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THE RELATIONSHIP BETWEEN POSTTRAUMATIC STRESS DISORDER AND HIGH AND LOW-CAPACITY WORKING MEMORY

By

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THESIS APPROVAL PAGE

This is to certify that the thesis prepared by Kelly M. Gallagher entitled The Relationship between Posttraumatic Stress Disorder and High and Low-capacity Working Memory has been approved by the thesis committee as satisfactorily completing the thesis requirements for the degree Master of Arts in Experimental Psychology.

Chair, Thesis Committee — Date: 12/7/11

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ABSTRACT

The Relationship between Posttraumatic Stress Disorder and High and Low-capacity Working Memory

Kelly M. Gallagher

High and low working memory capacity in relation to post-traumatic stress disorder (PTSD) symptomology was investigated. Working memory capacity was determined through both verbal and visual working memory tasks; a letter-number sequencing task and a visual serial working memory task. PTSD symptomology was measured using the civilian version of the post-traumatic stress disorder checklist (PCL-C). Undergraduate college students over the age of 18 participated in the study and results were computed using a multiple regression analysis and principle components factor analysis. The correlation between the working memory task and the PCL-C was not statistically significant, support for a positive relationship between working memory capacity and PTSD symptoms was not found. Future research should address a PTSD diagnosed or at-risk population using the verbal and visual working memory scales presented in the current study.

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The Relationship between Posttraumatic Stress Disorder and High and Low-capacity Working Memory

Posttraumatic stress disorder (PTSD) results from combat related stress and is a problem for many military veterans. Much of the PTSD research that includes the veteran population addresses questions regarding demographic risk-factors, such as socioeconomic status (SES), gender, education, intelligence, psychiatric history of abuse, and race (Brewin, Andrews, & Valentine, 2000). The primary interest of the current study is to investigate the relationship between working memory and PTSD.

The PTSD diagnosis was first introduced in the Diagnostic and Statistical Manual of Mental Disorders (3rd Ed.) in 1980 with three core symptoms, (a) re-experiencing of the trauma, (b) avoidance and numbing, and (c) increased arousal (Ozer, Best, Lipsey, Weiss, 2003). Most of the research in the 1960's and 70's focused on veterans from the Vietnam War who were almost all males and their symptoms included intrusive thoughts or images, hyper-vigilance, a feeling of numbness or detachment, nightmares, and distancing themselves from social situations (Ozer et al., 2003). Around the same time, research also assessed the effects of sexual trauma on women along with patterns of symptoms in women who had been sexually assaulted (Ozer et al.). It was another ten years before researchers began to speak of these two syndromes as one and thereafter, PTSD was added to the DSM (III) (Ozer et al.).

Since its original inclusion in the DSM (III), two additional symptoms were added with the publication of the DSM (IV) in 1994. The new symptoms indicate that the possible traumatic event must be a threat of death, serious injury, or to the person's

integrity of themselves or others and their response to the event must include intense fear, helplessness, and horror (Tolin & Foa, 2006). These criteria are designated as A1 and A2, respectively in the DSM (IV) (Tolin & Foa, 2006). These additional symptoms were added to subjectively categorize and define an event as traumatic for different individuals (Tolin & Foa, 2006).

In the past, PTSD was conceptualized as a general response to the experience of a traumatic event, and it was believed that people who experienced different types of traumas would evidence PTSD in the same manner (Brewin et al., 2000). Research that is more recent has emphasized individual differences in PTSD experience and the extent to which of these factors make a person more or less vulnerable to the symptoms and occurrence of the disorder. Tolin and Foa (2006) conducted a meta-analysis on sex-difference research over the previous twenty five years and found that female's have twice the probability of being diagnosed with PTSD than males (OR=1.98, $p<.001$). Ozer et al. reported a moderate effect size for prior adjustment problems before the experience of a traumatic event. They also found stronger effect sizes when the trauma was an accident or interpersonal violence as compared to combat related trauma (Ozer et al.). Ozer, et al. also found a relationship between the amount of social support the individual experiences after the traumatic event and the diagnosis of PTSD. When individuals were tested for PTSD more than three years after the traumatic event, they found a moderate effect size (-.42) for the relationship between perceived social support and time elapsed between the traumatic event and assessment of PTSD. Interpreting their results, an individual has a higher probability of being diagnosed with PTSD as the amount of time

increases from exposure to diagnosis and as the amount of perceived social support decreases during exposure to diagnosis. This effect was larger when the individual experienced a traumatic combat event (-.26) as opposed to interpersonal violence (-.11) (Ozer et al.).

Moreover, a meta-analysis conducted in 2009 found that if a person does not experience symptoms within the first few months following traumatic exposure, the likelihood of developing PTSD was exceptionally rare (Smid, Mooren, van der Mast, Gersons, Kleber, 2009). Most research points to the immediate response of the individual when they experience the traumatic event and how they process the sensory information during exposure (Brewin et al., 2000; Ozer et al.). Brewin et al. (2000) found that the greater the individual rated the trauma severity the more likely they would receive a diagnosis of PTSD (-.14 to -.76). Ozer, et al. (2003) found that the peritraumtic response (fear, helplessness, horror) of an individual is the strongest predictor of occurrence of PTSD symptoms following the event. Ozer et al. identified the amygdala and hippocampus as important components in the perception of the traumatic event and the formation of memories of that event. Bower (1981) investigated the different brain models presented to explain mood and memory and states that when an individual experiences an emotional event, their memory of that event is different from those formed in the absence of emotion.

Further, military clinical investigators have reported that the majority of veterans being treated for PTSD symptoms have memory and concentration problems (Vasterling, Brailey, Constans, & Sutker, 1998). Vasterling et al. (1998) found that individuals

diagnosed with PTSD have greater problems with encoding, recall, and they experienced increased sensitivity to retroactive interference. Retroactive interference occurs when newly learned information interferes with information learned in the past (Goldstein, 2011, pg. 224). However, interference requires that the memory must be activated and recalled in working memory (Goldstein, 2011) after which new information can replace information that was previously stored. Once the memory is stored back in long term memory the new information has "overwritten" portions of the original memory (Goldstein, 2011).

Accordingly, Goldstein (2011) defines working memory as "a limited-capacity system for temporary storage and manipulation of information for complex tasks such as comprehension, learning, and reasoning" (pg 131-132). There are three main components of working memory – the phonological loop (verbal and auditory), the visuospatial sketchpad, and the central executive. The central executive is the main functioning piece of working memory as it coordinates between the phonological loop and visuospatial sketchpad and also switches attention between the two (Goldstein, 2011). Individuals with traumatic brain damage often have damage to the frontal lobe which causes problems with attention and executive functioning (Goldstein, 2011).

Vasterling et al. (1998) found that individuals with PTSD are easily distracted even when the distractions are emotionally neutral; they have difficulty controlling intrusive thoughts even when they are experiencing relatively normal conditions. This evidence can help explain why PTSD diagnosed individuals have flashbacks and disassociations during everyday life experiences as well as when they are emotionally

stressed. It has been found that PTSD diagnosed individuals have difficulty during recall of traumatic experiences, the memory of the traumatic event is not chronologically accurate and typically has some disorganization and lacks detail (Ehlers & Clark, 2000). Vasterling et al. also found performance weaknesses on the WAIS-R arithmetic scale for individuals diagnosed with PTSD; they attributed this decreased performance to trouble with encoding or mentally manipulating information. This would relate to the construct of working memory where encoding takes place through the central executive.

Individuals diagnosed with PTSD also speak as though they are re-experiencing the trauma in the present tense as opposed to recalling the features of the memory (Lyttle, Dorahay, Hanna, & Huntjens, 2010). The sensory information presented while reexperiencing these memories is usually the most vivid and detailed quality of the memory (Lyttle et al., 2010). An increased feeling of dissociation may explain this behavior. Dissociation occurs when someone feels as though they are having an out of body experience, in other words they don't feel as though they have a sense of themselves or what is happening (Lyttle et al.). It is as if the person is watching themselves experience the event in the present.

Further, when dissociation occurs during a traumatic event, it is believed that a bottom-up processing method is used by the individual (Lyttle et al.). Bottom-up processing indicates that stimuli from sensory information such as form and structure produces memory traces that are in large part sensory based. Conversely, top-down processing is organized and based on interpretation and meaning and is considered a conceptual information processing model where larger chunks of information are

processed first with concentration on the overall concept or idea before the smaller, perceptual details are processed (Lyttle et al.). Therefore if a memory is based more on perception, such as a color, rather than on meaning and organization the cue of that color may easily trigger that memory to be recalled. This is the case with most PTSD diagnosed individuals, they have not included interpretation and meaning of the traumatic event in to the memory and when they recall the memory they lack organization and may have disjointed memory regarding additional details or surrounding factors of the traumatic event (Lyttle et al.).

In order to interact socially and overcome everyday life challenges, a person must selectively attend to important features of their experiences and inhibit distracting information. Individuals affected by PTSD are not as capable of accomplishing these acts compared to those not affected (Schweizer & Dalgleish, 2011). These tasks are difficult for PTSD diagnosed individuals because of the amount of cognitive resources they have available. Negative emotional thoughts and feelings compete for available space in working memory (Schweizer & Dalgleish, 2011). Working memory capacity has been described as the amount of space available for task-critical information to be stored momentarily while also comprehending competing information (Schweizer & Dalgleish, 2011). If the competing information is taking up most of that space, the task at hand will not be properly attended to and this leads to a deficit in learning and properly retaining that information. Schweizer & Dalgleish (2011) assert that individual differences in working memory capacity are related to the process of logical thinking and problem solving.

Additionally, a study conducted by Bustamante, Mellman, David, & Fins (2001) measured patients admitted to a hospital because of trauma. The patients were first measured 1-2 days following the traumatic event and again about 6 weeks later following discharge. They were given a verbal learning test which assessed verbal learning and memory at both initial and follow-up assessments. About half of the participants met two out of three diagnostic criteria for PTSD at follow up which resulted in a diagnosis of full or threshold PTSD. The study found a significant correlation between PTSD severity at follow-up and delayed recall (recalling a list of words after a delay, -.42) and retroactive interference (-.42) (Bustamante et al., 2001). Interpretation of these results show added deficits in verbal memory as PTSD diagnosis increases, supporting Vasterling et al.'s (1998) results and providing additional support for the idea of frontal lobe pathology in PTSD diagnosed individuals .

Further, Vogel, McCollough, & Machizawa (2005) used a working memory task to divide participants into two groups – high memory capacity and low memory capacity based on how many items they were able to hold in working memory. Both groups performed a sequential attention task; the individuals in the high memory capacity group were better able to attend to the selected message and ignore the distracting information compared to the low memory capacity group. The researchers concluded that the central executive was functioning much more efficiently in the high memory capacity then the low memory capacity group; the distracting material took up a lot of space in the low memory capacity group's working memory and therefore they were not able to direct their full attention towards the relevant stimuli (Vogel et al.,

2005). Other studies have found similar results and support for the notion that individuals with high-capacity working memory can hold and manipulate relevant information and focus attention on that information while simultaneously filtering out irrelevant information better than those with low-capacity working memory (Goldstein, 2011).

Schweizer & Dalgleish (2011) used an emotional working memory capacity task to measure PTSD diagnosed individuals compared with a trauma-exposed control group with no history of PTSD. Participants in the study had to recall a word list after a short interval while simultaneously reading sentences that either described trauma related thoughts or were neutral sentences. They found that when compared to controls, the PTSD diagnosed group had impaired performance on the emotional working memory task during trials that included trauma related sentences relative to trials with neutral sentences ($F(144)=4.15$, $P<.05$), (Schweizer & Dalgleish, 2011). There was also an overall effect of group with the PTSD diagnosed group performing worse on the emotional working memory task relative to the control group regardless of sentence type, trauma or neutral (Schweizer & Dalgleish, 2011). This study suggests that working memory is disrupted in PTSD diagnosed individuals.

Additionally, the cocktail party phenomenon has been investigated in terms of high and low working memory capacity. The cocktail party phenomenon explains why an individual holding a conversation with someone else in a crowded room may hear their name in the crowd even though they are not selectively attending to the crowd noise. Conway, Cowan, and Bunting (2001) revisited this idea using an operation span task where participants had to answer a simple math question (e.g. $(6/2) + 1 = 4$) and then

remember a word presented briefly after the math question. Each set included between two and six math/word combinations before the participant was shown all of the words in that set and asked to choose the order that they were presented. They used the results of this task to divide the participants in to a low working memory group and a high working memory group. Participants then completed a dichotic listening procedure where they wore headphones that had different auditory stimuli coming through each ear. They were told which message to attend to and which message to ignore. They message that they were told to ignore included the insertion of the participant's first name in addition to a control subject's first name (Conway et al., 2001).

Twenty percent of the high-working memory span subjects reported hearing their name in comparison to sixty five percent of the low-working memory span subjects. In both groups, all of the subjects reported that they did not hear the control subject's name (Conway et al.). Low working memory span subjects were more likely to be distracted by the information they were instructed to ignore and were not able to remember the first few words after hearing their name in the message they were instructed to attend to. This shows support for the notion that low working memory span individuals have difficulty blocking out irrelevant information and are more easily distracted from a relevant task then high working memory span individuals. Conway et al. (2001) go on further to indicate that selective attention and divided attention are both measures of working memory as participants who did well on the divided attention task (operation span) also did well on the selective attention task (dichotic listening).

In summary, the studies presented above provide evidence for differences between high and low span working memory individuals when they are presented with cognitive interference (Conway et al.). They also provide evidence that individuals diagnosed with PTSD have difficulty in every day functioning and that this may be explained by the concept of working memory capacity. The present study focuses on verbal and visual short-term memory, both of which have been shown to be measures of working memory. The purpose of the study is to establish a correlation between PTSD symptoms and working memory, specifically to find out if there is a negative correlation between working memory capacity and PTSD symptoms.

PCL

For the most part, PTSD diagnosis is done through clinical interviews and is screened for in medical settings (Lang & Stein, 2005). Recently there has been focus on developing short screening tools and self-assessments for PTSD in order to reach a greater population and decrease the amount of time and money spent by healthcare providers. The PTSD checklist (PCL) was developed in response to these needs; specifically it measures PTSD symptomatology and severity (Lang & Stein, 2005). It is a 17-item inventory that assesses the primary symptoms of PTSD as defined by the DSM-IV and is measured on a 5-point scale (not at all to extremely) (Hirschel & Schulenberg, 2010). The PCL can be used for screening and diagnosis; scores are obtained by adding up the responses to the 17 items and comparing them to pre-determined cut off scores. There are different cut-off scores based on the population being measured and the cut-off score should be chosen accordingly (VA National Center for PTSD, 2010).

Moreover, Blanchard, Jones-Alexander, Buckley, & Forneris (1996) validated the PCL by administering both the PCL and the CAPS (Clinician-Administered PTSD Scale) to motor vehicle accident and sexual assault victims. The CAPS is a widely used and well established structured interview for PTSD assessment and diagnosis (Blanchard et al., 1996). Using a cutoff score of 44, the PCL correctly identified 17 of the 18 participants that received a PTSD diagnosis and had a 0.900 diagnostic efficiency. The correlation of PCL total score with CAPS total score was $r(38)=0.929$, $p<0.0001$ (19). Blanchard et al.'s study provides statistical support for the PCL, they found high internal consistency and when compared to the CAPS diagnoses in the study they had good sensitivity and specificity (Ruggiero, Del Ben, Scotti, & Rabalais, 2003). The researchers concluded that the PCL is a good screening device for the presence of PTSD (Blanchard et al.).

Correlations on each item of the 17-item scale have been calculated against the total score and correlations range from 0.5763 to 0.8315 (Lang & Stein, 2005). In a study utilizing hurricane Katrina survivors as participants the internal consistency of the PCL was found to be .95 using Cronbach's alpha (Hirschel & Schulenberg, 2010). Bliese, Adler, Cabrera, Castro, and Hoge (2008) found sensitivity at .90 and specificity to remain above .70 when cutoff values of the PCL are between 30 and 34. They recommend the use of the PCL as a screening tool for PTSD symptoms (Bliese et al., 2008)

Ruggiero et al. (2003) used college students as participants to test the PCL-C (civilian version) to provide support for internal consistency, test-retest reliability, convergent validity, and discriminant validity. They used college students after finding in previous research that a traumatic event is experienced by the majority of individuals in

the general population at least once in their lifetime (Ruggiero et al.). They compared PCL-C scores of their subjects to scores of other well-established measures of PTSD. They found a high correlation for both internal consistency (.94) and convergent validity ($r > .75$) showing that the PCL-C is similar to other scales used to measure PTSD symptoms (Ruggiero et al.). Likewise, they found statistical significance for discriminant validity against scales that do not assess PTSD, such as depression and anxiety scales (Ruggiero et al.). Lastly, test-retest reliability correlation coefficients ranged from .68 to .92 depending on the amount of time elapsed between the first test and second test (Ruggiero et al.). Ruggiero et al. concluded that the PCL-C is most useful as a brief screening tool for PTSD, not for diagnostic purposes.

For the current study, the PCL-C will be utilized to measure PTSD symptom prevalence among undergraduate college students. The PCL-C is used to measure any stressful experiences and does not have to be specific to a single event (VA National Center for PTSD, 2010). It takes approximately 5-10 minutes to administer and asks the participant to note how much they have been bothered by each problem in the past month. Examples of the questions are "repeated, disturbing, memories, thoughts, or images of a stressful life experience from the past", "trouble remembering important parts of a stressful experience from the past", and "feeling irritable or having angry outbursts" (Weathers, Litz, Huska, & Keane, 1994). A total symptom severity score will be used by summing up the answers to the 17-item inventory with a cutoff score of 44 based on suggested cutoff scores for a civilian primary care and motor vehicle crash population (VA National Center for PTSD, 2010).

Working Memory Tasks

Two working memory tasks were used in the present study; the first was a verbal task and the second was a visual task. The verbal task used was the letter-number sequencing procedure from the Wechsler Adult Intelligence scale. In this task, the person hears a sequence of letters and numbers presented randomly and then recalls the numbers first in numerical order followed by the letters in alphabetical order. This task is commonly assumed to measure verbal working memory. It is a standardized and normed procedure that is available on the latest version of the Wechler Adult intelligence scale.

The second working memory scale that was be used is a serial visual working memory task that differentiates between high and low span individuals. Studer, Wangler, Diruf, Kratz, Moll, and Heinrich (2010) used this task in their study on working memory and healthy adults. Participants saw four, five, or six consecutive pictures on a monitor screen, each picture was presented for 1s followed by a blank screen for 4.5s. At the end of the sequence, one of the pictures was presented to the subjects again and they were asked to recall where in the sequence this picture was shown, varying from first to sixth depending on the length of the original sequence of that picture (Studer et al., 2010). They ran a total of 24 randomized trials and found that performance decreased with increased working memory load, the sets that included only four pictures (22.36) had a higher number of correct responses compared to the sets that had five (20.18) or six pictures (17.45) (Studer et al.).

In summary, it has been shown that working memory capacity is related to functioning in individuals diagnosed with PTSD however, this relationship is not fully understood. Most research has focused on verbal working memory and visual working memory has not been investigated (Schweizer & Dalgleish, 2011). Past research has found that memories of a traumatic event, as described by PTSD diagnosed individuals, is regularly vivid and disorganized and in large part sensory based (Lyttle et al., 2010). Based on the prior research, it is important to investigate the relationship between the prevalence of PTSD symptoms and both verbal and visual working memory capacity. Using the PCL-C, letter-number sequencing procedure, and a serial visual working memory task, it is hypothesized that individuals will have a negative correlation between working memory span and PTSD symptom severity. Specifically, as working memory span decreases (low capacity) the PTSD symptom severity scores will increase and as working memory span increases (high capacity) the PTSD symptom severity scores will decrease.

Method

Participants

Seventy five undergraduate college students participated in this study. The students were recruited from a biostatistics class at Towson University during the fall, 2011 semester. Participation was voluntary and each participant was over the age of 18. Each participant signed an informed consent form and were told they could withdraw from the study at any time without penalty.

Materials

Participants completed the PCL-C as well as the letter-number sequencing task and the serial visual working memory task. The scales were administered separately with instructions given for each task before the participants completed the task. The serial visual working memory task was administered first followed by the letter-number sequencing task and then the PCL-C.

Procedure

Testing occurred in one session in a classroom group setting, the experiment took a total of 30 minutes to complete. The serial visual working memory task was administered first and the participants were instructed to view the task on an overhead projection and write their responses on the first page of their response packet. There were twelve trials in this task, each trial was randomized and consisted of either, four, five, or six pictures. After each sequence the participants were shown one of the pictures in the sequence and asked to respond on a piece of paper by circling a number one through six depending on the length of the picture sequence. The pictures used in the task were black and white line drawings of simple objects (e.g. a dog). The letter-number sequencing task was administered next, according to procedures outlined in the manual for the WAIS-IV. Participants responded on the second page of their response packet after each letter/number sequence was read. They were asked to record the numbers first, in numerical order followed by the letters in alphabetical order for each sequence.

After completion of the working memory tasks, the PCL-C was administered to the participants and they were given fifteen minutes to complete the scale. The third page of the response packets included the PCL-C scale, the participants circled a number for each of the seventeen questions, 1 (not at all), 2 (a little bit), 3 (moderately), 4 (quite a bit), and 5 (extremely). Scores were summed for all seventeen questions to reach a total score between 17 and 85 for each participant.

Results

A multiple regression analysis was conducted with the working memory scales, both the serial visual working memory task and the letter-number sequencing task, as the predictors and the total PCL-C score for each participant as the outcome variable. The model produced an R square of .251 which was not statistically significant ($p<.05$). The scores for each question of the working memory tasks were correlated with the total PCL-C score and none of the correlations were statistically significant.

A principle components analysis was conducted on the 17 items from the PCL-C scale to cluster the items into related groupings. Three principle components accounted for the majority of the total variance (62.645%). The first PC included items related to disturbing thoughts, the second included items that described disturbing dreams, and the third included items that described a déjà vu experience of stress. The scores for each PC were correlated with the visual working memory measures and the letter-number sequencing scores. Neither of these memory measures correlated significantly with the

PTSD components. In general, there is no evidence in these data that self-reports of PTSD is related to measures of working memory.

Discussion

The results of the current study do not provide evidence of a negative correlation between working memory and posttraumatic stress disorder symptomology as predicted in the hypothesis. Specifically, there was no indication that individuals with a lower working memory capacity experience more symptoms of post-traumatic stress disorder (PTSD) than those with a higher working memory capacity. When analyzed individually, neither the visual working memory task (serial visual working memory task) nor the verbal working memory task (letter-number sequencing task) produced a significant correlation with the PCL-C total scores.

Past research has found verbal working memory deficits with PTSD diagnosed individuals but there is not any literature available on visual working memory capacity and PTSD. Bustamante et al's (2001) study used a verbal working memory task and the participants were measured immediately following the traumatic event and again a few weeks later. Data was compared from time one measurement to time two measurement on the task and deficits were found. The current study did not address the issue of time since traumatic event exposure and the individuals completed the tasks once, we were not able to compare deficits over time. In Schweizer & Dalgleish (2011) study they found impaired performance on a verbal working memory task with PTSD diagnosed individuals when trauma related words were used in the task, the current study used

letters and numbers in the verbal working memory task which would not elicit an emotional response from the participant.

In most of the past research, data was collected from military veterans or previously PTSD diagnosed individuals. Though past research using the PCL-C has identified college students as suitable participants for PTSD research (Ruggiero et al., 2003), the students used in this sample did not evidence a high level of PTSD symptomology. Only 22 out of 75 participants met the civilian cut-off score for a positive PTSD screening, in a primary care setting these individuals would receive additional clinical evaluations to determine if they meet diagnostic criteria for PTSD. Of these 22 participants, 7 of them me the civilian cut-off score for PTSD diagnosis. If the sample size in the current study were larger there may have been more students that met the PTSD diagnostic cut-off score which would add to the power of the study.

The serial visual working memory task was administered and completed adequately by the participants however, based on the response sheets there were a handful of students that did not understand how to record their responses for the letter-number sequencing task. The misunderstanding lead to a decrease in the number of correct responses for these participants and lower overall scoring on the task. In future studies, the directions should be modified to demonstrate exactly how the students should record their responses on the response sheet. A visual aid illustrating this may need to be included in the directions to assure participants are responding incorrectly due to lower working memory capacity as opposed to a lack of general understanding of the task itself.

Future research should focus on groups that have been previously diagnosed with PTSD or are considered at-risk population (e.g. natural disaster survivors, cancer survivors, survivors of car crashes, and military combat veterans) in order to further investigate the relationship between working memory capacity and PTSD symptoms. There is still a gap in the literature regarding visual working memory capacity and PTSD. The serial visual working memory task was administered effectively in the current study and has been shown to be effective in differentiating high and low working memory capacity individuals; it would be a sufficient scale to use with a PTSD diagnosed individuals or at risk-populations in subsequent research.

APPENDICES

APPENDIX A

IRB Approval Letter

APPENDIX B

Informed Consent Form

INFORMED CONSENT FORM

PRINCIPAL INVESTIGATOR: Kelly Gallagher
PHONE: (410) 533-1122
FACULTY ADVISOR: Frederick Parente, Ph.D.
PHONE: (410) 704-3073

Purpose of the Study:

This study is designed to evaluate high and low working memory capacity in relation to Posttraumatic Stress Disorder (PTSD) symptomology.

Procedures:

All participants must be over the age of 18. Participants will be given three tasks administered by the principle investigator. The tasks will be given during regularly scheduled classroom time and participation is voluntary. The first task will be the serial visual working memory task in which participants will view a series of 12 picture sets. The second task will be the number letter sequencing task in which participants will be read aloud letters and numbers. The third task the participants will be given is the Posttraumatic Stress Disorder Checklist (PCL-C) which is a 17-item inventory that assess the experience of PTSD symptoms on a 5-point scale.

Risks/Discomfort:

There are no known risks associated with participation in the study. Should the any of the tasks become distressing to you, you are allowed to terminate your participation in this study.

Benefits:

It is hoped that the results of this study will have beneficial effects in identifying pre-cursing individual characteristics in working memory capacity that may lead to the development of PTSD symptoms and diagnosis after the experience of a stressful life event.

Alternatives to Participation:

Participation in this study is voluntary. You are free to withdraw or discontinue participation at any time.

Confidentiality:

All information collected during the study period will be kept strictly confidential. You will be identified through identification numbers. No publications or reports from this project will include identifying information on any participant. If you agree to join this study, please sign your name below.

_____ I have read and understood the information on this form.

_____ I have had the information on this form explained to me.

_____ _____

Subject's Signature Date

_____ _____

Principal Investigator Date

If you have any questions regarding this study please contact the principle investigator, Kelly Gallagher (410) 533-1122 or the Institutional Review Board Chairperson, Dr. Debi Gartland, Office of University Research Services, 8000 York Road, Towson University, Towson, Maryland 21252; phone (410) 704-2236.

APPENDIX C

Survey Instruments

11. Letter–Number Sequencing

Start
Ages 16–69
Demonstration Item A, Sample Item A, then Item 1
Ages 70–90
Do Not Administer

Discontinue
After scores of 0 on *all three trials* of an item

Score
Score 0 or 1 point for each trial
LLNS
Number of letters and digits recalled on last trial scored 1 point

	Item	Trial	Correct Responses	Response	Trial Score	Item Score
16–69	DA	C – 1	1 – C			
16–69	SA	A – 4	4 – A			
		2 – B	2 – B		0 1	0 1
16–69	†1.	D – 1	1 – D		0 1	2 3
		4 – C	4 – C		0 1	
		E – 5	5 – E		0 1	0 1
	†2.	3 – A	3 – A		0 1	2 3
		C – 1	1 – C		0 1	

†If the examinee does not say the number first, say, **Remember to say the number first, then say the letter.**

DR	2 – B	1 – 2				
SB	1 – A	2 – 4				
	2 – 4 – B					
	5 – C – A	5 – A – C	A – C – 5		0 1	0 1
3.	F – E – 1	1 – E – F	E – F – 1		0 1	2 3
	3 – 2 – A	2 – 3 – A	A – 2 – 3		0 1	
	1 – G – 7	1 – 7 – G	G – 1 – 7		0 1	0 1
4.	H – 9 – 4	4 – 9 – H	H – 4 – 9		0 1	2 3
	3 – Q – 7	3 – 7 – Q	Q – 3 – 7		0 1	
	Z – 8 – N	8 – N – Z	N – Z – 8		0 1	0 1
5.	M – 6 – U	6 – M – U	M – U – 6		0 1	2 3
	P – 2 – N	2 – N – P	N – P – 2		0 1	
	V – 1 – J – 5	1 – 5 – J – V	J – V – 1 – 5		0 1	0 1
6.	7 – X – 4 – G	4 – 7 – G – X	G – X – 4 – 7		0 1	2 3
	S – 9 – T – 6	6 – 9 – S – T	S – T – 6 – 9		0 1	
	8 – E – 6 – F – 1	1 – 6 – 8 – E – F	E – F – 1 – 6 – 8		0 1	0 1
7.	K – 4 – C – 2 – S	2 – 4 – C – K – S	C – K – S – 2 – 4		0 1	2 3
	5 – Q – 3 – H – 6	3 – 5 – 6 – H – Q	H – Q – 3 – 5 – 6		0 1	
	M – 4 – P – 7 – R – 2	2 – 4 – 7 – M – P – R	M – P – R – 2 – 4 – 7		0 1	0 1
8.	6 – N – 9 – J – 2 – S	2 – 6 – 9 – J – N – S	J – N – S – 2 – 6 – 9		0 1	2 3
	U – 6 – H – 5 – F – 3	3 – 5 – 6 – F – H – U	F – H – U – 3 – 5 – 6		0 1	
	R – 7 – V – 4 – Y – 8 – F	4 – 7 – 8 – F – R – V – Y	F – R – V – Y – 4 – 7 – 8		0 1	0 1
9.	9 – X – 2 – J – 3 – N – 7	2 – 3 – 7 – 9 – J – N – X	J – N – X – 2 – 3 – 7 – 9		0 1	2 3
	M – 1 – Q – 8 – R – 4 – D	1 – 4 – 8 – D – M – Q – R	D – M – Q – R – 1 – 4 – 8		0 1	
	6 – P – 7 – S – 2 – N – 9 – A	2 – 6 – 7 – 9 – A – N – P – S	A – N – P – S – 2 – 6 – 7 – 9		0 1	0 1
10.	U – 1 – R – 9 – X – 4 – K – 3	1 – 3 – 4 – 9 – K – R – U – X	K – R – U – X – 1 – 3 – 4 – 9		0 1	2 3
	7 – M – 2 – T – 6 – F – 9 – A	2 – 6 – 7 – 9 – A – F – M – T	A – F – M – T – 2 – 6 – 7 – 9		0 1	

LLNS (Max = 8)	

Letter–Number Sequencing Total Raw Score (Maximum = 30) ☐

PCL-C

INSTRUCTIONS: Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please read each one carefully, then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

	Not at all	A little bit	Moderately	Quite a bit	Extremely
1. Repeated, disturbing *memories, thoughts,* or *images* of a stressful experience from the past?	1	2	3	4	5
2. Repeated, disturbing *dreams* of a stressful experience from the past?	1	2	3	4	5
3. Suddenly *acting* or *feeling* as if a stressful experience *were happening again* (as if you were reliving it)?	1	2	3	4	5
4. Feeling *very upset* when *something reminded you* of a stressful experience from the past?	1	2	3	4	5
5. Having *physical reactions* (e.g., heart pounding, trouble breathing, sweating) when *something reminded you* of a stressful experience from the past?	1	2	3	4	5
6. Avoiding *thinking about* or *talking about* a stressful experience from the past or avoiding *having feelings* related to it?	1	2	3	4	5
7. Avoiding *activities* or *situations* because *they reminded you* of a stressful experience from the past?	1	2	3	4	5
8. Trouble *remembering important parts* of a stressful experience from the past?	1	2	3	4	5
9. *Loss of interest* in activities that you used to enjoy?	1	2	3	4	5
10. Feeling *distant* or *cut off* from other people?	1	2	3	4	5
11. Feeling *emotionally numb* or being unable to have loving feelings for those close to you?	1	2	3	4	5
12. Feeling as if your *future* will somehow be *cut short*?	1	2	3	4	5
13. Trouble *falling* or *staying asleep*?	1	2	3	4	5
14. Feeling *irritable* or having *angry outbursts*?	1	2	3	4	5
15. Having *difficulty concentrating*?	1	2	3	4	5
16. Being "*super-alert*" or watchful or on guard?	1	2	3	4	5
17. Feeling *jumpy* or easily startled?	1	2	3	4	5

APPENDIX D

Survey Response Forms

Letter Number Sequencing Response Sheet

1		0	1
		0	1
		0	1
2		0	1
		0	1
		0	1
3		0	1
		0	1
		0	1
4		0	1
		0	1
		0	1
5		0	1
		0	1
		0	1
6		0	1
		0	1
		0	1
7		0	1
		0	1
		0	1
8		0	1
		0	1
		0	1
9		0	1
		0	1
		0	1
10		0	1
		0	1
		0	1

Serial Visual Working Memory Task Response Sheet

1		1	2	3	4	5	
2		1	2	3	4		
3		1	2	3	4		
4		1	2	3	4	5	6
5		1	2	3	4		
6		1	2	3	4	5	6
7		1	2	3	4	5	6
8		1	2	3	4	5	
9		1	2	3	4	5	6
10		1	2	3	4	5	
11		1	2	3	4		
12		1	2	3	4	5	

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