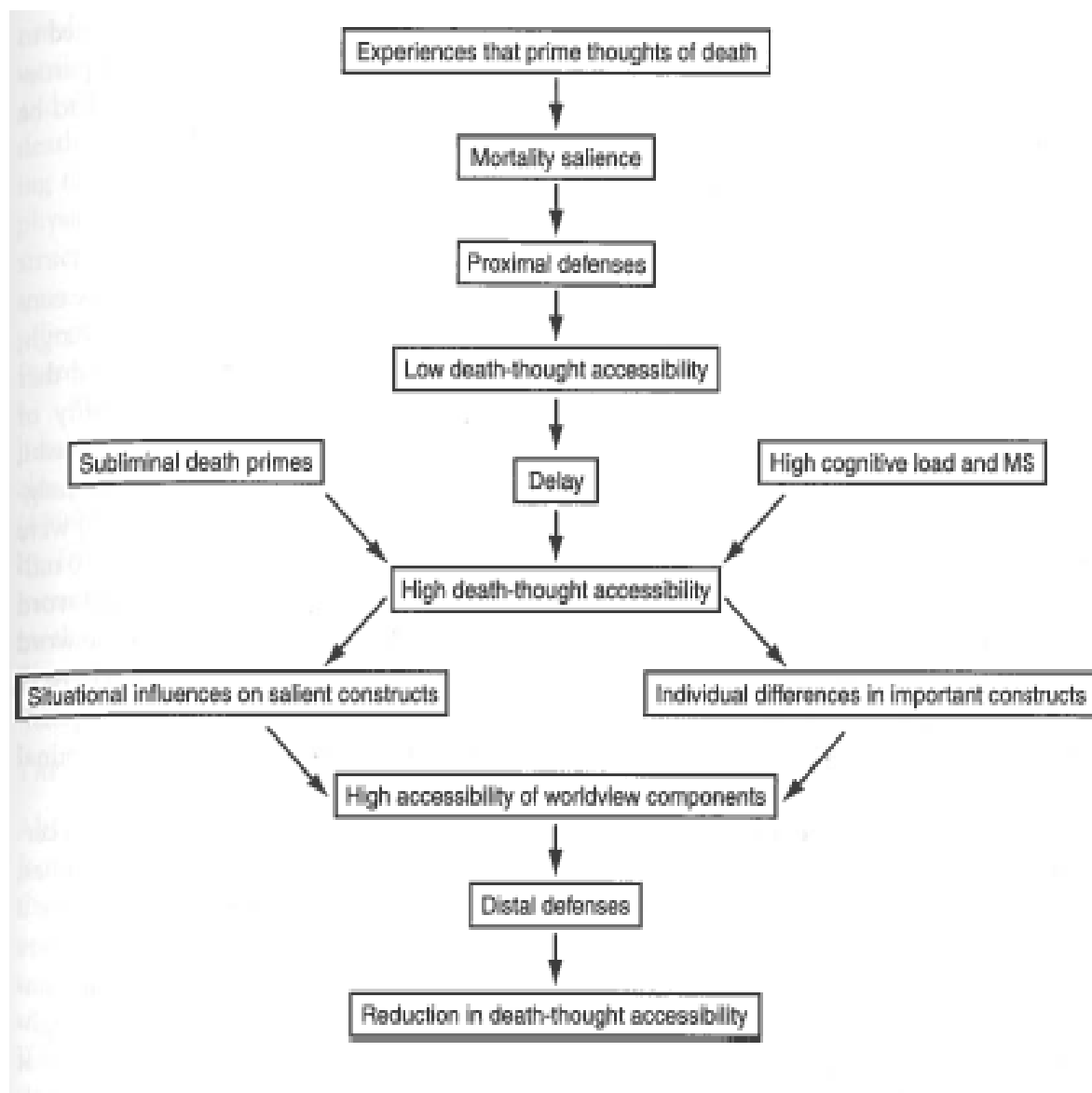
Figure 1: The cognitive architecture of terror management. Adopted from Arndt, Cook and colleagues (2004).
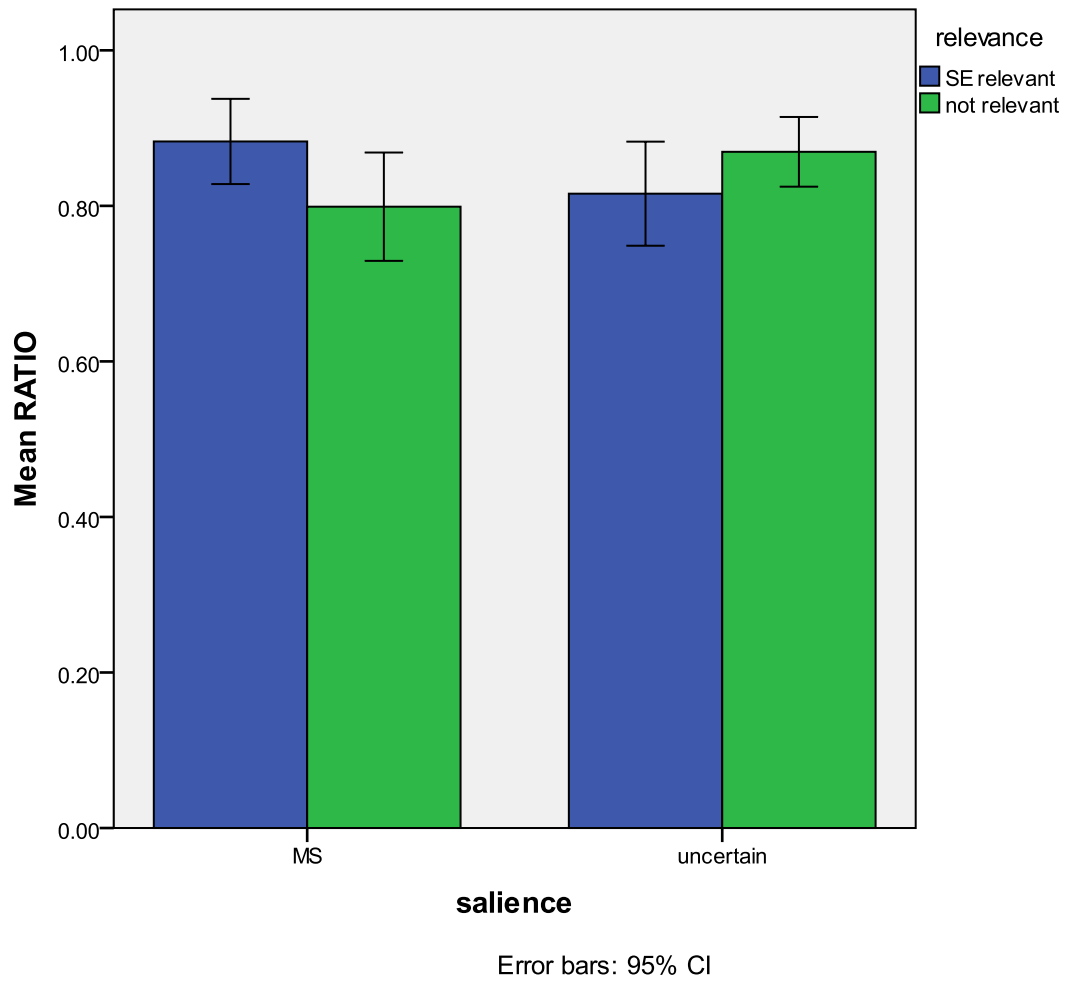
Figure 2. Study 1: Serial subtraction performance as a function of salience and self-esteem

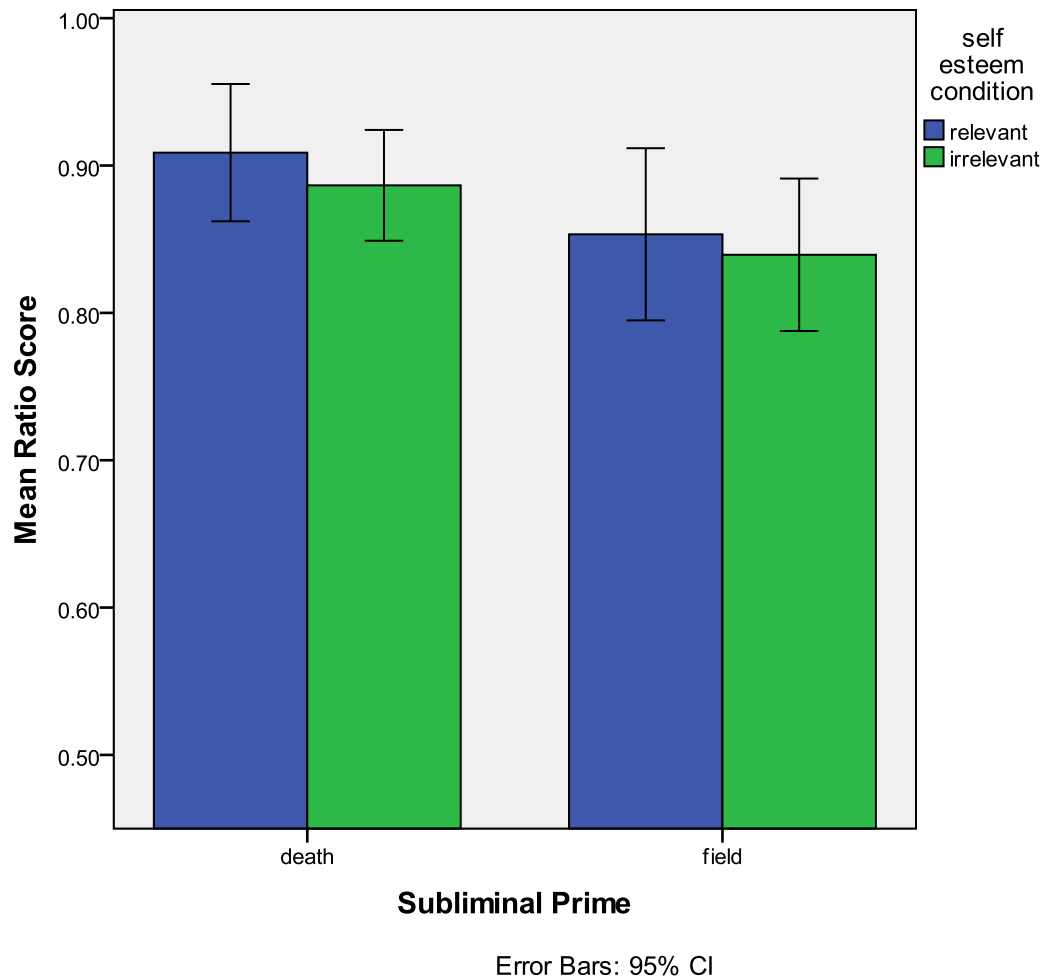conditions. Higher scores indicate better performance.

Figure 3. Study 2: Serial subtraction performance as a function of prime and self-esteem

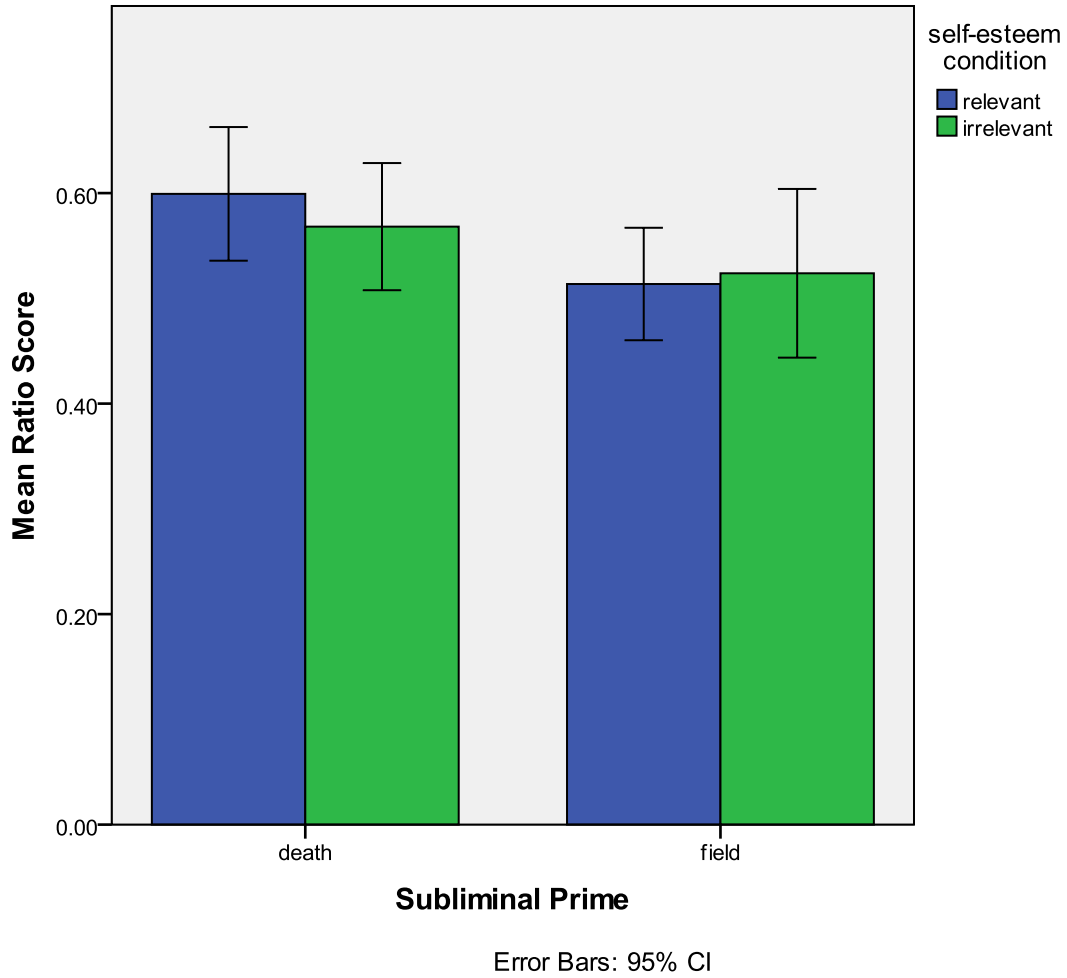conditions. Higher scores indicate better performance.

Figure 4. Study 3: GRE performance as a function of prime and self-esteem conditions. Higher

scores indicate better performance.