ASSOCIATIONS AMONG SEXUAL ASSAULT, PTSD, AND COGNITIVE FUNCTIONING

by

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LIST OF ABBREVIATIONS

Abbreviation	Description
PTSD	Post Traumatic Stress Disorder
DSM-5	Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition
CVLT	California Verbal Learning Test
LDFR	Long Delay Free Recall
SDFR	Short Delay Free Recall
LDCR	Long Delay Cued Recall
SDCR	Short Delay Cued Recall
WMI	Working Memory Index
PCL-C	Posttraumatic Checklist - Civilian
SES-SFV	Sexual Experiences Survey – Short Form Victimization
CTQ	Childhood Trauma Questionnaire

ABSTRACT

Purpose: The purpose of the current study was to determine if past experiences of sexual assault and current symptoms of PTSD impacted performance on measures of cognitive functioning.

Method: Four-hundred and two (402) Texas State University students participated in part one of the study via Qualtrics which included measures that asked questions about PTSD symptoms, and potential sexual abuse. All participants were invited to participate in part two of the study, which included assessments of working memory and learning. Forty-one (41) individuals participated in part two of the study.

Results: Past experiences of sexual assault and current symptoms of PTSD were not found to be significant predictors of poor performance on cognitive measures. Significant differences in performance on cognitive measures were not observed between groups.

Conclusion: Past experiences of sexual assault and current symptoms of PTSD are not significantly associated with poorer performance on cognitive measures compared to healthy controls.

Keywords: Posttraumatic stress disorder, sexual assault, cognitive functioning, memory, working memory, learning

I. INTRODUCTION

Sexual assault and rape are serious crimes that affect many people of all ages, although women are disproportionately affected. Sexual assault is defined as any type of sexual behavior or contact that is performed without the consent of the recipient. Actions that fall under the term "sexual assault" include rape, forced sodomy, incest, fondling, and child molestation (Department of Justice, 2017). Rape is defined as penetration, no matter how slight, of the anus or vagina with any object or body part, or penetration performed orally by a sex organ of another person, without the full consent of the victim (Uniform Crime Report, 2013).

According to the Department of Justice, as of 2016 there are at least 323,450 victims of sexual assault and rape, aged 12 and older, per year (Morgan & Kena, 2016). Currently, one in six women (17.6%) has been the victim of an attempted or completed rape in her lifetime (Department of Justice, 2015). While females are most likely to be victims of sexual assault, with 86% of all sexual assaults involving female victims (Department of Justice, 2000) this type of sexual violence also affects males. One in 33 males (3%) have experienced an attempted or completed rape during their lifetime (National Institute of Justice, 1998).

PTSD is a psychological disorder that is characterized by recurring flashbacks, or dreams, that are related to a traumatic event that an individual witnessed or experienced directly. If these and other trauma-related symptoms persist for at least one month, a diagnosis of PTSD may be assigned. About 7-8% of the U.S. population will meet criteria for PTSD at some point in their lives. 10% of females will be diagnosed with PTSD in their lifetime, and 4% of males will be diagnosed within their lifetime.

Approximately 2.4% of U.S. adults (approximately 8 million) have a diagnosis of PTSD during a given year (Gradus, 2017). Sexual assault before the age of 18 accounts for 34.2% of PTSD cases, and sexual assault in adulthood accounts for 12.2% of PTSD cases (Goldstein et al., 2016).

This study will examine whether a history of sexual assault, with or without PTSD, is associated with cognitive deficits. The participants who report high levels of PTSD symptomology and sexual assault experiences are expected to have the lowest level of cognitive functioning based on results from previous studies investigating similar expectations (Scott et al., 2014; Jenkins, Langlais, Delis, & Cohen, 1998), meaning that they will score lower than controls on various measures of cognitive functioning. Cognitive deficits include limitations in learning, memory, and processing as part of daily functioning. The influence on cognitive functioning of PTSD and sexual assault will also be examined independently of one another. It is expected that participants who report either PTSD or sexual assault experiences, but not both, will also score lower on measures of cognitive functioning compared to those with no history of either PTSD or sexual assault. The participants who report sexual assault and PTSD symptomology are expected to have the lowest scores. This is predicted based on prior studies that have examined cognitive functioning in populations that have experienced sexual assault as well as in populations with PTSD (Scott et al., 2014; Jenkins, Langlais, Delis, & Cohen, 1998).

II. LITERATURE REVIEW

Introduction

This section will present relevant literature to this study. Specifically, the effects of sexual assault on cognitive functioning, as well as the effects of PTSD on cognitive functioning, that have been examined together and separately, will be presented. This section will also present the DSM-5 criteria for the diagnosis of PTSD, as well as the associations between PTSD and decreased functioning in certain areas of the brain.

Sexual Assault

Investigating academic performance and the relation of poor performance in relation to sexual assault is an essential component to this study. A study conducted by Baker et al. (2016) investigated 338 college women who had experienced sexual violence in their lifetime at any point in relation to their academic performance. The study looked specifically at sexual violence being a predictor of high school rank, standardized test scores (SATs), and conscientiousness. Men were excluded from the study due to the authors' desire to focus on women. The majority of the women within this study who experienced sexual violence experienced it during their childhood. The results of this study indicated that exposure to more types of sexual violence was associated with a lower GPA in female students. While GPA is considered to be weakly correlated to cognitive functioning in college student samples, it is still important to present the evidence of this study to have a comprehensive understanding of available literature related to this topic. In addition, a 4-year follow-up revealed that 83% of the sample (n=171) had graduated from their university and 17% (n=35) had dropped out of their university and had not graduated. In addition, there were correlations between sexual

violence and the likelihood of leaving the university. The only predictor of leaving without graduating within this study was degree of sexual violence. There are no specifications made as to the individual reasons that the students decided to drop out, only that sexual violence within the individual's lifetime was a significant predictor. The relationship between academic performance and sexual violence was significant when external variables were controlled. The students who were most likely to leave the university and perform at a lower level academically had experienced two instances of sexual violence in their lifetime.

Unfortunately, sexual assault can occur during childhood as well, and, as the studies reviewed will demonstrate, can have a lasting impact on the child even into adulthood. Gould, et al., (2012) studied a sample of individuals that included participants with and without early life stress (ELS) before the age of 13 years, and participants with and without major depressive disorder (MDD). Early life stress within this study included child sexual assault, child abuse and neglect, not being given enough to eat, and not being provided with proper medical care. This study included all forms of early life stress, not only the childhood sexual assault. To classify subjects as positive or negative for a history of childhood trauma, the Childhood Trauma Questionnaire (CTQ) was administered. Participants also completed the Cambridge Neuropsychological Testing Automated Battery (CANTAB) to assess neurocognitive functions including reasoning and planning, motor speed, memory and attention. The results indicated that a history of early life stress measured by the CTQ was associated with deficits in cognitive functioning. In addition, sexual abuse was associated with lower levels of working memory performance compared with individuals who had suffered from physical or

emotional abuse but not sexual abuse. Individuals with a history of early life trauma are distinguished from non-traumatized individuals by deficits in emotional processing, visual memory, and executive functioning.

Male sexual assault is detrimental to a degree similar to that of childhood and female sexual assault. As stated previously, 1 in 33 males (3%) are victims of an attempted or completed sexual assault at some point in their life. The research on the impact of sexual assault on cognitive functioning in males is limited in comparison to the research on females.

In a study conducted by Walker, Archer, and Davies (2005), the effect of rape on males was investigated. The authors compared a control group that had not experienced rape to the group that had experienced rape. Measures were administered to assess psychological functioning, self-esteem, assumptions about the world, and PTSD-related intrusion and avoidance symptoms. Rape survivors showed more negative effects of distress and effects on psychological health. Survivors within this study showed these elevated levels even when the event had occurred to them several years prior to the study. In addition, survivors showed high levels of post-traumatic symptoms, including avoidance and intrusive thoughts about the rape.

Sexual Assault and PTSD

Previous studies such as the ones summarized above have found sexual assault to be associated with later cognitive deficits, such as lower standardized testing scores and GPA, as well as other consequences, such as self-esteem, and overall psychological health. Sometimes these deficits and consequences can cause further psychological distress, and can have an impact on the development of future psychopathologies, such as

PTSD (Goldstein et al., 2016).

In a study conducted by Riggs, Kilpatrick, and Resnick (1992) the authors compared four groups of women who had reported being the victim of a single violent crime, as well as a group who had not experienced a violent crime. These groups consisted of women who had experienced marital rape only, stranger rape only, marital assault only, and other assault only. Measures were utilized to record demographics, determine levels of psychological distress and the impact of the particular stressful event. The victims in this study, on average, had experienced their assault more than 13 years prior, but continued to experience heightened levels of psychological distress in comparison to those who had not been victimized, and this distress has a lasting effect on these victim's lives. There were no significant victim group differences in education level, family income, or race. In addition, there were no significant differences observed in age or in time since the assault. The authors observed no significant differences in the severity of psychological distress between the victims of rape and the victims of a non-sexual assault.

Contrary to the conclusions of the previous study, another study conducted by some of the same authors (Kilpatrick et al., 1989), found that rape victims experienced more psychological distress compared to those who had experienced solely physical assaults; the rape victim's experiences were a significant predictor of PTSD. Kilpatrick et al. (1989) attributed these differences to the inclusion of solely severe physical assaults, whereas the previous study included assaults that were not physical in nature.

A study conducted by Thompson et al. (2003) investigated the occurrence of psychopathology in women who experienced rape in childhood only, women who

experienced rape in adulthood only, women who experienced rape in both childhood and adulthood, and women who had experienced no rape in their lifetime. It was found that women who had experienced sexual trauma at any age were much more likely to exhibit psychopathologies compared to controls. These psychopathologies commonly found in victims of sexual assault include anxiety disorder, depression, PTSD, eating disorders, sleep disorders, and suicide ideations (Chen et al., 2010). There were no differences observed in psychopathologies between survivors of childhood sexual trauma and survivors of adult sexual trauma. In addition, rates of PTSD in the trauma groups were 6-7 times higher than the control group.

In a study conducted by Jenkins, Langlais, Delis, and Cohen (1998), rape victims with or without PTSD were recruited from a rape crisis center. These two groups were compared to non-traumatized controls. The Structured Clinical Interview for DSM-III-R (SCID), Beck Depression Inventory (BDI), and modified Michigan Alcoholism Screening Test (MAST) were administered to the groups to assess for anxiety disorders, depression, and substance abuse. The California Verbal Learning Test (CVLT) was administered to assess verbal learning and memory. The PTSD-positive rape victim group performed more poorly on the CVLT in comparison to the normal standard.

Research specifically examining sexual assault and its relationship with PTSD has been conducted, however, research examining the potential relationship between sexual assault and cognitive deficits is scarce, and often focuses on other types of trauma aside from sexual assault. Literature looking into the effects of experiencing sexual assault in addition to experiencing PTSD symptoms on cognitive functioning is very limited. The current study specifically focuses on sexual assault and potential cognitive deficits as a

result of experiencing sexual assault, in addition to examining the effects of sexual assault, combined with PTSD symptoms, on cognitive functioning.

PTSD Symptomology

Many individuals who have experienced sexual assault have a risk of developing PTSD, which may affect cognitive functioning. PTSD is defined by the DSM-5 as a condition in which an individual who was exposed directly or indirectly to trauma, subsequently experiences recurring, intrusive re-experiencing symptoms related to the event. This includes symptoms such as flashbacks, nightmares, and intrusive memories of the event.

There are eight symptom clusters involved in the diagnosis of PTSD, and each cluster includes different symptoms or events that contribute to the diagnosis of PTSD. Each cluster requires a certain number of symptoms and/or events to be present for the individual to meet the diagnosis of PTSD. Criterion A involves death, threats of death, threatened injury or actual injury, threatened or actual sexual violence in one of the following ways: witnessing trauma, direct exposure to trauma, learning of a loved one that was exposed to trauma, and/or indirect exposure to details of the trauma (usually applies to first responders and/or those on a medical team. One of the previously listed means of exposure must be present in order for the diagnosis to be made.

Criterion B requires re-experiencing of the traumatic event in at least one or more of the following ways: flashbacks, nightmares, emotional distress after reminders, physical reactions after traumatic reminders, and upsetting memories that are unwanted.

Criterion C requires avoidance of stimuli related to the trauma in one or more of the following ways: avoiding reminders associated with the trauma, or avoiding thoughts or

feelings related to the trauma.

Criterion D requires the presence of at least two of the following negative changes in cognitions or feelings following the trauma: feeling detached, decreased interest in activities, trouble experiencing positive affect, negative affect, unable to recall key features of trauma, exaggerated blame of oneself or others for the trauma, or overly negative thoughts about oneself and the world. Two of the previously listed must be present in order for the diagnosis to be made.

Criterion E requires reactivity and arousal related to trauma that worsened following the trauma such as: hypervigilance, difficulty concentrating, difficulty sleeping, increased startle reaction, irritable or aggressive behavior, and destructive or risky behavior.

Criterion F requires that the symptoms persist for more than a month. Criterion G requires that the experienced symptoms cause clinically significant distress or functional impairment within one's social or occupational life. Criterion H requires that the experienced symptoms are not due to illness, medication, or substance use (American Psychiatric Association, 2013).

Due to many studies being conducted before 2013, which is when the DSM-5 was published, it is important to understand some of the changes made to several of the criterion for PTSD. Changes in criterion for PTSD from DSM-IV to DSM-5 broadened the scope of Criterion A by adding the unexpected death of a close friend or family member due to natural causes as a stressor. Criterion A2 was revised and broadened by removing the requirement that a traumatic event had to be followed by hopelessness, intense fear, or horror. Criterion C, which included that avoidance and numbing cluster, was split into Criterion C, avoidance, and Criterion D, negative alterations in cognitions

and mood. A new requirement brought about by this is that the PTSD diagnosis must include one avoidance symptom (American Psychiatric Association, 2013).

Three symptoms were added to the DSM-V. Two of the symptoms were added to Criterion D: (1) Negative affect; and (2) overly negative thoughts about oneself, other people, or the world. The third new symptom was added to Criterion E: reckless or destructive behavior (American Psychiatric Association, 2013).

PTSD and Cognitive Decrements

Traumatic stress can have acute and long-term effects on certain regions, circuits, and neurochemical systems of the brain that are indicated in the brain's stress response (Bremner, 2006). It is thought that symptoms of PTSD are represented through behavioral manifestations that are brought on by stress-induced changes. Brain regions that are affected the most by PTSD include the Hypothalamic Pituitary Adrenal (HPA) Axis, amygdala, hippocampus, and medial prefrontal cortex (Vermetten & Bremner, 2002). Hormones affected by PTSD include cortisol and norepinephrine, which are critically important when it comes to the brain's stress response. (Vermetten & Bremner, 2002; Bremner, 2001,2006; Pitman, 2001). Studies have found changes in memory functioning following traumatic stress alongside changes in brain circuit systems such as lower levels of activity and atrophy in regions including the amygdala, hippocampus, and medial prefrontal cortex (Elzinga and Bremner, 2002; Bremner, 2003). For example, Zeitlin and McNally (1991) found that patients with PTSD experienced difficulties with encoding and retrieval, a key function of the hippocampus, when presented with neutral information. The traumatic memories interfered with these functions even when the presented information was neutral.

The HPA Axis is affected by traumatic stress in the form of long-term dysregulation in the production of certain hormones such as cortisol and norepinephrine. Studies have shown very low levels of cortisol (Kellner et al., 1997; Delahanty et al., 2003; Stein et al., 1997) as well as elevated levels of cortisol, especially in children (Lemieux & Coe, 1995; De Bellis et al., 1999). This contradictory finding is interesting, in that low and elevated levels have been observed in groups of individuals who have all experienced traumatic stress. Elevated levels of corticotrophin releasing factors have been thought to possibly play a role in arousal disturbances, a key symptom in the indication of PTSD (Bremner, 2006).

The hippocampus is involved in memory storage and encoding, and is also very sensitive to the effects of stress (Bremner, 2006). Decreased activity has been found in the hippocampus among patients with PTSD, as well as a smaller hippocampal volume. It is important to note that this smaller hippocampal volume in not necessarily caused by PTSD, but is simply associated with PTSD, meaning that it cannot be definitively stated that either of these factors causes the other. In addition, it appears that neurogenesis can become inhibited following these exposures to traumatic stress. The CA3 region within the hippocampus is an area that is involved in memory processes, such as episodic and spatial memory, and is rich with connections. Neuronal damage to this region has been indicated in patients with PTSD, which is especially important to note, due to many other important neural connections found within the CA3 region. Lastly, higher levels of glucocorticoids (cortisol) have been found in individuals who have experienced traumatic stress and have also been found to be associated with deficits in learning (Bremner, 2006; Magarinos et al., 1996).

Increased activation within the amygdala has been found to be associated with early life stress and PTSD. This increased activation may be associated with the symptom of hypervigilance implicated in PTSD (Pitman, Shin, & Rauch, 2001). The medial prefrontal cortex modulates emotional responsiveness through the inhibition of the amygdala. Previous studies have found associations between early life stress and less activation and decreased neuronal branching (Radley et al., 2004). It is thought that the decreased functioning in the medial prefrontal cortex could result in the failure to inhibit impulses sent to the amygdala, which then is thought to be associated with the rise of PTSD symptoms with traumatic reminders (Shin et al., 2004).

While differences in responsiveness have been found in these brain regions previously mentioned, it is very important to remember that these differences are simply associated with PTSD, and cannot be definitively proven to cause PTSD, and vice versa.

PTSD Literature

Gilbertson et al. (2002) examined hippocampal volume and its association with PTSD. The authors compared the hippocampal volumes of the trauma-exposed patient with PTSD, and their non-trauma exposed twin without PTSD. Within the PTSD twin pairs it was found that not only did the trauma-exposed twin have a smaller hippocampal volume, the twin who was not exposed to trauma also had a smaller hippocampal volume. Thus, it seems that a smaller hippocampal volume could potentially constitute a vulnerability factor for the development of PTSD.

Multiple types of traumas can contribute to PTSD. Breslau et al. (1998) examined different types of traumas in PTSD. The authors examined 2,181 persons between the ages of 18-45 by way of random-digit dialing telephone interviews. Participants listened

to a list of traumatic events and identified those they had experienced, and at what age. The Diagnostic Interview Schedule, Version IV (DIS-IV) and the Composite International Diagnostic Interview (CIDI) were utilized to evaluate PTSD in connection with the worst trauma that the participant had identified. A computer-selected random event was chosen from the list of events the participant had reported and the participant was asked to re-experience this event in order to evaluate its relation to the participant's PTSD diagnosis. The last measure was the evaluation of PTSD based on the earliest event reported by the participant. PTSD diagnoses were assigned as warranted using DSM-IV criteria. The authors found that the assault-related traumatic events accounted for 39.5% of PTSD cases. This included combat, physical, rape, or sexual assault. Other events that accounted for large percentages of PTSD cases included other injury or shock (22.5%) and sudden unexpected death (31.1%). The assault-related traumatic events accounted for the largest percentage of PTSD cases within this study.

Scott et al. (2014) conducted a meta-analysis in which neurocognitive functioning in PTSD was analyzed. Their report consisted of 60 studies that encompassed 4,108 participants; 1,779 participants had a PTSD diagnosis, 1,446 participants were trauma-exposed without PTSD, and 895 healthy control participants had no trauma exposure or PTSD diagnosis. Participants within the PTSD group were split into four subgroups: military trauma, interpersonal trauma, state persecution/terror, and mixed/unknown trauma type. Neurocognitive measures assessing PTSD, trauma-exposed, and healthy control groups were conducted and compared. The largest effect sizes were within the medium range; these domains included verbal learning, speed of information processing, and attention/working memory. Results revealed smaller effect sizes within other

domains as well, which included verbal memory, executive functions, and language. Smallest effect sizes included visuospatial functioning, visual learning, and visual memory. Overall, across the multiple domains of neurocognitive testing, significant mean-effect size estimates were found, indicating that the PTSD groups performed more poorly overall compared to the trauma-exposed group and the healthy controls. No significant differences were found across the four PTSD groups. The authors conclude that their findings cannot determine whether the neurocognitive deficits that they have found within these PTSD samples are due to the disorder, reflect a vulnerability factor present within the population, or are a consequence of the interaction of both. Based on the results of this meta-analysis, it can be concluded that PTSD is associated with medium magnitude neurocognitive deficits within the domains of attention/working memory, verbal learning and memory, and processing speed. In addition, smaller deficits in executive functions, visual learning and memory, language, and visuospatial abilities are also associated with PTSD. However, as the authors have stated, this does not mean that PTSD causes these deficits, but that it is simply associated with the presence of these deficits.

Lastly, childhood PTSD and trauma have been associated with lower levels of neurocognitive functioning as well. Malarbi et al., (2017) conducted a meta-analysis assessing cognitive functioning in trauma-exposed children with and without PTSD. 27 studies were eligible for inclusion, with a total of 1,526 participants. These participants consisted of 412 trauma-exposed children in which the presence of PTSD was not assessed, 300 children with PTSD, 323 without PTSD, and 491 non-traumatized controls. Information extracted from each study included trauma type (familial or non-familial),

time since trauma, and PTSD severity. Measures used to assess cognitive functioning included the CVLT along with many other validated measures of cognitive functioning. 15 studies reported participants with trauma exposure but did not report PTSD status. Averaged across neurocognitive domains, trauma exposed children performed at a lower level in comparison to healthy controls. The trauma-exposed groups performed significantly worse on measures of perceptual/visuospatial skills, general intelligence, cognitive flexibility, attentional control, and overall cognitive functioning with medium effect sizes. Trauma-exposed groups also performed significantly worse on measures of language/verbal skills with large effect sizes. 8 studies within the meta-analysis analyzed cognitive functioning in children with PTSD compared to healthy controls. Children with PTSD performed significantly worse on measures of language/verbal skills, perceptual/visuospatial skills, verbal learning and memory, information processing, overall learning and memory and overall executive functioning with medium effect sizes. Children with PTSD also performed significantly worse on measures of general intelligence and goal setting with large effect sizes. Overall, the trauma exposed children and the children with PTSD showed a lower level of performance than the healthy controls on measures of cognitive functioning.

Learning and Memory

The literature that has been reviewed thus far has shown worse performance in individuals exposed to trauma, such as sexual assault, and PTSD. Worse performance in the realms of memory and learning have been discussed thus far. Due to these trends in the research, further discussion of these realms was deemed necessary for this study. Specifically, the potential effects of sexual assault and PTSD on learning, verbal

memory, and working memory will be examined.

PTSD

In a study conducted by Diener, Flor, and Wessa (2010), performance on the CVLT, a measure of verbal learning and memory, was examined in a group with PTSD, a trauma-exposed group without PTSD, and a healthy control group. Participants were grouped by individuals with PTSD, and individuals who had experienced trauma but did not have PTSD. The PTSD group performed significantly more poorly on nearly all CVLT indices when compared with the two comparison groups.

In a study conducted by Scheiner et al., (2014), medication-free patients meeting DSM-IV criteria for MDD and PTSD were compared to medication-free patients with MDD and to non-patients. To assess verbal learning and memory, the Buschke Selective Reminding Test, the California Verbal Learning Test (CVLT), and the Rey Auditory Verbal Learning Test (RAVLT) were administered. Attention was measured using the continuous performance test (CPT), working memory was measured using the A not B reasoning task, and executive functioning was measured using the Wisconsin Card Sorting Test. The group with both MDD and PTSD performed significantly more poorly on measures of verbal learning and memory compared to healthy controls and to patients with MDD alone. In addition, the group with both MDD and PTSD performed significantly more poorly on measures of word retrieval ability and word list acquisition, in addition to exhibiting less efficient learning, which caused poor recall. All of the groups exhibited the ability to recall and retain what they had learned. All groups performed at about the same level when it came to attention, working memory, and executive functioning, which was noted by the authors to be quite surprising based on all

of the supporting literature that states otherwise. The authors noted that this sample mostly included women and victims of early abuse, and so may not generalize to other populations.

A meta-analysis of 28 studies conducted by Johnsen and Asbjornsen (2008) assessed the strength of the association between PTSD and memory. Results of the meta-analysis showed medium effect sizes in PTSD patients compared to healthy controls on measures of verbal memory across all studies. The strongest effects were in cases of PTSD in war veterans compared to sexual assault and physical assault related PTSD. Studies analyzed within the meta-analysis that used the Auditory Verbal Learning Test (AVLT) and the Wechsler Memory Scale (WMS) showed stronger effects than studies using the CVLT.

Sexual assault

A study by Brownlie et al., (2007), investigated language impairment in victims of sexual assault. The participants were 5-year-olds who were participating in a 3-stage survey in Ontario, Canada, in which they were screened for impairment in speech or language. The children that failed these assessments completed further speech and language assessments administered by speech-language pathologists. The control group was obtained from the same classroom and consisted of children from the same classrooms who had passed the assessments. Measures were obtained once again at 12, 19, and 25 years of age. At age 25, participants took part in the University of Michigan composite international diagnostic instrument (UM-CIDI). This assessment screened for certain psychiatric disorders, but also contained a section (Section P) that asked participants about potentially traumatic events, including whether or not the individual had sex forced upon them by threat, and whether the individual had ever been molested.

The women involved within the study (men were excluded from sexual assault conclusions due to the small number that reported sexual assault) who had language impairment were the most likely to have experienced sexual assault. A total of 25 women reported sexual assault, with 3 reporting the assault occurred before the age of 5, and the remainder of the women reported their assault between the average ages of 10 and 13. This is an important study to consider, due to the cognitive differences that were present prior to the reported sexual assaults. The authors have concluded that cognitive differences, mainly language impairment, increase the vulnerability factor of sexual assault in women, due to the inability to adequately communicate.

A study conducted by Stein et al., (1999) examined two groups of women; one of which experienced childhood sexual abuse, and the others had not experienced any sort of abuse. The CVLT and the Benton Visual Retention Task were administered to measure memory retention. The results of this study indicated no major differences between the control group and the sexually abused group, meaning that within this study, memory retention was not affected by childhood sexual abuse. This study had a small sample size (n=42), which may have had an effect on the overall outcome.

PTSD and sexual assault

A study conducted by Shin et al., (2015) investigated psychological and cognitive factors associated with PTSD as a result of sexual violence. 34 participants were recruited from a university hospital for women and children; all of the participants were females who had been sexually assaulted in the previous 4 months and had been actively seeking out psychiatric help. Baseline scores measuring verbal memory and PTSD symptom severity were obtained shortly after the trauma occurred. The goal of this study was to

determine whether or not baseline scores that indicated PTSD symptoms, and poorer performance in measures of verbal memory, were predictors of a later diagnosis of PTSD. The results of this study indicated that baseline symptoms of avoidance and poorer performance on measures of verbal memory scores were predictors of PTSD that developed one to five months later.

Working Memory

Working memory is an important part of the executive functioning system. Working memory is the system essential for manipulating and storing information while performing multiple types of complex tasks such as comprehension, learning, and reasoning (Baddeley, 2010). Research examining potential effects of sexual assault on working memory is scarce, and much of the research focuses on PTSD and trauma, but trauma is not always specified by type. Oftentimes, trauma is measured by asking participants to recall instances of trauma, known as recall or trauma-cueing, in order to replicate the reaction to initial traumatic event ethically. Observations of the effects of the recalled trauma and its impact on working memory can be useful to determine the severity of its effects.

Shields et al., (2017) investigated the effects of recent life stress over a two-week period on long-term memory and working memory. It was found that greater recent life stress exposure was associated with lower scores on measure of working memory and long-term memory.

Kolts, Lombardo, and Faulkner (2004) assessed undergraduate college students from introductory psychology courses from a university in the south. Traumatic experiences were assessed using the Trauma Assessment for Adults (TAA), and PTSD

symptomology was assessed using the Modified PTSD Symptom Scale-Self Report Version (MPSS-SR). The Beck Depression Inventory-Second Edition (BDI-II) was used to assess levels of depression. Short-term memory was assessed through the visual reproduction and logical memory subscales of the Wechsler Memory Scale-Revised (WMS-R), the CVLT was used to measure serial list learning, and the Digit Span subtest of the WMS-R was used to measure attention, although normally it is used to assess working memory. First the participants completed the cognitive tests, and then were exposed to cueing that was either their identified trauma or a neutral cueing event (tooth-brushing). Following this the participants were asked to write either a description of the traumatic event they experienced ("trauma cueing condition"), or a description of what they feel, taste, and think before and while brushing teeth (neutral cueing condition). Results indicated a lack of an effect on PTSD status on these functions. Throughout this study, there was not a main effect of PTSD status on scores of attention, visual memory, serial list learning, or verbal memory. The authors attribute this difference from the general body of research to the fact that the type and duration of stressor that the participants were exposed to could differ from other studies.

Dodaj et al., (2017) studied the potential relationship between maltreatment in childhood and working memory capacity in adulthood. Maltreatment in childhood included sexual, physical, and psychological abuse, as well as family violence and neglect. It was found that maltreatment in childhood was a significant predictor for deficits in self-reported working memory capacity in adulthood.

Purpose of Study and Hypotheses

The purpose of this study is to determine if elevated scores on the PCL-C and past

sexual assault experiences are associated with lower levels of performance on measures of cognitive functioning; specifically measures of verbal learning, verbal memory, and working memory. The CVLT was administered to assess verbal learning and memory, as it has been used in multiple studies to detect differences between PTSD patients and healthy controls (Diener et al., 2010; Scheiner et al., 2014; Jenkins et al., 1998; Stein et al., 1999). The WAIS-IV subtests Digit Span and Arithmetic were administered to assess working memory, and these have also been used in other studies assessing working memory in PTSD (Kolts et al., 2004). The combined standardized scores from these two subtests were used to create the Working Memory Index (WMI) score for each participant.

Based on results from previous studies examining PTSD and its effects on measures of cognitive functioning (Scott et al., 2014; Malarbi et al., 2017; Diener, Flor, & Wessa, 2010; Scheiner et al., 2014) it is expected that the PTSD only group will perform at a lower level on measures of verbal memory, learning, and working memory compared to controls. Based on results from previous studies examining the effects of sexual assault on measures of cognitive functioning (Baker et al., 2016; Gould et al., 2012; Walker, Archie, & Davies, 2005), it is expected that the sexual assault only group will perform at a lower level on measures of verbal memory, learning, and working memory compared to controls. Based on results from studies examining the effects of PTSD and sexual assault together on cognitive functioning (Jenkins, Langlais, Delis, & Cohen, 1998; Shin et al., 2015) it is expected that the PTSD + Sexual Assault group will perform at a lower level on measures of verbal memory, learning, and working memory compared to healthy controls, but will also perform at a lower level compared to the

PTSD only and Sexual Assault only groups.

This study differs from previous studies in that it examines elevated PTSD symptoms alongside previous experiences of sexual assault and the associations among these predictors with scores on measures of verbal learning and memory, and working memory in a college sample. Previous studies have used PTSD patients and compared their verbal learning, memory, and working memory scores to controls, and studies have examined presence of experiences of sexual assault and associations among lower verbal learning, memory, and working memory. This study aims to assess the lack of research in this specific realm.

III. RESEARCH DESIGN AND METHODS

Participants

Participants were recruited through psychology classes at Texas State University. Psychology professors were asked to email a link to the study to their students, prompting them to follow the link to the online Qualtrics survey. 402 students participated in the initial pre-screening survey, which included the Posttraumatic Checklist – Civilian (PCL-C), Sexual Experiences Survey – Short Form Version (SES-SFV), and the Childhood Trauma Questionnaire (CTQ).

All participants were informed of the potential risks of the study before participating, which included potential distress association with answering questions pertaining to sexual assault history. Participants were excluded from the study if they reported being diagnosed with any type of disorder that could interfere with effective learning, such as dyslexia or Attention deficit disorder. Inclusion criteria required that participants were 18 or older and attend Texas State University. Any participant was allowed to withdraw from the study at any time, or take a break if the subject material became distressing. Once the initial pre-screening survey was completed, all students that indicated interest in participating in the second part of the study were asked to include their email at the end of the initial survey. All participants were contacted and asked to sign up for a time slot for part two of the study. It was expected that 100 participants would sign up for part two, with 25 participants being placed into each of the four groups. However, only 41 people participated in part two. Due to issues with recruitment and participation, the compensation was increased from $10 to $20 per participant. Participants were sorted based on their responses into one of four categories: PTSD,

Sexual Assault (SA), PTSD + SA, or control. PTSD only consisted of 5 participants, Sexual Assault only consisted of 7 participants, PTSD + Sexual Assault consisted of 8 participants, and the control group consisted of 12 participants, for a total of 32 participants. For part two of the study, the in-person assessment, participants were asked if they had consumed substances such as drugs, alcohol, or prescription medications within the past 24 hours that they believed would interfere with their cognitive abilities prior to beginning the assessment. Each participant was compensated for completing the initial part of the study through Qualtrics with an entry into a drawing for a $50 Amazon gift card. If participants completed the second part of the study, they were compensated with an additional entry into the gift card drawing, as well as with $20.

Measures

Sexual assault experiences after the age of 14 were assessed using the Sexual Experiences Survey – Short Form Victimization (SES-SFV). This survey measures unwanted sexual experiences (a) within the last year, and (b) since turning 14 years old. An example of an item from this assessment would be: "A man put his penis into my vagina, or someone inserted fingers or objects without my consent." This instrument contains 10 items that are scaled by asking the participant to indicate how many times the event has happened to them within the past year and since turning 14 years old (0, 1,2,3 +). The SES-SFV has demonstrated predictive validity, internal consistency reliability (Women since age 14 and in the past 12 months: r = .92) (Men since age 14: r = .98, Men in the past 12 months: r = .99), and two-week test-retest reliability (Women: coefficients range from .70 to .73), (Men: r=.91) (Johnson, Murphy, and Gidcyz, 2017).

Childhood sexual assault experiences before the age of 14 were assessed using

items from the Childhood Trauma Questionnaire (CTQ). This questionnaire is a 25-item measure that asks about childhood physical, emotional, and sexual abuse, as well as neglect, and overall well-being. The entire questionnaire was given to participants, but only 5 of the items were used for analyses. These 5 items were apart of the sexual abuse section: the other sections within the survey were not included in analyses due to irrelevance to the study. The questionnaire asks for the participant to indicate how often the following situations occurred to them before the age of 14. An example of an item from this questionnaire would be: "Hurt if I didn't do something sexual." The items on this questionnaire are measured on a 1-5 scale ranging from "Never true" (1) to "Very often true" (5).

Post-Traumatic Stress Disorder (PTSD) symptoms were assessed using the Post-Traumatic Checklist – Civilian (PCL-C). This is a 17-item measure that assesses PTSD symptoms that occur due to any traumatic event. Items are scaled from 1-5 with responses ranging from "Not at all" (1) to "Extremely" (5). Items are added together to obtain an overall severity score, with 50 being a generally accepted cut-off score that suggests clinically significant PTSD symptomology. For the purposes of this study, participants with scores of 45 and above were included in the PTSD group. These participants were considered to have elevated self-reported PTSD symptoms, but did not receive a diagnosis of PTSD. Those with elevated scores were placed in the "PTSD" group, but have not been diagnosed with PTSD. Conybeare, Behar, Solomon, Newman, and Borkovec (2012) determined that the PCL-C demonstrated acceptable internal consistency as well as test-retest reliability. Convergent and discriminant validity were demonstrated to be adequate as well.

The California Verbal Learning Test (CVLT) was used to measure verbal learning and verbal memory. During Trial A of the CVLT, a list of 16 nouns is read at a pace of about one second per word, and the participant is asked to recall these words in any order in 5 separate trials. The administrator of the test reads the list to the participant each trial before the participant is asked to repeat as many of the words as they can. During Trial B, a new list of 16 words is read and the participant is asked to recall as many of these words as possible, followed by asking for as many of the words from Trial A that the participant can remember (Short Delay Free Recall). After this, the participant is asked to name all of the items they can remember from four different categories (furniture, vegetables, methods of transportation, and animals) by category cueing such as "Name all of the vegetables from List A" (Short Delay Cued Recall). Following this, the 20-minute delay of the CVLT is administered.

Following a 20-minute delay, participants are again asked to recall words from List A (Long Delay Free Recall), followed by category cueing (Long Delay Free Recall). Lastly, words are read to the participant, and he or she has to decide which word was from the first list (Yes/No Recognition). The CVLT is one of the most widely used neuropsychological tests in the United States. Strong construct validity as a measure of verbal memory and learning has been demonstrated, and test-retest reliability has been demonstrated (Woods et al., 2006).

The Arithmetic and Digit Span subtest of the Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV) was used to measure working memory. The digit span subtest primarily measures attention and working memory. Digit Span comprises three distinct tasks. For Digits Forward, participants are read a series of digits and asked to recall the

numbers in the same order. For Digits Backward, they are read a number sequence and then are asked to repeat the digits in reverse order. For Digit Sequencing, participants are read a number sequence, and are asked to report in ascending order. The Arithmetic subtest primarily measures working memory, although it also engages numerical reasoning ability. Participants are asked to solve a set of arithmetic problems within a specific time limit per item. Raw scores for Digit Span and Arithmetic were converted to scale scores, which were combined to produce a Working Memory Index score (WMI).

Procedure

Participants were emailed a link to participate in the first part of the study, which includes the PCL-C, the SES-SFV, and the CTQ. Consent was obtained and contact information for the counseling center was provided. Upon completion, the researcher invited participants to take part in the second part of the study until the desired number of participants per group was obtained. For the PCL-C, elevated scores of 40 and above placed the participant within the PTSD group. For the SES-SFV, a score greater than 0 within any of the sections placed the student within the sexual assault group. For the CTQ, if a participant scored greater than 5 within the sexual abuse subsection, they were placed into the sexual assault group.

For the second part of the study, participants arrived at their scheduled time at the lab in the Undergraduate Academic Center at Texas State. They were given the consent form upon arrival, and procedures were reviewed with each participant. First, the CVLT was administered, and the twenty-minute break between the two sections was utilized. During this break, the WAIS-IV subtests of digit span and arithmetic were administered.

Once these tests were completed, the participant was provided with compensation

of $20 and was informed of the Amazon gift card drawing and the time in which the winners would be announced.

Confidentiality measures included connecting the participant's email, without their name, to their assigned group and data in an Excel document that only the researcher was able to access. Following completion of data collection, participant's emails were deleted as well. Data will be kept securely for seven years following the experiment, and will then be destroyed.

Statistical Analysis

A linear regression to determine associations between pre-tests and cognitive functioning was conducted. PCL-C, SES-SFV and CTQ were used as predictor variables of the WMI and CVLT. Six separate linear regressions were conducted between the predictor variables and each of the totals from the CVLT Trials 1-5, SDFR, LDFR, SDCR, LDCR and the WMI.

An ANOVA was conducted to assess differences among group means. The four groups included: PTSD only, Sexual Assault only, PTSD + Sexual Assault, and controls. The outcome variables included the total scores from each of the cognitive tests conducted. These included the Trials 1-5 Total, Short Delay Free Recall (SDFR), Long Delay Free Recall (LDFR), Short Delay Cued Recall (SDCR), Long Delay Cued Recall (LDCR), and the Working Memory Index. Total scores from the Digit Span and Arithmetic subtests from the WAIS-IV were combined to create the Working Memory Index.

IV. RESULTS

Demographics and Group Characteristics

Univariate analyses were conducted to assess demographics for the sample as a whole and within groups. This sample primarily consisted of females (87.5%), and most were Caucasian (75%). Trauma-exposed participants made up 62.5% of the sample (see Table 1).

Correlation of Measures

Pearson correlations were computed between all measures utilized within this study. All measures of the CVLT (CVLT Trials 1-5, SDFR, LDFR, SDCR, LDCR) were significantly correlated with each other ($p < .01$) (see Table 2).

Group Mean Comparisons

A MANOVA was conducted to compare means of the PTSD, sexual assault, PTSD + sexual assault and control groups on scores of the CVLT Trials 1-5, SDCR, LDCR, SDFR, LDFR, and WMI. The results of the MANOVA indicated that there were no significant differences in measures of cognitive functioning based on current symptoms of PTSD and past sexual assault experiences (see Table 3).

One-Way ANOVA between Trauma Exposure and No Trauma Exposure

In addition, a One-Way ANOVA was conducted to compare means of groups with trauma exposure (PTSD, SA, and PTSD + SA) and no trauma exposure (controls). The results of the one-way ANOVA indicated that there were no significant differences in measures of cognitive functioning based on trauma exposure (see Table 4).

Group Effect Sizes

Although group mean differences did not reach statistical significance in ANOVA

analyses, effect sizes were computed to indicate the magnitude of differences on cognitive measures. Group effect sizes for each of the cognitive measures ranged from -0.62 – 0.94. A large effect size was observed between PTSD and SA on the WMI (d = 0.94). Medium effect sizes were observed between PTSD and PTSD + SA on the CVLT 1-5 (d = -0.55), SDCR (d = -0.59), and LDCR (-0.62). Medium effects were observed between PTSD + SA and controls on SDCR (d = .60), and between PTSD + SA and SA on SDFR (d = 0.65), SDCR (d = 0.72), LDCR (d = 0.66), and WMI (d = 0.64) (see Table 5).

PTSD and Sexual Assault as Predictors

A simple linear regression analysis was used to test if PTSD and sexual assault predicted scores on the CVLT Trials 1-5 total. The regression indicated that PTSD and sexual assault were not significant predictors of scores on the CVLT Trials 1-5 total ($F(3,21) = .781$, $p > .05$, $R^2 = .100$) (see Table 6).

A simple linear regression analysis was used to test if PTSD and sexual assault predicted CVLT SDFR scores, and the results of the regression indicated that PTSD and sexual assault were not significant predictors of CVLT SDFR scores ($F(3,21) = .800$, $p > .05$, $R^2 = .103$ (see Table 7).

A simple linear regression analysis was used to test if PTSD and sexual assault predicted CVLT LDFR scores, and the results of the regression indicated that PTSD and sexual assault were not significant predictors of CVLT LDFR scores ($F(3,21) = .690$, $p > .05$, $R^2 = .090$) (see Table 8).

A simple linear regression analysis was used to test if PTSD and sexual assault predicted CVLT SDCR scores, and the results of the regression indicated that PTSD and

sexual assault were not significant predictors of CVLT SDCR scores ($F(3,21) = .986$, $p > .05$, $R^2 = .123$) (see Table 9).

A simple linear regression analysis was used to test if PTSD and sexual assault predicted significantly lower scores on the CVLT LDCR, and the results of the regression indicated that PTSD and sexual assault were not significant predictors of CVLT LDCR scores ($F(3,21) = 1.205$, $p > .05$, $R^2 = .147$) (see Table 10).

A simple linear regression analysis was used to test if PTSD and sexual assault predicted scores on the Digit Span, and the results of the regression indicated that PTSD and sexual assault were not significant predictors of Digit Span scores ($F(3,21) = .827$, $p > .05$, $R^2 = .106$) (see Table 11).

A simple linear regression analysis was used to test if PTSD and sexual assault predicted scores on Arithmetic, and the results of the regression indicated that PTSD and sexual assault were not significant predictors of Arithmetic scores ($F(3,21) = .187$, $p > .05$, $R^2 = .026$) (see Table 12).

Table 1. Demographic and group characteristics

	PTSD (*n* = 5)		SA (*n* = 7)		PTSD+SA *(n = 8)*		Controls *(n = 12)*				Entire Sample (*n*=32)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F/X^2	Sig	Mean	SD
Age (years)	23.6	10.1	22.6	7.8	22.8	4.1	19.8	1.3	.79	.51	21.7	5.7
Education (years)	17.4	9.9	14.7	1.5	15	.93	13.8	1.2	1.0	.39	14.8	3.9
%Females	80%	-	85.7%	-	100%	-	83.3%	-	.22	.66	87.5%	-
Ethnicity(% white)	60%	-	85.7%	-	87.5%	-	66.7%	-	.53	.40	75%	-
Trauma exposed	100%	-	100%	-	100%	-	0%	-	.71	.00	62.5%	-

Table 2. Correlations among predictors and cognitive measures

	CVLT Trials 1-5	SDFR	LDFR	SDCR	LDCR	WMI	PCL-C	SES-SFV	CTQ-SA
CVLT Trials 1-5									
r		.666	.745	.626	.658	.260	-.111	.238	.147
p		**.000**	**.000**	**.000**	**.000**	.151	.546	.252	.429
CVLT SDFR									
r			.846	.846	.834	.345	.069	.214	.163
p			**.000**	**.000**	**.000**	.053	.709	.305	.381
CVLT LDFR									
r				.834	.929	.293	-.081	.302	.051
p				**.000**	**.000**	.104	.659	.142	.787
CVLT-SDCR									
r					.925	.239	.029	.261	.174
p					**.000**	.187	.874	.207	.349
CVLT-LDCR									
r						.206	-.056	.303	.073
p						.258	.762	.141	.697
CVLT-WMI									
r							.091	.130	-.125
p							.622	.536	.505

Table 2. Continued Correlations among predictors and cognitive measures

	CVLT Trials 1-5	SDFR	LDFR	SDCR	LDCR	WMI	PCL-C	SES-SFV	CTQ-SA
PCL-C									
r								.344	.176
p								.092	.343
SES-SFV									
r									.236
p									.256
CTQ-SA									
r									
p									

CVLT, California Verbal Learning Test; SDFR, Short delay free recall; LDFR, Long delay free recall; SDCR, short delay cued recall; LDCR, long delay cued recall; WMI, Working memory Index; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault

Table 3. MANOVA between groups analysis

	PTSD (*n* = 5)		SA (*n* = 7)		PTSD+SA *(n = 8)*		Controls *(n = 12)*			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F(3,28)	p
CVLT Trials 1-5	42	9.35	46.43	9.38	47.13	9.39	45.42	8.96	.350	.789
CVLT-SDFR	-.50	1.06	-.64	1.07	-.06	.68	-.54	1.57	.351	.789
CVLT-LDFR	-.70	.84	-.71	.76	-.31	.96	-.42	1.14	.305	.822
CVLT-SDCR	-.70	1.40	-.64	.90	.00	.89	-.67	1.30	.678	.573
CVLT-LDCR	-.80	1.04	-.79	.91	-.19	.92	-.54	1.25	.505	.682
WMI	99.40	3.78	91.57	11.16	99.25	12.79	96.08	12.69	.688	.567

CVLT, California Verbal Learning Test; SDFR, Short delay free recall; LDFR, Long delay free recall; SDCR, short delay cued recall; LDCR, long delay cued recall; WMI, Working memory Index' SD, standard deviation;
All means are z-scores except for CVLT Trials 1-5 Total = t score; WAIS-IV WMI = index score

Table 4. One-Way ANOVA Trauma exposure vs. No trauma exposure

	Trauma exposure (n = 20)		No trauma exposure (n = 12)			
	Mean	SD	Mean	SD	F(1,30)	p
CVLT Trials 1-5	45.60	9.13	45.42	8.86	.003	.956
CVLT-SDFR	-.375	.916	-.542	1.57	.145	.706
CVLT-LDFR	-.550	.841	-.417	1.14	.144	.707
CVLT-SDCR	-.400	1.03	-.667	1.30	.411	.527
CVLT-LDCR	-.550	.945	-.542	1.25	.000	.983
WMI	96.60	10.82	96.08	12.69	.015	.903

CVLT, California Verbal Learning Test; SDFR, Short delay free recall; LDFR, Long delay free recall; SDCR, short delay cued recall; LDCR, long delay cued recall; WMI, Working memory Index' SD, standard deviation

Table 5. Group effect sizes for cognitive measures

		CVLT 1-5	SDFR	LDFR	SDCR	LDCR	WMI
		d	d	d	d	d	d
PTSD vs.	Control	-0.37	0.03	-0.28	-0.02	-0.23	0.35
	PTSD + SA	-0.55	-0.49	-0.43	-0.59	-0.62	0.02
	SA	-0.47	0.13	0.01	-0.05	-0.01	0.94
PTSD + SA vs.	Control	0.19	0.39	0.10	0.60	0.32	0.25
	SA	0.07	0.65	0.46	0.72	0.66	0.64
Control vs.	SA	-0.11	0.07	0.29	-0.03	0.23	0.38

CVLT, California Verbal Learning Test; SDFR, Short delay free recall; LDFR, Long delay free recall; SDCR, short delay cued recall; LDCR, long delay cued recall; WMI, Working memory Index' SD, standard deviation

Table 6. Linear Regression evaluating the associations among predictors and CVLT Trials 1-5 Total

	B	SE	T	p
PCL-C	-.096	.112	-.858	.401
SES-SFV	.067	.057	1.181	.251
CTQ-SA	.250	.392	.637	.531
Constant	51.89	5.07	10.24	.000

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

Table 7. Linear Regression evaluating the associations among predictors and CVLT Short Delay Free Recall

	B	SE	T	p
PCL-C	.034	.051	.665	.514
SES-SFV	.017	.026	.651	.522
CTQ-SA	.137	.177	.770	.450
Constant	7.87	2.29	3.43	.002

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

Table 8. Linear Regression evaluating the associations among predictors and CVLT Long Delay Free Recall

	B	SE	T	p
PCL-C	.012	.044	.278	.784
SES-SFV	.018	.022	.806	.429
CTQ-SA	.120	.154	.775	.447
Constant	9.80	1.99	4.92	.000

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

Table 9. Linear Regression evaluating the associations among predictors and CVLT Short Delay Cued Recall

	B	SE	T	p
PCL-C	-.015	.038	-.403	.691
SES-SFV	.032	.020	1,642	.115
CTQ-SA	.017	.134	,126	.901
Constant	10.80	1.73	6.24	.000

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

Table 10. Linear Regression evaluating the associations among predictors and CVLT Long Delay Cued Recall

	B	SE	T	p
PCL-C	-.006	.040	-.143	.888
SES-SFV	.035	.021	1.70	.104
CTQ-SA	.043	.142	.305	.763
Constant	10.83	1.83	5.92	.000

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

Table 11. Linear Regression evaluating the associations among predictors and Digit Span

	B	SE	T	p
PCL-C	.077	.065	1.17	.255
SES-SFV	.018	.033	.524	.606
CTQ-SA	-.168	.230	-.731	.473
Constant	24.94	2.96	8.42	.000

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

Table 12. Linear Regression evaluating the associations among predictors and Arithmetic

	B	SE	T	p
PCL-C	.035	.050	.699	.492
SES-SFV	-.001	.026	-.021	.983
CTQ-SA	-.044	.175	-.251	.804
Constant	11.47	2.263	5.07	.000

CVLT, California Verbal Learning Test; PCL-C, Posttraumatic checklist – civilian; SES-SFV, sexual experiences survey – short form victimization; CTQ-SA, childhood trauma questionnaire – sexual assault
B, Beta; SE, Standard Error

V. DISCUSSION

Analyses did not find-PTSD and sexual assault to be significantly associated with poor performance on the CVLT and the WMI. The results of the current study are inconsistent with a number of previous studies that show PTSD to be significantly associated with poor performance on cognitive measures when compared to controls and to traumatized individuals (Diener et al., 2010; Scheiner et al., 2014; Scott et al., 2014). In previous studies, sexual assault in childhood and adulthood was observed to be significantly associated with poor performance on cognitive measures compared to controls (Gould et al., 2012; Baker et al., 2016). Lastly, individuals with past experiences of sexual assault who also have PTSD have been observed in previous studies to show poor performance on cognitive measures in comparison to healthy controls (Malarbi et al., 2017; Jenkins et al., 1998) and in comparison to those who do not have PTSD, but have experienced a traumatic event (Diener et al., 2010).

Effect sizes ranged from -0.62 – 0.94 across the CVLT and WMI. Scott et al., (2014) found medium effect sizes for verbal learning and working memory in a PTSD sample, and within this study medium effect sizes were also observed between PTSD + SA and controls within SDCR. Medium effect sizes were also observed between PTSD + SA and PTSD groups within CVLT Trials 1-5, SDCR, and LDCR. While significance was not found within this study, effect sizes similar to previous studies that found significant associations, and had larger sample sizes, suggests that if our sample size had been larger, significant associations may have been observed as well.

The small sample size of this study resulted in a low statistical power of 20%. This low statistical power results in the lower likelihood of detecting potential differences

that might be present. The lack of observed decrements in this study, especially the PTSD group, could be attributed to the low statistical power that is associated with the small sample size within this study.

Performances across groups were below the norms of the CVLT and the WAIS-IV. Within a college sample, this should not be the case, and in fact quite the opposite should occur. Since all of the participants are currently attending a university, it is expected that they would be cognitively more intact than those who are not or have not ever attended a university. However, our sample showed an overall underperformance compared to norm scores. Potentially, there could have been an issue in test administration, in which instructions may not have been explained clearly enough, or the participant did not understand and failed to ask for clarification. In addition, if students had just come from taking a test in a class, or hadn't gotten enough sleep the night before, the effort that they were giving may not have been adequate, which could also account for low mean scores across groups.

Surprisingly, the PTSD + SA group performed superior on all measures compared to other groups with the exception of the WMI. This is the exact opposite of what was predicted within this study, and was unexpected. The PTSD group performed worse than the control group on CVLT Trials 1-5, LDFR, SDCR, and LDCR and the SA group performed worse than controls on the SDFR, LDFR, LDCR and the WMI, but these differences were not significant.

No significant differences were found across the groups. However, the lack of differences raises an important question that should be considered when looking into the impacts of sexual assault and PTSD, specifically, how are college students different than

the general population? Studies such as Scott et al., 2014 and Jenkins et al., 1998 identify significantly lower scores on cognitive measures within PTSD positive rape victims and PTSD positive sexual assault victims, however the majority of participants within these groups do not consist of students, and represent a wider range of individuals. Potentially, the participants within our study who were identified as having elevated scores on the PCL-C may not actually have a case of PTSD that is equivalent to the degree of severity of those who are participants in previous studies. Studies that had participants with a diagnosis of PTSD (Scott et al., 2014; Malarbi et al., 2017; Diener et al., 2010; Scheiner et al., 2014; Jenkins et al., 1998; Johnsen & Asbjornsen, 2008) all found significant associations among PTSD and worse performance on measures of cognitive functioning, and this is possibly because the participants within these studies had more severe symptomology than the patients within this study. Symptoms of these participants may have been more intrusive and extreme than those of this sample. The lack of diagnosis within this study could be a major factor in the lack of significance, specifically because it cannot be known for sure that the participants within the PTSD group in this study actually have PTSD, since there was no clinical diagnosis.

It is important to consider that perhaps PTSD and sexual assault do not impact cognitive functions in the way that was predicted within this study. Stein et al., (1999), who examined differences in memory retention between victims of childhood sexual abuse and non-victims using the CVLT, found no significant differences in memory retention between the two groups. This is important to consider alongside the current study due to the similarities in makeup of both studies, since both used college samples and had such a small sample size. Perhaps this suggests a trend within the population,

that possibly sexual assault alone does not impact memory as measured by the CVLT. In studies such as Diener et al., 2010 and Scheiner, 2014, the CVLT was used to assess cognitive functioning in participants with PTSD, and these studies found significant differences between PTSD groups and controls. It is possible that the CVLT accurately captures the impacts of PTSD on memory and learning, but does not capture the impacts of sexual assault on memory and learning.

Limitations

Limitations of the study include lack of diversity within age, race, and gender. 87.8% of the participants were female, as well as 73.2% of participants were Caucasian. The majority of participants were 18-21 years of age (78.1%), as well as every participant within the study being a current student at Texas State University, which makes the results of this study unable to be generalized to the general population. In addition attrition was a major limitation within this study. There were many participants in part one who chose to not participate in part two, especially those that were part of the SA, PTSD, or PTSD + SA groups. Participants that reported sexual assault and PTSD in part one of the study were reluctant to participate in part two, possibly due to the sensitive nature of the study, which caused difficulties in obtaining enough participants for each of the groups.

Low statistical power (20%) was a limitation within this study, as this lowers the likelihood of being able to detect significant effects within the sample. Selection bias was present within this study, due to the researcher using only college students as participants, and assigning group membership based on answers to part one assessments.

The administration of the Digit Span and Arithmetic during the 20-minute break

of the CVLT could have potentially caused retroactive and proactive interference. This could account for the lower than average performance on the long delay trials of the CVLT and the lower than average performance on Digit Span and Arithmetic. This has been observed between trials of the CVLT in previous studies (Kramer & Dellis, 1991). In the CVLT-II manual, it has been recommended that nonverbal tasks be administered during the 20-minute break, and while the Digit Span and Arithmetic tasks are numerically based, the introduction of material that requires the memory to work could potentially result in similar interferences (Williams & Donovick, 2008).

Conclusion

While this study did not result in significant findings, there are still important potential factors to consider that are contributing to this lack of significance. Low statistical power contributed to the lower likelihood of detecting significant differences among groups. Differences among college students in comparison to the people with a clinical diagnosis of PTSD may account for lack of significant findings within this study as well. In future research, measures of attention and attentional capacity should be incorporated, since symptoms of PTSD can have a major effect on attention span. Time since the sexual assault occurred would be useful to consider, since this may have something to do with effects of past experiences on current cognitive performances. Despite the lack of significant findings within this study, further research to determine the impacts of sexual assault and PTSD on cognitive functions continues to be of importance, and should be considered for future investigation.

REFERENCES

American Psychiatric Association (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Association.

Baddeley, A.D., (2010). Working memory. *Current Biology, 20*(4), R136-R140.

Baker, M.R., Frazier, P.A., Greer, C., Paulsen, J.A., Howard, K., Meredith, L.N., Anders, S.L., & Shallcross, S.L. (2016). Sexual victimization history predicts academic performance in college women. *Journal of Counseling Psychology, 63*(6), 685-692.

Bremner, J.D., (2002). *Does stress damage the brain? Understanding trauma disorders from a mind-body perspective.* New York, NY. W.W. Norton.

Bremner, J.D., (2003). Functional neuroanatomical correlates of traumatic stress revisited 7 years later, this time with data. *Psychopharmacological Bull, 37*, 6-25.

Bremner, J.D., (2006). Traumatic stress: Effects on the brain. *Dialogues Clinical Neuroscience, 8*(4), 445-461.

Breslau, N., Kessler, R.C., Chilcoat, H.D., Schultz, L.R., Davis, G.C., & Andreski, P. (1998). Trauma and posttraumatic stress disorder in the community: The 1996 Detroit area survey of trauma. *Archives of General Psychiatry, 55*(7), 626-632.

Brownlie, E.B., Jabbar, A., Beitchman, J., Vida, R., & Atkinson, L. (2007). Language impairment and sexual assault of girls and women: findings from a community sample. *Journal of Abnormal Child Psychology, 35*, 618-626.

Chen, L.P., Murad, M.H., Paras, M.L., Colbenson, K.M., Sattler, A.L., Goranson, E.N., Elamin, M.B., Seime, R.J., Shinozaki, G., Prokop, L.J., & Zirakzadeh, A. (2010). Sexual abuse and lifetime diagnosis of psychiatric disorders: Systematic review and meta-analysis. *Mayo Clinic Proceedings, 85*(7), 618-629.

Conybeare, D., Behar, E. Solomon, A., Newman, M.G., Borkovec, T.D. (2012). The PTSD checklist – civilian version: reliability, validity, and factor structure in a nonclinical sample. *Journal of Clinical Psychology, 68*(6), 699-713.

De Bellis, M.D., Baum, A.S., & Keshavan, M.S., (1999). A.E. Bennett Research Award: Developmental traumatology: Part I: Biological stress systems. *Biological Psychiatry, 45,* 1259–1270.

Delahanty, D.L., Raîmonde, AJ., & Spoonster, E., (2003). Injury severity, prior trauma history, urinary Cortisol levels, and acute PTSD in motor vehicle accident victims. *Journal of Anxiety Disorders,* 17, 149–164.

Department of Justice, (2000). Sexual assault of young children as reported to law enforcement (2000). *Office of Justice Programs, Bureau of Justice Statistics*.

Department of Justice, (2015). National Crime Victimization Survey, 2010-2014. *Office of Justice Programs, Bureau of Justice Statistics,*

Department of Justice, (2017). Areas of focus, sexual assault. *Office on Violence Against Women.*

Diener, S.J., Flor, H., Wessa, M. (2010). Learning and consolidation of verbal declarative memory in patients with posttraumatic stress disorder. *Journal of Psychology, 218*(2), 135-140.

Dodaj, A., Krajina, M., Sesar, K., & Šimić, N. (2017). The effects of maltreatment in childhood on working memory capacity in adulthood. *Europe's Journal of Psychology, 13*(4), 618–632.

Elzinga, B.M., & Bremner, J.D., (2002). Are the neural substrates of memory the final common pathway in PTSD? *Journal of Affective Disorders, 70*, 1-17.

Gilbertson, M.W., Shenton, M.E., Ciszewski, A., Kasai, K., Lasko, N.B., Orr, S.P., & Pitman, R.K., (2002). Smaller hippocampal volume predicts pathologic vulnerability to psychological trauma. *Nature Neuroscience, 5*(11), 1242-1247.

Goldstein, R. B., Smith, S. M., Chou, S. P., Saha, T. D., Jung, J., Zhang, H., & Grant, B. F. (2016). The epidemiology of DSM-5 posttraumatic stress disorder in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions-III. *Social psychiatry and psychiatric epidemiology*, *51*(8), 1137–1148.

Gould, F., Clarke, J., Heim, C., Harvey, P.D., Majer, M., & Nemeroff, C.B. (2012) The effects of child abuse and neglect on cognitive functioning in adulthood. *Journal of Psychiatric Research, 46*(4), 500-506.

Gradus, J.L. (2017). Epidemiology of PTSD. *PTSD: National Center for PTSD: U.S. Department of Veteran Affairs.*

Jenkins, M.A., Langlais, P.J., Delis, D., Cohen, R. Learning and memory in rape victims with posttraumatic stress disorder. *The American Journal of Psychiatry, 155*(2), 278-279.

Johnsen, G.E., & Asbjornsen, A., (2008). Consistent impaired verbal memory in PTSD: A meta-analysis. *Journal of Affective Disorders, 111*(1), 74-82

Johnson, S.M., Murphy, M.J., & Gidcyz, C.A. (2017). Reliability and validity of the sexual experiences survey – short forms victimization and perpetration. *Violence and Victims, 32*(1), 78-92.

Kellner, M., Baker, D.G., & Yehuda, R., (1997). Salivary cortisol in operation Desert Storm returnees. *Biological Psychiatry, 42*, 849-850

Kilpatrick, D. G., Saunders, B. E., Amick-McMullan, A. E., Best, C. L., Veronen, L. J., & Resnick, H. S. (1989). Victim and crime factors associated with the development of crime-related post-traumatic stress disorder. *Behavior Therapy, 20,* 199-214.

Kolts, R.L., Lombardo, T.W., & Faulkner, G. (2004). Trauma-cueing and short-term memory in college students with PTSD. *Journal of College Student Psychotherapy, 19*(2), 29-47.

Kramer, J. H., & Delis, D. C. (1991). Interference effects on the California Verbal Learning Test: A construct validation study. *Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3*(2), 299-302.

Lemieux, A.M., & Coe, C.L., (1995). Abuse-related posttraumatic stress disorder: Evidence for chronic neuroendocrine activation in women. *Psychosomatic Medicine, 57,* 105–115.

Magarinos, A.M., McEwen, B.S., & Flugge, G., (1996). Chronic psychosocial stress causes apical dendritic atrophy of hippocampal CA3 pyramidal neurons in subordinate tree shrews. *Journal of Neuroscience, 16*, 3534–3540.

Malarbi, S., Abu-Rayya, H.M., Muscara, F., & Stargatt, R. (2017). Neuropsychological functioning of childhood trauma and post-traumatic stress disorder: A meta-analysis. *Neuroscience and Biobehavioral Reviews, 72*, 68-86.

Morgan, R.E., & Kena, G. (2016). Criminal Victimization. U.S. department of justice, office of justice programs. *Bureau of Justice Statistics.*

National Institute of Justice & Centers for Disease Control & Prevention, Prevalence, Incidence and Consequences of Violence Against Women Survey (1998).

Pitman, R.K., Shin, L.M., Rauch, S.L. (2001). Investigating the pathogenesis of posttraumatic stress disorder with neuroimaging. *Journal of Clinical Psychiatry, 62*(17), 47-54

Radley, J.J., Sisti, H.M., & Hao, J., (2004). Chronic behavioral stress induces apical dendritic reorganization in pyramidal neurons of the medial prefrontal cortex. *Neuroscience, 125,*1–6.

Riggs, D.S., Kilpatrick, D.G., & Resnick, H.S. (1992). Long-term psychological distress associated with marital rape and aggravated assault: A comparison to other crime victims. *Journal of Family Violence, 7*(4), 283-296.

Scheiner, D.L., Keilp, J., Mindt, M.R., Burke, A.K., Oquendo, M.A., & Mann, J.J. (2014). Verbal learning deficits in posttraumatic stress disorder and depression. *Journal of Traumatic Stress, 27,* 291-298.

Scott, J.C., Wrocklage, K.M., Crnich, C., Jordan, J., Krystal, J.H., Matt, G.E., Southwick, S.M., & Schweinsburg, B.C. (2014). A quantitative meta-analysis of neurocognitive functioning in posttraumatic stress disorder. *Psychological Bulletin, 14*(1), 105-140.

Shields, G.S., Doty, D., Shields, R.H., Gower, G., Slavich, G.M., & Yonelinas, A.P. (2017). Recent life stress exposure is associated with poorer long-term memory, working memory, and self-reported memory. *Stress: The International Journal on the Biology of Stress, 20*(6), 598–607.

Shin, L.M., Wright, C.I., & Cannistraro, P.A. (2005). A functional magnetic resonance imaging study of amygdala and medial prefrontal cortex responses to overtly presented fearful faces in posttraumatic stress disorder. *Archives of General Psychiatry, 62*, 273-281.

Shin, K.M., Chang, H.Y., Cho, S.M., Kim, N.H., Kim, K.A., & Chung, Y.K. (2015). Avoidance symptoms and delayed verbal memory are associated with post-traumatic stress symptoms in female victims of sexual violence. *Journal of Affective Disorders, 184*, 145-148.

Stein, M.B., Yehuda, R., & Koverola, C., (1997). Enhanced dexamethasone suppression of plasma Cortisol in adult women traumatized by childhood sexual abuse. *Biological Psychiatry, 42,* 680–686.

Stein, M.B., Hanna, C., Vaerum, V., & Koverola, C. (1999). Memory functioning in adult women traumatized by childhood sexual abuse. *Journal of Traumatic Stress, 12*(3), 527-534.

Thompson, K.M., Crosby, R.D., Wonderlich, S.A., Mitchell, J.E., Redlin, J., Demuth, G., Smyth, J., Haseltine, B. (2003). Psychopathology and sexual trauma in childhood and adulthood. *Journal of Traumatic Stress, 16*(1), 35-38.

Uniform Crime Report (2013). Crime in the United States. *U.S. Department of Justice, Federal Bureau of Investigation.*

Vermetten, E., & Bremner, J.D., (2002). Circuits and systems in stress. II. Applications to neurobiology and treatment of PTSD. *Depression and Anxiety, 16,* 14-38.

Walker, J., Archer, J., & Davies, M. (2005). Effects of male rape on psychological functioning. *British Journal of Clinical Psychology, 44*(3), 445-451.

Williams, B.R., & Donovick, P.J., (2008). Questioning the rule of thumb: Can verbal tasks be administered during the CVLT-II delay interval? *The Clinical Neuropsychologist, 22*(5), 807-812.

Woods, S.P., Delis, D.C., Scott, J.C., Kramer, J.H., & Holdnack, J.A., (2006). The California verbal learning test – second edition: test-retest reliability, practice effects, and reliable change indices for the standard and alternate forms. *Archives of Neuropsychology, 21*, 413-420.

Zeitlin, S.B., & McNally, R.J., (1991). Implicit and explicit memory bias for threat in post-traumatic stress disorder. *Behavior Research and Therapy, 29*, 451–457.