The Relationship Between Neuropsychological Functioning and Trauma Within the LGB Community

By

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ABSTRACT

Psychological stressors experienced by individuals has been shown to impact the brain both structurally and functionally. Two major areas indicated to be impacted by psychological stress are the hippocampus and the prefrontal cortex, which are crucial to memory and executive functioning. The propensity for members of the LGB population to experience various forms of trauma makes studying neuropsychological functioning among this population particularly important. Due to inadequate literature focusing on this topic, my study sought to investigate the relationship between psychological stressors and neuropsychological functioning on tests of memory and executive functioning in the LGB population. A sample of 23 participants were administered questionnaires to assess depression and victimization and then subsequently administered neuropsychological tests designed to measure memory and executive functioning. Correlational analysis showed no relationship between victimization and scores on memory and executive functioning tests.

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CHAPTER 1: INTRODUCTION

The word trauma often evokes mental images of individuals with post-traumatic stress disorder (PTSD). This mental image of PTSD may be a result of the influx of symptomatic Vietnam soldiers returning home from war that allowed for societal awareness of the concept of psychological trauma. The pattern of symptomology associated with PTSD was so wide-spread and debilitating for its sufferers, that it was conceptualized and added to the American Psychiatric Association's Diagnostic and Statistical Manual, Third Edition (DSM-III) in 1980 (Stone, 1993). Although PTSD helped society recognize and conceptualize trauma as a real and distinguishable psychological problem, trauma is a very complex concept and is not limited to PTSD or military veterans; it encompasses several different circumstances and types of individuals.

The Substance Abuse and Mental Health Services Administration defines trauma as "an event, series of events, or set of circumstances that is experienced by an individual as physically or emotionally harmful or life threatening and that has lasting adverse effects on the individual's functioning and mental, physical, social, emotional, or spiritual well-being" (SAMHSA, 2019, para. 1). More than half of the entire United States population reports having been exposed to a traumatic event at least once in their lifetime, with percentages as high as 61% in males and 51% in women. Notably, when exploring these numbers in the public behavioral health care setting, 90% of all clients have reported experiencing traumatic events (SAMHSA, 2019).

Research has indicated that Lesbian, Gay, and Bisexual individuals, as well as self-identified heterosexuals who have been in a same-sex relationship, are an especially vulnerable population in regard to experiencing psychological trauma. The LGB community has been found to experience higher rates of potentially traumatic events, including but not limited to, physical and sexual abuse, interpersonal violence, including intimate partner violence, and witnessing trauma or the death of close friends or relatives (Roberts, Austin, Corliss, Vandermorris, & Koenen, 2010). Roberts et al. (2010) also concluded that due to this increased exposure to violence and potentially traumatic events, this subgroup was at a greater risk for developing PTSD (Roberts, Austin, Corliss, Vandermorris, & Koenen, 2010).

Mclaughlin et al. (2012) concluded and expanded upon the disproportionate discrimination and victimization of the LGB community, both on the individual and institutional level. When focusing specifically on LGB adolescents, researchers found that this population was more likely to experience violence at school and in the community, victimization within their family unit and romantic relationships, including physical and sexual abuse, and higher rates of suicidal ideation and suicide attempts (Mclaughlin, Hatzenbuehler, Xuan, & Conron, 2012). Research has also indicated that members of the LGB community experience higher rates of bullying (Birkett, 2009). In a National School Climate Survey that compiled data from all 50 states, it was reported that 55.5% of LGBTQ adolescents felt unsafe at school simply because of their sexual orientation. In the same sample, 74.1% of respondents reported being verbally harassed and 36.2% reported being physically harassed because of their sexual orientation (Kosciw, Greytak, Palmer, & Boesen, 2014).

The high prevalence of trauma in the United States is striking because trauma has been shown to negatively affect mental health and neuropsychological functioning. The propensity for members of the LGB community to experience various forms of trauma and therefore potentially even develop PTSD makes studying neuropsychological functioning among this population particularly important. Hence, the purpose of the present study was to investigate whether there was an association between psychological stressors and neuropsychological functioning in this community. A series of tests analyzing memory and executive functioning were utilized since these functions have consistently been shown to be impeded by trauma.

CHAPTER II: LITERATURE REVIEW

Traumatic Stress and the Brain

Much like societal conceptions, the vast majority of the literature regarding trauma's effect on the brain focuses on the brain changes and implications of PTSD specifically. Studies have shown that abnormalities in several brain regions are indicated in PTSD, notably the hippocampus and the prefrontal cortex. MRI studies have shown those with PTSD have decreases in both hippocampus (Bremner et al., 2003; Gurvits et al., 1996; Karl et al., 2006) and frontal cortex volume (Carrion & Wong, 2012; Bremner, 2006). Research using clinical structural neuroimaging has shown an association between PTSD and abnormal interactions between the hippocampus and the medial pre-frontal regions of the brain (Miller & Sadeh, 2014). Deficits in prefrontal cortex white matter connectivity have also been found when comparing children with PTSD due to maltreatment with a control group (De Bellis et al., 2002). These changes in brain

structure and functioning, which are correlated with the occurrence of the severe post-traumatic stress indicated in PTSD, may lead to changes in neuropsychological functioning. With such a high percentage of the population experiencing traumatic events and not developing PTSD, it is important to also investigate how traumatic stress in absence of a PTSD diagnosis affects the brain.

Aligning with the results found in PTSD studies, it appears as if the brain structure and functioning of those who have experienced traumatic events but do not meet criteria for PTSD are similarly affected. Findings consistently point to decreased volume in both the hippocampus (Karl et al., 2006) and the prefrontal cortex (Fennema-Notestine, Stein, Kennedy, Archibald, & Jernigan, 2002; Sheffield, Williams, Woodward, Heckers, 2013) of individuals who were exposed to trauma but did not develop PTSD. Additionally, connectivity impairment between the hippocampus and prefrontal cortex has also been shown in rats exposed to both acute and chronic stress (Cerqueira, Mailliet, Almeida, Jay, & Sousa, 2007; Rocher, Spedding, Munoz, Jay, 2004). Thus, traumatic stress, even in absence of PTSD, may negatively impact neuropsychological functioning. To understand how this neuropsychological functioning may be impacted, it is important to understand the role that the hippocampus and prefrontal cortex play in various cognitive abilities and the consequences that traumatic stress has on these regions.

Traumatic Stress and the Hippocampus

Major responsibilities of the hippocampus include encoding, retrieval, and consolidation of information, making it an important component of learning and memory, particularly in regard to the formation of new memories (Preston & Eichenbaum, 2013).

The hippocampus is also a central component of verbal declarative memory (Bremner, 2006), which is the memory of facts and events that can be consciously recalled. High levels of cortisol, which are experienced after a traumatic event, have been shown to act as a neurotoxin to cells in the hippocampus (Carrion & Wong, 2012). The hippocampus is one of the brain regions able to undergo neurogenesis, so these cells are typically able to regenerate; however, both animal and human studies have shown that high levels of traumatic stress early on can have negative long-term effects.

Rat pups that went through traumatic events early on had higher levels of glucocorticoids (a type of cortisol) in response to stress throughout the lifespan (Bremner, 2006). To investigate the long-term consequences of traumatic stress in humans, Trickett et al. (2010), conducted a longitudinal study on young girls who were sexually abused. Results found that compared to girls who were not abused, the sexual abuse victims showed significantly higher levels of cortisol during childhood but weakened levels in adolescence and significantly lower levels in adulthood (Trickett, Noll, Susman, Shenk, & Putnam, 2010). However, additional research indicates that experiencing early trauma is correlated with an overexaggerated stress response and higher levels of cortisol when exposed to new emotional stressors (De Bellis, Zisk, 2014). In addition to causing initial cell-death, it appears as if highly traumatic events may lead to overexaggerated stress responses later in life, further damaging cells in the hippocampus. This cell death ultimately can lead to decreases in hippocampal gray matter, which in turn, may lead to hindered functioning on tasks that utilize the hippocampus (Starkman, Gebarski, Berent, & Schteingart, 1992; Starkman, Giordani, Gebarski, & Schteingart, 2003; Bremner, 2006).

Studies utilizing neuropsychological tests have indicated that decreased volume in the hippocampus is correlated with lower performance on neuropsychological tests of learning and memory, such as the Wechsler Memory Scale with Russell modification, which measures immediate and delayed verbal memory (Starkman, et al., 1992), the Selective Reminding Test, which is a word-list learning task (Starkman, et al., 2003), and the Auditory Verbal Learning Test, the California Verbal Learning Test, and the Rivermead Behavioral Memory test, which all assess verbal declarative memory (Bremner, 2006). These results further indicate that lower hippocampal volume is correlated with deficits in verbal memory, particularly verbal declarative memory. Thus, traumatic stress, which can lead to a decrease in the volume of the hippocampus, could be potentially related to this hindered performance on tasks that require verbal declarative memory.

Traumatic Stress and the Prefrontal Cortex

In addition to the hippocampus, another brain region that appears to be affected by traumatic stress is the prefrontal cortex. The prefrontal cortex is responsible for many complex executive and cognitive functions such as reasoning, planning and decision making, inhibition of responses and actions, set-shifting and switching, attention, and working memory (Diamond, 2013). Because of its many functions, it is also critically important to learning and memory (Diamond, 2013; Preston & Eichenbaum, 2013; Carrion & Wong, 2012). Comparable to that of the hippocampus, the high levels of cortisol experienced after a traumatic event have also been shown to act as a neurotoxin to cells in the prefrontal cortex (Carrion & Wong, 2012). This may partly contribute to

the results of studies finding deceased gray matter volume in the frontal lobes of those who have experienced traumatic stress such as intimate partner violence (Fennema-Notestine et al., 2002) and sexual abuse (Sheffield et al., 2013).

Additionally, correlations have been found between traumatic stress and the inhibition of prefrontal neurons from branching out to neurons in the hippocampus (Radley, et al., 2004). This is of interest because parts of the prefrontal cortex, namely the medial prefrontal cortices, interact with the hippocampus in order to organize, consolidate, and retrieve memories, making this interaction an important aspect of learning (Preston & Eichenbaum, 2013). Correlations between reduced medial prefrontal volume and traumatic stress in the form of childhood emotional maltreatment (Van Harmelen et al., 2010), childhood physical abuse (Hanson et al., 2010), and life trauma including physical, sexual, and emotional abuse, and witnessing violence (Ansell, Rando, Tuit, Guarnaccia, & Sinha, 2012) have also been found. As part of the greater prefrontal cortex, medial prefrontal cortices contribute to working memory (Jin & Maren, 2015) and decision-making abilities (Botvinick, Cohen, & Carter, 2004; Bechara & Damasio, 2005). Ansell at al. (2012) additionally found that life trauma was correlated with decreased volume in the frontopolar cortex, which also contributes to working memory tasks (Braver & Bongiolatti, 2002), and the right inferior frontal gyrus, which is crucial for response inhibition (Swick, Ashley, & Turken, 2008). Thus, neurodegeneration and inhibition of functional connectivity in these prefrontal regions may lead to hindered performance on tasks that require the abilities housed in these regions.

Research investigating the effects of lesions to the prefrontal cortex indicates that damage to the prefrontal cortex results in impaired decision-making abilities (Bechara, Tranel, & Damasio, 2000) and a decreased ability to shift attention (Carrion & Wong, 2012). Additionally, smaller prefrontal cortex volume has been correlated with worse performance on working memory tasks (Goghari, Macdonald, & Sponheim, 2014).

In sum, the hippocampus and prefrontal cortex are indicated to be affected by traumatic stress. These brain regions play critical roles in memory and executive functioning, so damage to these areas likely affects neuropsychological functioning in these cognitive domains. To further investigate this, results of memory and executive functioning tests of those with severe post-traumatic stress resulting in PTSD diagnoses, and those who have experienced other forms of post-traumatic stress will be discussed.

PTSD and Memory Functioning

Inhibited memory functioning in those with PTSD has been cited in several studies (Scott et al., 2015; Yehuda, Golier, Tischler, Stavitsky, & Harvey, 2005; Yehuda et al., 2006). In fact, memory deficits are currently thought to be a major determinant for several aspects of PTSD symptomology (Scott et al., 2015). When comparing memory functioning between Vietnam veterans who were diagnosed with PTSD and those who did not exhibit symptoms, a group of researchers found that those with PTSD scored significantly lower on the Rey Auditory Verbal Learning Test (AVLT) which investigates immediate verbal memory abilities (Vasterling et al., 2002). Using the California Verbal Learning Test (CVLT) to examine the differences between delayed free recall and rate of total learning, another set of researchers found the male veterans with

PTSD performed worse on both of these tests than those without (Yehuda, et al., 2005). Yehuda (2006) also led a similar study in which the CVLT was utilized to investigate memory functioning in Holocaust survivors with PTSD. This study similarly found that the PTSD group performed worse than the non-PTSD group, but interestingly, a follow-up assessment of groups discovered that the PTSD groups' symptom severity declined over time which correlated with improvements on the CVLT (Yehuda et al., 2006). This indicates that PTSD symptom severity could potentially play a role in cognitive memory impairments and highlights the importance of therapy and intervention to combat symptom severity.

PTSD and Executive Functioning

Studies have shown lower performance on attention and executive functioning tasks in those with PTSD. Beckham and colleagues conducted a study to compare performance on the Trail Making Test (TMT) between those with PTSD and those without. Part A of the TMT requires "perceptual tracking of a sequence and speeded performance" (Spreen Strauss, & Sherman, 2006, p. 657) Part B of the TMT adds the additional element of divided attention and cognitive flexibility, both of which are prefrontal cortex functions. The results demonstrated that those with PTSD performed worse on part B of the TMT, indicating that they exhibit lower attention and cognitive flexibility than the general population. (Beckham, Crawford, & Feldman, 1998). A study by Kertzamn et al., found that in comparison to healthy individuals, those with PTSD performed worse on the Color-Word Stroop task, which is designed to assess inhibition, fluid ability, and processing speed (Kertzman, Avital, Weizman, & Segal, 2014). Those

with PTSD tended to have more errors and significantly longer processing time when completing this task (Kertzman et al., 2014). These results indicate a deficit in both processing speed and inhibition due to decreased prefrontal lobe functioning. Another study that focused on the effects of PTSD due to intimate partner violence similarly concluded that victims performed significantly lower on tasks requiring processing speed and speeded fluency, and close to significance level in tasks requiring reasoning abilities (Twamley et al., 2009).

Although several studies have been conducted that have expanded public knowledge regarding the effect of PTSD on neuropsychological functioning, there is a lack of literature on the neuropsychological effects of those who have experienced trauma, but do not meet the diagnostic criteria for PTSD. These studies have illustrated how the severe post-traumatic stress that is characteristic of PTSD may affect the brain and neuropsychological functioning, but it is also important to distinguish and understand how less severe forms of post-traumatic stress may affect functioning. Although not as prevalent as articles relating to PTSD, some studies have been published that illustrate that experienced traumatic events not leading to PTSD still influence neuropsychological functioning.

Effects on Memory and Executive Functioning by Trauma Subtype

Intimate Partner Violence

Parallel to the results found from PTSD studies, participants who experienced intimate partner violence in the form of physical or sexual abuse, or both, regardless of PTSD status, performed more poorly on the Stroop task and Part B of the Trail Making

Test. Both Stroop and Part B of the Trail Making Test are tests of executive functioning that assess an individual's selective attention, inhibition, cognitive flexibility, and processing speed. Participants who experienced intimate partner violence also performed poorer on the Paced Auditory Serial Addition Test (PASAT), a test designed to assess speeded, sustained auditory attention and working memory (Stein, Kennedy, & Twamley, 2002).

Sexual and Physical Abuse

When focusing on the executive functioning of individuals exposed to recent sexual assault that met the criteria for Acute Stress Disorder, one study found that compared to the control group, this population performed worse (Park et al., 2018). The Park et al. study utilized the Cambridge Neuropsychological Test Automated Battery (CANTAB) to assess executive functioning abilities in set-shifting, attention, planning, and response inhibition. Those exposed to sexual assault performed worse on all of these tasks. State anger seemed to play a significant contributing role in these deficits (Park et al., 2018).

Another study investigating the executive functioning of women who experienced sexual abuse at some point during the life-span found that this group performed worse on measures of deductive reasoning (Blanchette, Lindsay, & Davies, 2014). For this study, researchers used a reasoning task with 3 different conditions: reasoning when exposed to neutral questions, reasoning when exposed to generally emotional questions, and reasoning when exposed to questions related to sexual abuse. Women who experienced

sexual assault performed worse on the neutral and sexual abuse related conditions (Blanchette, Lindsay, & Davies, 2014).

Rivera-Vélez et al. reached a similar conclusion in their study; women with a history of childhood sexual abuse had lower performance on the Picture Arrangement, Letter Number Sequencing, Digit Span Backward, and Digit Symbol-Coding subtests of the Wechsler Adult Intelligence Scale- Third Edition (WAIS-III), which they used for the purpose of measuring executive functioning (Rivera-Vélez, González-Viruet, Martínez-Taboas, & Pérez-Mojica, 2014). Additionally, they found that this population also performed worse on the Logical Memory and Visual Reproduction subtests of the WAIS-III, indicating a deficit in both visual and verbal memory (Rivera-Vélez et al., 2014).

Additionally, a study that used the Stroop task to investigate executive functioning of children who were exposed to sexual abuse found that compared to a control group, both children who were exposed to sexual abuse and exhibited PTSD symptoms and children who were exposed to sexual abuse but did not exhibit PTSD symptoms performed worse on attentional inhibition (Barrera, Calderón, & Bell, 2013). These findings further illustrate that traumatic events, even in the absence of PTSD development, can impact cognitive functioning.

Aligning with results found from sexual abuse studies, physical abuse has also shown to have neuropsychological effects. A study that looked at differences in cognitive functions between each type of childhood abuse (physical, sexual, and emotional) found that physical abuse seemed to be directly correlated with lower performance on tests that required executive functioning and processing speed (Gould et al., 2012). An additional

study assessed executive functioning in individuals with a history of child abuse (physical, sexual, and sexual abuse) using the Wisconsin Card Sorting Task, the Operation Span Task, and the Connors Continuous Performance Task. Results found that when completing the executive functioning tests, individuals who experienced child abuse used significantly more mental effort (Mark, Poltavski, Petros, & King, 2019). This study did not separate the different forms of child abuse to investigate the differences in effects between types, however.

When investigating sustained attention in Veterans, those who experienced early life trauma including physical abuse, sexual abuse, and/or exposure to family violence before the age of 18, researchers found that those who experienced early life trauma had significant impairments in sustained attention (Fortenbaugh, 2017). Researchers found that there was a significant correlation between impairment on the sustained attention task and the amygdala's connection between other brain regions, particularly with increased connectivity with the prefrontal cortex and decreased connectivity with the parahippocampal gyrus area (Fortenbaugh, 2017).

In order to see if neuropsychological deficits persisted throughout the life-span, Bremner et al., (1995) investigated short-term memory effects in adults who endured childhood physical and sexual abuse. Using the Logical Memory and Figural Memory subtests from the Wechsler Memory Scale (WMS) and the Verbal and Visual Selective Reminding Tests (SRT), researchers concluded that even as adults, individuals who experienced childhood abuse performed more poorly on measures of verbal memory

(Bremner et al., 1995). This is especially important because it highlights how traumatic events experienced in early life can have lasting cognitive consequences.

Bullying

A study that looked at performance on executive functioning tests in children who experienced bullying, which is defined as "intentional, repetitive, and persistent aggressive behavior that causes damage to the victim" (Medeiros et al., 2016, p. 1), versus those who did not, indicated that being bullied correlated with lower performance on the Trail Making Test Part B (Medeiros et al., 2016). Another study seeking to investigate memory and cognitive functioning of children being bullied utilized the California Verbal Learning Test Children's Version (CVLT-C), which assesses verbal learning and memory, and the *CANTABeclipse,* which assesses "visual memory, executive functioning, attention, semantic/verbal memory, and decision making" (Vaillancourt et al., 2011, p. 194). The results of Vaillancourt et al.'s study showed a positive correlation between being bullied and lower performance on these assessments (Vaillancourt et al., 2011). These results demonstrate deficits in "prefrontal executive functions and medial temporal lobe memory functions in addition to fronto-striatal motivational deficits" (Vaillancourt et al., 2011, p. 196) and potentially implicate that bullying may have similar effects to PTSD on memory and executive functions.

Implications for the LGB Community

The studies mentioned above indicated that trauma, regardless of what form it takes, affects the brain both structurally and functionally. More consequentially, many of the studies implicated that traumatic events experienced in early life have lasting

consequences on brain functioning, which in turn, may affect neuropsychological functioning related to learning and memory and quality of life in general. This makes researching populations that are vulnerable across the lifespan, such as the LGB community, even more important.

Although the neuropsychological effects of different forms of trauma have been investigated, the literature on the effects of these traumas on the lesbian, gay, and bisexual (LGB) community specifically is inadequate at best. A recent dissertation by McGarrity (2016) was one of the only evident sources relating to this topic. McGarrity's results demonstrated that although minority stress led to poorer self-regulation, it actually appeared to increase cognitive performance on the Trail Making Test, Design Fluency, Verbal Fluency, and Color-Word Interference subtests of the Delis-Kaplan Executive Function System battery (D-KEFS). Interestingly, in contrast to other studies, these results were concluded to be partially mediated by state anger; state anger helped to increase executive functioning (McGarrity, 2016). Since McGarrity's experiment was set up to test individuals' executive functioning after they were exposed to a confederate with antigay views, it is possible we would not see this mediating effect when utilizing a different experimental design.

It would be beneficial to have more research in this area, particularly in regard to vulnerable populations such as the LGB community, which is often confronted with traumatic events such as bullying, interpersonal violence, intimate partner violence, and physical and sexual abuse. Finding a relationship between trauma in this community and subsequent deficits in neuropsychological functioning could have implications not only

for the individual, but psychologists, the public health system, the education system, multidisciplinary intervention teams, and society at large. Given that social justice efforts to combat the discrimination against disadvantaged groups (such as the LGB community) continue to grow, understanding the possible link between victimization, subsequent psychological stress or trauma, and the impact this has on neuropsychological functioning could potentially further motivate the eradication of discrimination for all minorities, or at least help guide efforts for early prevention and intervention procedures in order to help the LGB population flourish despite adversity.

Current Study – Hypothesis

The purpose of the present investigation was to explore the association between endured trauma among LGB community members, regardless of PTSD diagnosis, and performance on neuropsychological tests. Specifically, based on the existing literature and previous studies, I utilized tests targeted at both memory and executive functioning because these measures have shown to be hindered in other populations of people who have experienced trauma as well. A correlational design was used to determine if associations existed between victimization levels and scores on multiple neuropsychological tests of memory and executive functioning. This correlational design was also used to investigate associations between scores on these neuropsychological tests and victimization perceived to be because of sexual orientation. Based on findings in related research studies, I hypothesized that a negative correlation would be found between victimization and scores on neuropsychological tests.

CHAPTER III: METHOD

Participants

To collect the sample for this study, volunteers who self-identified as lesbian, gay, or bisexual (LGB) and were above the age of 18 were recruited from MTSU classrooms. To ensure privacy, the name of the study, inclusion criteria, and the researcher's contact information was provided, and students were simply instructed to contact the researcher if they are eligible and willing to participate. Students recruited from MTSU classrooms were compensated with extra credit points in these courses.

Because this sample is limited to a small subgroup of the population, snowball sampling was also used in recruiting participants, meaning my contact information was given to each participant, and they were encouraged to pass it on to any of their peers who they thought might also be interested in volunteering; thus, anonymity and the voluntary nature of participating was ensured. Participants were excluded if they reported a history of head trauma that led to loss of consciousness. Additionally, a flier was distributed to the MTSU LAMBDA organization. Recruitment was also attempted through the MTSU Sona system and the Reddit website, but these methods did not gather any participants.

The final sample for this study consisted of 16 female and 7 male volunteers from the contiguous United States (n = 23) with an age range of 19 and 32 (M = 23.70, SD = 3.13) and an education level of 15.43 years (SD = 1.78). Most of the sample was Caucasian (20 of 23), with one being Caucasian and Hispanic, one being Caucasian and African American, and another being African American and Latino.

Apparatus

Sociodemographic Questionnaire. Participants were asked demographic questions about their age, race/ethnicity, gender, sexual orientation, education level, and religion. Two additional questions were added to this form to assess the importance of religion and perceived social support.

Beck Depression Inventory II. The Beck Depression Inventory II (BDI-II) is a 21 item self-report questionnaire used for measuring the severity of depression. The items of the BDI-II address problems related to numerous psychological, cognitive, and physiological symptoms. Each item is rated by the patient on a scale of 0 to 3, with a range of possible scores from 0 to 63. Raw scores of 0 to 13 indicate minimal depression, 14 to 19 indicate mild depression, 20 to 28 indicate moderate depression, and 29 to 63 indicate severe depression (Beck, Steer, & Brown, 1996). The BDI-II was administered to serve as a control for the potential confounding variable of depression.

The BDI-II has an internal consistency coefficient of .92 and test-retest-reliability coefficient of .93 (Beck et al., 1996). The BDI-II demonstrates construct validity by correlating with other measures of depression such as the Center for Epidemiological Studies of Depression Scale (CES-D), the Zung Self-Rating Depression Scale, the Beck Hopelessness Scale, and the Revised Hamilton Psychiatric Rating Scale for Depression (Beck et al., 1996). Additionally, The BDI-II discriminates depressed from non-depressed patients (Beck et al., 1996).

Juvenile Victimization Questionnaire. Exposure to traumatic events were investigated using the 2013 version of the Juvenile Victimization Questionnaire (JVQ).

The JVQ includes 53 questions assessing the following 6 general areas: conventional crime, child maltreatment, peer and sibling offenses, sexual assault, witnessing and indirect exposure to violence, and internet offenses (Finkelhor, Turner, Shattuck, & Hamby, 2015). Sample questions from this questionnaire include "Sometimes people are attacked with sticks, rocks, guns, knives, or other things that would hurt. At any time in your life did anyone hit or attack you on purpose with an object or weapon? Somewhere like: at home, at school, at a store, in a car, on the street, or anywhere else?" and "At any time in your life, did anyone TRY to force you to have sex, that is sexual intercourse of any kind, even if it didn't happen?" The retrospective version of this questionnaire was administered. This questionnaire was also slightly modified, asking after each question if the event happened because of sexual orientation. Total scores, ranging from 0-52, were used to determine if the participants had been exposed to traumatic events.

Affective Verbal Fluency. The Affective Verbal Fluency test (AVF) requires the individual to generate as many emotionally laden words as possible within a specific time limit. More specifically, the participants were asked to name or list as many words as possible within one minute that have a positive meaning for them (posAVF). The words may be individual in nature regarding the affective meaning or connotation of the words, i.e. the words may be specifically positive for them but not necessarily to others. Individuals were given one minute to name or list as many personally negative words as possible (negAVF). The variables of interest included the total number of positive words produced and the total number of negative words produced.

Design Fluency Test. The Design Fluency Test assesses executive functioning by investigating individuals' ability to produce novel abstract designs. This test consists of a five minute free-response condition where participants will be able to draw designs with few restrictions and then a four minute fixed-condition where participants will be required to draw only designs that have exactly four lines or components. For each of the two conditions, the final novel output score was considered the number of drawings remaining after eliminating perseveration and rule-breaking items. These two final novel output scores serve as the variables of interest. Test-retest reliability has been found to be (r = .69). Inter-rater reliability in regard to total score have been found to be high (r = .98). Additionally, modest correlations have been found between the Design Fluency Test and the Ruff Figural Fluency Test (r = .38) (Spreen et al., 2006).

Logical Memory. Logical Memory (LM) is a subtest from the Weschler Memory Scale, 4th edition (WMS-IV) that measures verbal episodic memory by assessing immediate recall, delayed recall, and delayed recognition. Two short passages are read to participants and they are then immediately asked to recall details from those passages. After a delay of 20 to 30 minutes, they are asked to recall those details again. For the recognition trial, participants are given yes or no questions regarding the passages.

The variables of interest included the participants' total number of story units recalled in the immediate trial (LMI) and the delayed trial (LMII), as well as the retention rate. Both LM I and LM II have high internal consistency (.82 and .85, respectively). Test-retest reliability was .72 for LM I and .67 for LM II. Research on construct validity found a correlation of .45 to .52 between LM and CVLT II long delay recall and a

correlation of .53 to .57 between LM and RBANS immediate memory index. Research on concurrent validity with moderate to severe TBI patients found that group mean differences in performance on LM I resulted in moderate effect sizes and LM II resulted in large effect sizes (Wechsler, Holdnack, & Drozdick, 2009).

Controlled Oral Word Association Test. The Controlled Oral Word Association Test (COWAT) is a measure of lexical fluency to confrontation requiring the individual to name as many words as possible within 60 seconds that begin with a specified letter (F, A, and S were used in this investigation). The participants are restricted from using proper nouns, numbers, and stem words with different endings.

The variable of interest consisted of the total number of words generated across the three letters. The internal consistency for the F, A, and S version of this test is high (.83) (Tombaugh, Kozak, & Rees, 1999). Test-retest reliability was also significant (.74) (Ruff, Light, Parker, & Levin, 1996). Research on construct validity has found the COWAT to have moderate to high correlations with the Boston Naming Test (.57 to .68) (Henry & Crawford, 2004). Research on concurrent validity has found that performance on the COWAT showed a clear relationship with the different classifications of traumatic brain injury severity (Henry & Crawford, 2004) and that patients with left frontal lesions show impairment on the F, A, and S task (Spreen et al., 2006).

Letter-Number Sequencing. Letter-Number Sequencing (LNS) is a subtest from the Wechsler Adult Intelligence Scale, 4th edition (WAIS-IV) that assesses working memory, attention, and cognitive flexibility. Participants are read a series of numbers and

letters and are then asked to recall that series with numbers in ascending order and letters in alphabetical order.

The variable investigated in this test was the participants' raw scores. LNS has been shown to have high internal reliability (.80-.89) and adequate test-retest reliability (.70-.79) (Spreen et al., 2006). Additionally, validity studies found that LNS discriminated between individuals with moderate to severe TBI and normal controls (Donders, Tulsky, Zhu, 2001).

Oral Trail Making Test. Due to remote procedures, the Oral Trail Making Test (OTMT) was administered in place of the traditional paper and pencil task. In the written version of the Trail Making Test (WTMT), participants complete Part A in which they draw a line connecting consecutive numbers from 1-25 and Part B in which they must draw a line connecting numbers and letters in alternating sequence. The oral version of the TMT removes the visual and motor components of this task, but still assesses divided attention, inhibition, and cognitive flexibility. For Part A, participants were simply asked to count from 1-25 as quickly as possible. For Part B, they were asked to count again, but switch between numbers and letters.

The variables of interest were the amount of time it took participants to complete the OTMT Part A and the amount of time it took them to complete Part B. Trial B of the OTMT shows moderate test-retest reliability across various populations (.44 to .87) (Graham, Parikh, Hynan, Grosch, Weiner, Cullum, 2010). Additionally, research has found a strong correlation between the OTMT and the WTMT, suggesting convergent validity (r = .62) (Mrazik, Millis, & Drane, 2010).

Procedure

This study consisted entirely of online testing and questionnaires due to safety and health concerns revolving around COVID-19. Participants who were interested in being a part of this study reached out via email. They were then provided with a brief description of the study and asked to sign an informed consent form by providing their initials, age, and date if they agreed to participate. Before any subsequent analysis, they were asked if they had ever had head trauma that led to loss of consciousness. If they had, they were excluded from the study. If they had not, they were sent the sociodemographic questionnaire, the BDI-II, and the Victimization questionnaire via encrypted email. Returned questionnaires were immediately assigned an identification number unique to each participant and entered into an Excel data file.

After completion, the neuropsychological tests assessing memory and executive functioning were administered. All testing was conducted on Zoom, an American web-based video conferencing tool. Privacy through this platform was ensured by establishing a secure connection through Middle Tennessee State University's licensing package. Additionally, the Zoom meeting was HIPAA compliant in that it did not have access to personal health information, encrypted all audio, video, and screen sharing data, and access to the Zoom meeting was password protected. Results from the testing battery were recorded on protocols, and the protocols for each participant were also coded with a unique identification number corresponding to the number on the participant's questionnaires.

To assess memory, the Logical Memory (LM) subtest of the Weschler Memory Scale – IV (WMS-IV) was administered. For the assessment of executive functioning, participants were administered several commonly used indices of executive functioning, including the Controlled Oral Word Association Test (COWAT), the Oral Trail Making Test (OTMT), and the Letter-Number Sequencing (LNS) subtest from the WMS-III. Additionally, the Design Fluency test was utilized to assess visuospatial executive functioning. In an attempt to assess executive functioning concentrated in the right hemisphere, an affective version of the COWAT called Affective Verbal Fluency (AVF) was also administered. The AVF included both a positive and negative affect version. The LM test was always administered first given that the delayed recall portion of this test requires a time delay of 25 to 35 minutes. After administration of the first trial of the LM test, all other neuropsychological tests were administered. The order of administration of these tests was randomized to control for potential sequence effects. The delayed trial of the LM test was then administered after all other neuropsychological tests had been completed, approximately 25 to 35 minutes following the initial administration.

CHAPTER IV: RESULTS

Initial Analyses. All statistical analyses were conducted with an alpha of .05. The data were initially analyzed to ensure that no major confounding variables were affecting the dependent variables. Specifically, correlations were conducted between age, education, depression, religious importance, perceived social support, and performance

on all of the neuropsychological tests. No significant correlations emerged. Hence, these variables were not considered potential confounds and were therefore not included as covariates in subsequent analyses.

Primary Analyses. The primary analyses consisted of conducting a series of Pearson bivariate correlations to assess the relationship between the amount of victimization one endured and performance on the neuropsychological tests of memory and executive functioning. The Pearson bivariate correlations were also used to determine if there was an association between victimization perceived by the individual as occurring specifically because of their sexual orientation and their scores on these neuropsychological tests. To control for experiment-wise error rate given the number of correlations that were planned, the alpha level for determining statistical significance was adjusted using a Bonferroni correction. Following the Bonferroni correction, the new alpha level was .005. The results indicated no significant correlations between overall victimization and performance on memory and executive functioning tests. Also, there were no significant correlations found between victimization perceived by the individual as occurring because of sexual orientation and performance on memory and executive functioning tests. Correlations between variables can be found in Table 1.

CHAPTER V: DISCUSSION

Using self-report questionnaires and a series of neuropsychological tests, the current study sought to investigate whether psychological stressors faced by the LGB population might potentially impact their functioning on tests that required memory and executive functioning skills. To investigate this, correlations were conducted between

measures of overall victimization and performance on tests designed to measure memory and executive functioning. Correlations were also conducted between victimization perceived to be because of sexual orientation and performance on these same neuropsychological tests. Negative correlations were predicted to exist between psychological stressors and neuropsychological test performance based on the results of many other studies indicating that psychological stress affects the hippocampus and prefrontal cortex, which are critically involved in memory and executive functioning. The negative correlations were also expected to exist based on research results indicating that psychological stress is associated with poorer performance on tests of memory and executive functioning. However, the results of the present investigation failed to find any significant correlations between the variables of interest. There were no significant correlations found between performance on tests of memory and executive functioning and scores on a measure of overall victimization or scores on a measure of victimization perceived to be because of sexual orientation. Hence, the present findings are in contrast to the results of many other research investigations that have supported these associations.

Rivera-Velez et al., (2014) found that women who had experienced psychological stress due to sexual abuse performed lower than a control group on Logical Memory and Letter-Number Sequencing, two tests that were included in the present investigation. Additionally, a study from Bremner et al., (1995) found that children who were physically or sexually abused as children performed lower on Logical Memory, even in adulthood, suggesting that this psychological stress could have life-long implications. A study by Medeiros et al., (2016) illustrated that on the Trail Making Test Part B, another

test included in the present investigation, children who experienced psychological stress due to bullying performed worse than a control group.

Although most of the current research has shown an inverse relationship between experiencing psychological stress and performance on memory and executive functioning tests, one study by McGarrity (2016), actually found that minority stress led to increased performance on Logical Memory, Design Fluency, and a verbal fluency task. McGarrity concluded that these findings were likely mediated by state anger. While state anger is not as relevant for the current study, it is possible that other potential mediators or moderators prevented my results from reaching significance.

One potential mediator could be that of resiliency, which is defined most simply as the capacity to effectively cope with, adapt to, or recover from stress. Resiliency is an extremely complex concept, however, that encompasses several different psychological and biological adaptation processes. Psychological resiliency encompasses individual attributes such as personality style, internal dialogue and perception of events, and sense of self-efficacy and strength to overcome adversity. The presence of at least one stable, caring relationship and perceived social support also helps foster resiliency. Psychological resiliency has been shown to lead to better outcomes for individuals who have experienced adversity (National Scientific Council on the Developing Child, 2015). Biological resiliency has been shown to protect the brain from the detrimental effects of psychological stress by producing proteins that control the stress response, balancing between pro-inflammatory and anti-inflammatory cytokines after sustained periods of stress, and allowing for recovery of the brain after sustained periods of stress (National

Scientific Council on the Developing Child, 2015). Extant research investigating the potential mediating effect of resiliency is scarce, but a dissertation by Welsh (2013) investigating the effects of trauma induced stress on attention, executive functioning, and processing speed suggested that resiliency may be associated with stronger neuropsychological functioning (Welsh, 2013). Keeping this in mind, further investigation on resiliency as a potential mediating factor might help shed some light on the relationship between victimization and subsequent neuropsychological performance.

It is also important to note that other research approached investigating the relationship between psychological stress and performance on tests of memory and executive functioning by focusing on the presence, or lack thereof, of a formal PTSD diagnosis. Generally, researchers find that those diagnosed with PTSD perform worse than adults without PTSD on neuropsychological tests, especially tests of memory and executive functioning (Schuitevoerder et al., 2013; Stein et al., 2002; Polak et al., 2012). These researchers all call for a need for further research in this area, notably in terms of differences among specific subgroups. Because psychological stress resulting in PTSD has shown to have a stronger inverse relationship with performance on neuropsychological tests, exploring PTSD diagnoses as another potential mediating factor would have been beneficial when interpreting findings.

Although statistical analyses suggested that there was no relationship between general victimization, victimization perceived to be because of sexual orientation, and performance on neuropsychological tests of memory and executive functioning, the majority of other researchers did find significant results when exploring this relationship.

Results from the current investigation may be valid, and victimization might not be related to deficits in neuropsychological performance in the LGB population. It is possible that resiliency in the LGB population helps mitigate some of the detrimental effects of psychological stress on the brain. Especially as the sociopolitical climate continues to evolve in terms of greater acceptance of and social support for the LGB community, this affects how victimization around sexuality is internalized (i.e., psychological resiliency), and thus, its effect on memory and executive functioning. Keeping this in mind, it is also important to note that the vast majority of the sample from the current investigation both experienced trauma and were college students or college graduates. Rising above their faced adversity in order to pursue higher education might potentially suggest resiliency in itself. More research specific to the LGB community would be needed to further investigate resiliency as a potential mediating factor, however. It is also possible that other potential mediators or limitations from my study prevented my results from reaching significance. Further investigation into these limitations will be discussed below.

Limitations

Although this research contributed to the limited literature investigating potential neuropsychological impacts of psychological stressors on the LGB community, it has several limitations. The main limitation in this study was a small sample size. Due to problems encountered because of the COVID-19 pandemic, participant interest, and difficulty accessing this population virtually, only 23 participants completed the study. Having such a small sample lessened the power of the study; thus, non-significant

findings may be the consequence of an inadequate sample size rather than an absence of an effect. Acquiring a larger sample also would have allowed for the use of a more complex statistical procedure in order to compare high and low trauma groups and to control for confounding variables.

Another important limitation to consider is that this study utilized a virtual administration method for neuropsychological testing and used a self-report questionnaire to measure victimization. Administering the neuropsychological tests virtually via Zoom may have potentially lessened the validity of these tests. Using a self-report measure was the only way to gain information about victimization, but the use of a self-report questionnaire could potentially be problematic because this allows for potential response set biases, including potential over-reporting and under-reporting. Additionally, the retrospective version of the victimization questionnaire was used for this study, meaning that participants had to rely on their own memory for events that occurred throughout the lifespan. Relying on memory for the recollection of these events could cause participants to forget about or inaccurately remember certain situations. Under-reporting could have also been an issue if participants were unwilling to disclose such personal information to a stranger. A potential solution for limitations stemming from the self-report format of the victimization questionnaire would be having a family member that is close to the participant fill out the same questionnaire on the participant's behalf and then using an agreement or average score, although this would bring its own limitations.

Three other potential limitations stem from the use of the victimization questionnaire. The first limitation includes the use of a slightly modified version in order

to assess whether victimization perceived to be due to sexual orientation affected neuropsychological performance. The problem with using this modified version is that no normative data was available. Without normative data, it is unclear whether the sample suffered more or less victimization than the larger population. The second limitation is that this questionnaire was selected for its inclusion of victimization in the form of bullying, which has been shown to be commonly experienced by the LGB population, but there are other forms of victimization it neglected to mention (e.g., stalking, systemic and institutionalized victimization, and microaggressions). Additionally, by assessing victimization using a yes or no format, important information is lost about context (e.g., age of occurrence, frequency of event, social support at time of occurrence, etc.). Lastly, due to time constraints and a small sample size, the analyses did not include an assigned weight to each category of victimization like initially intended. It is likely that a more intense event of victimization such as rape would cause more psychological stress than being excluded from a group as a youth.

The present investigation focused on the LGB population specifically, as it has been well-established by prior research that this group is often subject to discrimination and experiencing various forms of traumatization and because there is a lack of literature investigating neuropsychological functioning related to trauma in this population. A sample of heterosexual individuals was not included in the present investigation. A more thorough approach would have been to include a group of heterosexual individuals who also experienced trauma related to victimization. Further, groups of LGB and heterosexual individuals who have not experienced trauma related to victimization would have been beneficial. Having a heterosexual control group would have allowed further

investigation as to whether victimization perceived to be because of sexual orientation had more of an effect than trauma unrelated to sexuality.

Lastly, an attempt was made to control for as many confounding variables as possible (e.g., age, education, religious importance, perceived social support, and depression). However, there are potentially many other variables that could have been potentially ruled out. For instance, it would have been beneficial to consider past or current drug and alcohol usage when collecting data, as these have both been shown to have a detrimental effect on brain functioning. As I mentioned previously, it would have also been beneficial to look into resiliency as a potential mediator in the relationship between victimization and neuropsychological performance, especially considering victimization due to sexual orientation can be a lifelong occurrence. Taking other research in this area into account, determining whether participants have diagnosable PTSD, or other diagnosable disorders for that matter, may also help explain the relationship between victimization and performance on neuropsychological tests of memory and executive functioning.

Conclusion and Future Direction

The purpose of the present study was to investigate whether there was an association between psychological stressors and neuropsychological functioning on memory and executive functioning tests in the LGB community. Based on previous research, individuals who self-identify as lesbian, gay, or bisexual have been shown to face disproportionate discrimination and victimization. The propensity for members of

the LGB community to experience various forms of trauma makes studying neuropsychological functioning among this population particularly important.

A correlational design was used to determine if associations existed between victimization levels and scores on multiple neuropsychological tests of memory and executive functioning. This correlational design was also used to investigate associations between scores on these neuropsychological tests and victimization perceived to be because of sexual orientation. Based on findings in related research studies, I hypothesized that a negative correlation would be found between victimization and scores on neuropsychological tests.

Contrary to my hypothesis, correlational analyses found no significant relationship between experiencing stressors and performance on neuropsychological tests. There was also no significant relationship between victimization perceived to be because of sexual orientation and performance on neuropsychological tests. It is possible that the non-significant findings were due to inadequate sample size or other study limitations, however.

Going forward, this particular study question could be more thoroughly investigated by mitigating these limitations. Acquiring a larger sample size would increase power and allow for a more complex statistical procedure that could compare high and low trauma groups. A control group of heterosexual individuals could also be added in order to compare high and low trauma groups amongst both populations. A larger sample size would also allow for more diversity in the sample and make findings more generalizable to the larger population.

This study addressed several variables that could potentially account for some of the variance between psychological stressors and neuropsychological performance, but in the future, it would also be beneficial to control for more potential confounding variables. Adding a self-report questionnaire to assess previous and current drug and alcohol usage would help rule out any potential effects caused by these variables. Assigning certain weight to each category of victimization could also help to determine if certain forms of victimization have more of an effect on neuropsychological performance than other types. Lastly, other variables could be investigated as potential mediators for the relationship between psychological stressors and neuropsychological performance. Resiliency, in particular, would be beneficial to explore considering that victimization due to sexual orientation can be a lifelong occurrence. Determining if participants have diagnosable PTSD or other disorders would also be beneficial.

Regardless of the findings of this study, its contribution to the limited literature investigating potential neuropsychological impacts of psychological stressors in the LGB community can help fill in some gaps and invite others to dedicate more attention to the subject. Understanding the relationship between victimization and neuropsychological functioning, especially within a vulnerable population such as the LGB population, will be fundamental for the development of proper interventions, safety measures, and future policies. Given that social justice efforts to combat the discrimination against disadvantaged groups (such as the LGB community) continue to grow, better understanding this possible link could potentially further motivate the eradication of discrimination for these minorities, or at least help guide efforts in order to help the LGB population flourish despite adversity.

References

Ansell, E. B., Rando, K., Tuit, K., Guarnaccia, J., & Sinha, R. (2012). Cumulative adversity and smaller gray matter volume in medial prefrontal, anterior cingulate, and insula regions. Biological psychiatry, 72(1), 57–64. doi:10.1016/j.biopsych.2011.11.022

Barrera, M., Calderón, L., & Bell, V. (2013). The cognitive impact of sexual abuse and PTSD in children: A neuropsychological study. *Journal of Child Sexual Abuse: Research, Treatment, & Program Innovations for Victims, Survivors, & Offenders, 22*(6), 625–638. doi:10.1080/10538712.2013.811141

Bechara, A., Tranel, D., & Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. *Brain : a Journal of Neurology*, 123(11), 2189–2202.

Bechara, A., & Damasio, A. R. (2005). The somatic marker hypothesis: A neural theory of economic decision. *Games and Economic Behavior*, *52*(2), 336–372. doi: 10.1016/j.geb.2004.06.010

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Manual for the Beck Depression Inventory-II. San Antonio, TX: Psychological Corporation.

Beckham, J. C., Crawford, A. L., & Feldman, M. E. (1998). Trail making test performance in vietnam combat veterans with and without posttraumatic stress disorder. *Journal of Traumatic Stress*, (4), 811. doi:10.1023/A:1024409903617

Birkett, M., Espelage, D. L., & Koenig, B. (2009). LGB and Questioning Students in Schools: The Moderating Effects of Homophobic Bullying and School Climate on Negative Outcomes. *Journal of Youth & Adolescence*, *38*(7), 989.

Blanchette, I., Lindsay, P., & Davies, S. (2014). Intense emotional experiences and logicality: An Exploration of deductive reasoning in survivors of sexual abuse. *Psychological Record, 64,* 859–867. doi:10.1007/s40732-014-0073-4

Botvinick, M. M., Cohen, J. D., & Carter, C. S. (2004). Conflict monitoring and anterior cingulate cortex: an update. *Trends in Cognitive Sciences*, *8*(12), 539–546. doi: 10.1016/j.tics.2004.10.003

Braver, T. S., & Bongiolatti, S. R. (2002). The role of frontopolar cortex in subgoal processing during working memory. NeuroImage, 15(3), 523–536. doi:10.1006/nimg.2001.1019

Bremner, J. D., Vythilingam, M., Vermetten, E., Southwick, S. M., McGlashan, T., Nazeer, A., Khan, S., Vaccarino, L. V., Soufer, R., Garg, P. K., Ng, C. K., Staib, L. H., Duncan, J. S., & Charney, D. S. (2003). MRI and PET study of deficits in hippocampal structure and function in women with childhood sexual abuse and posttraumatic stress disorder. *The American journal of psychiatry*, 160(5), 924–932. doi:10.1176/appi.ajp.160.5.924

Bremner, J. D. (2006). Traumatic stress: Effects on the brain. *Dialogues in clinical neuroscience, 8,* 445. doi:10.1300/J229v06n02_06. 51

Bremner, J., Randall, P., Scott, T., Capelli, S., Delaney, R., Mccarthy, G., & Charney, D. (1995). Deficits in short-term memory in adult survivors of childhood abuse. *Psychiatry Research, 59*, 97–107. doi:10.1016/0165-1781(95)02800-5

Carrion, V. G., & Wong, S. S. (2012). Can traumatic stress alter the brain? understanding the implications of early trauma on brain development and learning. *Journal of Adolescent Health, 51*(2), S23-S28. doi:10.1016/j.jadohealth.2012.04.010

Cerqueira, J., Mailliet, F., Almeida, O., Jay, T., & Sousa, N. (2007). The prefrontal cortex as a key target of the maladaptive response to stress. *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience*, 27(11), 2781–2787. doi:10.1523/JNEUROSCI.4372-06.2007

Diamond A. (2013). Executive functions. *Annual review of psychology, 64*, 135–168. doi:10.1146/annurev-psych-113011-143750

De Bellis, M. D., Keshavan, M. S., Shifflett, H., Iyengar, S., Beers, S. R., Hall, J., & Moritz, G. (2002). Brain structures in pediatric maltreatment-related posttraumatic stress disorder: a sociodemographically matched study. Biological psychiatry, 52(11), 1066–1078. doi:10.1016/s0006-3223(02)01459-2

De Bellis, M. D., & Zisk, A. (2014). The biological effects of childhood trauma. Child and adolescent psychiatric clinics of North America, 23(2), 185–vii. doi:10.1016/j.chc.2014.01.002

Donders, J., Tulsky, D. S., & Zhu, J. (2001). Criterion validity of new WAIS-II subtest scores after traumatic brain injury. *Journal of the International Neuropsychological Society : JINS*, *7*(7), 892–898.

Fennema-Notestine, C., Stein, M., Kennedy, C., Archibald, S., & Jernigan, T. (2002). Brain morphometry in female victims of intimate partner violence with and without posttraumatic stress disorder. Biological Psychiatry, 52(11), 1089–1101. doi:10.1016/S0006-3223(02)01413-0

Finkelhor, D., Turner, H., Shattuck, A., & Hamby, S. (2015). Prevalence of childhood exposure to violence, crime, and abuse: results from the national survey of children's exposure to violence.(Report). 169(8), 746–74654. https://doi.org/10.1001/jamapediatrics.2015.0676

Goghari, V. M., Macdonald, A. W., 3rd, & Sponheim, S. R. (2014). Relationship between prefrontal gray matter volumes and working memory performance in schizophrenia: a family study. *Schizophrenia research*, *153*(1-3), 113–121. doi:10.1016/j.schres.2014.01.032

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*, 500–506. doi:10.1016/j.jpsychires.2012.01.005

Graham, L., Parikh, M., Hynan, L., Grosch, M., Weiner, M., Cullum, M. (2010). D-50 reliability of the oral trail making test. *Archives of clinical neuropsychology*, 25(6), 475-583.

Gurvits, T. V., Shenton, M. E., Hokama, H., Ohta, H., Lasko, N. B., Gilbertson, M. W., Orr, S. P., Kikinis, R., Jolesz, F. A., McCarley, R. W., & Pitman, R. K. (1996). Magnetic resonance imaging study of hippocampal volume in chronic, combat-related posttraumatic stress disorder. *Biological psychiatry,* 40(11), 1091–1099. doi:10.1016/S0006-3223(96)00229-6

Hanson, J. L., Chung, M. K., Avants, B. B., Shirtcliff, E. A., Gee, J. C., Davidson, R. J., & Pollak, S. D. (2010). Early stress is associated with alterations in the orbitofrontal cortex: a tensor-based morphometry investigation of brain structure and behavioral risk. The Journal of neuroscience : the official journal of the Society for Neuroscience, 30(22), 7466–7472. doi:10.1523/JNEUROSCI.0859-10.2010

Henry, J. D., & Crawford, J. R. (2004). A meta-analytic review of verbal fluency performance in patients with traumatic brain injury. *Neuropsychology*, 18(4), 621.

Herek, G. M., Gillis, J. R., & Cogan, J. C. (1999). Psychological sequelae of hate-crime victimization among lesbian, gay, and bisexual adults. *Journal of Consulting and Clinical Psychology*, *67*, 945-951. doi:10.1037/0022-006X.67.6.945

Jin, J., & Maren, S. (2015). Prefrontal-hippocampal interactions in memory and emotion. *Frontiers in Systems Neuroscience*, *9*. doi: 10.3389/fnsys.2015.00170

Karl, A., Schaefer, M., Malta, L., Dorfel, D., Rohleder, N., & Werner, A. (2006). A meta-analysis of structural brain abnormalities in PTSD. *Neuroscience & Biobehavioral Reviews*, *30*(7), 1004–1031. doi: 10.1016/j.neubiorev.2006.03.004

Kertzman, S., Avital, A., Weizman, A., & Segal, M. (2014). Intrusive trauma recollections is associated with impairment of interference inhibition and psychomotor speed in PTSD. *Comprehensive Psychiatry*, *55*, 1587–1594. doi:10.1016/j.comppsych.2014.05.004

Kosciw, J. G., Greytak, E. A., Palmer, N. A., & Boesen, M. J. (2014). The 2013 National School Climate Survey: The experiences of lesbian, gay, bisexual and transgender youth in our nation's schools. New York: GLSEN.

Mark, C., Poltavski, D., Petros, T., & King, A. R. (2019). Differential executive functioning in young adulthood as a function of experienced child abuse. *International Journal of Psychophysiology*, *135*, 126-135. doi:10.1037/e511372018-001

McGarrity, Larissa A. (2016). Minority stress, self-regulation, and executive function: An experimental investigation of gay and lesbian adults (Doctoral dissertation). Retrieved from ProQuest LLC. (10158466)

Mclaughlin, K. A., Hatzenbuehler, M. L., Xuan, Z., & Conron, K. J. (2012). Disproportionate exposure to early-life adversity and sexual orientation disparities in psychiatric morbidity. *Child Abuse & Neglect*, 36(9), 645–655. doi: 10.1016/j.chiabu.2012.07.004

Medeiros, W., Torro-Alves, N., Fernandes Malloy-Diniz, L., & Moita Minervino, C. (2016). Executive functions in children who experience bullying situations. *Frontiers in Psychology*. *7*, 1-9. doi:10.3389/fpsyg.2016.01197

Miller, M. W., & Sadeh, N. (2014). Traumatic stress, oxidative stress and post-traumatic stress disorder: Neurodegeneration and the accelerated-aging hypothesis. *Molecular Psychiatry*, *19*, 1156–1162. doi:10.1038/mp.2014.111

Mrazik, M., Millis, S., & Drane, D. L. (2010). The oral trail making test: effects of age and concurrent validity. *Archives of clinical neuropsychology : the official journal of the National Academy of Neuropsychologists*, *25*(3), 236–243. doi:10.1093/arclin/acq006

National Scientific Council on the Developing Child. (2015). Supportive Relationships and Active Skill-Building Strengthen the Foundations of Resilience: Working Paper 13. http://www.developingchild.harvard.edu

Park, S. M., Choi, J., Lee, J. S., Lee, J., Lee, S., & Jung, H. E., (2018). Impaired executive functioning of sexual assault survivors with acute stress disorder. *Journal of Clinical Medicine, 7*, 362. doi:10.3390/jcm7100362

Polak, A. R., Witteveen, A. B., Reitsma, J. B., & Olff, M. (2012). The role of executive function in posttraumatic stress disorder: A systematic review. *Journal of Affective Disorders*, 141(1), 11–21. https://doi-org.ezproxy.mtsu.edu/10.1016/j.jad.2012.01.001

Preston, A. R., & Eichenbaum, H. (2013). Interplay of hippocampus and prefrontal cortex in memory. *Current biology*, *23*(17), 764–773. https://doi.org/10.1016/j.cub.2013.05.041

Radley, J., Sisti, H., Hao, J., Rocher, A., Mccall, T., Hof, P., … Morrison, J. (2004). Chronic behavioral stress induces apical dendritic reorganization in pyramidal neurons of the medial prefrontal cortex. *Neuroscience*, *125*(1), 1–6. doi: 10.1016/j.neuroscience.2004.01.006

Rivera-Vélez, G., González-Viruet, M., Martínez-Taboas, A., & Pérez-Mojica, D. (2014). Post-traumatic stress disorder, dissociation, and neuropsychological performance in latina victims of childhood sexual abuse. *Journal of Child Sexual Abuse*, *23*, 55–73. doi:10.1080/10538712.2014.864746

Roberts, A. I., Austin, S. B., Corliss, H. L., Vandermorris, A. K., & Koenen, K. C. (2010). Pervasive trauma exposure among US sexual orientation adults linked to posttraumatic stress disorder risk. *Comprehensive Psychiatry*, *51*(6), 1–9. doi: 10.1016/j.comppsych.2010.06.039

Rocher C., Spedding M., Munoz C., Jay T. M. (2004). Acute stress-induced changes in hippocampal/prefrontal circuits in rats: effects of antidepressants. *Cerebral Cortex*, 14(2), 224–229. doi:10.1093/cercor/bhg122

Ruff, R., Light, R., Parker, S., & Levin, H. (1996). Benton controlled oral word association test: Reliability and updated norms. *Archives of Clinical Neuropsychology*, *11*(4), 329–338. doi:10.1016/0887-6177(95)00033-X

SAMHSA. (2019, January 14). Trauma and Violence. Retrieved from https://www.samhsa.gov/ trauma-violence.

Schuitevoerder, S., Rosen, J. W., Twamley, E. W., Ayers, C. R., Sones, H., Lohr, J. B., Goetter, E. M., Fonzo, G. A., Holloway, K. J., & Thorp, S. R. (2013). A meta-analysis of cognitive functioning in older adults with PTSD. *Journal of Anxiety Disorders, 27*(6), 550–558. https://doi-org.ezproxy.mtsu.edu/10.1016/j.janxdis.2013.01.001

Sheffield J. M., Williams L. E., Woodward N. D., Heckers S. (2013). Reduced gray matter volume in psychotic disorder patients with a history of childhood sexual abuse. *Schizophrenia Research*, 1, 185-191. doi:10.1016/j.schres.2012.10.032

Sherin, J. E., Nemeroff, C. B. (2011). Post-traumatic stress disorder: the neurobiological impact of psychological trauma. *Dialogues in Clinical Neuroscience,* 13(3), 263-278.

Spreen, O., Strauss, E., & Sherman, E. M. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed.). New York, NY: Oxford University Press.

Spreen, O., Strauss, E., & Sherman, E. M. (2006). Attention. In *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed., pp. 546-677). New York, NY: Oxford University Press.

Spreen, O., Strauss, E., & Sherman, E. M. (2006). Memory. In *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed., pp. 678-890). New York, NY: Oxford University Press.

Starkman, M. N., Gebarski, S. S., Berent, S., & Schteingart, D. E. (1992). Hippocampal formation volume, memory dysfunction, and cortisol levels in patients with Cushings syndrome. *Biological Psychiatry, 32*(9), 756-765. doi:10.1016/0006-3223(92)90079-f

Starkman, M. N., Giordani, B., Gebarski, S. S., & Schteingart, D. E. (2003). Improvement in learning associated with increase in hippocampal formation volume. *Biological Psychiatry, 53*, 233-238. doi:10.1016/s0006-3223(02)01750-x

Stein, M. B., Kennedy, C. M., & Twamley, E. W. (2002). Neuropsychological function in female victims of intimate partner violence with and without posttraumatic stress disorder. *Biological Psychiatry- New York, 52*, 1079. doi:10.1016/S0006-3223(02)01414-2

Stone, A.A. (1993). Post-traumatic stress disorder and the law: Critical review of the new frontier. *Bull Am Acad Psychiatry Law, 21,* 23-36.

Swick, D., Ashley, V. & Turken, A.U. (2008). Left inferior frontal gyrus is critical for response inhibition. BMC Neurosci, 9(102), doi:10.1186/1471-2202-9-102

Tombaugh, T., Kozak, J., & Rees, L. (1999). Normative Data Stratified by Age and Education for Two Measures of Verbal Fluency: FAS and Animal Naming. Archives of Clinical Neuropsychology, 14(2), 167–177. doi:10.1016/S0887-6177(97)00095-4

Trickett, P. K., Noll, J. G., Susman, E. J., Shenk, C. E., & Putnam, F. W. (2010). Attenuation of cortisol across development for victims of sexual abuse. Development and psychopathology, 22(1), 165–175. doi:10.1017/S0954579409990332

Twamley, E. W., Allard, C. B., Thorp, S. R., Norman, S. B., Cissell, S. H., Berardi, K. H., . . . Stein, M. B. (2009). Cognitive impairment and functioning in PTSD related to intimate partner violence. Journal of the International Neuropsychological Society, 15, 879-887. doi:10.1017/s135561770999049x

Vaillancourt, T., Duku, E., Becker, S., Schmidt, L. A., Nicol, J., Muir, C., & MacMillan, H. (2011). Peer victimization, depressive symptoms, and high salivary cortisol predict poorer memory in children. *Brain and Cognition, 77,* 191–199. doi:10.1016/j.bandc.2011.06.012

Van Harmelen, A. L., Van Tol, M. J., Van der Wee, N. J., Veltman, D. J., Aleman, A., Spinhoven, P., van Buchem, M. A., Zitman, F. G., Penninx, B. W., & Elzinga, B. M. (2010). Reduced medial prefrontal cortex volume in adults reporting childhood emotional maltreatment. Biological psychiatry, 68(9), 832–838. https://doi.org/10.1016/j.biopsych.2010.06.011

Vasterling, J. J., Duke, L. M., Brailey, K., Constans, J. I., Allain, A. N., Jr., & Sutker, P. B. (2002). Attention, learning, and memory performances and intellectual resources in Vietnam veterans: PTSD and no disorder comparisons. *Neuropsychology, 16*(1), 5–14. doi:10.1037/0894-4105.16.1.5

Wechsler, D., Holdnack, J. A., & Drozdick, L. W. (2009). Wechsler Memory Scale: Fourth Edition. Technical and Interpretive Manual. San Antonio: Pearson.

Welsh, A., (2013). "Effects of Trauma Induced Stress on Attention, Executive Functioning, Processing Speed, and Resilience in Urban Children" Seton Hall University Dissertations and Theses (ETDs). 1907.

Yehuda, R., Golier, J. A., Tischler, L., Stavitsky, K., & Harvey, P. D. (2005). Learning and memory in aging combat veterans with PTSD. *Journal of Clinical and Experimental Neuropsychology*, *27*(4), 504–515.

Yehuda, R., Tischler, L., Golier, J. A., Grossman, R., Brand, S. R., Kaufman, S., & Harvey, P. D. (2006). Longitudinal Assessment of Cognitive Performance in Holocaust Survivors with and without PTSD. *Biological Psychiatry*, *60*(7), 714–721. doi:10.1016/j.biopsych.2006.03.069

Table 1

Table of Correlations for Main Variables

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Victimization	23	27.783	10.884	—												
2. BC Sexual	23	5.130	4.224	.465*	—											
3. LM1 Total	22	40.818	12.742	-.116	.035	—										
4. LM2 Total	22	27.318	8.300	-.139	-.144	.825*	—									
5. LM Retention	22	68.533	12.512	.015	-.212	-.431*	.130	—								
6. AVF Positive	23	16.522	7.531	.082	.001	.320	.164	-.226	—							
7. AVF Negative	23	13.565	5.907	.155	.110	.324	.309	−.087	.702**	—						
8. DF Free	23	15.565	10.723	.126	-.168	.435*	.575**	.170	.179	.096	—					
9. DF Fixed	23	18.652	13.503	.064	-.332	.294	.344	.050	.485**	.389*	.749**	—				
10. COWAT	23	41.652	10.482	-.137	-.338	.351	.443*	.077	.576**	.566**	.379	.440*	—			
11. LNS	23	12.261	2.816	-.050	-.064	.448*	.417*	-.192	.201	.365*	.270	.428*	.365*	—		
12. OTMTA	23	8.928	2.297	-.175	.190	-.161	.087	.455*	-.404*	-.444*	-.041	-.328	-.266	-.140	—	
13. OTMTB	23	29.551	10.255	.262	.303	-.554**	-.636**	.094	-.164	-.404*	-.303	-.290	-.581**	-.692**	.133	—

* Correlation is significant at the 0.05 level (1-tailed).

** Correlation is significant at the 0.01 level (1-tailed).

Note. BC Sexual = victimization perceived to be because of sexual orientation; LM = Logical Memory; AVF = Affective Verbal Fluency; DF = Design Fluency; COWAT = Controlled Oral Word Association Test; LNS = Letter-Number Sequencing; OTMT = Oral Trail Making Test