Death-Primed Memory Suppression

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Abstract

Motivated forgetting can be unconscious, as in the controversial and contentious repressed memory literature—or conscious, as in the suppression of undesirable thoughts, like cravings or impulses. The current work aimed at developing an experimental analogue of suppressed memories by converging death word priming and thought suppression research. Participants (17 males, 37 females) performed a computer-based, five-phase, study-recall-suppress-test-recognition task. Left-hand primes consisted of 22 nonwords (BLAY). Right-hand targets included 6 death (SLAY), 6 neutral (CLAY), and 6 nonword prime matches (BLAY). Participants significantly suppressed death-related prime-target pairs at a lesser rate and with less suppression confidence than nonword prime-target pairs. The discussion focuses on implications, contradictions and parallels to previous research findings, and future directions for research on thought suppression.

Humans have thoughts regarding all aspects of life, and typically believe they have control over those thoughts. For example, a person can change his or her mind, think in new ways, formulate new ideas, and shift attention from one thought to the next (Wegner, 1989). It seems as though humans have control over thoughts; however, try not thinking about something. This task is difficult for most because of the seeming permanence of the unwanted thought; however, people who are motivated to forget can sometimes do so. Because of the influence of unwanted thoughts, there are many reasons why a person wishes to forget. For example, an undesirable thought may interfere with day-to-day work, cause anxiety, loss of sleep, or simply be annoying (Wood, 2005). In the extreme cases, potential suppressors are the victims of physical, verbal, or sexual abuse, or have visions of a loved one dying, that may cause impairments in all aspects of the experiencer's life. Because people cannot control life's events, thought suppression could serve as a helpful coping strategy.

Motivated forgetting comes in two forms: unconscious, as in the controversial and contentious repressed memory literature, and conscious, as in the attempted suppression of undesirable thoughts (Bjork, Bjork, & Anderson, 1998). Thought suppression is an effortful process, uses cognitive control, and requires conscious initiation, often perhaps to regulate emotions when undesirable thoughts yield unpleasant emotions (Wegner, 1989). Therefore, "it requires people to override or stop the retrieval process to impair later retention" (Anderson et al, 2004, p. 232). This active process recruits areas of the brain that putatively carries out executive control functions. Wegner and Gold's (1995) defensive suppression hypothesis suggested a plausible mechanism for the suppression of emotional thoughts that was supported by applied and experimental evidence. Thought suppression has implications for patients and therapists. Implications for the patient include alleviating stress, physical and emotional pain, and other side effects from the memory of a traumatic event. On a secondary level, implications exist for the family, friends, and therapists who work with the patient: seeing the healing of the patient and coping with the event, and reducing the worry and distress caused by seeing the victim relive the trauma. Overall, thought suppression, if possible, may be an effective coping mechanism that helps produce happier, healthier lives.

The current work develops an experimental analogue of suppressed memories in which participants perform a five-phase, computer-based, study-recall-suppress-test-recognition task that used 22 prime-target pairs. This allows investigation into whether suppression of death, neutral, and nonword prime-target pairs occurs at different rates and confidences. If death-primed words (i.e., BLAY-SLAY) produce mortality salience (Bjork et al., 1998), the death-primed condition ought to suppress more target items than the neutral (i.e., BLAY-CLAY) and nonword (i.e., BLAY-BLAY) prime-target pairs. The following paper highlights historical and influential research dating back to early 1900's in the area of suppression, current experiments that employ a suppression task or death word priming, and a description of the conducted experiment, results, implications, conclusions, and future directions of the research.

Historical Suppression Research

Muller and Pilzecker (1900) reported the first empirical demonstration of forgetting due to interference, produced evidence of retroactive interference, and developed the Perseveration Consolidation Theory. The theory predicted that the process of storing new memories might disrupt the consolidation process that would ordinarily strengthen memories, therefore resulting in memory impairment. Muller and Pilzecker (1900) found that participants were less likely to recall a memory if the cue to retrieve that memory became associated with another memory. Therefore, "the memory impairment occurs when the storing of a new memory disrupts the consolidation process. That process should have strengthened the traces that subjects had acquired earlier" (Muller & Pilzecker, 1900, p. 415).

The work of Muller & Pilzecker (1900) began the classical interference era in memory research dating from 1900 to 1970 (Anderson, 2003). Many researchers attempted to discover what was involved in interference because it addressed the fundamental problem of everyday forgetting. Muller and Pilzecker (1900) suggested that when a person forgets, it was because the person was affected by the ever-changing structure of our memory and the basic limitations in our ability to differentiate similar traces. Muller and Pilzecker's (1900) Perseveration Consolidation Theory involved with retroactive interference and was able to stand the test of time by researchers having little success of disproving it. With more than 100 years of research and thousands of research papers on the topic of forgetting, there should be little doubt that interference is a powerful cause of forgetting.

A question that emerged from the work of Muller and Pilzecker's (1900) was how interference caused forgetting. Classical theories such as Response Competition Theory attributed interference effects to heightened competition arising from the association of additional memory traces to a retrieval cue or to strengthening of an existing competitor (McGeoch, 1942). Thus, the thought that memory was fundamentally associative, and that cues guide retrieval, determined which items in memory were associated (Bjork et al., 1998). That is, having more than one response attached to a retrieval cue led those responses to compete with one another when later presented with the cue. Thus, the more intense or vivid a competing response became for an already established retrieval cue, the more difficult it became to recall a given item or memory. The overall concept of McGeoch's (1942) Response Competition Theory was that adding a new structure into memory led to the occlusion, or blocking, of a target event. With this implication, the theory stimulated a great deal of empirical research over the several decades that follow.

Melton and Irwin (1940) proposed one of the most widely known examples of an associative decrement mechanism, unlearning. After testing Muller and Pilzecker's (1900) theory, Melton and Irwin (1940) concluded that the factor of unlearning and goal-directed forgetting played a role in forgetting. Further, the researchers' deduced that unlearning was extinction of conditioned responses (Melton & Irwin, 1940). Of theoretical importance in studies of retroactive interference was the analysis of evidence of active competition between the original and interpolated response systems during the learning of the interpolated material and, particularly, during the recall and relearning of the original material (Melton & Irwin, 1940). This study revealed a relationship between the amount of loss in retention and the degree of interpolated learning. It was probably a function of the definition of "degree of learning," and definitely a function of the degree of learning of the original list before the interpolation of the second list (Wood, 2005).

Postman, Stark, and Fraser (1968) proposed the response-set suppression hypothesis that explicated retroactive interference effects and the conditions under which items suffering retroactive interference exhibited spontaneous recovery. Melton and Irwin (1940) proposed a clear contradiction of unlearning, stating that response-set suppression was clearly a goal-directed inhibitory mechanism. The response-set suppression was an example of retrieval inhibition because the participant lost retrieval to one set of responses. Findings by Postman et al. (1968) supported the idea that representations continued to exist in memory as demonstrated by the spontaneous recovery under certain conditions. A condition possible for spontaneous recovery was the virtual disappearance of retroactive interference effects if used a multiple-choice recognition test rather than a recall test.

Bjork (1970) proposed item-by-item cuing, which attributed directed-forgetting to the participants segregating or differentiating in memory the items to remember from the items to forget. This theory explained directed-forgetting effects by focusing post cue rehearsal and other mnemonic activities on the to-be-remembered items. Next, the participant segregated in memory the to-be-remembered items from the earlier to-be-forgotten items. Geiselman, Bjork, and Fishman (1983) proposed that differential grouping of the items was necessary to conduct selective rehearsal efficiently.

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Although most instances of forgetting are unintentional or incidental, there are occasions when people try to forget, because the memory is unappealing, or because the memory constitutes a source of interference in conducting routine mental operations such as memory updating (Geiselman et al., 1983). Therefore, a cue to forget a word could cause a disruption in the retrieval process of the word later on. That is, disruption of retrieval of a word or event plays a significant role in intentional-forgetting experiments. Geiselman et al. (1983) proposed that intentional forgetting and posthypnotic amnesia had a strong parallel.

Wegner (1989) referred to unwanted thoughts as occurring at all points in the spectrum from normal to abnormal, spanning across different kinds of disorders rather than distinguishing one from another. It was necessary to understand because unwanted thoughts are a general symptom of mental distress, which occur in everyone and cause anxiety and anguish. Wegner (1989) proposed that people engage in a self-distracting strategy to circumvent unwanted thoughts, and that people literally think of distracters. There are two strategies for distracting: unfocused distraction strategy and focused distracter. The former consists of using many different distracters, causing a rebound of the suppressed thought, which defeats the purpose. The latter is more successful because "the rebound effect is attenuated creating an adaptive strategy for reducing distress associated with aversive thoughts" (Najmi, Wegner, & Nock, 2007, p. 1958).

Reich and Mather (2008) examined "the quality of the thoughts people consciously generate to distract themselves from the undesired thought" (p. 706). The researchers were interested in how distracter thoughts affect people when pursuing suppression tasks. Results from three studies found that participants were more successful at suppression tasks when they generated "high-quality oppositely valence distracter thoughts" (Reich & Mather, 2008, p. 716). Therefore, not only is a distracter important when pursuing a suppression task, but the quality of the distracter affects the participant's success. These results lend support for focusing on the operating process when doing suppression tasks under cognitive load and the role of high-quality distracter thoughts.

Wegner and Zanakos' (1994) White Bear Suppression Inventory is a 15-item self-report measure of an individual's propensity to try to suppress unwanted thoughts. An example of using it in Wegner's experiments (1989, 2003) was to drop what the participant was doing and try to not think about a white bear. It was usually impossible, it was just like when someone says, "I need to talk to you, but not right now and do not worry about it," which was virtually impossible as well. The rest of the day, participants' minds were consumed with thoughts about the future conversation. In a typical experiment, Wegner (1989, 2003) instructed the participant to sit in a room and discuss whatever came to mind. The researcher returned, "asking them to continue but this time not to think of a white bear, if the thought of a white bear came up anyway, the person was to ring the bell and go on" (Wegner, 1989, p. 2). In a five-minute period, participants rang the bell on average six times. Wegner (1989) suggested that attempting to suppress a thought made it more salient in the participants' minds.

Wegner and his fellow researchers used the White Bear Suppression Inventory to examine different aspects of suppression. The most enduring contribution from Wegner's (1994) research was the development of the Theory of Ironic Processes, which is currently the most complete account for suppression-related phenomena. Wenzlaff and Wegner (2000) wrote,

> thought suppression involves two mechanisms: an intentional operating process that seeks thoughts that will promote the preferred state (i.e. anything other than the unwanted thought), and an ironic monitoring process that remains in the background of the consciousness and searches for mental contents that signal the failure to achieve the desired state (i.e., the unwanted thought) (p. 68).

The former is a conscious process that takes effort and the latter takes less mental effort and in most instances, is unconscious. The monitoring process was the ironic portion of the theory, which actively attuned to occurrences of the unwanted item. Despite its ironic nature, the vigilance was necessary for successful mental control because it alerted the operating process of the need to renew distraction when conscious awareness of the unwanted thought became imminent (Wenzlaff & Wegner, 2000).

Current Suppression Research

Anderson (2001, 2003, 2004) examined many of the main points from the above theories to develop a research paradigm to test suppression. Recent research with neurologically normal college students found suppression of unwanted memories, whereas recall of suppressed items worsens with increased suppression trials (Anderson, 2001, 2003, 2004). This resulted in evidence for suppression when a participant encountered a cue to forget an unwanted memory and continually rejected that unwanted memory upon the cue. As the number of the rejection of the unwanted memory increased, the more difficult it became to later recall that unwanted memory. This resulted in successful suppression of the unwanted memories by the participants.

More specifically, Anderson (2001, 2003, 2004) used a four phase (i.e., learn, recall, think-no-think, test) procedure to examine suppression. Learning the pairs consisted of viewing the two words simultaneously on the computer screen, each pair appeared alone in the center of the screen for a specific amount of time. The researchers

used a recall task to test the participant's memory of the pairs; the participant had to recall at least 50 percent of the pairs. Next, was the think/no-think phase in which the researchers used color to cue participants to either suppress (i.e., red font) or recall (i.e., green font), manipulating the number of repetitions each participant suppressed or recalled (Anderson, 2001, 2003, 2004). If the left-hand member word was in green, the participant was to recall and say the right-hand member word that goes with the pair. If the word was in red, the participant was to suppress and not say the matching word. At repetition levels, zero and one, researchers found no difference; however, at levels, one and eight, researchers found a statistically significant difference, and at levels eight and 16, researchers found no difference (Anderson & Green, 2001).

Anderson and Green's (2001) experiment utilized two different testing methods, same or independent probe, to determine if the participant actually suppressed or recalled. In the same probe method, the participant saw all the left-hand member words individually and was to recall and say the correct right-hand member. With the independent probe method, participants saw a clue to the left-hand member, and the first letter of the right-hand member, and were to recall and say the correct right-hand member. The researchers deemed successful suppression if the participant could not recall one of the pairs that was a suppression pair. This was true for both testing methods. The authors equally supported both ways of testing, but did not suggest why use of both methods and did not make a distinction or preference for use of one method over the other.

Anderson and Green (2001) proposed that a deliberate effortful process plays a role in targeting recall of some memories, and forgetting of others. This suggested that when presentation of a stimulus triggered an unwanted memory in the victim, recruiting the process prevented awareness of the memory. Clinical studies of psychogenic amnesia suggested that the more encounters with stimuli that reminded one of an unwanted memory should make that memory less accessible (Wood, 2005). These findings supported Freud's suggestion of a suppression mechanism that forced unwanted memories out of awareness. Anderson and Green (2001) proposed evidence for a viable model for repression as well as the potential to move from an unintentional to an intentional process of forgetting.

Anderson et al. (2004) used functional magnetic resonance imaging (fMRI) to identify the neural systems involved in keeping unwanted memories out of consciousness. The experiment replicated the experiment by Anderson and Green (2001) published in Nature which used the same procedure and the two aforementioned methods (i.e., same and independent probe) for testing. The researchers scanned each participant with the fMRI when both suppressing and recalling the words. The participant knew to suppress or recall depending on the color of the word (i.e., green for recall or red for suppress). To identify the neural systems involved in suppression, the researchers contrasted activation during suppression and recall trials. Researchers pinpointed the prefrontal cortical and right hippocampal activations as predictors for the extent of forgetting the unwanted memory (Anderson et al., 2004). These results confirmed the existence of an active forgetting process and established a neurobiological model for guiding inquiry into motivated forgetting (Anderson et al., 2004).

Currently, researchers incorporated autobiographical events into directed forgetting paradigms and got results that support the findings of Anderson (2001, 2003, 2004) as well as others who conducted suppression research. Joslyn and Oakes (2005) instructed participants to intentionally forget material previously written in a journal. The researchers suggested that participants had the ability to suppress memories of autobiographical events similarly to the way participants forget words on a memory list. These findings were true regardless of whether the events were positive or negative in mood and emotional intensity did not matter (Joslyn & Oakes, 2005). The effect was seen even after a full week after issuing the forget cue. With these findings in place, there was little doubt of the possibility that intentional forgetting of autobiographical events occurs. Joslyn and Oakes (2005) contended this allows a therapist to instruct patients to keep a journal of events or to write down if possible the traumatic event that is causing so much psychological pain. The psychologist can implement this coping mechanism by giving the client a cue to forget and instructing the patient to forget the unwanted memory.

Having established a general understanding of suppression and the empirical research that helps formulate the rationale for the current research, this paper can now focus on the path to the current study. The current researcher previously worked with Anderson's (2001, 2003, 2004) think/no-think paradigm, specifically the same probe method, used neutral words (e.g., neutral, open, similar) as the left-hand members and death-related words (e.g., death, blood, coffin) as the right-hand members. The hypothesis was that when comparing data of neutral-related pairs to the death-related pairs, participants in the death-related group would statistically suppress more pairs. The reasoning was that "conscious death-related thoughts lead to suppression of further death-related thoughts" (Arndt et al., 1997, p. 17). Therefore, when a participant encountered death-related pairs it was more likely that suppression would occur versus neutral pairs. Surprisingly, in previous pilot studies by the current researcher the participants did not recall at least 50 percent of the death-related pairs, and therefore, the participants were not able to complete the experiment (i.e., the think/no-think and the suppression test).

Death-Related Research

Previous research utilizing mood states reported asymmetries between different moods and different participant populations. Power, Dalgleish, Claudio, Tata, and Kentish (2000) used a directed forgetting task modeled after Bjork's (1970) task to investigate emotionally valent material and different mood states: "The depressed subjects demonstrated significantly higher levels of recall for negative material under 'forget' instructions than when under 'remember' instructions" (p. 154). That is, participants had more difficulty suppressing the negative material and had more difficulty recalling the negative material when instructed to do so compared to the other materials. After careful analysis, Power et al. (2000) concluded this was due to a facilitation effect because there were more items that are negative in the first half of the list compared to the second half of the list. A similar problem occurred in a pilot study by the current researcher in which participants did not recall at least 50 percent of the word pairs resulting in termination of the experiment. However, the facilitation effect was not occurring during the current researcher's pilot study because each word pair had a death-related right-hand member; therefore, each word pair is negatively valenced. In addition, participants received two chances to recall the pairs, and in each trial, random presentation of the left-hand member occurred.

Power et al.'s (2000) research provided possible explanations for the difficulty of recalling death-related prime-target pairs by participants. For instance, the effects occurred at the retrieval of the material, not the encoding. Participants in the pilot studies by the current researcher recalled many of the right-hand members, but did not successfully recall the pairs with the appropriate left-hand member. Essentially guessing occurred. Therefore, it seemed encoding happened, but was it a problem with the encoding or the retrieval causing the problem. It was significant that the preliminary evidence suggested that the directed forgetting effect was stronger for negative or threat-related material rather than positive material in normal individuals (Power et al., 2000). Findings from Power et al.'s (2000) research suggested that if participants in the current research can recall the death-related pairs, and then complete the think/no-think task, the results would indicate successful suppression of the word pairs. In addition, when comparing the neutral pairs, the results should indicate better suppression for death-related pairs.

Wessel and Merkelbach (2006) examined previous results showing that participants should have the ability to inhibit aversive material when wishing to do so, and emotion that had an arousal component exerts a memory enhancing effect. When participants had to learn the death-related prime-target pairs, stimulation should occur; therefore, the death-related prime-target pairs should be more difficult to forget. If this is the case, suppression using negative material should be more difficult than positive or neutral material. The results from Wessel and Merkelbach (2006) indicated that directed forgetting of negative and neutral words occurred to a similar extent. The most pertinent results for the purposes of the current study were that recall performance for negative emotional and neutral words was similar across the board. The stimuli of negative emotional words consisted of some death-related words (e.g., murder, grave, and corpse). Results of Wessel and Merkelbach (2006) indicate that there should be no difference in suppression of different valenced word pairs across participants.

Arndt, Greenberg, Solomon, Pyzczynski, and Simon (1997) suggested that immediately following an explicit reminder of death, death-thought accessibility was low, however, when the mortality prime followed a delay, death-thought accessibility increased. That is, as thoughts about death consumed participants' minds, participants tended to think of death, and then consciously attempted to remove the death-related thoughts from focal attention. According to the researchers, "the awareness of our mortality, when juxtaposed with an instinct for self-preservation, creates in humans the potential for paralyzing terror" (Arndt et al., 1997, p. 6). This suggested that when the current researchers' pilot studies presented participants with the death-related pairs in the learning phase, participants began thinking of death and then focused on not thinking about the death-related pair. Therefore, it was possible participants were distracted with death thoughts which hindered proper encoding of the pairs, creating difficulty in the recall phase.

The results of Arndt et al. (1997) provided strong support to the hypothesized role of an active suppression process in the delayed increase in death thought accessibility after mortality salience. Our culture avoids the topic of death usually at all costs. For example, when there is a death in the family, people find distractions to keep from thinking about it. This suggested that people were not consciously controlling thoughts about death because of ongoing terror management. The researchers concluded, "people are not well practiced at suppressing such thoughts once they have in fact entered consciousness" (Arndt et al., 1997, p. 9). Unfortunately, cognitive load affected the ability, interfering with suppression of death-related thoughts. One would predict that when participants' trials increased, so would successful encoding, retrieval, recall, and suppression of death-related prime-target pairs.

Greenberg, Arndt, Schimel, Pyszczynski, and Solomon (2001) focused on whether post defense reduction in accessibility was a consequence of a renewed effortful suppression of death-related thoughts or an actual dissipation of such thoughts. After a high cognitive load delay, a participant accessed death-related thoughts better

than with no delay. Were participants actually suppressing or was it just the salience of death that had dissolved? Greenberg et al. (2001) reported support of an actual dissipation of death-related thoughts because high cognitive load did not disrupt suppression and did not increase accessibility.

Arndt, Cook, Goldenberg, and Cox (2007) explored patterns of death-thought accessibility when concerned about cancer rendered salient or otherwise active. This study was based on Terror Management Theory developed by Greenberg, Solomon, and Pyszczynski (1997), which hypothesized that humans are in a precarious position due to the conflict between biological motives to survive and the cognitive capacity to realize life will ultimately end (as cited in Arndt et al., 2007). While humans know that death is an inevitable end, most try not to think about it. However, things in our lives, like death-related words, bring it to the mind's forefront. Arndt et al. (2007) presented participants with two letter matrices, which served as a distraction task between the salience induction and the accessibility measure. The researchers implemented this because of previous findings that showed having a delay after the mortality prime increased death-thought accessibility.

Research by Russac, Gatliff, Reece, and Spottswood (2007) suggested that young adults often reported higher levels of concern over mortality issues than older adults, with women typically reporting higher levels of death anxiety than men. The researchers used the Collett-Lester Fear of Death Scale-Revised to assess the participant's fear, which confirmed the reports of gender and age effects. Therefore, if participants are successful at recalling and able to complete the experiment, younger college students as well as women should have more anxiety than men and older participants.

This literature review presented a historical background into the research area of suppression as well as current research with methodology using death-related materials. The research discussed emotionally valent material and mortality salience gave suggestions of incorporation of procedures into the current research method. A lack of research exists for suppression and death-related prime-target pairs in the extensive review of the literature conducted by the current researcher. Most research included negative valence words, some pertaining to death, but that was the extent. In addition, many of the experiments had the participants learn the first half of a list, and then instructed participants to forget that section, and remember the second half of the list. In the current methodology, the prime-target pairs chosen as suppression words were at random for the six separate lists of suppression pairs; therefore, having half the participants suppress one portion of the list in each group, and the other suppressing the rest. Cues to suppress or recall occurred on an individual word basis, and then participants practiced recalling or suppressing four times. Because of the methodological differences, difficulty arises in analyzing the results to infer comparisons and conclusions.

The current study compared three types of prime-target pairs (i.e., nonword, neutral, and death-related). The intention of this experiment was to determine the generalizability of the ability to suppress unwanted death-related prime-target pair memories. After determining how to successfully suppress death-related thoughts, one result is the incorporation of the process into treatment plans as a coping mechanism for survivors of traumatic events; this could dramatically reduce the negative impact on their lives.

Current Study

The first hypothesis for the current study was participants will successfully suppress death-related prime-target pairs at a lower rate than nonword and neutral prime-target pairs. The second hypothesis was participants will successfully suppress death-related prime-targets at a lower suppression confidence then neutral and nonword prime-target pairs. The first dependent variables were number of prime-target pairings recalled, and the number suppressed. This first dependent variable was then broken down into number of death-related, neutral, and nonword prime-target pairs suppressed. The second dependent variable was confidence of suppression (i.e., did not, maybe, probably, and definitely suppressed). The second dependent variable was broken down into mean confidence for the death-related, neutral, and nonword prime target pairs. The quasi independent variable was gender (i.e., male or female). The second independent variable was target type (i.e., death-related, neutral, nonword). The third independent variable was group (i.e., one, two, three, four, five, or six), resulting in 2x3x6 completely between participant's design. Portions of this methodology came from previous research by Anderson and Green's (2001, 2004) experiments; however, the current study did not use the independent probe test method and incorporated other modifications.

Method

Participants

Fifty-four students (17 males, 37 females), nine per group, from the University of Central Oklahoma general psychology pool participated in this experiment. The students used the internet to access Sona Systems, which was the experiment management system, to sign up for a desired time slot. Participants received one credit for participation in this experiment. Participants received the credit if the students showed up for the appropriate

time slot, and attempted to complete the experiment. The researcher posted the credit on Sona Systems, in which instructors of the general psychology courses at the University of Central Oklahoma accessed to confirm participation. The experiment required approximately 30 minutes from start to finish for each participant. Each participant signed a consent form, which acknowledged that the participant understood he or she could stop the experiment at any time and receive full credit. Treatment of all participants met the ethical guidelines of the American Psychological Association. Participants were debriefed, and thanked for their participation.

Exclusion of participants from the experiment occurred if the student had a history of Attention-deficit/hyperactivity disorder (ADHD). Addressing this happened at the time the participant signed up through Sona Systems, which stated under eligibility requirements "has never been or is not currently diagnosed with ADHD". Characteristics of adults with this disorder include inattentiveness, impulsivity, unfocused and immature cognitive behavior patterns that impair functioning in multiple environments (Wadsworth & Harper, 2007). The year 2000 Diagnostic & Statistical Manual for Mental Disorders, (DSM-IV-TR) provides criteria for diagnosing ADHD. The manual states that a person who has six symptoms of inattentiveness or hyperactivity-impulsivity for a period of six months or longer meets the criteria for ADHD.

The experiment caused cognitive strain, had a long duration, and required concentration to complete the experiment; participants diagnosed with Attention-deficit/hyperactivity disorder would have difficulty completing the experiment. Mattes (1980) reported a dysfunction in the prefrontal cortex as a neurobiological expression of the genetic disorder. Over the years, there has been extensive documentation by researchers regarding abnormalities in the brain structure and function of adults with ADHD (Harvey, as cited in Wadsworth & Harper, 2007). By not excluding participants with these differences in the brain that is consistent with Attention-deficit/hyperactivity disorder from this experiment, the results would not generalize to the general population. Even taking this precaution, one problem still arises; ADHD more often than not goes undiagnosed and untreated. Therefore, many participants will not know if they fulfill the requirements of the Diagnostic & Statistical Manual for Mental Disorders, (DSM-IV-TR).

In addition, exclusion of participants from the experiment occurred if the student had red-green color blindness. Addressing this happened at the time in which the participant signed up through Sona Systems, which stated under eligibility requirements "does not have red/green color blindness." People suffering from this have difficulty distinguishing red and green hues. This difficulty would cause problems during the experiment because of the use of red and green fonts to cue the participant to suppress or recall.

Materials

Presentation of the experiment, except for the manipulation check (i.e., questionnaire) is on a Hewlett-Packard (HP) laptop computer, the model is a Compaq nx6110, and the company resides in Palo Alto, CA. The monitor screen display measures 15 in. Each participant sat about two to three feet from the computer. The program used to present the experiment is E-Prime version 1.1 developed by Psychology Software Tools, Inc. located in Pittsburgh, Pennsylvania, E-Prime. The researcher downloaded E-Prime on to the Hewlett-Packard laptop computer.

There were 22 prime-target pairs for each participant, four of which are for practice purposes only. However, groups one and two saw the same stimuli pairs, the same goes for groups three and four, and groups five and six. The formation of the pairs occurred by combining a pronounceable nonword prime (i.e., left-hand member) with either itself (e.g., GEAD-GEAD), an orthographically and phonologically similar, same-length word that was death-related (e.g., GEAD-DEAD) or neutral (e.g., GEAD-READ), which served as the target (i.e., right-hand member).

The left-hand members (i.e., prime) consisted of 22 nonword words, four of which were for practice purposes only. The formation of these occurred by taking a death-related word and changing one or two letters to form the nonword. The right-hand members (i.e., target) consisted of 22 targets, four of which were for practice purposes only. These target stimuli were 18-yoked triplets of equal length (e.g., DEAD-READ-GEAD). The four practice pairs had the same characteristics as the other prime-target pairs, and each participant saw the same ones. Each triplet contained a death-related base word, a neutral word, and a pronounceable nonword. Preservation of the orthographic and phonological similarity of the three stimuli occurred by changing one letter of the base word to create the other two. For example, the base word DEAD yielded one real word (READ) and one nonword (GEAD). The base words were death-related words of length three, four, or five letters taken from Arndt et al. (1997), Arndt et al. (2007), and online thesauruses. Counterbalancing of the relationship of prime to target occurred between groups such that repetition of primes and targets occurred for groups one and two, three and four, and five and six. Therefore, only two of the groups saw the same prime-target pairs.

Code sheets developed by the current researcher using Microsoft Excel were used to record the participants' responses. The sheets were the same for groups one and two, for groups three and four, and for groups five and six.

However, one modification for each code sheet for groups two, four, and six was that for the think/no-think and suppression portion the recall words and suppress words switched spots. The test-feedback phase code sheet had all 22 pairs listed in two different orders. Each list was for one of the two trials in which the participant had to recall the right-hand target stimulus when presented with the left-hand prime. There was a space to the right of each pair to mark if the participant successfully recalled the right-hand target stimulus. The practice think/no-think phase code sheet had four pairs for the participant to practice the suppression task. The think/no-think phase code sheet had the 18 pairs listed. To the right of the pairs were spaces to mark if the participant successfully recalled on a think word or to mark if a participant mistakenly recalled on a no-think word. The test-phase code sheet had the 18 pairs, and a space to the right to mark if the participant successfully recalled the right-hand target when presented with the left-hand prime. The recognition phase code sheet had 30 words lifted, 18 were the right-hand target the participant saw during the experiment, the remaining 12 were words that the participant did not see at any time during the experiment. There was a space to the right of each word to mark if the participant responded yes or no in response to the word. The questionnaire phase used a 5-point anchored scale for the participant to indicate responses to the six questions. The data was taken from the code sheets and put into SPSS for each participant.

Design

The design of the experiment was a completely between participant's 2 x 3 x 6, gender (i.e., male, female) x target type (i.e., death-related, neutral, nonword pairs) x group (i.e., one through six). The quasi independent variable was gender, and the manipulated independent variables were target type and group. The second independent variable (i.e., prime-target type) referred to if the right-hand target is death-related, neutral, or nonword pairs. Each participant saw six of each target type, with groups one and two seeing the same pairs, groups three and four saw the same pairs, and groups five and six saw the same pairs. The third independent variable (i.e., group) referred to which group one, two, three, four, five, or six the participant was in. Groups one, three, and five recalled the first half of the list, and suppressed the second half of the list. Groups two, four, and six suppressed the first half of the list, and recalled the second half of the list.

The first dependent variable was confidence of suppression (i.e., not, maybe, probably, and definitely suppression), number of pairs recalled correctly on first trial of the feedback-phase, number of pairs recalled correctly on second trial of the feedback-phase, and number of right-hand targets recognized correctly. The researcher randomly assigned participants to groups based on the order of participation, which resulted in nine participants per group. Deciding the first dependent variable (i.e., suppression confidence) coding occurred by participant's responses on the two recall trials, the suppression test, and recognition test.

A coding of not suppression resulted from three different scenarios. First, correctly recalling the right-hand target during the suppression test. Second, incorrectly recalling the right-hand target during the suppression test, not recalling right-hand target during either trial of the feedback phase, and not recognizing it. Third, incorrectly recalling the right-hand target during the suppression test, not recalling right-hand target during either trial of the feedback phase, but recognizing it. A coding of maybe suppression resulted from two scenarios. First, incorrectly recalling the right-hand target during the suppression test, recalling the right-hand target during one trial of the feedback-phase, and not recognizing. Second, incorrectly recalling the right-hand target during the suppression test, recalling the right-hand target during both trials of the feedback-phase, and not recognizing. A coding of probably suppression resulted from incorrectly recalling the right-hand target during the suppression test, recalling the right-hand target during one trial of the feedback-phase, and recognizing. A coding of definitely suppression resulted from incorrectly recalling the right-hand target during the suppression test, recalling the right-hand target during both trials of the feedback-phase, and recognizing.

The second dependent variable was death suppression confidence, which was out of the three death-related suppression prime-target pairs, the mean of the suppression confidence codings (i.e., not, maybe, probably, or definitely suppression) for the three death-related prime-target pairs. The third dependent variable was neutral suppression confidence, which was out of the three neutral prime-target pairs, the mean of the suppression confidence codings (i.e., not, maybe, probably, or definitely suppression) for the three neutral prime-target pairs. The fourth dependent variable was nonword suppression confidence, which was out of three nonword suppression prime-target pairs, the mean of the suppression confidence codings (i.e., not, maybe, probably, or definitely suppression) for the three nonword prime-target pairs.

The fifth dependent variable was number of targets suppressed, which was out of the nine suppression prime-target pairs, how many total the participant suppressed. The prime-target pair was determined as suppressed if the participant's response met one of the situations for the coding of maybe, probably, or definitely suppression on the first dependent variable (i.e., suppression confidence). The sixth dependent variable was targets recalled, which was out of the nine recall prime-target pairs, how many total targets the participant recalled during the test phase. The seventh dependent variable was death targets suppressed, which was out of the three death-related suppression

prime-target pairs, how many total the participant suppressed. The eighth dependent variable was neutral targets suppressed, which was out of three neutral prime-target pairs, how many total the participant suppressed. The ninth dependent variable was nonword targets suppressed, which was out of three nonword prime-target pairs, how many total the participant suppressed. For dependent variables seven, eight, and nine, the prime-target pair was determined as suppressed if the participant's response met one of the situations for the coding of maybe, probably, or definitely suppression on the first dependent variable (i.e., suppression confidence).

Procedure

Participation in the experiment occurred in one of the Psychology Department's rooms at the University of Central Oklahoma. Upon entering the room, the participant filled out the consent form. The researcher sat behind the participant to record responses and read aloud the instructions as the participant read. Presentation of each phase occurred automatically and consecutively on a computer screen using the E-Prime program. The five-phase computer-based procedure occurred in order of learn-recall-suppress-test-recognize. Treatment consisted of learning 22 unrelated prime-target pairings. Next, the participant was tested to see how many of the pairs can be recalled. Each trial consisted of presenting the left-hand prime from one pair on a computer screen, and recalling the right-hand target. As long as the participant got at least 50 percent correct, the next phase began. When presented with a left-hand prime that was in green font, the participant recalled and said the right-hand target of the pair. If the left-hand prime was in red font, the participant was to suppress by not thinking and not saying the right-hand target of the pair aloud. Next was a suppression test to determine suppression of the unwanted memory prime-target pairs. Presentation of each left-hand prime was in black, and the participant was to recall the right-hand target. Then presentation of the 18 right-hand target members was in black, along with 12-filler words. The participant was to respond yes or no if the word was part of a pair during the experiment. Lastly, the participants filled out the questionnaire (i.e., the manipulation check).

Study phase. A screen appeared with instructions (See Appendix A), which the research instructed the participant to read silently as the researcher read aloud. This phase presented a prime-target pair on the computer screen that E-Prime randomly chose. The participant's goal in this phase was to learn the two words together as a pair. Each pair appeared on the screen for 1000 ms. Then a blank screen appeared followed by another slide that had the next pair of words. This continued through all 18 prime-target pairs as well as four practice pairs. During this phase, the researcher did not have to record any responses.

Test-feedback phase. A screen appeared with instructions (See Appendix B), which the research read aloud as the participant read silently. This phase presented one of the left-hand prime for one of the pairs that E-Prime randomly chose. The participant's goal in this phase was to recall the right-hand target as quickly as possible. The correct answer was displayed on the next computer slide in blue font, regardless of the participant's response, giving the participant another opportunity to study the pair again. The participant went through this for each word prime-target pair while the researcher recorded whether the participant responded correctly. A screen appeared with instructions, which the researcher read aloud as the participant read silently, "Please continue saying the correct answer when you see a hint word".

After both trials, the researcher assessed the feedback to see if the participant successively recalled 50 percent or better. The four practice word prime-target pairs were not included in the percentage of correct word prime-target pairs recalled. If this was accomplished, then the next phase began. If the participant did not recall 50 percent of the word prime-target pairs after two attempts, the researcher thanked the participant, and the researcher exclude that participant's data from the experiment.

Practice think/no-think phase. A screen appeared with instructions (See Appendix C), which the research read aloud as the participant read silently. This phase presented the four practice prime-target pairs; each presented a left-hand prime in red or green font. The left-hand prime stayed on the screen for 5000 ms no matter the font color. If in red font, the participant's goal was to not think or say the right-hand target. If in green font, the participant's goal was to think of and recall the right-hand target. When the left-hand prime was in green font, the correct right-hand target appeared on a new screen in blue font for 500 ms. If a participant did not follow directions, and verbally responded to a prime that was in red font, the participant heard a loud error click. After this brief practice session that used the four practice prime-target pairs that the participants learned and recalled in the previous two phases, the actual think/no-think phase began. The researcher recorded by making a check mark if the participant got the green word correct.

Think/no-think phase. A screen appeared with instructions (See Appendix D), which the researcher read aloud as the participant read silently. This phase presented at random, a left-hand prime in red or green font, four times per left-hand prime. If the left-hand prime was in green font, it stayed in green font, if the left-hand prime was in red font it stayed in red font. If in red, the participant's goal was to not think or say the right-hand target. If in green font, the participant's goal was to think of and recall the right-hand target. If a participant failed to follow

directions, and verbally responded to a stimulus that presented in red font, the participant heard a loud error click. The left-hand prime stayed on the screen for 5000 ms no matter the font color. When the left-hand prime was in green font, the correct right-hand target appeared on a new screen in blue font for 500 ms. The researcher recorded by making a check mark if the participant got the green word correct.

Test phase. A screen appeared with instructions (See Appendix E), which the researcher read aloud as the participant read silently. This phase presented a left-hand prime for 3600 ms in black at random. The participant's goal was to respond to each prime with its correct right-hand target.

Recognition phase. A screen appeared with instructions (See Appendix F), which the researcher read aloud as the participant read silently. This phase presented individually for 3600 ms 18 right-hand target and 12-filler words in black at random. The participant's goal was to respond yes to right-hand target used in a pair during the experiment, or to respond no if the word was not used in a prime-target pair during the experiment. A screen appeared with instructions, which the researcher read aloud as the participant read silently, "Thank you for your participation in this experiment! Please complete the questionnaire."

Questionnaire phase. The researcher handed the questionnaire, which served as a manipulation check, to the participant, along with an ink pen. Each participant answered three questions, which addressed whether the participant had intentionally disregarded the instructions and allowed the responses to the left-hand prime member stimulus in red font come to mind. The forth question addressed how difficult the participant perceived the task of not allowing the right-hand target member stimulus of a suppression pair to come to mind. The fifth and sixth questions addressed whether the participant knew someone who had died, how close that person was to the participant, and how long ago that event occurred.

Results

The participant sample (17 males, 37 females) was reduced to those who suppressed at least one prime-target pair, therefore, filtering out participants who did not successfully suppress any prime-target pairs. All data analyses were conducted on the remaining participants (10 males, 29 females). A multivariate analysis of variance (MANOVA) was conducted on a portion of this completely Between 2x3x6 (e.g., Gender: male/female; Target Type: death-related/neutral/nonword; Group: one/two/three/four/five/six) design. The participants' gender and group was included in the analysis. The results revealed no statistically significant *F* tests.

Three two-way contingency table analyses were conducted to evaluate the target type (i.e., death-related, neutral, nonword), specifically the number of prime-targets suppressed by participants for each of those target types. Death-related and nonword prime-targets suppressed were found to be significantly related, Pearson $X^2(9, N = 39) = 28.32$, $p = .001$. See Table 1. Therefore, there are significantly higher proportions of nonword prime-target pairs suppressed than death-related prime-target pairs. The other two contingency tables did not produce significant results. Out of 117 nonword prime-target pairs, participants successfully suppressed 36; out of 117 neutral prime-target pairs, participants successfully suppressed 28; and out of 117 death-related prime-target pairs, participants suppressed 24 prime-target pairs. See Figure 1. This supports a portion of the first hypothesis, that participants did significantly suppress death-related prime-target pairs at a lesser rate than nonword prime-target pairs. These results confirm a portion of the second hypothesis that death-related prime-targets are suppressed at a lesser rate than nonword prime-targets.

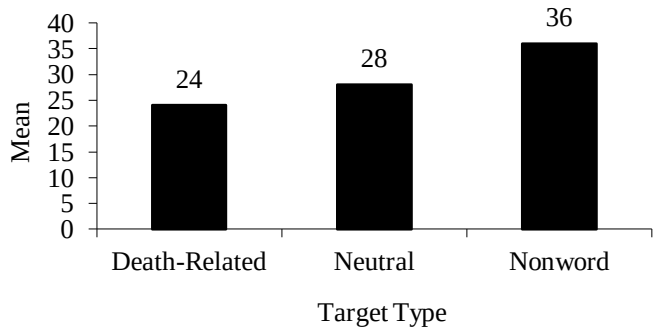
Table 1

Two-Way Contingency: Suppression Targets (Death-Related x Nonword)

Source	*Value*	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	28.32[a]	9	0.001
Likelihood Ratio	16.10	9	0.07
Linear-By-Linear Association	0.18	1	0.67
N of Valid Cases	39		

a. 13 cells (81.3%) have expected count less than 5. The minimum expected count is .05.

Figure 1. Memory Suppression. Bar graph of number of prime-target pairs successfully suppressed for each target type (e.g., death-related, neutral, nonword).



Three two-way contingency table analyses were conducted to evaluate the suppression confidence (i.e., not, maybe, probably, definitely suppression) for target type (i.e., death-related, neutral, nonword). Suppression confidence for death-related and nonword prime-target pairs were found to be significantly related, Pearson $X^2(36, N = 39) = 54.54$, $p = .02$. See Table 2. Therefore, there is a significantly higher mean confidence of suppression for nonword prime-target pairs versus death-related prime-target pairs. The other two contingency tables did not have significant results. The mean suppression confidence for nonword prime-target pairs is 2.05, the mean suppression confidence for neutral prime-target pairs is 1.51, and the mean for death-related prime-target pairs is 1.18. See Figure 2. These results confirm a portion of the third hypothesis that death-related prime-target pairs have a lesser suppression confidence than nonword prime-target pairs.

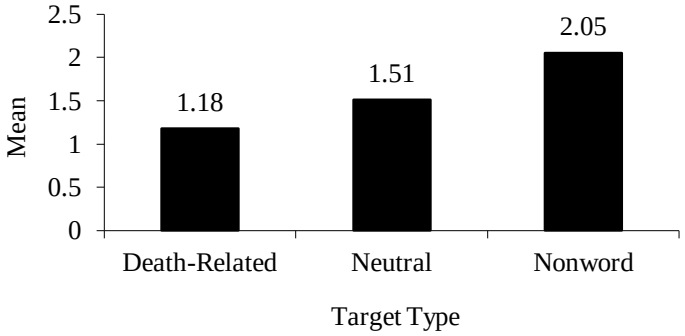
Table 2

Two-Way Contingency: Suppression Confidence (Death-Related x Nonword)

Source	*Value*	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	54.54[a]	36	0.02
Likelihood Ratio	36.64	36	0.44
Linear-By-Linear Association	0.72	1	0.40
N of Valid Cases	39		

a. 48 cells (98.0%) have expected count less than 5. The minimum expected count is .03.

Figure 2. Memory Suppression. Bar graph of mean suppression confidence for prime-target pairs for each target type (e.g., death-related, neutral, nonword).



Discussion

Removing participants who did not successfully suppressed at least one prime-target pair occurred because if the participant was not suppressing, the researcher would not be analyzing suppression data. The multivariate analysis of variance resulted in no significant findings. Therefore, there is no significant difference between gender (i.e., male, female) or group (i.e., one, two, three, four, five, six). Therefore, it did not matter whether the participant was male or female, or out of the six groups, to which one the participant was assigned. In addition, because there is not a significant difference for group, the list of prime-target pairs each participant saw, and the prime-target pairs each participant suppressed did not make a difference.

The two-way contingency for number of death-related by nonword prime-targets pairs supports a portion of the second hypothesis that death-related prime-target pairs are suppressed at a lesser rate than nonword prime-target pairs. The two-way contingency for suppression confidence of death-related by nonword prime-targets pairs supports a portion of the third hypothesis that death-related prime-target pairs are suppressed at a lower confidence than nonword prime-target pairs. The lack of statistical difference between neutral and death-related material parallels Wessel and Merkelbach (2006) results that indicate that directed forgetting of negative and neutral words occurs to a similar extent.

The results found no significant difference between the target type neutral and death-related prime-target types, and found better suppression of nonword prime-target pairs than death-related prime-target pairs. These findings contradict previous research using negative, neutral, or death materials, and terror management theory. According to Arndt et al. (1997) immediately following an explicit reminder of death, death-thought accessibility is low; however, when the mortality prime follows a delay, death-thought accessibility increases. It is possible that after each phase when the participants read the instructions as the researcher read the instructions aloud was a long enough delay to increase death-thought accessibility. Therefore, the salience of the death-related prime-target pairs could have influenced the lower number of death-related word pairs beings suppressed, and the less confidence in those death-related prime-target pairs suppressed. This saliency of death-related prime-targets is evolutionarily based. According to Arndt et al. (1997) when there is an awareness of a person's own mortality, keeping in mind humans instincts for survival, there is potential for paralyzing terror. In addition, because people avoid this topic, humans are not prepared or well practiced at thought suppression for death-related materials (Arndt et al., 1997).

Limitations

A methodological limitation of the current research is the lack of participants, especially participants that successfully suppressed at least one prime-target pair, therefore resulting in analyses of the participant's data. Conducting a replication of this research with more participants will address this issue. If the same results occur, it will lend further support for the findings. However, if conflicting results occur, further replication studies will be necessary. In addition, by determining the least amount of participants necessary to provide sufficient power will save the researcher from conducting numerous studies.

Another limitation is that the prime-target pairs for each group have little to no previous use in experiments, much less together or in a suppression task. The primes that are death-related have not all been used in research as death words. The right-hand primes taken from Arndt et al. (1997) and Arndt et al. (2007) were determined to be of negative valence. In addition, some of the death-related targets could refer to the act of killing

or being killed (e.g., slay, slain, drown, choke, bomb), or pertain to words regarding after death (e.g., grave, mourn, tomb, skull, ghost). Further review of previous research regarding mortality salience or any relation to death could reveal words or word pairs that refer to death.

Future Research

One future research project could examine the effects of age on suppression of death-related, neutral, and nonword prime-target pairs. Research by Russac et al. (2007) suggests that young adults often report higher levels of concern over mortality issues than older adults, with women typically reporting higher levels of death anxiety than men. According to Kastenbaum (2000), with age comes less anxiousness regarding a person's own mortality because (a) death does not threaten as many of our values, or (b) there is a continuous developmental process through which people 'come to terms' with dying. In addition, little suppression research with older adults (i.e., 60 and above) exists. Therefore, this project could give insight into anxiety regarding death, and age differences when using a suppression task.

Conclusions

The current research revealed results that conflict with the suggestion by Bjork et al. (1998), which proposes that mortality saliency produces better accessibility to death-related thoughts. Therefore, the current study aids further understanding of the use of different valence words in a suppression task. There is a lack of research using death-related and nonword pairs in suppression tasks. Therefore, the current study reveals a new area needing further investigation, as well as a conflict between previous research results. A practical implication that can be taken from this study is that therapists may have more difficulty teaching patients to suppress undesirable death-related thoughts. Unfortunately, patients are most likely seeking to suppress content that is either negative or death-related.

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Appendix A

Welcome to the Experiment!!! Press the Space Bar to Continue when reading any instructions!! In the first part of this task, you will be learning words paired together and then will be quizzed on them later. Please read aloud each pair of words as you study them. Your task will be to link the two words together in your mind, so that when you are given one word you will be able to remember the other word that was paired with it. It is important that you take the whole time to study the pair of words together because you will be quizzed on the pair right after the whole list has been shown to you. Do you have any questions?

Appendix B

Now that you have had time to review all of the pairs of words, we want you to see how well you can remember them before we go on to the next part of the task. In this part, we want you to test your ability to remember each pair of words. We will show one of the words of the pair each time. We will call this the "Hint" word. When you see this hint word, your job will be to remember the word that goes with it and say the word as fast as you can. The hint word will stay on the computer screen for a short period of time. After this short period of time, the correct answer will appear in blue. Take this chance to study the word again. Then we will go on to the next pair of words. Do you have any questions? Again, we will show you a hint word. Think of the word that goes with it and say it aloud as quickly as you can. The computer will then show the correct answer and you will have time to study the two words again. Do you have any questions?

Appendix C

In this next part of the task, you will again see the hint words on the computer screen, but we will show them to you in a different way. This time some of the words will be in GREEN. For the GREEN words, it will be the same as we have practiced before. You will say the correct word as quickly as you can remember it. GREEN words mean, "go", and say the word as fast as you can. The computer screen will show you the right answer. We

will go through these several times and your job is to get faster at giving the correct answer. In addition, some of the hint words will be shown in RED. For the RED words, your job will be to NOT say the word and NOT think about it. Think of RED words as "stop" words. Therefore, instead of trying to remember and say the word quickly, your job will be to NOT think of the word that goes with the RED word. This is very important, so I will explain exactly what to do for each of these hint words. When a RED word appears on the screen, look at the word as you would any of the other words. Please pay full attention to the word and look straight at it for the full time that it appears on the screen. However, it is very important that you DO NOT think of the word that goes with it. DO NOT think of the word at all, not even for a second. The important thing is to learn to NOT think about the word that goes along with the RED word. Learning to NOT remember the RED word's pair may take a while, we might have to go over them several times. The important thing is to try as hard as you can and we will keep going until you CANNOT think of all of the words that are paired with the RED words. If you accidentally do remember and say the word that goes with the RED word, we will let you know when you hear this click. The click means that you have mistakenly responded when you were instructed not to. The RED word will stay on the screen for a short amount of time. Now we are going to practice so that you that you get used to this task. Remember, when a word appears in RED your job is to NOT think about the word that was paired with it. Please keep looking at the word on the screen but DO NOT let the word that was paired with it come to mind. Also, remember the words that are listed in GREEN, please continue as before and respond as quickly as possible to the GREEN words. Do you have any questions?

Appendix D

Now that you have had time to practice, we will go on with the actual test. It will be exactly the same as we just practiced. For GREEN hint words, you are to say the correct response as quickly as possible. For the RED words, your job is to NOT think about the word that was paired with that word to start with. Just as before, if you respond to the RED word, you will hear a click. Please remember, it is not enough to just NOT say the response; we want you to NOT think of the response. NOT even a little, NOT for one second. We really need you to follow directions carefully, as well as you can. Do you have any questions?

Appendix E

In this part, you will again be remembering the response words that you learned earlier in the task and saying them aloud. All of the hint words will be in black and we would like for you to respond to all of the hint words, even if before the word was in red. Please try to respond as quickly and as accurately as possible. Do you have any questions?

Appendix F

In this part, a word will appear on the screen. If it is a word from a pair seen at any time during this experiment please say "yes". If the word on the screen is not a word from a pair seen during this experiment please say "no". Do you have any questions?

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