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# Exploring the Relationship of Gender, COVID-19-Related Stress and Autobiographical Memory

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# Exploring the Relationship of Gender, COVID-19-Related Stress and Autobiographical Memory

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## Abstract

The Coronavirus (COVID-19, SARS-CoV-2) pandemic erupted in March 2020 and significantly disrupted the daily lives of all individuals. The limited number of COVID-19 research studies have focused on psychological distress in general adult populations or in essential workers, but its effects on Autobiographical Memory (AM), the collection of personal memories that aid in the formation of one's goals and identities, have not yet been explored. The current study contributes important discoveries to the growing body of literature through its exploration of the intersection of COVID-19-related stress, AM performance, and sex assigned at birth in undergraduate college students. Results suggest that COVID-19-related stress, induced via a modified Mannheim Multicomponent Stress Test (MMST), significantly impeded an individual's ability to produce a specific memory. Additionally, biological sex significantly influenced a participant's duration of memory retrieval, level of memory specificity, and affective response to the memory during the Autobiographical Memory Test (AMT). Female participants recalled memories faster, produced more specific memories, embodied a more negative affect, and experienced more physiological stress, measured by the Empatica E4 Wristband. These results suggest that the consequences of COVID-19-related stress include disruptions of identity formation, and that biological sex modulates one's memory recall, memory specificity, affective response, and physiological stress response. Furthermore, COVID-19 appears to evoke amplified stress in college students who are assigned female at birth, are diagnosed with an anxiety disorder, and/or have elevated baseline anxiety levels, which increases their likelihood of developing a psychological disorder and/or symptomatology. This study adds to current literature on the impact of COVID-19 on depressive, anxiety, trauma, and stress-related disorders.


*Key words:* COVID-19, Stress, Autobiographical Memory, Biological Sex

## Dedication

Dedicated to Joseph A. Schroeder, Ph.D., for always supporting me in my passions and endeavors and for always believing in me.

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## List of Abbreviations

| | |
|---|---|
| AM | Autobiographical Memory |
| AMT | Autobiographical Memory Test |
| amPFC | Anterior Medial Prefrontal Cortex |
| ASD | Acute Stress Disorder |
| BOLD | Blood Oxygenation Level Dependent Signal |
| BPD | Borderline Personality Disorder |
| COVID-19 | Coronavirus Disease 2019 |
| CQ-PTEI | Coronavirus Questionnaire on Perceived Threat, Experiences and Impacts |
| DID | Dissociative Identity Disorder |
| DLPFC | Dorsolateral Prefrontal Cortex |
| DMN | Default Mode Network of the Brain |
| DSM | Diagnostic and Statistical Manual of Mental Disorders |
| DSM-V | Diagnostic and Statistical Manual of Mental Disorders, 5$^{th}$ Edition |
| EDA | Electrodermal Activity |
| GAD | Generalized Anxiety Disorder |
| GAD-7 | General Anxiety Disorder Scale-7 |
| HR | Heart Rate |
| HRV | Heart Rate Variability |
| HPA | Hypothalamus-Pituitary-Adrenal Axis |
| MDD | Major Depressive Disorder |
| MMST | Mannheim Multicomponent Stress Test |
| MTL | Medial Temporal Lobe |
| OGM | Overgeneral (autobiographical) Memory |
| PASAT | Paced Auditory Serial Addition Task |
| PHQ-9 | Patient Health Questionnaire-9 |
| PTSD | Post-traumatic Stress Disorder |
| PTSS | Post-traumatic Stress Syndrome |
| PSY 100 | Introduction to Psychology |
| SAM | Self-Assessment Manikin |
| SARS-CoV-2 | Severe Acute Respiratory Syndrome Coronavirus 2 |
| SDS | Semantic Differential Scale |
| STAI-AD | State-Trait Anxiety Inventory for Adults |
| STAI-S | State-Trait Anxiety Inventory – State Anxiety |
| STAI-T | State-Trait Anxiety Inventory – Trait Anxiety |
| STCRS | Subjective Two-Component Rating Scale |

## List of Key Terms

*Affective Response to the Memory* or *Affective Response*

The emotional response that a participant embodies when recalling a memory.

*Autobiographical Memory*

Collection of personal semantic and episodic memories.

*Duration of Memory Retrieval*

The length of time it takes a participant to recall a memory.

*Electrodermal Activity*

A physiological measure of stress through looking at electrical currents in the skin.

*Memory Specificity*

How detailed a memory is recalled.

*Overgeneral (Autobiographical) Memory*

An autobiographical memory deficit when a memory is recalled in a categorical manner.

*Stress Response*

Subjective or objective measure of how a person reacts to a stressor.

# Exploring the Relationship Between Gender, COVID-19-Related Stress and Autobiographical Memory

## Introduction

### Autobiographical Memory

Autobiographical Memories (AMs) refer to the collection of personal semantic and episodic memories that expand over the course of one's lifetime and help create an individual's identity, life script, and values (Çili & Stopa, 2019). AMs are compilations of memories, not single memories, which allow for their complexity. Subsequently, this defining feature is extremely attractive to memory researchers (Conway, 1996). One interpretation of AMs was through the perspective of the Autobiographical Knowledge Base, which categorizes AM memory types as "lifetime periods, general events, and event specific knowledge" (Conway, 1996, p. 104). Conway and Bekerian (1987) coined the term "lifetime periods" to signify the "extended periods in a person's autobiography" (Conway, 1996, p.104). Since then, lifetime periods have been studied independently from AMs and have been incorporated into more recent AM models, e.g., Conway and Pleydell-Pearce's (2000) Self-Memory System model. This model incorporates the emotions, thoughts, and functions of the working self (memories related to self-perception and short-term goals), of the long-term self (memories related to autobiographical knowledge and the theoretical self), and of the episodic memory system (specific characteristics and details of memories that are readily available for memory retrieval) (Çili & Stopa, 2019; Conway & Pleydell-Pearce, 2000; Conway, Singer, & Tagini, 2004). According to this model, lifetime periods consist of both thematic and temporal knowledge (Conway & Pleydell-Pearce, 2000). Memories that contain a greater level of specificity and heterogeneity than lifetime periods are known as general events (Conway & Pleydell-Pearce, 2000). Along with these two types of memories, there are event-specific memories. Event-specific memories are researched

the most frequently, especially in relation to trauma (Conway & Pleydell-Pearce, 2000). This is because event-specific memory recall is perceived as "a defining feature of memory vividness" (Conway & Pleydell-Pearce, 2000, p. 263). Nonetheless, the memories that are deemed the most important to an individual's identity formation are characterized as self-defining memories (Çili & Stopa, 2019; Singer & Salovey, 1993). Self-defining memories are strongly linked to the positive and negative affect associated with goal attainment and are easily retrieved in the presence of external or internal cues. But, most importantly, they aid the individual in "maintaining a coherent sense of self" (Çili & Stopa, 2019, p. 31). Lifetime periods, general events, event-specific memories, and self-defining memories demonstrate the complexity of AMs, along with exemplifying the variety of AMs that exist.

To study AMs, Williams and Broadbent (1986) developed the Autobiographical Memory Test (AMT) in their study on suicide attempters. They found that those who had attempted suicide demonstrated greater difficulty in retrieving specific memories in response to positive and negative word cues (Williams & Broadbent, 1986). Their study prompted other researchers to use their validated psychological measure; Kuyken and Brewin's (1995) study was one of the first studies to incorporate their AMT. In this study, the researchers did not find a link between duration of memory retrieval and previous sexual assault, but they did find that those who had previously reported childhood sexual abuse produced more overgeneral, or categorical, autobiographical memories in response to both positive and negative word cues (Kuyken & Brewin, 1995). Overgeneral (autobiographical) memory (OGM), also known as reduced autobiographical memory specificity, is a particularly important cognitive phenomenon, and is most extensively described in Williams, et al.'s (2007) CaR-FA-X model (Capture And Rumination, Functional Avoidance, and impaired eXecutive control). This model suggests that OGMs are influenced by three mechanisms, of which the most important is a lack of prefrontal cortex processing (Sumner, 2012; Williams, 2006; Williams et.al., 2007). OGMs and flashbacks

are two examples of when traumatic memories are stored in the Situationally Accessible Memory or Non-declarative Memory, in a fragmented manner (Axmacher, et.al., 2010; Brewin, 2001). This phenomenon, described by Brewin, Dalgleish and Joseph's (1996) Dual Representation Theory, argues that OGMs and flashbacks occur when the traumatic memory is processed by the Situationally Accessible Memory through a lower-level perceptual processing, rather than by the higher-level Verbally Accessible Memory system, where memories can be edited and intertwined into the person's AM (Brewin, 2001).

These theories and models are used to explain the findings of many studies that have found significant relationships between OGMs and various psychological disorders. For instance, Gibbs and Rude (2004) found that students who produced more OGMs had experienced more stressful life events, e.g., traumas. Furthermore, they found that increased OGMs were associated with the presence of depressive symptoms later on in life (Gibbs & Rude, 2004). Ono, Devilly and Shum's (2016) meta-analysis only included psychological research studies that used Williams and Broadbent's (1986) AMT. Out of the 25 studies, 48% were on depressive disorders and 52% were on exposure to trauma or trauma disorders (Ono, Devilly & Shum, 2016). Their meta-analysis found that individuals who had been exposed to a traumatic event and/or had been diagnosed with either Post-traumatic Stress Disorder (PTSD) or a depressive disorder produced more OGMs compared to their healthy counterparts (Ono, Devilly & Shum, 2016). McNally and colleagues also found that individuals showed decreased AM specificity following a trauma-induced stressor (McNally, Litz, Prassas, Shin & Weathers, 1994). These results led the researchers to conclude that OGMs not only "[appear] to characterize PTSD as much as it does depression" but that "a relative inability to retrieve specific autobiographical memories, especially [ones] of positive valence, may contribute to the maintenance of PTSD" (McNally, et al., 1994, p. 351). Watkins and Teasdale (2001) drew similar conclusions about OGMs as a maintaining factor for psychological symptomatology. Their study, however, differed from

McNally, et al.'s (1994) in that instead of focusing on a sample group with a specific psychological disorder, i.e., PTSD, they focused on rumination, a specific coping style that an individual with PTSD may engage in.

## Autobiographical Memory and Trauma

### *Ruminative Coping Styles*

Rumination, or excessive recurrent thinking about past events and/or current negative emotions, exists on the opposite side of the spectrum of trauma-related responses from repression and dissociation (Michael, Halligan, Clark & Ehlers, 2007; Olff, Langeland, & Gersons, 2005). Ruminative models and theories continue to expand, despite rumination being a less developed and newer area of research compared to repression and dissociation. Beyond being considered as a cognitive obsession with a certain thought, no comprehensive definition of rumination has been accepted yet; rather, models have defined this term in different ways (Smith & Alloy, 2009). The Response Styles Theory (Nolen-Hoeksema, 1991), the Rumination on Sadness scale (Conway, Csank, Holm & Blake, 2000), and the Stress Reactive Rumination model (Alloy, et.al., 2000) all view rumination as a factor of vulnerability for depression; however, even the focus of rumination *within* these models differs (Smith & Alloy, 2009). The first two models argue that rumination is heavily focused on the factors surrounding current negative feelings, whereas the Alloy, et al.'s (2000) Stress Reactive Rumination model asserts that rumination centers around negative thoughts correlated to stressful events in one's life (Smith & Alloy, 2009). Research on the role of rumination as a key aspect in self-regulation has led to the development of other models (e.g., the Goal-Progress Model, Martin, Tesser, & McIntosh, 1993; the S-REF model, Wells & Matthews, 1996; and the Rumination and Self-Regulation model, Beckmann & Kellmann, 2004).

Preliminary research has found this coping style to be a significant predictor of suicidal ideation (Miranda & Nolen-Hoeksema, 2007) and depressive disorders (Stone, Hankin, Gibb, &

Arbela, 2011), a significant mediator for perfectionism in individuals with PTSD (Egan, Hattaway & Kane, 2014) and a significant symptom in individuals with major depressive disorder (MDD) and generalized anxiety disorder (GAD; Ruscio, Gentes, Jones, Hallion, Coleman, & Swendsen, 2015). Studies that have looked at the relationship between rumination and memory recall deficits have found OGMs to be the most prominent and notable AM retrieval deficit in individuals who engage in rumination (Ono, Devilly & Shum, 2016; Sutherland & Bryant, 2007). Many studies have found that individuals who engage in rumination and exhibit depressive symptomology produce more OGMs compared to their healthy counterparts (e.g., Hamlat, Connolly, Hamilton, Stange, Abramson, & Alloy, 2015). But not all trauma survivors obsessively overthink; some of them actively try to avoid the pain through repression or dissociation.

***Repressive Coping Styles***

Repression was first discussed by Sigmund Freud and Breuer in 1894 as a psychological and unconscious self-defense mechanism (Breuer & Freud, 1894/1957; Jones, 1993). Since then, many cognitive psychologists, psychoanalysts, and neurobiologists have built upon these first findings of repression, through their respective theories and models (Jones, 1993; See Bower, 1990, Davidson, 1980, Erdelyi, 1990, Galin, 1976, Holmes, 1990, Kihlstrom & Hoyt, 1990, Kissin, 1986, Piaget, 1973, Schwartz, 1987, Spiegel, 1990). In general, repression is considered an avoidant coping mechanism, in which individuals actively downplay their anxieties and emotions to protect themselves when faced with stressful or traumatic situations. Repression has been linked to lower levels of distress, which can actually be quite detrimental to the individual because they actively ignore negative symptomatology (Denollet, Martens, Nyklíček, Conraads, & de Gelder, 2008). A major controversy in this area of research focuses on whether or not there are gender differences in repressive coping styles, as the findings from these studies have yet to form a clear consensus on this relationship (Ros, Ricarte, Serrano, Nieto, Aguilar, & Latorre,

2014). For instance, Ros, et al.'s (2014) study found a link between depressive symptoms, OGMs and repression in their female participants, but only a link between depressive symptomatology and repression was found in their male participants. Geraerts, Dritschel, Kreplin, Miyagawa, and Waddington (2012) found that individuals who exhibit a repressive coping style produced significantly more OGMs when asked to produce a negatively-charged AM, suggesting that the emotional valence of the memory might also be an important factor to consider. Furthermore, when faced with a positively-charged word cue, all groups were roughly equivalent in the number of OGMs they recalled (Geraerts, et al., 2012). The same result was observed in a study of memory recall in participants with Borderline Personality Disorder (BPD) and dissociative habits; those with BPD and dissociative habits expressed more general AMs than the control cohort when the AMT was administered (Jones, Heard, Startup, Swales, Williams, & Jones, 1999). Additionally, when the emotional component of the word cue was analyzed, those with dissociative tendencies produced significantly more OGMs and non-specific responses to *negatively-charged* word cues than their counterparts (Jones, et al., 1999)

***Dissociative Coping Styles***

Dissociation is often misunderstood as being the same phenomenon as repression; however, they are actually quite different. Previously, dissociation was believed to be on a dimensional continuum, extending from normal to dissociative disorders (Bryant, 2007; James, 1890; Prince, 1905; Spitzer, Barnow, Freyberger & Grabe, 2006). Today, it is understood that dissociation is a type of disconnectedness from oneself and/or environment, resulting in dissociative re-experiencing, derealization, and/or depersonalization (Carlson, Dalenberg, & McDade-Montez, 2012). Dissociative re-experiencing or "flashbacks" are short but intense occurrences that are often prompted by an external stimulus related to a traumatic event (Carlson, Dalenbeg & McDade-Montez, 2012). Derealization and depersonalization are distortions of one's surroundings or within oneself, respectively (Carlson, Dalenberg & McDade-

Montez, 2012). More mild expressions of dissociation are regarded as symptoms or habits caused by an event, whereas more extreme versions are characterized as their own disorders (e.g., Dissociative Identity Disorder (DID)). Brain imaging research on dissociation and memory in those with PTSD has led to the Hippocampal-Amygdala Double Dissociation Theory, which argues that, in the face of fear and panic, the amygdala is deactivated and consequently, causes a disruption in the processing and integration of the event's contextual components; normal hippocampal memory processing requires the hippocampus to work in conjunction with the amygdala and glucocorticoids (Axmacher, et.al., 2010; Bechara, Tranel, Damasio, Adolphs, Rockland, & Damasio, 1995; Brewin, 2001; LaBar, LeDoux, Spencer, & Phelps, 1995; Raybuck & Lattal, 2011). Preliminary brain imaging studies on rumination and memory suggest functional abnormalities in the default mode network (DMN) of the brain, which includes the anterior medial prefrontal cortex cortex (amPFC), the posterior cingulate cortex, the dorsal medial prefrontal cortex subsystem, and the medial temporal lobe (MTL) subsystem (Zhou, et al., 2020). It is believed that many of these brain structures involved in the DMN are important areas for memory processing and recall. For instance, the amPFC and the MTL subsystem were found to be involved in self-reference memory that influence memory processing and autobiographical memory recollection, respectively (Zhou, et al., 2020). Huntjens, et al. (2014) explored OGMs in patients with DID. They found that, compared to the healthy controls, the DID sample group produced significantly more OGMs during Williams and Broadbent's (1986) AMT (Huntjens, et al., 2014). This study also found increased AM specificity deficits in their DID sample group compared to their PTSD sample group (Huntjens, et al., 2014).

***Types of Trauma***

Along with examining at specific trauma coping styles, research on the relationship between trauma and AM have also looked at specific *types* of trauma. For instance, Crane and Duggan's (2009) study on individuals, who had experienced childhood sexual abuse, found that

those who had been sexually abused at an earlier age produced more OGMs and less specific memories. Ogle, et al.'s (2013) study also found increased OGMs and decreased AM specificity in their sample group of individuals who had experienced childhood sexual assault; this correlation remained significant even after they controlled for depressive symptoms. Similar findings were observed in Raes, Hermans, Williams and Eelen's (2005) study on memory specificity in survivors of emotional abuse. More specifically, they found that those who had not received support for their past trauma reported even more OGMs compared to those who had been emotionally abused and *did* receive support (Raes, et al., 2005). These studies exemplified the findings of the literature in this area — that individuals who have experienced a traumatic event in their lifetime produce more OGMs and less specific AMs. However, a key limitation in this body of research is that the treatment groups in almost all of these studies have a clinical trauma-related diagnosis, i.e., PTSD or acute stress disorder (ASD). Few studies explore whether a person who has experienced a traumatic event, but does not meet the Diagnostic and Statistical Manual of Mental Disorders, 5$^{th}$ Edition (DSM-V) criteria for PTSD or ASD, produces OGMs and exhibits reduced memory specificity. It is crucial that this gap be addressed, given that only 7-8% of the U.S. population will receive a clinical diagnosis of PTSD, despite the fact that more than 50% of the entire U.S. population will experience a traumatic event at some point in their lives (*VA.gov: Veterans Affairs*, 2018).

**The Coronavirus Pandemic**

In our current day and age, a new "cultural trauma" has been distinguished (Demertzis & Eyerman, 2020, pp. 1). The first positive Coronavirus (COVID-19, SARS-CoV-2) case was confirmed in the United States on January 15, 2020; however, public fear and mass hysteria consumed the entire country before this confirmation (Centers for Disease Control and Prevention, 2020). Since then, this pandemic has severely affected all persons, nationally and internationally. Throughout the year of 2020, various state-wide lockdowns, stay-at-home orders,

and travel restrictions have been implemented. Although these orders were applied to help the country's citizens by *flattening the curve*, aspects of these state and federal orders have been found to cause increased depressive thoughts (Holman, Thompson, Garfin, & Silver, 2020; Rossi, et al., 2020; Son, Hedge, Smith, Wang, & Sasangohar, 2020), sleep-related problems and disruptions, e.g., insomnia (Rossi, et al., 2020; Son, et al., 2020), difficulties with concentration (Son, et al., 2020), adjustment disorder symptoms and Post-traumatic Stress Syndrome (PTSS; Rossi, et al., 2020). Therefore, we can conclude that there are major psychological consequences, along with social and economic repercussions, that have already occurred in response to this disaster that has "[created] an immense barrier on the usual functioning of the society" (Makwana, 2019, p. 3091).

The pandemic has not impacted every person equally. One study found that 53.8% of the 1,210 Chinese adults surveyed, reported that their psychological impact from the pandemic was either moderate or severe (Wang, Hedge, Son, Keller, Smith & Sasangohar, 2020). More specifically, 28.8% and 8.1% of these participants reported moderate or severe anxiety symptoms and stress levels, respectively (Wang, et al., 2020). In this preliminary study, 84.7% spent 20-24 hours per day at home, supporting the argument that the pandemic's stay-at-home orders may actually be contributing to the psychological distress that the general population is experiencing (Matias, Dominski & Marks, 2020; Wang, et al., 2020). In another study, more than 50% of the 678 participants demonstrated signs of stress, anxiety, and/or depression, with increased days in quarantine and isolation and decreased exercise all being associated with more symptoms (Shah, Mohammad, Quereshi, Abbas & Aleem, 2021). They also identified young adults (ages 18-24), students, and participants who identify as female as three subpopulations that were significantly associated with greater stress, anxiety, and depressive symptomatology (Shah, et al., 2021).

These subpopulations have hardly been explored, despite the fact that many studies have identified these groups as being at increased risk for more psychological distress from COVID-19. Most of the studies that have examined the psychological impact of COVID-19 have focused on general adult populations or essential healthcare workers. College students have only been included in a limited number of studies; however, these studies suggest that this specific population is experiencing tremendous psychological distress and diminished mental health and well-being (Hasan & Bao, 2020; Yang, Tu & Dai, 2020), along with increased perceived stress, alcohol use, and mood disorder symptoms (Charles, et al., 2021). Additionally, in Son, et al.'s (2020) study of 195 U.S. college students, a frightening 71% reported that they were experiencing increased anxiety and stress from the current pandemic. This statistic was also observed in Wang, et al.'s (2020) study, even though their sample group was approximately ten times larger. Furthermore, Wang, et al. (2020) also found that 18.04% of their sample group of U.S. undergraduate students reported having suicidal thoughts.

Although almost every population has been found to have increased psychological distress from COVID-19, it is important to remember that this specific population already has been found to have higher levels of baseline psychological distress compared to the general population, even during pre-pandemic life. For instance, one study found that 50.7% of the 5,689 American university students surveyed met criteria for MDD, panic disorder, and/or GAD (Keyes, et al., 2012). Given that individuals with pre-existing psychological conditions have already been found to have higher stress levels from the COVID-19 pandemic, it is crucial that we understand more about how the pandemic affects high stress populations, such as college students (Asmundson, et al., 2020).

**Autobiographical Memory and The Coronavirus Pandemic**

Additionally, the period between 18 and 29 are crucial for self-identification and identity formation (Arnett, 2004). According to McAdams's (1987, 2001) Life Story Theory, an

individual's adolescent years are when "we find our voice and begin to tell our life [stories]" (Singer & Bluck, 2001, p. 95). If one's AM narratives are disrupted, especially when an individual is an adolescent or a young adult, the development of their own identity will very likely also be negatively impacted. Therefore, it is crucial that we study AM specificity in individuals around this age group. Thus far, preliminary research has been conducted to examine AM specificity in college students in regard to psychological disorder vulnerability (e.g., Gibbs and Rude, 2004) or to specific traumatic events (e.g., Pezdek, 2003). Pezdek's (2003) study explored AM in response to the events of September 11, 2001 in a sample of 559 college students from New York, California, and Hawaii. They found that the New York college students had the most accurate event memory but were also the most distressed by the situation (Pezdek, 2003). It is important to note that this group of college students also produced significantly more categorical memories, e.g., OGMs, compared to the college students from California and Hawaii (Pezdek, 2003). Furthermore, Pezdek (2003) observed that 73% of the sample group incorrectly recalled what they were doing during the traumatic event.

COVID-19, like September 11, 2001, is considered a traumatic event (Demertzis & Eyerman, 2020). However, unlike September 11, 2001 which occurred over the span of a couple hours, COVID-19 has been traumatizing the U.S. for over a year. Stress has been found to significantly impair a person's mental health and psychological well-being, especially when sustained over a long duration. Studies have found that exposure to prolonged stress significantly disrupts a person's homeostatic processes, which subsequently increases their chance of developing a psychological disorder, e.g., depression (Takeda, et al., 2004). The body's autonomic nervous system is responsible for controlling a person's response to a stressor (Masood, 2015). Therefore, most research studies have used electrodermal activity (EDA) and/or heart rate variability (HRV) to track their participants' physiological measures of stress (Masood, 2015). EDA, measured by an Empatica E4 Wristband, was incorporated into the present study to

track participants' physiological stress levels. These studies on stress have also identified prolonged stress as having the potential to cause significant changes to a person's brain functions and structures, which may eventually result in working memory impairments (Bagheri, 2020).

The working memory, as discussed by Alan Baddeley and Graham Hitch, is divided into three parts: the central executive, the phonological loop, and the visuospatial sketchpad (Baddeley & Hitch, 1974). The working memory allows for short chunks of information to be easily accessed and recalled over a short period of time. One study looked at working memory task performance in response to emotionally salient memory recollections (Allen, Schaefer, & Falcon, 2014). These researchers found significant disruptions in working memory functioning for AM + positive affect recollections and for AM + negative affect recollections (Allen, Schaefer, & Falcon, 2014). Other studies have linked working memory deficits to attentional and executive dysfunctions (Gathercole, et al., 2008), schizophrenia (Park & Holzman, 1992), and attention-deficit/ hyperactivity disorder (Rapport, et al., 2008).

Thus far, there are many studies that have looked at stress (e.g., academic and social stressors, Brougham, Zail, Mendoza, & Miller, 2009) in college students; however, there is a lack of literature on college students' stress *responses* towards general stressors and traumatic stressors.

**Objectives of the Present Study**

Additionally, although there are many studies about the psychological consequences of the current COVID-19 pandemic, there are no studies that look at the intersection of biological sex, AM specificity, and COVID-19-related stress. Therefore, in this study, we examined the effects of an induced pandemic-related stressor on Autobiographical Memory performance and functioning through the use of the Autobiographical Memory Test (AMT; Williams & Broadbent, 1986) and the Mannheim Multicomponent Stress Test (MMST; Kolotylova, et al., 2009) (Primary Study Outcome). Williams and Broadbent's (1986) AMT was chosen due to its

availability and wide usage throughout current AM literature. Kolotylova, et al.'s (2009) MMST was used as the induced stressor. The MMST has been designed to induce heightened levels of stress in individuals due to its incorporation of four different modalities of stressors (motivational, acoustic, emotional, and cognitive) over a duration of five minutes. This test was chosen because it is more reliable in eliciting a stress response in its participants compared to other stress tests, e.g., the Trier Social Stress Test (Allen, et al., 2016), and because of its ability to adapt to the present study's topic of COVID-19. More specifically, the MMST's emotional stress modality refers to its incorporation of imagery of both positive and negative affect. Therefore, these pictures were able to be adapted to the present study's topic (COVID-19) and the present study's sample group (college students). Similarly, to how Rubaltelli, Scrimin, Moscardino, Priolo and Buodo's (2018) study on perceptions of terrorism included pictures related to terrorism, the present study included imagery related to the Coronavirus pandemic. Due to the current literature in this area, the study hypothesizes that AM performance will decrease in the second AMT (stressed condition), administered immediately after the induction of the COVID-19-related stressor.

Previous studies that have used the AMT and/or the MMST have not united on whether or not there are gender differences in AMT performance or in stress response to an induced stressor. Therefore, the present study also aimed to explore whether a participant's sex assigned at birth affects their Autobiographical Memory performance (Secondary Study Outcome) and/or their response to the induced pandemic-related stressor (Tertiary Study Outcome). Additionally, although it was previously hypothesized that individuals respond differently to stress as a result of their biological sex, the literature on this relationship is very limited (Verma, Balhara, & Gupta, 2011). Furthermore, the research on the psychological consequences of trauma by biological sex is incompatible, as some studies have suggested an elevated response in males (e.g., Kudielka, Buske-Kirschbaum, Hellhammer & Kirschbaum, 2004), whereas others have

found no significant differences (e.g., Kirschbaum, Klauer, Filipp & Hellhammer, 1995). As for the effects of experiencing a traumatic event on AM performance, no conclusive link between these two variables have been found or explored in-depth. This gap in literature is also seen in regard to the relationship between biological sex and AM performance; some studies have found no significant effects of sex (e.g., Kihlstrom & Harackiewicz, 1982), whereas others have found better AM performance in females (e.g., Dudycha & Dudycha, 1933). Additionally, preliminary research has suggested that the psychological consequences of trauma, e.g., PTSD diagnoses, are more prevalent in females than for males (e.g., Ditlevsen & Elklit, 2010); however, more extensive research needs to be completed before this correlation can be confirmed. Given the inconsistency of the literature, the present study made no predictions regarding the effect of participant's sex assigned at birth on their AM performance or their stress response to the induced pandemic-related stressor. The present study uses the terms "sex" and "gender" to refer to a participant's sex assigned at birth and not how the participant identifies.

Lastly, an extensive literature review of the current COVID-19 pandemic has prompted a tremendous amount of literature on risk and public perceptions. Studies have found that certain factors, e.g., personal experience with the COVID-19 virus, greatly increases one's risk perceptions and levels of concern (Dryhurst, et al., 2020). The fact that risk perceptions are so great, especially in younger populations, is worrisome as exposure and victimization to a trauma has been correlated with poorer academic and social outcomes (Ratner, Chiodo, Covington, Sokol, Ager & Delaney-Black, 2006). Therefore, the present study also aimed to explore the relationship between participants' perceptions of and past experiences with the current COVID-19 pandemic, measured by three of Conway III, Woodard and Zubrod's (2020) Coronavirus Questionnaires, in regard to their performance and response to the MMST (Quaternary Study Outcome). Given the novelty of the pandemic, very few questionnaires, besides Conway III, Woodard and Zubrod's (2020) collection of Coronavirus questionnaires have been validated.

Short versions of their three questionnaires: Perceived Threat, Experiences and Impacts, were combined in the present study to appropriately understand how the participant has experienced and how they currently perceive the current pandemic. It was hypothesized that more negative perceptions and past experiences will result in decreased performance on the two MMST tasks (arithmetic and photo recognition).

## Method

### The Photographic Validation Study

#### *Participants*

The photographic validation study protocol was approved by the Connecticut College Institutional Review Board (IRB). This study was conducted using Connecticut College Introduction to Psychology (PSY 100) undergraduate students (*N*=115) from November 2020 to December 2020. The purpose of this study was to find the reliability and validity of the 100 photos (80 unique and 20 repeated) that will be used in the present study (the main study). The majority were assigned female at birth (*n*=65) and identified as female (*n*=63). The major or intended major of the majority of the participants was psychology (*n*=25). The sample consisted of 61.4% of participants identifying with the Democratic Party and 12.5% of participants identifying with the Republican Party. Out of the 88 participants who answered questions about their past experience with COVID-19, only six participants (6.8%) had ever received a positive COVID-19 test. Furthermore, 92% of participants (*n*=80) knew at least one person who had tested positive for COVID-19, with 21.3% knowing at least ten people.

#### *Measures*

**Photographic Stimuli from the Mannheim Multicomponent Stress Test (MMST) (see Appendix C).** Participants were presented with 120 unique photos. 20 of these photos were of positive/neutral emotion and 100 of them were stressful, COVID-related images (negative

emotion). The first part of the study included the presentation of the 20 positive/neutral emotion images. The second part of the study consisted of the presentation of the 100 negative COVID-related images. All photos were in color and presented on the screen for three seconds.

**Subjective Two-Component Rating Scale (STCRS) (see Appendix D).** A version of the Subjective Two-Component Rating Scale (STCRS) was created for the validation study to assess the stressfulness and emotionality of the photographic stimuli. The STCRS has been adopted from previous studies (Korre, et al., 2014; Lang, 1980; Mehrabian & Russel, 1974). The multicomponent aspect (two self-report questionnaires that used 9-point Likert scales to assess three different components: pleasure, arousal, and dominance) was adopted from the Self-Assessment Manikin (SAM; Lang, 1980) and from the Semantic Differential Scale (SDS; Mehrabian & Russel, 1974). The components for the validation study were 1) stressfulness and 2) emotionality. *Stressfulness*, designed from Korre, et al.'s (2014) study, used a 9-point Likert scale, instead of an 11-point Likert scale, to be consistent with the 9-point Likert scale, derived from the SAM and SDS, used for *emotionality* (Lang, 1980; Mehrabian & Russel, 1974). *Stressfulness* mirrored Korre, et al.'s (2014) scale through its use of a single continuum design (1=No stress at all, 9=Extreme stressful). *Emotionality* used a double continuum design (1=Emotionally negative, 4=Emotionally neutral, 9=Emotionally positive).

***Procedure***

The validation study was administered remotely via Qualtrics. Participants were first presented with an informed consent document (see Appendix A) before viewing the directions page (see Appendix B). They began with the first set of positive/neutral photos (see Appendix C) and were prompted to answer the two STCRS questions immediately after each photo (see Appendix D). After all 20 photos were viewed and rated, the participants began the second set of stressful, COVID-19-related images (see Appendix C). After viewing and rating all 100 pandemic-related images, they were provided with a short demographic questionnaire (see

Appendix E), a debriefing form (see Appendix F), and 0.75 SONA Credit hours for their participation.

***Results***

RStudio (Version 1.3.1093) was used to find the average stressfulness and emotionality scores of the 20 photos of positive/neutral emotion and 100 COVID-19-related photos. The main study used 16 photos of positive/neutral emotion focused on identifying and validating these images.

**Positive/Neutral Images.** RStudio (Version 1.3.1093) was used to find the average emotionality and stressfulness rating for each photo to identify the 16 photos with the lowest stressfulness rating and the highest positive emotionality rating. Then, RStudio (Version 1.3.1093) was used to calculate the average ratings for all 16 photos. These photos had an average emotionality rating of 7.53 (*SD*=1.67) on a 9-point Likert scale (1=Emotionally negative, 9=Emotionally positive), and an average stressfulness rating of 1.81 (*SD*=1.49) on a 9-point Likert scale (1=No stress at all, 9=Extreme stress). Good reliability was found for emotionality (Cronbach's $\alpha$ = .8544) and for stressfulness (Cronbach's $\alpha$ = .6701). Internal consistency and construct validity were calculated using Confirmatory Factor Analysis (CFA). CFA scores for stressfulness and emotionality were found to be .7041 and .8565, respectively.

**Stressful, COVID-19-related Images.** RStudio (Version 1.3.1093) was used to find the average emotionality and stressfulness rating for each photo to identify the 64 photos with the highest stressfulness rating and the highest negative emotionality rating. Then, RStudio (Version 1.3.1093) was used to calculate the average ratings for all 64 photos. These photos had an average emotionality rating of 2.34 (*SD*=1.53) on a 9-point Likert scale (1=Emotionally negative, 9=Extremely positive) and an average stressfulness rating of 6.474 (*SD*=2.44) on a 9-point Likert scale (1=No stress at all, 9=Extreme stress). High reliability was found for emotionality (Cronbach's $\alpha$ = .9680) and for stressfulness (Cronbach's $\alpha$ = .9865). Internal

consistency and construct validity were again calculated using CFA. CFA scores for stressfulness and emotionality were found to be .9866 and .9691, respectively.

## The Main Study

### *Participants*

The study protocol was approved by the Connecticut College IRB. This study includes data from 33 undergraduate students at Connecticut College, between the ages of 18 and 25. Data collection was conducted through in-person interviews, beginning on February 22nd, 2021 and concluding on March 17, 2021.

Inclusion criteria included being fluent in English, being an undergraduate student at Connecticut College, living on campus or being able to commute to campus during the COVID-19 hybrid semester, being at least 18 years of age, and not being enrolled in Introduction to Psychology (PSY 100) during the 2020-2021 academic year. Additionally, any participant who did not complete the COVID-19 Pre-Study Agreement Form at least one week prior to their testing date were excluded from the study (see Appendix H). A total of 33 undergraduate students at Connecticut College (15.8% freshmen, 42.1% sophomores, 21.1% juniors, 21.1% seniors) were included in the present study. All participants received $40 as monetary compensation for the study; however, they believed that their actual amount of compensation was between $25-$40 and would be determined by their performance on the Mannheim Multicomponent Stress Test (MMST). The payment was consistent with the Connecticut College Human Subjects Payment Policy and was provided as a gift card (e.g., Amazon). This use of deception was approved by the Connecticut College IRB and was the only use of deception in the study.

### *Measures*

**Coronavirus Questionnaire on Perceived Threat, Experiences, and Impacts (CQ-PTEI) (see Appendix J).** Three of Conway III, Woodard & Zubrod's (2020) Coronavirus

questionnaires were combined and used in this study. The Coronavirus Questionnaire on Perceived Threat, Experiences, and Impacts (CQ-PTEI) was created from consolidating the Perceived Coronavirus Threat Questionnaire (Short), Coronavirus Experiences Questionnaire (Short), and the Coronavirus Impacts Questionnaire (Short) (Conway III, Woodard, & Zubrod, 2020). The CQ-PTEI included 16-items and was rated on a 7-point Likert scale, ranging from 1 (not like me at all) to 7 (very much like me) (see Appendix E). Conway III, Woodard and Zubrod (2020) found high Cronbach's alpha scores for all three questionnaires (.90, .64-.71, and .76-.93, respectively). For the present study, high reliability was found for the combined questionnaire (Cronbach's $\alpha$ = .811). Cronbach's alpha scores for the individual three questionnaires (Perceived Coronavirus Threat Questionnaire (Short), Coronavirus Experiences Questionnaire (Short), and the Coronavirus Impacts Questionnaire (Short)) were .858, .835, and .484, respectively.

The CQ-PTEI was used as a pre-study screening tool. It was used as a method of ethically identifying participants who may have had traumatic past experiences with COVID-19 that would cause them to possibly experience too much anxiety from the main study. Due to these Coronavirus questionnaires being quite new, a threshold or cut-off score has not yet been established. The method used in Chung, Lanier, and Wong's (2020) study to determine a threshold for the Coronavirus Impacts Questionnaire influenced the method used in the present study (Conway III, Woodard & Zubrod, 2020). As a result, a cut-off score of $\geq 80$ was applied.

**State-Trait Anxiety Inventory for Adults (STAI-AD) (see Appendix K).** An electronic version of the State-Trait Anxiety Inventory for Adults (STAI) Form-Y-1, created by Spielberger, Gorsuch, Lushene, Vagg and Jacobs (1983), was used. For the purpose of this study, the STAI for Adults S-Anxiety (state anxiety) was used. This self-report measure, conducted at the beginning and at the end of the study, indicated participants' awareness of their own stress levels and demonstrated how much psychological anxiety they were experiencing at that

moment. High internal consistency and validity has been found for both parts of the STAI (STAI-S and STAI-T), with Cronbach's alphas ranging from .86-.95 and test-retest reliability coefficients ranging from .69-.89 (Spielberger, 1989; Spielberger, et al., 1983). The STAI-S includes 20 statements (e.g., "I feel tense") that are rated by the participant using a 4-point Likert scale, ranging from 1 (not at all) to 4 (very much so). According to the STAI-S, low, medium, and high anxiety corresponds to scores of 20-40, 40-60, and 60-80, respectively (Delgado, Freire, Wanderley, & Lemos, 2016). Therefore, for the present study, a cut off score of ≥ 60 was used. A Remote Online Survey License of 66 copies of the STAI-AD Form-Y-1 was purchased for $165 from MindGarden. In the present study, high reliability was found for the 20 statements in both the unstressed (Cronbach's $\alpha$ = .938) and the stressed (Cronbach's $\alpha$ =.922) conditions.

**Autobiographical Memory Test (AMT) (see Appendix L).** The AMT for the present study used the cue word structure from Williams and Broadbent's (1986) Autobiographical Memory Test (AMT) and the study procedure from McNally, Lasko, Macklin, and Pitman's (1995) study. The first AMT (unstressed condition) and the second AMT (stressed condition) followed the same procedure (two practice words followed by eight test words that alternate between positive and negative emotions). Cue words were chosen from Anderson's (1986) list of 555 personality-trait words, according to their relevance to the present study's population (e.g., positive cue word: loyal; negative cue word: dishonest). All of the positively- and negatively charged word cues were words that comprised the top fifty "most liked" or "least liked" words, respectively (Anderson, 1986). The practice words were all located in the middle of Anderson's (1986) word list, which suggested that they were of neutral emotion. These words were used to create two word lists: Word List A and Word List B (see Appendix G). The words were cross analyzed using the Oxford English Dictionary (OED), the Affective Norms for English Words (ANEW), and the Word Frequencies in Written and Spoken English (WFWSE) to ensure

consistency across the two word lists (Bradley & Lang, 1999; Leech, Rayson, & Wilson, 2001; Oxford English Dictionary).

Participants were instructed to recall a specific memory during which they experienced the cue word presented. All participants (*N*=33) agreed to be recorded during both AMTs. The study's PI scored participants on three parameters. *Duration of memory retrieval* was scored by the length of time it took the participant to recall the memory (in seconds). Participants received up to 60 seconds for each cue word. *Affective response to the memory* ("affective response") referred to the emotion that the participant embodied when recalling the memory. Participants received a score of -1 (negative), 0 (neutral) or +1 (positive) for each memory. *Memory specificity*, how detailed the recalled memory was, was scored a scale of 0 (no memory recalled) to 4 (specific AM). Below are examples of memories that were recalled during the study; any identifying information has been redacted and cue words are <u>underlined</u>. Consent forms were obtained in order for the memories to be used (see Appendix Q). The study's PI was the rater for all participants. For the purposes of participant confidentiality, only the study's PI was approved to access the recordings and to complete the scoring of these tests. For full information on how participants were scored, please see Appendix L.

**Specific AM (score = 4)**

> *I felt <u>friendly</u> today when I saw a friend at the testing center. And we stopped and talked because we hadn't seen each other in a while, and we were just catching up.*

**Extended Memory (score = 3)**

> *During finals week last year, my boss at [location] where I work, [they] are lovely; however [they] are very outspoken and [they] decided to get involved in some college drama that I was having…and yeah that was very <u>rude.</u>*

**Semantic Associate Memory (score = 2)**

*I did an interview with a prospective student 2 weeks ago, and those are always situations where I have to be like really friendly and like talkative.*

**OGM (score = 1)**

*Unkind…last month, having feelings of hate towards [person] instead of being compassionate.*

**Mannheim Multicomponent Stress Test (MMST) (see Appendix M).** Kolotylova, et al.'s (2009) Mannheim Multicomponent Stress Test (MMST) was used to induce stress in the study's sample group. The MMST is designed to induce heightened stress in a participant due to the incorporation of four modalities of stressors (motivational, acoustic, emotional, and cognitive) over a duration of five minutes. In this test, once each stressor was introduced, it was sustained until the end of the five minutes. The primary acoustic stressor in this study was a white noise played through a computer from the White Noise Lite application (Tmsoft, 2008). The secondary acoustic stressor was the "Game Show Buzzer" from the iBuzz iPhone application (Swift Fox Software LLC, 2009), which was played every time a mistake was made in the arithmetic task. To ensure consistency across all participants, a 1.5 second recording of this sound was recorded into a red buzzer, purchased off of Amazon. The emotional stressor included the 80 photographs that were validated from the validation study. 64 of the 80 photographs and news headlines were associated with the Coronavirus pandemic on topics that specifically pertained to events related to college students, e.g., academic performances and social interactions. The cognitive stressor was a verbal arithmetic task, designed from the Paced Auditory Serial Addition Task (PASAT), where participants were presented with single digit numbers and instructed to add them consecutively (Fischer, Jak, Kniker, Rudick, & Cutter, 2001). The PASAT is frequently used as the arithmetic task in the MMST (e.g., Cackowski, et

al., 2014; Krause-Utz, et al., 2016; Reinhardt, Schmahl, Wüst, & Bohus, 2012). The motivational stressor referred to the participant's belief that their monetary reward would decrease by 35 cents with each mistake that they made in the arithmetic task. The test began with the white noise and the photographic recognition task. At the beginning of the second minute, the arithmetic task began.

**Empatica E4 Wristband.** An Empatica E4 Wristband was used to measure and record each participant's electrodermal activity (EDA) throughout the entire duration of the study, particularly at the baseline timepoint (unstressed condition) and during the MMST (stressed condition). The unit of measurement that is commonly used for skin conductance (EDA), microSiemens (μS), was used in the present study. This device is noninvasive, records values in real time, and was available for use at Connecticut College. Further, the validity and effectiveness of the E4 Wristband has been proven in many studies (e.g., Can, et al., 2020; Kaczor, Carreiro, Stapp & Indic, 2020; Menghini, et al., 2019).

***Procedure (see Figure 1)***

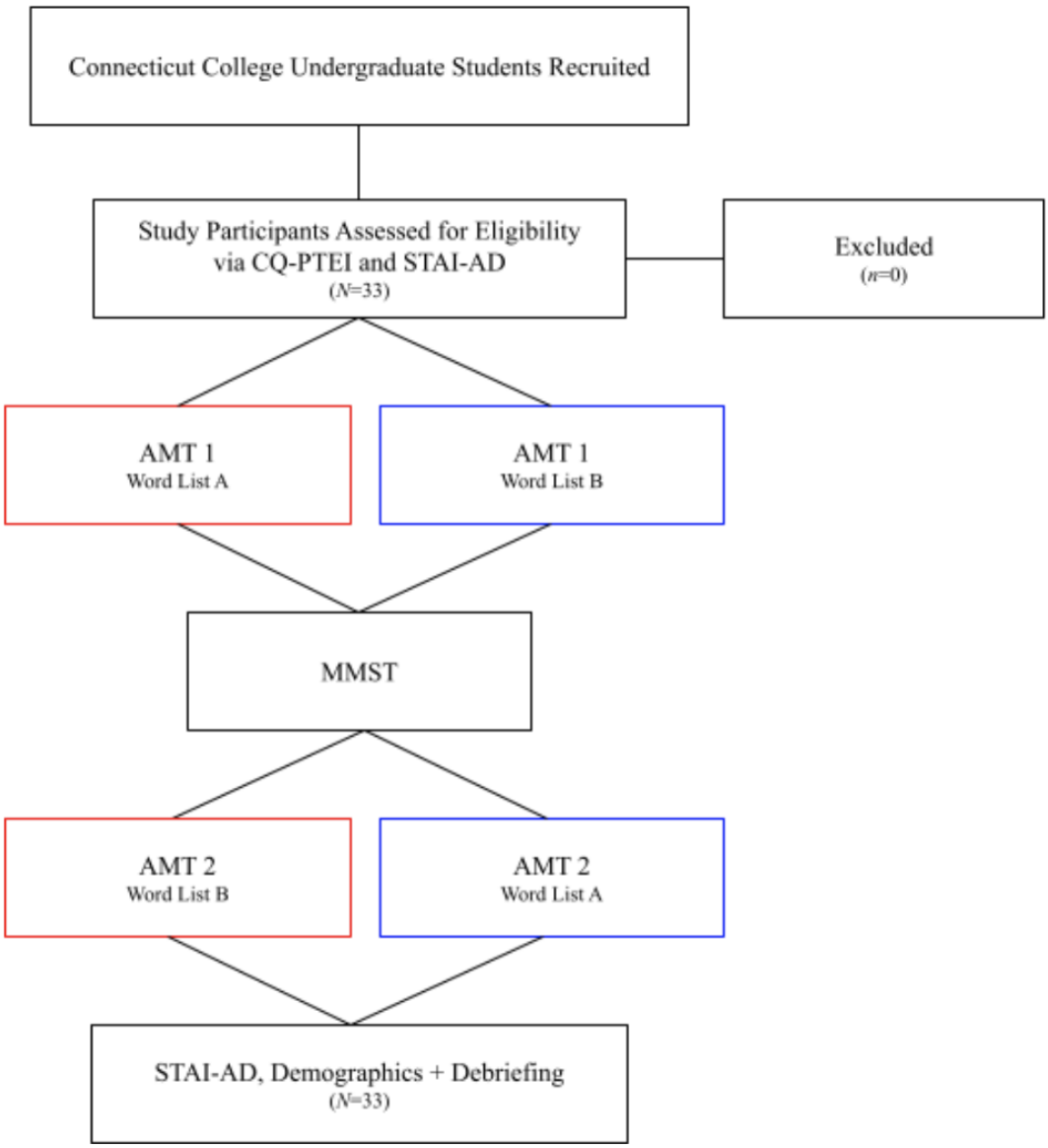
Recruitment to the study was completed via emails which contained the official Letter of Invitation to Participate in Research (see Appendix G). An equal number of emails were sent to Connecticut College students from each class year (2021, 2022, 2023, 2024). The students who received emails were selected randomly. All prospective participants were required to complete and return the COVID-19 Pre-Study Agreement Form to the study's PI at least one week prior to their scheduled testing time (see Appendix H). The COVID-19 Pre-Study Agreement Form ensured the safety of the study team and of all participants and complied with Connecticut College's COVID-19 policies.

At the beginning of each testing time block, proper COVID-19 precautions were taken, e.g., the PI sanitized all applicable materials and ensured that the participant was wearing a mask. The participant then completed an electronic version of the study's Informed Consent

Form (see Appendix I), of the Coronavirus Questionnaire on Perceived Threat, Experiences, and Impacts (CQ-PTEI; Conway III, Woodard & Zubrod, 2020) and of the State-Trait Anxiety Inventory for Adults (STAI-AD; Spielberger, et al., 1983). At this time, any participant who received a CQ-PTEI score ≥80 and/or a STAI-AD score ≥60 was eliminated from the study and was provided with the simplified debriefing form ($n$=0) (see Appendix P). Eligible participants ($N$=33) were then instructed to put the Empatica E4 Wristband on their left wrist. All participants who did not reach the cut-off scores were randomly assigned to Group 1 or Group 2 (see Figure 1). They then completed the first AMT (unstressed condition) of either Word List A (Group 1) or Word List B (Group 2; see Appendix L). Then, the MMST was conducted (see Appendix M). Immediately after, the second AMT (stressed condition) was conducted, with the word list that was not previously used for the current participant (see Appendix L). The participants were instructed to complete the electronic version of the STAI-AD again (see Appendix K). Then, they were instructed to take off the Empatica E4 Wristband and complete the electronic demographic questionnaire (see Appendix N). Lastly, the PI verbally asked the participant about their general mental and physical conditions and provided them with an electronic debriefing form (see Appendix O). Participants were emailed upon conclusion of data collection regarding their compensation. Study compensation was in the form of $40 gift cards and aligned with the Connecticut College Human Subjects Payment Policy.

**Figure 1**

*Study Design*




*Note.* Participants were divided into Group 1 (*n*=16) and Group 2 (*n*=17) randomly. Red boxes denote steps unique to Group 1 and blue boxes denote steps unique to Group 2. All participants completed the black boxes in the same manner.

# Results

## Sample Characteristics

In total, 33 undergraduate students from Connecticut College completed the study. No students were eliminated from the study due to incomplete responses or to exclusion criteria. The majority of participants identified as female (*n*=18, 54.5%) and reported that their assigned sex at birth was “female” (*n*=19, 57.6%). All participants (*N*=33) were born between 1998 and 2002, making the age range 18-23 years. The study found that 90.9% (*n*=30) of participants identified as white/Caucasian and 66.7% (*n*=22) of participants reported being part of the Democratic Party. In the sample, 18.2% (*n*=6) of participants reported experiencing a traumatic event, while 27.3% and 6.1% of participants reported being clinically diagnosed with an anxiety disorder or a trauma/ stress-related disorder, e.g., PTSD, respectively (American Psychiatric Association, 2013). Full study sample demographic characteristics are shown in Table 1.

**Table 1**

*Study Sample Demographic Characteristics*

| Sex Assigned at Birth | Female *n* = 19 | | Male *n* = 14 | |
|---|---|---|---|---|
| | *n* | % | *n* | % |
| Gender Identified With | | | | |
| Female | 18 | 94.7% | 0 | 0.0% |
| Male | 0 | 0.0% | 14 | 100.0% |
| Other | 1[a] | 5.3% | 0 | 0.0% |
| Class Year | | | | |
| 2021 | 4 | 21.1% | 5 | 35.7% |
| 2022 | 4 | 21.1% | 5 | 35.7% |
| 2023 | 8 | 42.1% | 2 | 14.3% |
| 2024 | 3 | 15.8% | 2 | 14.3% |
| Birth Year | | | | |
| 2002 | 1 | 5.3% | 1 | 7.1% |
| 2001 | 8 | 42.1% | 1 | 7.1% |
| 2000 | 3 | 15.8% | 4 | 28.6% |
| 1999 | 5 | 26.3% | 6 | 42.9% |
| 1998 | 2 | 10.5% | 2 | 14.3% |
| Race/Ethnicity[b] | | | | |
| Asian | 1 | 5.3% | 1 | 7.1% |
| White/Caucasian | 17 | 89.5% | 13 | 92.9% |
| Other | 1 | 5.3% | 0 | 0.0% |

| | | | | |
|---|---|---|---|---|
| Political Party | | | | |
| Democratic | 16 | 84.2% | 6 | 42.9% |
| Republican | 2 | 10.5% | 5 | 35.7% |
| Other | 0 | 0.0% | 2 | 14.3% |
| Prefer Not to Answer | 1[c] | 5.3% | 1[c] | 7.1% |
| Ever Experienced a Trauma?[d] | | | | |
| Yes | 6 | 31.6% | 0 | 0.0% |
| No | 13 | 68.4% | 14 | 100.0% |
| Ever Been Clinically Diagnosed with a Trauma or Stress-Related Disorder? | 2 | 10.5% | 0 | 0.0% |
| Yes | 17 | 89.5% | 14 | 100.0% |
| No | | | | |
| Ever Been Clinically Diagnosed with an Anxiety Disorder? | | | | |
| Yes | 7 | 36.8% | 2 | 14.3% |
| No | 12 | 63.2% | 12 | 85.7% |

[a] This participant reported that they self-identified as "genderfluid/genderqueer."

[b] No participants identified as Black/African, Hispanic/Latino, Pacific Islander, or Native American.

[c] These individuals reported that they politically identified as "Independent."

[d] Participants were told to use the DSM-5 definition of a trauma (American Psychiatric Association, 2013).

***Coronavirus Socio-Demographic Characteristics***

At the time of testing, most participants reported that they had not received a positive COVID-19 test (*n*=30, 90.9%); however, all participants (*N*=33, 100.0%) reported that they knew at least one person who has tested positive for COVID-19, with 81.8% of participants knowing at least four persons. Full Coronavirus socio-demographic variables are shown in Table 2.

**Table 2**

*COVID-19 Socio-demographic Variables*

| Sex Assigned at Birth | Female *n* = 19 | | Male *n* = 14 | |
|---|---|---|---|---|
| | *n* | % | *n* | % |
| Ever Received a Positive COVID-19 Test | | | | |
| Yes | 3 | 15.8% | 0 | 0.0% |
| Were You Hospitalized?[a] | | | | |
| Yes | 0 | N/A | N/A | N/A |
| No | 2 | N/A | N/A | N/A |
| No | 16 | 84.2% | 14 | 100.0% |
| Number of Persons Who Have Received a Positive COVID-19 Test | | | | |
| 0 | 0 | 0.0% | 0 | 0.0% |
| 1-3 | 3 | 15.8% | 3 | 21.4% |
| 4-6 | 6 | 31.6% | 5 | 35.7% |
| 7-9 | 5 | 26.3% | 2 | 14.3% |
| 10+ | 5 | 26.3% | 4 | 28.6% |
| Know Someone Hospitalized for COVID-19 | | | | |
| Yes | | | | |
| Number of Persons[a] | 7 | 36.8% | 5 | 35.7% |
| 1-3 | | | | |
| 4-6 | 7 | N/A | 5 | N/A |
| 7-9 | 0 | N/A | 0 | N/A |
| 10+ | 0 | N/A | 0 | N/A |
| Number of Persons Hospitalized ≥ 4 days[ab] | 0 | N/A | 0 | N/A |
| 0 | | | | |
| 1-3 | | | | |
| 4-6 | 0 | N/A | 1 | N/A |
| 7-9 | 7 | N/A | 3 | N/A |
| 10+ | 0 | N/A | 0 | N/A |
| | 0 | N/A | 0 | N/A |
| No | 0 | | 1 | N/A |
| | 12 | 63.2% | 9 | 64.3% |

| | | | | |
|---|---|---|---|---|
| Know Someone Who Passed Away from COVID-19 | | | | |
| Yes | | | | |
| Number of Persons[a] | 3 | 15.8% | 4 | 28.6% |
| 1-3 | | | | |
| 4-6 | 3 | N/A | 4 | N/A |
| 7-9 | 0 | N/A | 0 | N/A |
| 10+ | 0 | N/A | 0 | N/A |
| | 0 | N/A | 0 | N/A |
| No | | | | |
| | 16 | 84.2% | 10 | 71.4% |

*Note*. This table demonstrates Coronavirus socio-demographic variables stratified by the sex that the participant was assigned at birth.

[a] Participants were only asked these questions if they answered affirmatively to the previous question.

[b] Rees, E. M., et al. (2020)

**Coronavirus Questionnaire on Perceived Threat, Experiences and Impact (CQ-PTEI)**

Participants' perceptions, experiences, and levels of impact were assessed using three of the short-version Coronavirus Questionnaires (Conway III, Woodard, & Zubrod, 2020). Overall, participants scored a mean of 50.82 (*SD*=15.63, range: 19-76). When the data were divided between those assigned male versus female at birth, females had a higher average score (*M* = 56.32, *SD*=15.67) compared to males (*M*=43.36, *SD*=12.54); however, the data did not reach statistical significance. SPSS Statistics (Version 26) was used to run an Independent Samples T-Test between groups. Male participants (*M*=2.79, *SD*=1.76) reported feeling less threatened when thinking about COVID-19 compared to female participants (*M*=4.68, *SD*=1.70), *t* (31)=-3.12, *p*=.004. Additionally, male participants (*M*=3.57, *SD*=2.07) reported feeling less afraid of COVID-19 than female participants (*M*=5.21, *SD*=1.36), *t* (31)=-2.75, *p*=.010. Females (*M*=4.79, *SD*=1.36) reported higher levels of stress due to fear of catching coronavirus compared to males (*M*=3.14, *SD*=1.83), *t* (31)=-2.97, *p*=.006. Additionally, coronavirus has negatively impacted psychological health in female participants (*M*=5.47, *SD*=1.43) more than in male participants (*M*=4.00, *SD*=2.15), *t* (31)=-2.37, *p*=.024. Females (*M*=2.05, *SD*=1.90) also reported being sick with something other than COVID-19 in the last two months more than males (*M*=1.00, *SD*=0.00), *t* (31)=-2.07, *p*=.047. Finally, female participants' average total score (*M*=56.32, *SD*=15.66) was statistically significantly higher than male participants' average total score (*M*=43.36, *SD*=12.54), *t* (31)=-2.55, *p*=.016 (see Table 3).

**Table 3**

*Means, Standard Deviations and T-Test Results of the CQ-PTEI by Participant's Sex*

| | Participant Group | | T-test for Equality of Means | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Female *n = 19* | Male *n = 14* | | | | | 95 % CI of the Difference | |
| | *M (SD)* | *M (SD)* | *t* | df | *Sig. (2-tailed)* | Mean Dif. | Lower | Upper |
| *Thinking about coronavirus (COVID-19) makes me feel threatened.* | 4.68 (1.70) | 2.79 (1.76) | -3.12 | 31 | .004 | -1.90 | -3.14 | -.66 |
| *I am afraid of coronavirus (COVID-19).* | 5.21 (1.36) | 3.57 (2.07) | -2.75 | 31 | .010 | -1.64 | -2.85 | -.43 |
| *I am stressed around other people because I worry I'll catch the coronavirus (COVID-19).* | 4.79 (1.36) | 3.14 (1.83) | -2.97 | 31 | .006 | -1.65 | -2.78 | -.52 |
| *The coronavirus (COVID-19) has impacted me negatively from a financial point of view.* | 3.79 (2.32) | 3.71 (2.16) | -0.10 | 31 | .925 | -.08 | -1.70 | 1.55 |
| *I have lost job-related income due to the coronavirus (COVID-19).* | 3.16 (2.48) | 2.71 (1.73) | -0.57 | 31 | .570 | -.44 | -2.02 | 1.13 |
| *I have had a hard time getting needed resources (food, toilet paper) due to the coronavirus (COVID-19).* | 2.58 (1.68) | 1.57 (1.16) | -1.93 | 31 | .063 | -1.01 | -2.07 | .06 |
| *It has been difficult for me to get the things I need due to the coronavirus (COVID-19).* | 2.89 (1.76) | 2.36 (1.82) | -0.85 | 31 | .400 | -0.54 | -1.82 | .75 |
| *I have become depressed because of the coronavirus (COVID-19).* | 4.53 (1.95) | 3.29 (2.13) | -1.74 | 31 | .092 | -1.24 | -2.70 | .22 |
| *The coronavirus (COVID-19) outbreak has impacted my psychological health* | 5.47 (1.43) | 4.00 (2.15) | -2.37 | 31 | .024 | -1.47 | -2.74 | -0.21 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *negatively.* | | | | | | | | |
| *I have been diagnosed with coronavirus (COVID-19).* | 1.68 (1.89) | 1.00 (.00) | -1.35 | 31 | .187 | -.68 | -1.72 | .35 |
| *I have had coronavirus-like symptoms at some point in the last two months.* | 1.58 (1.50) | 1.00 (.00) | -1.44 | 31 | .161 | -.58 | -1.40 | .24 |
| *I have been sick with something other than the coronavirus in the last two months.* | 2.05 (1.90) | 1.00 (.00) | -2.07 | 31 | .047 | -1.05 | -2.09 | -.01 |
| *I have been in close proximity with someone who has been diagnosed with coronavirus (COVID-19).* | 3.21 (2.64) | 2.64 (2.59) | -0.62 | 31 | .543 | -.57 | -2.45 | 1.31 |
| *I have been in close proximity with someone who has had coronavirus-like symptoms in the last two months.* | 3.05 (2.55) | 2.21 (2.29) | -0.98 | 31 | .338 | -.84 | -2.60 | .92 |
| *I watch a lot of news about the coronavirus (COVID-19).* | 4.58 (1.92) | 5.00 (1.84) | 0.63 | 31 | .532 | .42 | -.94 | 1.78 |
| *I spend a huge percentage of my time trying to find updates online or on TV about coronavirus (COVID-19).* | 3.05 (1.58) | 3.36 (2.06) | 0.48 | 31 | .634 | .31 | -.99 | 1.60 |
| Total Score | 56.32 (15.66) | 43.36 (12.54) | -2.55 | 31 | .016 | -12.96 | -23.33 | -2.59 |

*Source*: Conway III, Woodard & Zubrod, 2020

**Mannheim Multicomponent Stress Test (MMST)**

Coronavirus pictures were used in the picture recognition task during the MMST. Omitted mistakes referred to situations where the participant did not specify that a picture had been repeated when it indeed had been previously shown. For the study, there was an average of 6.88 (*SD*=5.17) omitted mistakes. Added mistakes referred to situations where the participants stated that a picture was previously shown when it had not been. For the study, there was an average of 3.70 (*SD*=4.0) added mistakes. The average total mistakes made (omitted + added) across participants (*N*=33) was 10.58 (*SD*=5.35).

Participants were asked to participate in an arithmetic task during the MMST. Average total mistakes across all participants were 16.09 (*SD*=12.33). 16 neutral/positive and 64 COVID-19 images were included. On average, mistakes were made on 21.1% of COVID-19 images and on 15.8% of neutral/positive images. A bivariate correlation analysis was conducted. A strong positive correlation was found among all three variables at the $p<.001$ level. (see Table 4)

**Table 4**

*Pearson Correlation of Mistakes Made During the MMST Arithmetic Task*

| | | Total Mistakes | Mistakes Made on Neutral/ Positive Pictures | Mistakes Made on COVID-19 Pictures |
|---|---|---|---|---|
| Total Mistakes | Pearson Correlation | 1 | .906*** | .995*** |
| | Sig. (2-tailed) | | <.001 | <.001 |
| | N | 33 | 33 | 33 |
| Mistakes Made on Neutral/Positive Pictures | Pearson Correlation | .906*** | 1 | .859*** |
| | Sig. (2-tailed) | <.001 | | <.001 |
| | N | 33 | 33 | 33 |
| Mistakes Made on COVID-19 Pictures | Pearson Correlation | .995*** | .859*** | 1 |
| | Sig. (2-tailed) | <.001 | <.001 | |
| | N | 33 | 33 | 33 |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

Types of mistakes on the photographic task and on the arithmetic task were examined by participant's sex (Table 5). Although males ($M$=11.50, $SD$=5.37) had more incorrect total mistakes than females ($M$=9.89, $SD$=5.37) on the photographic recognition task, an Independent Sample T-Test found that this difference was not statistically significant ($p > .05$). On the MMST arithmetic task, females ($M$=18.05, $SD$=13.57) made more errors than males ($M$=13.43, $SD$=10.29); however, this difference was not statistically significant on an Independent Sample T-Test ($p >.05$).

**Table 5**

*Means and Standard Deviations of MMST Mistakes by Participant's Sex*

| | | Female Participants *n* = 19 | | Male Participants *n* = 14 | |
|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* |
| Photographic Recognition Task | Total Mistakes | 9.89 | 5.37 | 11.50 | 5.37 |
| | Omitted Mistakes | 6.05 | 4.98 | 8.00 | 4.98 |
| | Added Mistakes | 3.84 | 3.79 | 3.50 | 4.40 |
| Arithmetic Task | Total Mistakes | 18.05 | 13.57 | 13.43 | 10.29 |
| | Mistakes Made on Neutral/Positive Pictures | 2.79 | 2.62 | 2.14 | 2.11 |
| | Mistakes Made on COVID-19 Pictures | 15.26 | 11.17 | 11.29 | 8.59 |

SPSS Statistics (Version 26) was used to run a bivariate correlation analysis between different types of errors that could be made during the MMST. A statistically significant correlation was found between the number of arithmetic mistakes and the number of photo recognition task mistakes, $r$ (33)=.100, $p$<.001. Furthermore, the total number of arithmetic mistakes was found to have a strong positive correlation with the number of mistakes on positive photos only, $r$ (33)=.906, $p$<.001, and with number of mistakes on COVID-19 photos only, $r$ (33)=.995, $p$<.001. Additionally, total number of arithmetic errors and total number of photo recognition errors both correlated the same amount with errors on positive pictures only and with errors on COVID-19-related images only (Table 6). These results suggest that the emotional valence or topic of the picture does not affect the individual's performance on the arithmetic task.

**Table 6**

*Pearson Correlation of MMST Arithmetic Mistakes by Picture Type*

| | | Total Arithmetic Task Mistakes | Total Picture Recognition Mistakes | Total Mistakes on Positive Pictures | Total Mistakes on COVID-19 Pictures |
|---|---|---|---|---|---|
| Total Arithmetic Task Mistakes | Pearson Correlation | 1 | 1.000*** | .906*** | .995*** |
| | Sig. (2-tailed) | | <.001 | <.001 | <.001 |
| | N | 33 | 33 | 33 | 33 |
| Total Picture Recognition Mistakes | Pearson Correlation | 1.000*** | 1 | .906*** | .995*** |
| | Sig. (2-tailed) | <.001 | | <.001 | <.001 |
| | N | 33 | 33 | 33 | 33 |
| Total Mistakes on Positive Pictures | Pearson Correlation | .906*** | .906*** | 1 | .859*** |
| | Sig. (2-tailed) | <.001 | <.001 | | <.001 |
| | N | 33 | 33 | 33 | 33 |
| Total Mistakes on COVID-19 pictures | Pearson Correlation | .995*** | .995*** | .859*** | 1 |
| | Sig. (2-tailed) | <.001 | <.001 | <.001 | |
| | N | 33 | 33 | 33 | 33 |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

A bivariate correlation analysis was conducted to compare a participant's CQ-PTEI scores with their performance on the two MMST tasks. A statistically significant negative correlation was found between CQ-PTEI total score and omitted mistakes made on the MMST photographic recognition task, $r$ (31)=-.488, $p$=.005 (Table 7). No other significant correlation was found.

**Table 7**

*Pearson Correlation of CQ-PTEI Total Scores and MMST Performance*

| | | Photo Recognition Task | | | Arithmetic Task | | |
|---|---|---|---|---|---|---|---|
| | | Total Mistakes | Omitted Mistakes | Added Mistakes | Total Mistakes | Mistakes Made on Neutral/ Positive Images | Mistakes Made on COVID-19 Images |
| CQ-PTEI Total Score | Pearson Correlation | -.352 | -.488 | .165 | -.142 | -.063 | -.156 |
| | Sig. (2-tailed) | .052 | .005 | .376 | .447 | .736 | .401 |
| | N | 31 | 31 | 31 | 31 | 31 | 31 |

**Autobiographical Memory Test (AMT)**

RStudio (Version 1.3.1093) was used to run a Paired Samples T-Test to look at the effect of Coronavirus-related stress on duration of memory retrieval, specificity of memory, and affective response to the memory. Affective response, the emotion that the person embodied when recalling the memory, was coded on a 3-point scale, with positive, neutral, and negative affective response corresponding to scores of 1, 0, and -1, respectively. There was a statistically significant difference between memory specificity in the unstressed ($M$=3.40, $SD$=1.10) and stressed ($M$=3.07, $SD$=1.41) conditions, $t$ (263)=3.59, $p$<.001; however, Coronavirus-related stress did not significantly affect duration of memory retrieval nor affective response between unstressed ($M$=12.26, $SD$= 9.67; $M$=2.06, $SD$=0.76) and stressed ($M$=13.18, $SD$=10.92; $M$=1.97, $SD$=0.76) conditions (Table 8).

**Table 8**

*Means, Standard Deviations and T-Test Results of AMT Variables by Condition for All Participants*

| | | | Paired Samples T-Test | | | |
|---|---|---|---|---|---|---|
| | | *M (SD)* | Mean Dif. | *t* | df | *Sig.* |
| Duration of Memory Retrieval | Unstressed | 12.26 (13.18) | -.924 | -1.227 | 263 | .221 |
| | Stressed | 13.18 (10.92) | | | | |
| Memory Specificity | Unstressed | 3.40 (1.10)*** | .333 | 3.593 | 263 | <.001 |
| | Stressed | 3.07 (1.41)*** | | | | |
| Affective Response | Unstressed | .17 (0.81) | .035 | .651 | 260 | .516 |
| | Stressed | .13 (0.85) | | | | |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

***AMT and Word List***

Participants were randomly assigned to Group 1 or Group 2. Group 1 received Word List A in the unstressed condition and Word List B in the stressed condition. Group 2 received Word List B in the unstressed condition and Word List A in the stressed condition. This was implemented for randomization purposes and to eliminate any biases caused by the specific words in each group. As previously mentioned, there should be no significant differences between the two word lists. RStudio (Version 1.3.1093) was used to conduct an Independent Samples T-Test of the three AMT variables between Word List A and Word List B for each condition (unstressed and stressed) separately, to identify any possible differences. The Welch Two Sample T-Test found significant differences for specificity between Word List A and Word List B in the unstressed condition, $t$ (231.6)=-3.37, $p$<.001 and in the stressed condition, $t$ (244.7)=3.39, $p$<.001 (Table 9.1). No statistically significant differences were found between Word List A and B for duration of memory retrieval or affective response in either condition (Table 9.1). Then, the three AMT variables were compared across conditions for each word list (Table 9.2). There were no significant findings for Word List A; however, both duration of memory retrieval, $t$ (222.0)=-1.98, $p$=.049, and memory specificity, $t$ (204.9)=5.49, $p$<.001, had statistically significant differences between the two conditions (Table 9.2). These results temporarily suggested that there may be differences between the two word lists. To either confirm or deny this hypothesis, RStudio (Version 1.3.1093) was used to conduct a Paired-Samples T-Test for each participant across all three AMT variables. This analysis found statistically significant results for memory specificity for participants who began with Word List A, $t$ (127)=2.73, $p$=.007, and for participants who began with Word List B, $t$ (135)=2.33, $p$=.021, which suggests that decreased memory specificity occurred *regardless of the word list the participant began with*. No significant results were found for duration of memory retrieval or affective response. (see Table 10).

**Table 9.1**

*Means, Standard Deviations and T-Test Results Across Word Lists in Each Condition*

| | | | | Welch Two Sample T-Test | | |
|---|---|---|---|---|---|---|
| Condition | AMT Variable | Word List | *M (SD)* | *t* | df | *Sig.* |
| Unstressed | Duration of Memory Retrieval | Word List A | 13.12 (11.32) | 1.389 | 223.0 | .166 |
| | | Word List B | 11.45 (7.76) | | | |
| | Memory Specificity | Word List A | 3.17 (1.24)*** | -3.367 | 231.6 | <.001 |
| | | Word List B | 3.62 (.91)*** | | | |
| | Affective Response | Word List A | .21 (.82) | .873 | 258.72 | .383 |
| | | Word List B | .13 (.80) | | | |
| Stressed | Duration of Memory Retrieval | Word List A | 12.57 (10.45) | -.941 | 256.4 | .347 |
| | | Word List B | 13.84 (11.41) | | | |
| | Memory Specificity | Word List A | 3.35 (1.23)*** | 3.391 | 244.7 | <.001 |
| | | Word List B | 2.77 (1.52)*** | | | |
| | Affective Response | Word List A | .10 (.87) | -.585 | 260 | .559 |
| | | Word List B | .16 (.82) | | | |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

**Table 9.2**

*Means, Standard Deviations and T-Test Results Between Conditions for Each Word List*

| | | | | Welch Two Sample T-Test | | |
|---|---|---|---|---|---|---|
| Word List | AMT Variable | Condition | *M (SD)* | *t* | df | *Sig.* |
| Word List A | Duration of Memory Retrieval | Unstressed | 13.12 (11.32) | .410 | 256.92 | .682 |
| | | Stressed | 12.57 (10.45) | | | |
| | Memory Specificity | Unstressed | 3.17 (1.24) | -1.189 | 260.76 | .235 |
| | | Stressed | 3.35 (1.23) | | | |
| | Affective Response | Unstressed | .21 (.82) | 1.111 | 260 | .268 |
| | | Stressed | .10 (.87) | | | |
| Word List B | Duration of Memory Retrieval | Unstressed | 11.45 (7.76) | -1.977 | 222.04 | .049 |
| | | Stressed | 13.84 (11.41) | | | |
| | Memory Specificity | Unstressed | 3.62 (.91)*** | 5.487 | 204.88 | <.001 |
| | | Stressed | 2.77 (1.52)*** | | | |
| | Affective Response | Unstressed | .13 (.80) | -.324 | 258.84 | .746 |
| | | Stressed | .16 (.82) | | | |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

**Table 10**

*Results of a Paired Samples T-Test of AMT Variables by Participant Group*

| | Group 1 (A=unstressed, B=stressed) | | | | | | Group 2 (B=unstressed, A=stressed) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Dif. | *t* | df | *Sig.* | 95% CI Lower | Upper | Mean Dif. | *t* | df | *Sig.* | 95% CI Lower | Upper |
| Duration of Memory Retrieval | -1.12 | -.60 | 127 | .548 | -2.98 | .75 | .40 | -1.19 | 135 | .238 | .11 | .69 |
| Memory Specificity | .40 | 2.73 | 127 | .007 | .11 | .69 | .27 | 2.33 | 135 | .021 | .04 | .50 |
| Affective Response | .05 | .60 | 125 | .551 | -.11 | .21 | .02 | .31 | 134 | .754 | -.12 | .16 |

*Note.* Participants were assigned to their groups randomly. Group 1 refers to the participants who received Word List A in the unstressed condition and Word List B in the stressed condition. Group 2 refers to participants who received Word List B in the unstressed condition and Word List A in the stressed condition.

***AMT and Participant's Sex***

Average duration of memory recall for all participants was quicker in the unstressed condition (*M*=12.26, *SD*=9.67) compared to the stressed condition (*M*=13.18, *SD*=10.92). For female participants, average duration of memory recall was also faster in the unstressed condition (*M*=11.04, *SD*=8.50) compared to the stressed condition (*M*=12.45, *SD*=10.11). And for male participants, the average duration of memory recall was also quicker in the unstressed condition (*M*=13.91, *SD*=10.88) than in the stressed condition (*M*=14.04, *SD*=11.38). (see Table 11).

Average memory specificity was higher in the unstressed condition (*M*=3.40, *SD*=1.10) than in the stressed condition (*M*=3.07, *SD*=1.41). Both females and males reported more OGMs in the stressed condition (*M*=3.21, *SD*=1.31; *M*=2.88, *SD*=1.52) compared to their performance in the unstressed condition (*M*=3.53, *SD*=1.02; *M*=3.23, *SD*=1.20). (see Table 11).

Average affective response for the whole sample was more positive in the unstressed condition (*M*=.17, *SD*=.82) compared to the stressed condition (*M*=.13, *SD*=.85). In the unstressed condition, female participants portrayed a more neutral affective response (*M*=.10, *SD*=.83) compared to the male participants, who exhibited a more positive affective response (*M*=.26, *SD*=.78). A decrease in affective response was found in both female participants (*M*=.07, *SD*=.88) and in male participants (*M*=.21, *SD*=.79) in the stressed condition. (see Table 11).

**Table 11**

*Means and Standard Deviations of AMT Variables by Condition*

| | | All Participants $N = 33$ | | Female Participants $n = 19$ | | Male Participants $n = 14$ | |
|---|---|---|---|---|---|---|---|
| | | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Unstressed Condition | Duration of Memory Retrieval | 12.26 | 9.67 | 11.04 | 8.50 | 13.91 | 10.88 |
| | Memory Specificity | 3.40 | 1.10 | 3.53 | 1.02 | 3.23 | 1.20 |
| | Affective Response | .17 | .82 | .10 | .83 | .26 | .78 |
| Stressed Condition | Duration of Memory Retrieval | 13.18 | 10.92 | 12.45 | 10.11 | 14.17 | 11.91 |
| | Memory Specificity | 3.07 | 1.41 | 3.21 | 1.31 | 2.88 | 1.52 |
| | Affective Response | .13 | .85 | .07 | .88 | .21 | .79 |
| Total | Duration of Memory Retrieval | 12.72 | 10.31 | 11.75 | 9.35 | 14.04 | 11.38 |
| | Memory Specificity | 3.23 | 1.27 | 3.37 | 1.18 | 3.06 | 1.37 |
| | Affective Response | .15 | .83 | .08 | .86 | .23 | .78 |

RStudio (Version 1.3.1093) was used to run a Paired-Samples T-Test to examine the three AMT variables across conditions for female and for male participants. Significant findings were found for memory specificity for female participants, $t$ (151)=2.83, $p$=.005, and for male participants, $t$ (111)=2.25, $p$=.026. Significance was not met for duration of memory retrieval or for affective response. (see Table 12). These findings suggest that all participants, regardless of sex assigned at birth, decreased in memory specificity as a result of COVID-19-related stress.

**Table 12**

*Results of a Paired-Samples T-Test According to Participant's Sex*

| | Female Participants *n*=19 | | | | | | Male Participants *n*=14 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean Dif. | *t* | df | *Sig.* | 95% CI Lower | Upper | Mean Dif. | *t* | df | *Sig.* | 95% CI Lower | Upper |
| Duration of Memory Retrieval | -1.42 | -1.45 | 151 | .150 | -3.34 | 0.52 | -.26 | -.22 | 111 | .827 | -2.61 | 2.09 |
| Memory Specificity | .32 | 2.83 | 151 | .005 | .10 | 0.54 | .35 | 2.25 | 111 | .026 | .043 | .66 |
| Affective Response | .03 | .39 | 149 | .696 | -.11 | 0.16 | .05 | .53 | 110 | .594 | -.12 | .21 |

### *AMT and Condition*

SPSS Statistics (Version 26) was used to run a bivariate correlation analysis of duration of memory recall, memory specificity, and affective response for the unstressed and the stressed conditions. In the unstressed condition, duration of memory retrieval was significantly negatively correlated with memory specificity, $r$ (264)=-.21, $p$=.001, and with affective response, $r$ (263)=-.20, $p$=.001 (Table 13.1). In the stressed condition, duration of memory retrieval was, again, significantly negatively correlated with memory specificity, $r$ (264)=-.22, $p$<.001, and with affective response, $r$ (262)=-.19, $p$=.003 (Table 13.2). Memory specificity and affective response were not significantly correlated in either condition ($p$ >.05).

**Table 13.1**

*Pearson Correlation of AMT Variables in the Unstressed Condition*

| | | Duration of Memory Retrieval | Memory Specificity | Affective Response |
|---|---|---|---|---|
| Duration of Memory Retrieval | Pearson Correlation | 1 | -.209 | -.201 |
| | Sig. (2-tailed) | | .001 | .001 |
| | N | 264 | 264 | 263 |
| Memory Specificity | Pearson Correlation | -.209 | 1 | .018 |
| | Sig. (2-tailed) | .001 | | .766 |
| | N | 264 | 264 | 263 |
| Affective Response | Pearson Correlation | -.201 | .018 | 1 |
| | Sig. (2-tailed) | .001 | .766 | |
| | N | 263 | 263 | 263 |

**Table 13.2**

*Pearson Correlation of AMT Variables in the Stressed Condition*

| | | Duration of Memory Retrieval | Memory Specificity | Affective Response |
|---|---|---|---|---|
| Duration of Memory Retrieval | Pearson Correlation | 1 | -.220*** | -.185 |
| | Sig. (2-tailed) | | <.001 | .003 |
| | N | 264 | 264 | 262 |
| Memory Specificity | Pearson Correlation | -.220*** | 1 | .111 |
| | Sig. (2-tailed) | <.001 | | .073 |
| | N | 264 | 264 | 262 |
| Affective Response | Pearson Correlation | -.185 | .111 | 1 |
| | Sig. (2-tailed) | .003 | .073 | |
| | N | 262 | 262 | 262 |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

Since significant correlations were found for all pairs of dependent variables, except for memory specificity and affective response, a 2 (participant's sex) x 2 (condition) between-subjects Multivariate Analysis of Variance (MANOVA) test was conducted in SPSS Statistics (Version 26). There was a significant effect of sex, Wilks' Lambda = .959, $F$ (3, 519)= 7.47, $p$<.001, and of condition, Wilks' Lambda = .983, $F$ (3, 519)= 2.98, $p$=.031. Full results are listed in Table 14. This finding confirms that a participant's biological sex affects *all three AMT variables*, whereas the study condition only affects memory specificity. When comparing means and standard deviations by participants' sex, we can conclude that females ($M$=11.75, $SD$=9.35) retrieved memories significantly faster compared to males ($M$=14.04, $SD$=11.38) (see Table 11). Additionally, throughout the entire study, female participants ($M$=3.37, $SD$=1.18) were significantly more specific in their memories compared to male participants ($M$=3.06, $SD$=1.37) (see Table 11). Lastly, male participants ($M$=0.23, $SD$=0.78) were significantly more positive in their affective response when recalling the memories compared to female participants ($M$=0.08, $SD$=0.86) (see Table 11).

**Table 14**

*Results from a 2(Sex) by 2(Condition) Between-Subjects MANOVA*

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | *F* | *Sig.* | Partial Eta Squared ($\eta_p^2$) |
|---|---|---|---|---|---|---|---|
| Corrected Model | Duration of Memory Recall | 897.54[a] | 3 | 299.18 | 3.219 | .023 | .02 |
| | Memory Specificity | 26.84[b] | 3 | 8.95 | 5.842 | .001 | .03 |
| | Affective Response | 3.13[c] | 3 | 1.05 | 1.526 | .207 | .01 |
| Intercept | Duration of Memory Recall | 81854.90 | 1 | 81854.90 | 880.608*** | <.001 | .63 |
| | Memory Specificity | 5349.62 | 1 | 5349.62 | 3493.368*** | <.001 | .87 |
| | Affective Response | 12.80 | 1 | 12.80 | 18.698*** | <.001 | .04 |
| Sex | Duration of Memory Recall | 742.93 | 1 | 742.93 | 7.993 | .005 | .02 |
| | Memory Specificity | 13.16 | 1 | 13.16 | 8.594 | .004 | .02 |
| | Affective Response | 2.90 | 1 | 2.90 | 4.233 | .040 | .01 |
| Condition | Duration of Memory Recall | 51.72 | 1 | 51.72 | .556 | .456 | .00 |
| | Memory Specificity | 13.46 | 1 | 13.46 | 8.792 | .003 | .02 |
| | Affective Response | .23 | 1 | .23 | .337 | .562 | .00 |
| Sex * Condition | Duration of Memory Recall | 79.84 | 1 | 79.84 | .859 | .354 | .00 |
| | Memory Specificity | .00 | 1 | .00 | .001 | .980 | .00 |
| | Affective Response | .01 | 1 | .01 | .016 | .899 | .00 |

[a] *R Squared = 0.018 (Adjusted R Squared = .013)*

[b] *R Squared = 0.033 (Adjusted R Squared = .027)*

[c] *R Squared = 0.009 (Adjusted R Squared = .003)*

*$p$<0.05, **$p$<0.01, ***$p$<0.001

**State-Trait Anxiety Inventory for Adults (STAI-AD)**

RStudio (Version 1.3.1093) was used to examine the STAI-AD (Form-Y-1) total scores across conditions (unstressed and stressed) and across sexes assigned at birth (females and males). Means and standard deviations are presented in Table 15. STAI-AD total scores were compared across sexes using an Independent Samples T-Test. No statistically significant difference was found between males and females for either condition ($p > .05$).

**Table 15**

*Means and Standard Deviations of STAI-AD Score by Condition and Participant's Sex*

| | All Participants *N* = 33 | | Female Participants *n* = 19 | | Male Participants *n* = 14 | |
|---|---|---|---|---|---|---|
| | Unstressed | Stressed | Unstressed | Stressed | Unstressed | Stressed |
| STAI-AD Total Score | 35.52 (11.46) | 37.85 (10.92) | 36.05 (9.51) | 40.00 (9.64) | 34.79 (14.03) | 34.93 (12.19) |

To examine whether or not there was a statistically significant effect of condition on self-reported anxiety scores, a Paired-Samples T-Test was completed. The analysis found that participants' total STAI-AD scores in the unstressed and stressed condition were positively correlated to each other, $r$ (32)=.67, $p$<.001, but that condition did not have a statistically significant effect on total score (Table 16). An One Way Analysis of Variance (ANOVA) test was conducted and no significant effect of condition on STAI-AD total score was found.

**Table 16**

*Results of a Pearson Correlation of STAI-AD Total Scores Across Condition*

| | Pearson Correlation | | |
|---|---|---|---|
| | N | Correlation | Sig. |
| Unstressed and Stressed Total STAI-AD Scores | 33 | .666*** | <.001 |
| Condition and STAI Total Score | 66 | .105 | .400 |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

A 2 (participant's sex) x 2 (condition) multivariate analysis of variance (MANOVA) test was conducted using SPSS Statistics (Version 26) to explore whether or not sex and/or condition had a significant effect on any individual statement. Participant's sex had a statistically significant effect on a participant's response to "I feel indecisive," $F$ (1,62)=4.80, $p$=.032, and condition had a statistically significant effect on a participant's response to "I feel calm," $F$ (1,62)=4.94, $p$=.030, and to "I feel at ease," $F$ (1,62)=4.85, $p$=.031.

**Empatica E4 Wristband**

Electrodermal activity (EDA) from the Empatica E4 wristband was analyzed for 84.8% of the participants ($N$= 28). Temporal data that was critical for the EDA analyses was lost for 5 participants (four female and one male participant). Baseline EDA values consisted of an average of the first 100 data points. Stressed EDA values consisted of an average of 75 data points, with each data point representing an average value over four seconds. Stressed EDA values consisted of the five minutes that the MMST was being conducted. The last minute of stressed EDA values always occurred exactly one minute before the second AMT was started to remain consistent across participants.

RStudio (Version 1.3.1093) was used to run a Paired-Samples T-Test to compare baseline EDA values against stressed EDA values. The analysis found a statistically significant increase in participants' EDA values from baseline ($M$=1.04μS, $SD$=1.31) to MMST ($M$=3.01μS, $SD$=4.20), $t$ (27)=3.27, $p$=.003 (Table 18). Two more Paired-Samples T-Tests were conducted to examine whether or not there was still a significant difference when females and males were analyzed independently. The difference between baseline and stressed EDA values were statistically significant for female participants, $t$ (14)=2.60, $p$=.021, but not for male participants, suggesting that female participants experienced greater physiological stress (Table 17).

**Table 17**

*Means, Standard Deviations and T-Test Results of EDA Values by Participant Group*

| | | | Paired Samples T-Test | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *M (SD)* | Mean of the Differences | *t* | df | *Sig.* | 95% CI Lower | 95% CI Upper |
| All Participants | Baseline | 1.04 (1.31) | 1.96 | 3.27 | 27 | .003 | .73 | 3.20 |
| | Stressed | 3.01 (4.20) | | | | | | |
| Female Participants | Baseline | 1.34 (1.63) | 2.47 | 2.60 | 14 | .021 | .43 | 4.50 |
| | Stressed | 3.80 (5.23) | | | | | | |
| Male Participants | Baseline | .71 (.75) | 1.39 | 1.99 | 12 | .070 | -.13 | 2.90 |
| | Stressed | 2.09 (2.47) | | | | | | |

To accurately compare EDA values between participants, RStudio (Version 1.3.1093) was used to calculate percent changes using the following equation:

$Percent\ Change\ = \frac{EDA\ during\ MMST - EDA\ at\ baseline}{EDA\ at\ baseline}\ x\ 100\%$. In the study, 86.7% of female participants (*n*=13) and 78% of male participants (*n*=10) experienced an increase in μS from the baseline timepoint to the induced stressor. The average percent change for female participants (*n*=15) was +205.21% (*SD*=292.71) and the average percent change for male participants (*n*=13) was +282.42% (*SD*=377.27). An One Way Analysis of Variance (ANOVA) test found that there was no statistically significant difference of percent changes between the two sexes ($p > .05$).

SPSS Statistics (Version 26) was then used to run an Independent Sample T-Test to compare baseline, stressed, and percent change EDA values across sexes. No significant differences were found (Table 18).

**Table 18**

*Means, Standard Deviations, and T-Test Results of EDA Values by Participant's Sex*

| | | | T-Test for Equality of Means | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *M (SD)* | *t* | df | *Sig. (2-tailed)* | Mean Dif. | 95% CI Lower | 95% CI Upper |
| Baseline (μS) | Females | 1.34 (1.63) | -1.28 | 26 | .212 | -0.63 | -1.64 | 0.38 |
| | Males | .71 (.75) | | | | | | |
| MMST (μS) | Females | 3.80 (5.23) | -1.08 | 26 | .290 | -1.71 | -4.97 | 1.55 |
| | Males | 2.09 (2.47) | | | | | | |
| Percent Change (%) | Females | 205.21 (292.71) | .61 | 26 | .548 | 77.21 | -183.26 | 337.69 |
| | Males | 282.42 (377.27) | | | | | | |

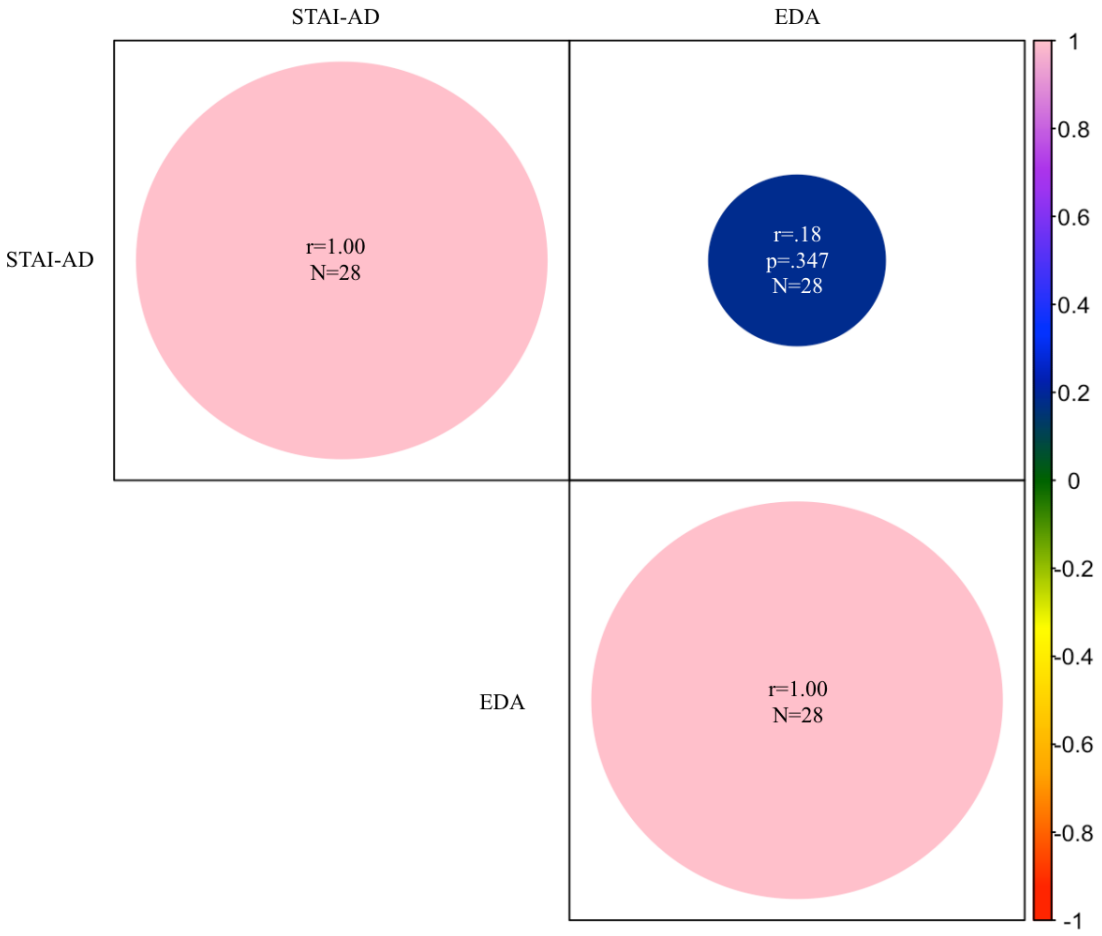
**STAI-AD and Empatica E4 Wristband**

SPSS Statistics (Version 26) was used to run a bivariate correlation between self-report, psychological anxiety levels (STAI-AD) and objective, physiological anxiety levels (Empatica E4 wristband) at baseline and at the stressed condition. Neither pair met statistical significance. RStudio (Version 1.3.1093) was used to run a correlation analysis of STAI-AD percent change and EDA percent change values. The lack of a significant correlation between these two variables ($p$ >.05) proposes that college students may lack an awareness of how stressed they actually are or that they may be experiencing physiological stress but not psychological stress (Figure 2).

RStudio (Version 1.3.1093) was used to create boxplots to visually compare averages for psychological (STAI-AD) and physiological (Empatica E4 Wristband) anxiety scores, by condition and sex. The psychological data for this figure can be viewed in Table 15 and the physiological data is located in Table 17. As demonstrated by Figure 3, there was a significant increase in physiological stress, measured by the Empatica E4 Wristband, in female participants ($p$ = .21) but not in male participants. Additionally, there were no significant changes in psychological stress, measured by the STAI-AD. This suggests that a COVID-19-related stressor may elicit greater physiological stress in female college students compared to male college students. Furthermore, these findings suggest that female college students may have some sort of resilience towards COVID-19-related stress, since they experienced significantly greater physiological stress, but not psychological stress, from the unstressed to the stressed condition.

**Figure 2**

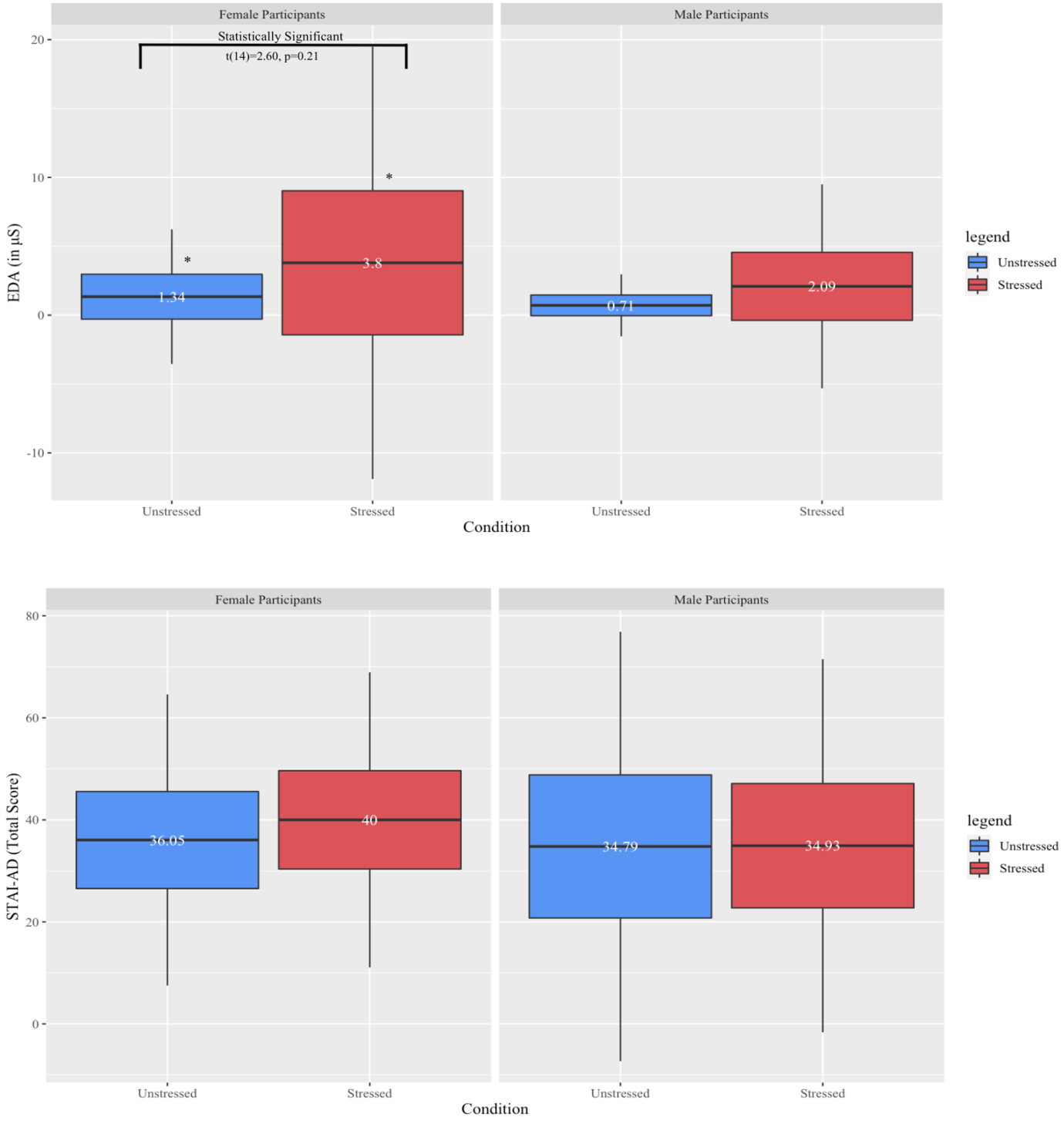
*Correlation Analysis Plot of STAI-AD and EDA Percent Change Values*




*Notes*. Pearson correlation coefficients (*r*), significance levels (p), and sample size (*N*) are shown by their numeric value. Pearson correlation coefficients are also displayed by size and color. Color is according to the scale on the right-hand side, with green referring to no correlation.

**Figure 3**

*Boxplots of Physiological and Psychological Anxiety Across Conditions by Participant's Sex*




*$p$<0.05, **$p$<0.01, ***$p$<0.001

***STAI-AD, Empatica E4 Wristband, and CQ-PTEI***

SPSS Statistics (Version 26) was used to run a bivariate correlation analysis between CQ-PTEI scores and participants' EDA values. No statistically significant correlation was found between CQ-PTEI scores and percent change or EDA values at baseline or during the induced stressor. Another bivariate correlation analysis was conducted between CQ-PTEI scores and STAI scores in the unstressed and in the stressed conditions. No statistically significant correlation was found. This disproves our quaternary hypothesis, that increased negative perceptions of COVID-19 would lead to higher stress. However, a statistically significant positive correlation was found between baseline and MMST EDA values, $r$ (28)=.84, $p$<.001, and between STAI scores in the unstressed and the stressed condition, $r$ (33)=.67, $p$<.001. This finding suggests that participants who had higher anxiety levels at the baseline timepoint (higher baseline EDA) remained higher during the stressed condition, while individuals with lower levels of stress at baseline (lower baseline EDA) remained lower during the stress condition. (see Table 19).

**Table 19**

*Bivariate Correlations of Physiological and Psychological Anxiety Levels Across Conditions*

| | Pearson Correlation | | |
|---|---|---|---|
| | N | Correlation | Sig. |
| Unstressed and Stressed EDA Values | 28 | .839*** | <.001 |
| Unstressed and Stressed STAI-AD Total Scores | 33 | .666*** | <.001 |

*$p$<0.05, **$p$<0.01, ***$p$<0.001

### *STAI-AD, Empatica E4 Wristband, and Clinical Anxiety Diagnoses*

The anxiety levels of eight out of the nine participants who reported that they had received a clinical anxiety diagnosis were analyzed in a bivariate correlation analysis using SPSS Statistics (Version 26). A statistically significant positive correlation was found between having an anxiety diagnosis and a participant's baseline EDA value, $r$ (28)=.48, $p$=.010, and their stressed EDA value, $r$ (28)=.40, $p$=.035 (Table 20). However, no anxiety measures were statistically correlated with experiencing a traumatic event ($p$ >.05).

**Table 20**

*Bivariate Correlation of Having an Anxiety Diagnosis with Anxiety Levels*

| | | STAI-AD Total Score | | EDA Value | |
|---|---|---|---|---|---|
| | | Unstressed Condition | Stressed Condition | Baseline Timepoint | Stressed Timepoint |
| Clinical Anxiety Diagnosis | Pearson Correlation | .030 | -.002 | .481 | .400 |
| | Sig. (2-tailed) | .879 | .992 | .010 | .035 |
| | N | 28 | 28 | 28 | 28 |

## Discussion

The present results contribute to literature surrounding the relationship between an individual's sex assigned at birth, COVID-19-related stress, and Autobiographical Memory (AM). Overall, the results supported our hypotheses for our primary and tertiary outcomes, partially support our hypothesis for our secondary outcome, and did not support our hypothesis for our quaternary outcome. COVID-19-related stress significantly disrupted all participants' abilities to produce a specific AM. Additionally, a participant's sex assigned at birth was found to affect how fast a memory was retrieved, the specificity of the recalled memory, and their affective response to the memory. Although no gender differences were found in the subjective anxiety measures, female participants experienced a significant increase in physiological stress, measured by their electrodermal activity, from the baseline to the stressed timepoint (presence of COVID-19-related stressor). Lastly, the study found that those with elevated baseline anxiety levels experienced more stress from the COVID-19-related stressor compared to those with lower baseline anxiety levels.

### COVID-19-Related Stress and Autobiographical Memory

The analyses found decreased AM specificity as a result of COVID-19-related stress; however, duration of memory retrieval and participants' affective response were unaffected, which aligned with Kuyken and Brewin's (1995) AMT findings. Our study, like Kuyken and Brewin's (1995) study, found that memory specificity, but not duration of memory retrieval, was significantly affected by the presence of a stressor. These findings also build on Pezdek's (2001) study on AM in college students in response to a specific stressor. As opposed to Pezdek's (2001) study in which only about ⅓ of participants were situated in the location of the stressor (the events on September 11, 2001), all of the present study's participants have and are still directly located in areas of this study's stressor (the COVID-19 pandemic). Therefore, we can hypothesize that physically experiencing a stressful event increases one's likelihood of

producing an OGM, compared to individuals who are *indirectly* impacted by a traumatic event. Along with direct, rather than indirect, exposure to a traumatic event being a possible contributing factor of decreased AM specificity, temporal duration of the trauma may also be relevant. This hypothesis is derived from the fact that all participants in the present study have experienced the traumatic stressor (the COVID-19 pandemic) continually for over a year and are still currently experiencing the trauma. As previously discussed, exposure to prolonged stress has been linked to the development of a clinical psychological disorder (Takeda, et al., 2004). Given that a previous study that was conducted 9 years ago, already found that over 50% of college students met clinical criteria for MDD, panic disorder, and/or GAD, it is possible that in the near future, the majority of college students will meet the DSM's criteria for one or more psychological disorders.

Along with temporal duration, the actual time when the trauma happened may also be a significant contributing factor. This hypothesis links to Crane, et al.'s (2014) study, which found that *when* a traumatic event occurred significantly correlated with the number of OGMs that were produced. Other studies (e.g., Crane & Duggan, 2009) have suggested that earlier exposure to a trauma results in greater OGMs, which suggests that our current children may be in grave danger. Traumatic events are severely more detrimental to the health of an individual when they happen during early childhood, so it is expected that our current youth will be extremely traumatized from COVID-19, especially since this "cultural trauma" has been relevant for over a year (Demertzis & Eyerman, 2020). This finding builds on previous literature (e.g., Bryant, Oo, & Damian, 2020) that has found that COVID-19 is not only considered a trauma itself, but that it significantly exacerbates previous adverse childhood experiences. Thus, future research should be done in this area to better understand the effects of direct exposure and temporal duration as possible predictors of decreased memory specificity in youth and young adults.

These results contribute to the AM literature as a whole due to the fact that the amount of literature on stressed individuals *without* a clinical trauma-related diagnosis is quite limited. From the present study, it can be hypothesized that merely being faced with a five-minute stressor can cause significant decreases in memory specificity. This is important because the majority of college students experience a tremendous amount of stress every day, whilst only a small percentage of the population has actually been clinically diagnosed with a DSM psychological disorder. It also conveys the weight of the current pandemic as being on par with other traumatic events that are severe enough to potentially evoke PTSD or another clinical stress-related disorder, e.g., child sexual abuse (Ogle, et al., 2013).

It is important to remember that decreased memory specificity is not only a symptom on its own, but that it is considered a contributing factor for the maintenance of PTSD symptomatology (McNally, et al, 1994; Watkins & Teasdale, 2001) and for depressive disorders (Valentino, Toth, & Cicchetti, 2009). This suggests that current college students who suffer from these disorders may not be able to fully recover through any therapeutic approach, merely due to being faced with the current pandemic. Additionally, sufficient AM specificity is needed to form one's identity, to curate one's life script, and to define one's goals and values. Identity distress and problems have already been linked to poor psychological adjustment in adolescents (Hernandez, Montgomery, & Kurtines, 2006). If these problems are exhibited at an extreme scale, the individual may develop an Identity Disorder, defined by the DSM as "a pathological 'identity' crisis" that includes:

> excessive and prolonged uncertainty over a variety of identity-related issues, including long-term goals, career choice, friendship patterns, sexual orientation and behavior, religious identification, moral value systems, and group loyalties, with significant distress and interference with normal adaptive functioning (Hernandez, Montgomery, & Kurtines, 2006, p.28).

**Sex Assigned at Birth and Autobiographical Memory**

The present study also found that all three AMT variables were significantly affected by participant's sex assigned at birth. Thus far, the limited literature on how biological sex affects AM specificity, duration of memory retrieval, and affective response has inconclusive findings, and therefore, the present study is extremely important to future literature in this area. In both conditions, females recalled memories significantly faster compared to males during the AMT. Additionally, the memories recalled by females were significantly more specific compared to the memories recalled by males in both conditions. These findings align with Dudycha and Dudycha's (1933) findings of better AMT performance in female participants compared to male participants. Interestingly enough, the difference of males' and females' average memory specificity scores in the stressed condition was *double* the difference in the unstressed condition. Lastly, even though males conveyed a significantly more positive affective response when recalling AMs compared to females, all participants regardless of sex experienced a decrease in affective response, meaning that their overall emotionality became more negative. These findings contribute greatly to the literature on the relationship between sex assigned at birth on AM performance and recall. The limited studies on this topic have found findings that partially align with our findings (e.g., Goddard, Dritschel & Burton, 1998); however, these studies have not focused on this relationship as in-depth as the current study has.

Our findings are supported by Young, et al.'s (2013) and Piefke, et al.'s (2005) studies, in which neurological differences between females and males have been found during AM tasks. More specifically, Piefke, et al. (2005) identified the right dorsolateral prefrontal cortex and the right insula as two of the areas that were uniquely activated in females when asked to recall AMs. In Young, et al.'s (2013) study, they observed that their female participants had "increased hemodynamic activity...in the dorsolateral prefrontal cortex (DLPFC), dorsal anterior insula, and precuneus" during the AMT (Young, et al., 2013, p.3320). Furthermore, they found specific

correlations between activation areas and the affective response associated with the recalled memory. Future studies should explore this relationship further, from both a neurological and a psychological perspective. It is extremely disheartening that the affect of every participant became more negative after they were exposed to a COVID-19-related stressor.

Every day, the U.S. general population is bombarded with various forms of media exposure about COVID-19; however, the majority of these news outlets do not consider how their media impacts the psychological health of their audience. The present study found that merely presenting college students with five minutes of COVID-19 imagery was enough stimuli to induce a negative affect in all 33 participants. This suggests that COVID-19 reminders via signs, newspaper articles, and podcasts may actually be a significantly increasing college students' depressive and anxiety symptomatology. This hypothesis aligns with previous studies (e.g., Liu & Liu, 2020; Yao, 2020) which have found a positive correlation between COVID-19 media exposure and the presence of psychological distress symptoms. More specifically, Yao's (2020) study found a strong relationship between increased COVID-19 media exposure with the presence of anxiety symptoms, measured by the Generalized Anxiety Disorder Scale (GAD-7), and with the presence of depressive symptoms, measured by the Patient Health Questionnaire (PHQ-9), even after mental disorder history, other COVID-19 factors, demographics, and social support were controlled for. In Liu and Liu's (2020) study, they found that media exposure, regardless of media type (social media, commercial media, overseas media, and official media) significantly evoked "vicarious traumatization" and increased anxiety in their sample of over 1,000 participants (Liu & Liu, 2020, p. 1). Vicarious traumatization is a term often used for healthcare workers and police officers who are persistently presented with stories from trauma survivors (Liu & Liu, 2020). The media, today, is constantly bombarding the entire population with trauma stories, which is causing a mass vicarious traumatization of our public. Given the mass hysteria that already exists around COVID-19 and the sudden high rates of depressive and

anxiety symptomatology caused by the current pandemic, future studies need to be done to better understand how media sources can *positively* affect the psychological health of the U.S. population, as currently, preliminary studies suggest that they are only magnifying psychological distress.

**Sex Assigned at Birth and Stress Response**

Additionally, the present study partially supported our tertiary hypothesis that a participant's sex assigned at birth was not found to significantly impact their self-reported stress response to the induced pandemic-related stressor. However, there was a significant difference when physiological stress responses were analyzed. In other words, self-reported stress, as measured by STAI-AD scores, of female participants did not significantly change from the unstressed to the stressed condition, but their physiological EDA values *did* increase significantly from the baseline timepoint to the stressed timepoint. For males, neither their STAI-AD scores nor their physiological EDA values significantly changed from the first to the second timepoint. Here, we can conclude that, in regard to perceived stress measured by the STAI-AD, neither participant group experienced a significant increase. However, when considering physiological stress measured by the Empatica E4 Wristband, females endured a greater stress response compared to male participants, which aligns with Goddard, Dritschel, and Burton's (1998) finding that being under pressure affected female participants but not male participants. Our findings contrast with previous studies (e.g., Anderson & Manuel, 1994; Kelly, Tyrka, Anderson, Price, & Carpenter, 2008) that have found that female participants score significantly higher on self-report anxiety measures compared to males. In the present study, average female self-report anxiety scores were higher than average male self-report anxiety scores, measured by the STAI-AD; however, this difference was not significant. It is important to note that many of these studies, unlike the present study, did not measure psychological *and* physiological anxiety. Therefore, our study is important to the current literature as it suggests that a person, specifically

a female individual, may experience significant physiological stress after an induced stressor, but not perceived psychological stress.

Neurological studies on stress response have explored activation levels and blood oxygenation level dependent (BOLD) signals of the hypothalamus-pituitary-adrenal (HPA) axis along with brain regions. Ježová, et al.'s (1996) study found that females have higher neuroendocrine activation compared to males during a heat exposure stressor. Goldstein, et al.'s (2010) study found BOLD signal differences between males and females in the brain regions associated with the stress response circuitry, e.g., amygdala, hypothalamus, brainstem, hippocampus, orbitofrontal cortex, anterior cingulate gyrus, and medial prefrontal cortex. Differences in BOLD signals between males and females were also observed in Young, et al.'s (2013) study. They found differences in BOLD signals in the hippocampus and in the dorsolateral prefrontal cortex (DLPFC) during an AMT (Young, et al., 2013). However, Goldstein, et al.'s (2010) study proposed that a woman's menstrual cycle may have influenced these changes. In the present study, we did not ask our female participants about their menstrual cycles, so this may have influenced our findings. Additionally, studies have suggested that the type of stressor can influence the severity of the stress response (e.g., Canoine, Hayden, Rowe, and Goymann, et al., 2002). This possibly explains why the present study did not see gender differences in overall stress response whilst other studies, that have used non-COVID-19-related stressors, *have* observed significant differences. It is also possible that the lack of significant findings of self-reported stress, measured by the STAI-AD, in the present study are due to the fact that college students are under more stress than the general population. In other words, this factor, of being a college student, might outweigh the other possible contributing factor (their sex assigned at birth).

Another factor that may have contributed to the differential findings in males versus females may be due to the fact that the number of participants who had been exposed to a trauma

or had been clinically diagnosed with a trauma or stress-related disorder or an anxiety disorder was higher in the female sample group compared to the male sample group. Our study found a significant positive correlation between elevated baseline anxiety and/or having a clinical anxiety disorder and greater stress response, measured by the Empatica E4 wristband. This finding builds on Faravelli, et al.'s (2012) discussion about anxiety disorders, e.g., GAD, and their role in an individual's stress response. It also further adds to Chaudieu, et al.'s (2008) study, in which increased stress responses, measured by cortisol levels, were found in elderly individuals with psychiatric disorders, e.g., anxiety disorders. Our study contributes to Chaudieu, et al.'s (2008) finding in that it suggests that having a clinical anxiety disorder is a significant contributor to how an individual responds to stress, *regardless of their age*. Increased stress levels in anticipation of a task have also been observed in individuals with PTSD (Bremner, et al., 2003). Our study adds to their findings by suggesting that increased baseline stress may not only be apparent in those with PTSD, but also in those with an anxiety disorder. Therefore, we can conclude that the present study adds to current literature about college students with clinical anxiety disorders, and that future research should be conducted on how COVID-19 is affecting these individuals specifically. It is incredibly important to identify at-risk populations, and it appears as though individuals with elevated baseline anxiety scores should be included in those groups.

**COVID-19 Perception and Stress Response**

Finally, participants' coronavirus perceptions and past experiences did not significantly correlate with their stress response to the induced COVID-19-related stressor; however, higher CQ-PTEI scores did have a significant negative correlation with the number of omitted errors that a participant made during the MMST's photo recognition tasks. These results suggest that COVID-19-related imagery may have been more memorable for participants who scored higher on the CQ-PTEI, meaning that these participants have a more intense emotional perception or a

more significant impact from the current pandemic. This finding aligns with Ratner, et al.'s (2006) study which found a significant correlation between negative perceptions of and experiences with negative events being associated with decreased performance. Thus far, the studies that have explored COVID-19-related perceptions in the general population have mostly looked at perceptions to specific aspects of COVID-19, e.g., levels of crowdedness (Wang, Yao & Martin, 2021), or in regard to psychological disorders (e.g., Lanciano, et al., 2020), but it would be interesting for future studies to build on this finding from our present study, by further looking at the effect of COVID-19 perceptions on academic performance.

**Study Limitations**

There are several limitations of the present study that deserve attention. The small sample size was determined based on the amount of funding available to compensate participants. Additionally, due to the nature and protocol of the present study, an inter-rater reliability of the AMT could not be completed. Inter-rater reliability would have added to the validity of the results and would have been addressed if there was more allotted time. Lastly, temporal data required for analyzing EDA data was lost for five participants. This was due to a misunderstanding of the format in which the Empatica E4 wristband's data can be downloaded. Given that this was only lost for 15% of the sample, the data can still be considered relevant and accurate. However, if this study were to be repeat4ed, this problem could be addressed. Additionally, the majority of participants who reported being clinically diagnosed with an anxiety disorder were female. This suggests that our findings of differing physiological stress responses being greater in females compared to males may be due to the fact that 36.8% of them had been diagnosed with an anxiety disorder. Or this may suggest that our finding of a positive correlation between having a clinical anxiety diagnosis and increased stress response to the COVID-19 stressor may be due to the majority of these participants being female. Therefore, it is important that future studies explore this relationship further, to better understand whether the

significant increase in EDA values from baseline to stressed was due to the participant's sex assigned at birth (being female) or their diagnosis of an anxiety disorder.

**Clinical Implications and Future Directions**

The present study also raises other questions that should be explored in future research. Most importantly, the question of whether merely a stressful situation is enough to affect AM specificity in an individual arises. Our present study suggested that merely inducing a stressor that references a potential trigger for the individual is enough stimuli for an individual to produce OGMs. Future studies should explore to what extent OGMs are state-like versus a characterological phenomenon, given that it has, in general, previously been considered as more persistent and trait-like. The present study suggests that, in reality, OGMs may be more malleable in the face of an induced stressor. Additionally, most OGM studies have only explored the effect of a clinically diagnosed trauma, so it would be appropriate to study the effect of COVID-19, which has recently been considered, but not defined as, a trauma. Additionally, our study adds to the discussion of gender specific differences in AM performance and in stress response. Since there is still no conclusive finding, future studies should study this topic more in-depth. Lastly, our study suggests that individuals with either a clinical anxiety disorder and/or higher baseline stress experience higher levels of stress from COVID-19, compared to individuals who had lower baseline stress levels. It would be interesting to look at these two populations in more depth, in regard to whether higher baseline stress is possibly linked to neurological, genetic, environmental or other aspects. It also adds to the discussion of individuals with clinical anxiety disorders and suggests that these persons are an at-risk population for more severe stress caused by COVID-19. Lastly, future studies must look at how COVID-19 induced chronic stress may have long term effects on individuals' coping strategies and identity formation.

## Conclusion

The present study significantly adds to the discussion of how Autobiographical Memory performance and functioning is affected by the current Coronavirus pandemic in undergraduate college students. It also touches on gender differences in memory performance and functioning in response to an induced COVID-19-related stressor. The study suggests merely inducing a COVID-19-related stressor significantly decreases memory specificity in all participants, which results in disruptions in a person's identity formation process. Additionally, a participant's sex assigned at birth significantly affects their duration of memory retrieval, memory specificity, *and* affective response to the memory. In both conditions, females were significantly faster in memory retrieval and significantly more specific in the memories that they recalled, whereas males displayed a significantly more positive affective response. These findings on gender differences are important as they suggest that there may be differences in brain activation during an Autobiographical Memory Test (AMT) between those assigned male versus female at birth. Additionally, all participants, regardless of sex assigned at birth, expressed a more negative affect following the COVID-19-related stressor (a five-minute presentation of COVID-19 imagery) This suggests that both COVID-19 *and* a person's sex assigned at birth significantly contribute to whether the person embodies a happy or sad emotional state. The present study identifies participants assigned female at birth, participants with elevated baseline anxiety levels, and participants with clinical anxiety disorders as three at-risk populations, in terms of the impact of stress from COVID-19. The study also raises important questions and hypotheses about the intersection between COVID-19, sex assigned at birth, and Autobiographical Memory (AM) that paves the way for future research to be conducted in this area.

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# Appendix A

## Validation Study: Informed Consent Document

### Informed Consent Document

**Title of Project: Exploring the Relationship of Gender, Stress, and Autobiographical Memory: Validation Study**
**Principal Investigator (PI): Elle C. Kass, Student, Connecticut College**
**Faculty Advisors: Joseph Schroeder, Ruth Grahn, Jefferson Singer**

### Invitation to be Part of a Research Study

You are invited to participate in a research study. In order to participate, you must be a Connecticut College undergraduate student enrolled in Introduction to Psychology (PSY 100), at least aged 18 and an English speaker. Taking part in this research project is voluntary.

### Important Information about the Research Study

Things you should know:

- The main purpose of this study is to determine how negatively emotionally salient and how stressful the pictures that are used in the parent study, Exploring the Relationship of Gender, Stress, and Autobiographical Memory, are. If you choose to participate, you will be asked to complete a two-part photographic questionnaire task, a short demographics questionnaire, and a short Google form survey. The study will take place remotely, through the Connecticut College SONA System. The study will take approximately 20-30 minutes to complete.
- Possible risks or discomforts from this research include elevated anxiety and stress levels. The study includes possible upsetting topics, which are listed in the section: Trigger Warnings, in this document.

- There are no direct benefits to you; however, you will receive between 0.75 SONA Credit Hours for your participation. Please see the section on compensation to better understand how you will be awarded these hours.
- Taking part in this research project is voluntary. You don't have to participate and you can stop at any time.

Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

**What is the study about and why are we doing it?**

The purpose of this study is to determine how negatively emotionally salient and how stressful the pictures that are used in the parent study, Exploring the Relationship of Gender, Stress, and Autobiographical Memory, are. The purpose of the parent study is to better understand the effects of pandemic-related stress on autobiographical memory, whether a participant's sex affects their stress response and/or autobiographical memory recall, and whether a participant's perception of COVID-19 correlates to their stress response. Autobiographical memory (AM) refers to a collection of personal semantic and episodic memories that expand over the course of one's lifetime, and helps create an individual's identity, life script, and values (Çili & Stopa, 2019). Preliminary studies have suggested that there is an individualized aspect to the emotion, stress, and memory relationship; however, this individualized component has not yet been studied extensively. Additionally, there is a lack of knowledge about how these variables relate to pandemic-related stress, specifically. National and international disasters are known to elicit significant psychological impairments in those who are exposed to them; however, the literature on how the current Coronavirus pandemic affects AM recall and whether a participant's sex

affects how they respond to pandemic-related stress is hugely insufficient. Therefore, this study aims to provide validation for the parent study.

**What will happen if you take part in this study?**

If you agree to take part in this study, you will be provided with the study link through the Connecticut College SONA System. You will first be asked to complete the photographic questionnaire. In this task, there will be two sets of photographs, the first consists of 20 photos and the second consists of 100 photos. After each photo, you will be prompted to answer 2 questions, each on a 9-point rating scale, about the previous photo (e.g., "did you find the previous photo emotionally positive, negative, or neutral?"). Then, you will complete a short demographics questionnaire (e.g., "What month and year were you born?" and "Have you ever received a positive Coronavirus (COVID-19, SARS-CoV-2) test result?"). Lastly, you will be provided with a link to a separate Google form. For you to receive SONA credit hours for your participation, you will need to fill out this Google form completely.

We expect this to take about 20-30 minutes. All information that you provide will remain confidential, be stored on a password-protected computer, and will not be associated with your name.

**How could you benefit from this study?**

There will be no direct benefits to you. However, members of the Connecticut College community might benefit from the study's results because pandemic-related stress is a very relevant variable for college students currently. Additionally, the results from this study will directly benefit the parent study: Exploring the Relationship of Gender, Stress, and Autobiographical Memory.

## What risks might result from being in this study?

There are some risks you might experience from being in this study. Primary risks from this study include slightly elevated anxiety and stress levels. Some of the pictures may cause you increased stress based on your past and current experience with the Coronavirus pandemic. If you have any questions about the content or potential risks of the study, please reach out to the PI, Elle Kass, at 408-888-6077 or mkass@conncoll.edu.

I do not foresee any other risks that are not listed here.

## Trigger Warnings

The photographic questionnaire task may cause you increased stress based on your past and current experience with the Coronavirus pandemic. It is important for you to take a moment to think about your relationship with the current international pandemic. This study also includes topics related to suicide, death, and dying. If you feel like these may be topics that are particularly upsetting or stressful for you, please contact the study's PI (email: mkass@conncoll.edu, cell: 408-888-6077) immediately and let them know that you have decided to terminate your participation in the study. You will still receive the 0.75 SONA Credit Hours. You will not have to disclose any information to the study's PI nor will you be asked any questions regarding your decision.

If you have any further questions or concerns, please feel free to ask the study's PI.

## How will we protect your information?

This study is intended to help validate the photographs used in the parent study: Exploring the Relationship of Gender, Stress, and Autobiographical Memory. The only information that will be used, will be findings from the statistical analyses of the stressfulness and emotionality of the photographs. No identifiable information (e.g., name) will be attached to your answers to the study. You will only be asked to provide your name to be awarded SONA credit hours. It is possible that other people may need to see the anonymized information we collect about you. These people work for Connecticut College and government offices that are responsible for making sure the research is done safely and properly.

**What will happen to the information we collect about you after the study is over?**

I will not keep your research data to use for future research or for any other purpose. Your name and other information that can directly identify you (e.g., collected for awarding SONA Credit Hours) will be kept secure and stored separately from the research data collected as part of the project. If the occasion arises, I may share your research data (anonymized) with other investigators without asking for your consent again, but it will not contain any information that could directly identify you.

**How will we compensate you for being part of the study?**

You will receive 0.75 SONA Credit Hours for your participation in the study. You will be presented with a Google form link at the end of the study. You must fill this form out completely in order to receive SONA credit hours. If you decide to end the study early, please email the PI at mkass@conncoll.edu to receive the Google Form link.

The information that you provide on the Google form will *not* be linked to the information that you provide in the Qualtrics study.

**What are the costs to you to be part of the study?**

There are no costs to you for participating in this study.

**Your Participation in this Study is Voluntary.**

It is totally up to you to decide to be in this research study. Participating in this study is voluntary. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer. If you decide to withdraw before this study is completed, your data will be erased from all sources (e.g., the password-protected computer).

**Contact Information for the Study Team and Questions about the Research**

If you have questions about this research, you may contact the study's PI Elle Kass by phone at +1-408-888-6077 or by email at mkass@conncoll.edu. You may also contact any of the study's faculty advisors: Professor Joseph Schroeder at jasch@conncoll.edu, Professor Ruth Grahn at regra@conncoll.edu, and Dean Jefferson Singer at jasin@conncoll.edu.

**Contact Information for Questions about Your Rights as a Research Participant**

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher, please contact the following:

Kira Phillips, IRB Administrator

Ann Devlin, IRB Chairperson

Connecticut College Institutional Review Board

270 Mohegan Avenue

New London, CT 06320

Phone: (860) 439-2330

Email: irb@conncoll.edu

**Your Consent**

If you have read the above information, consent to take part in the study, and are at least 18 years of age, please click the submit button below to confirm your consent.

# Appendix B

## Validation Study: Directions for Set 1 and Set 2

**Set 1**
**Directions**: The purpose of this study is to validate a set of photos. There are two sections to this study.

This first section consists of a total of 20 photos. Each photo will be shown to you one at a time, for a total of 3 seconds. Then, you will be asked to answer 2 questions (each on a 9-point Likert scale) about the previous photo. There are no right or wrong answers, but please answer the questions as truthfully as possible. This section is estimated to take approximately 5-10 minutes.

**Set 2**
**Directions**: The second, and last, section of this study consists of a total of 100 photos related to the Coronavirus (COVID-19) pandemic. Each photo will be shown to you one at a time, for a total of 3 seconds. Then, you will be asked to answer 2 questions (each on a 9-point Likert scale) about the previous photo. There are no right or wrong answers, but please answer the questions as truthfully as possible. This section is estimated to take approximately 10-15 minutes.

Please note that some of these photos may induce high levels of stress. If you feel as though you are experiencing too much stress or discomfort, please terminate the study. You will still receive the full SONA credit hours and you will not receive any punishment for your termination.

# Appendix C

## Validation Study: Photographic Stimuli

Photographic Stimuli Presentation: https://docs.google.com/presentation/d/15ni-5gyMt8hkKa4fAniZhuc1_wy7sIo8ALd404TSRGs/edit?usp=sharing

## Appendix D

### Validation Study: Subjective Two-Component Rating Scale (STCRS)

The two questions below will be shown right after each photo.

**Directions: Please rate the previous image on these two scales.**

1. How much stress did you feel?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Not Stress At All | | | | Some Stress | | | | Extreme Stress |

2. What emotion did you feel?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Emotionally Negative | | | | Emotionally Neutral | | | | Emotionally Positive |

## Appendix E

### Validation Study: Demographics Questionnaire

**Directions:** Please answer the following questions to the best of your abilities. You are encouraged to answer questions 3 and 4, since gender is a key variable to the study's key outcomes; however all questions are optional and you do not have to answer any question that you don't want to.

1. What month were you born? Month: _____
2. What year were you born? Year: _____
3. *With what gender do you identify?

   Select one: Male Female Other:_____

4. *What sex were you assigned at birth?

   Select one: Male Female Other: _____

5. With what race/ethnicity do you identify? Select all that apply:

   Asian Black/African White/Caucasian Hispanic/Latino Native American Pacific Islander Other:_____

   Prefer Not to Answer

6. What is your major or intended major?_____
7. What political party do you identify with?

   Select one: Democratic Party Republican Party Other:_____

   Prefer Not to Answer

8. Have you ever received a positive Coronavirus (COVID-19, SARS-CoV-2) test result?

   Select one: Yes No Prefer Not to Answer

   If yes, were you hospitalized? Select one: Yes No Prefer Not to Answer

9. How many people, do you know, have received a positive Coronavirus (COVID-19, SARS-CoV-2) result?

Select one: 0 1-3 4-6 7-9 10+ Prefer Not to Answer

10. Did any picture(s), topic(s), and/or theme(s) from the Mannheim Multicomponent Stress Test seem especially significant, stressful, or relevant to you? If so, please describe the picture(s), topic(s), and/or theme(s) to the best of your ability.

    Select one: Yes No Prefer Not to Answer

    If yes, please describe: _____

# Appendix F

## Validation Study: Debriefing Statement

### Debriefing Statement

First of all, thank you for participating in this validation study. I am conducting this study to validate the photographs that will be used in my Senior Honors Thesis on the relationship between gender, pandemic-related stress and autobiographical memory. For this project, I am exploring how a college student's autobiographical memory recall differs in stressed and unstressed conditions. Additionally, I am looking at whether participants respond differently to the pandemic-related stress due to their gender and whether there is a statistically significant relationship between males' and females' autobiographical memory recall. Lastly, I am looking at whether a participant's perception of the current pandemic affects how they respond from the pandemic-related stressor.

Your participation in this validation study is incredibly important to my thesis, so thank you again for taking the time to engage in this research study. If you are interested in these topics and want to read the literature in this area, you might enjoy the following articles:

Charles, N. E. (2020). Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. https://doi.org/10.31234/osf.io/rge9k

Gibbs, B. R., & Rude, S. S. (2004). Overgeneral autobiographical memory as depression vulnerability. *Cognitive Therapy and Research*, *28*(4), 511–526.

Ono, M., Devilly, G. J., & Shum, D. H. K. (2016). A meta-analytic review of overgeneral

memory: The role of trauma history, mood, and the presence of posttraumatic stress disorder. *Psychological Trauma: Theory, Research, Practice, and Policy, 8*(2), 157–164.

If you are interested in information about Coronavirus and mental health specifically, please check out the resources below:

The Jed Foundation: https://www.jedfoundation.org/covid-19-and-managing-mental-health/

Ten Percent Happier: https://www.tenpercent.com/coronavirussanityguide

If you have any questions or concerns about the manner in which this study was conducted, please contact the IRB Chairperson Professor Ann S. Devlin (asdev@conncoll.edu).

You may also contact me at mkass@conncoll.edu for additional resources.

## Appendix G

### Main Study: Letter of Invitation to Participate in Research

### Exploring the Relationship of Gender, Stress, and Autobiographical Memory

Date: _____

Dear_____

We invite you to participate in a research study conducted by Elle Kass, a Behavioral Neuroscience student at Connecticut College. The study's faculty advisors are Professor Joseph Schroeder, Professor Ruth Grahn, and Dean Jefferson Singer.

The purpose of this study is to better understand the relationships between COVID-19-pandemic-related stress, gender, and autobiographical memory recall. You are eligible to participate in this study if you are a student at Connecticut College and at least 18 years of age. We will ask you to complete a self-report questionnaire about your experiences with and perception of Coronavirus and about your anxiety level (completed 2 times in total). You will also be asked to participate in two autobiographical memory tests and one stress test. Your responses will be anonymous and confidential and we will not ask you to provide any identifying information (e.g., name or student identification number). Additionally, you will receive between $25-$40 monetary compensation for your participation. The monetary compensation will be awarded upon the completion of the study's testing period and consistent with the Connecticut College Human Subjects Payment Policy. The study should take approximately 45 minutes.

The primary risks involved with this study include COVID-19 exposure and elevated stress levels. It is important to understand that if contact tracing is required, your identity will be revealed. Appropriate precautions have been incorporated to the study to ensure your safety, health, and well-being. To better inform you of the COVID-19 related risks, please see the second document titled: COVID-19 Pre-Study Agreement Form.

To indicate that you are interested in participating in this study, please email me back a completed COVID-19 Pre-Study Agreement Form. At this time, we will schedule your testing time block in Bill Hall room 307 for a date that is at least 1 week after the date specified on the COVID-19 Pre-Study Agreement Form. Your participation in this study is completely voluntary. If you choose to participate, you may decide to discontinue participation at any time. You will be provided with an informed consent form upon arrival on your testing time. Completion of this informed consent form indicates your consent to participate in the present study. Feel free to contact me at mkass@conncoll.edu or at 408-888-6077 if you have any questions.

Sincerely,
Elle Kass '21

**Appendix H**

**Main Study: COVID-19 Pre-Study Agreement Form**

## COVID-19 Pre-Study Agreement Form

**Title of Project: Exploring the Relationship of Gender, Stress, and Autobiographical Memory Principal Investigator (PI): Elle C. Kass, Student, Connecticut College, mkass@conncoll.edu Faculty Advisors: Joseph Schroeder (jasch@conncoll.edu), Ruth Grahn (regra@conncoll.edu), Jefferson Singer (jasin@conncoll.edu)**

The Coronavirus Disease (COVID-19 or SARS-CoV-2) is a disease that originated in Wuhan, China and has now been spread internationally. This document is created to ensure the safety of yourself, the study team, and other participants, to reduce the spread of COVID-19, and to assist Connecticut College's COVID-19 contact tracing. **Please review the entire document and email a completed copy to the PI Elle Kass at mkass@conncoll.edu no later than _____.**

❏ I agree to inform the study's PI immediately if I experience any COVID-19 symptoms, test positive for COVID-19, or am required to enter a (contact) quarantine period in the 7 days prior to my scheduled time block.

❏ I understand that any information provided to the PI will be relayed to appropriate individuals for contact tracing and will be deleted by the PI once it has been reported.

❏ I understand that the study's PI may need to cancel or postpone my participation in this study if they experience any COVID-19 symptoms, enter a (contact) quarantine period themselves or tests positive for COVID-19.

❏ I agree to properly sanitize my hands (either before my arrival or at my arrival with the hand sanitizer provided), bring proof of my most recent negative COVID-19 test, show that I am "cleared" on the CoVerified app, and bring my own electronic device (e.g., laptop) when I arrive for the study. I also understand that the study's PI will show me her COVID-19

status (i.e., negative COVID-19 test and “cleared” on the CoVerified application) upon my arrival of the study.

❏ I agree to wear a mask and remain in the assigned seat, located 6-feet from the PI, during the entire duration of the study, unless otherwise authorized by the PI (e.g., to go to the bathroom).

❏ I agree to inform the study team if I experience any COVID-19 symptoms or test positive for COVID-19 in the 3 days following my participation in the study.

**If you have any questions, please contact the study team by their contact information above.**

*By entering my name and initials below, I am electronically signing this document.*

| Full Name | Initials | Date |
|---|---|---|

# Appendix I

## Main Study: Informed Consent Document

### Informed Consent Document

**Title of Project: Exploring the Relationship of Gender, Stress, and Autobiographical Memory**
**Principal Investigator (PI): Elle C. Kass, Student, Connecticut College**
**Faculty Advisors: Joseph Schroeder, Ruth Grahn, Jefferson Singer**

### Invitation to be Part of a Research Study

You are invited to participate in a research study. In order to participate, you must be a Connecticut College undergraduate student, between the ages of 18 and 25, and an English speaker. Taking part in this research project is voluntary.

### Important Information about the Research Study

Things you should know:

- The main purpose of this study is to better understand the effect of pandemic-related stress on autobiographical memory recall. This study also plans to explore the effect of sex on stress response and on autobiographical memory recall. If you choose to participate, you will be asked to complete a self-report anxiety questionnaire, a demographics questionnaire, a memory test, a stress test, and wear an Empatica E4 Wristband. The study will take place in Bill Hall at Connecticut College at the time you have scheduled with the study's PI. This will take approximately 45 minutes.
- Possible risks or discomforts from this research include risks of COVID-19, elevated anxiety and stress levels, and confidential breaches. The study includes possible upsetting topics, which are listed in the section: Trigger Warnings, in this document.

- Please understand that the present study will only be conducted when the college is in Green or Yellow Alert Levels.
- There are no direct benefits to you; however you will receive between $25-$40 as a monetary compensation.
- Taking part in this research project is voluntary. You don't have to participate and you can stop at any time.

Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

**What is the study about and why are we doing it?**

The purpose of this study is to better understand the relationships between, stress, gender, and autobiographical memory recall. Autobiographical memory (AM) refers to a collection of personal semantic and episodic memories that expand over the course of one's lifetime, and helps create an individual's identity, life script, and values (Çili & Stopa, 2019). Current AM studies of individuals diagnosed with varying severities of Post Traumatic Stress Disorder (PTSD) have found that those in the PTSD group tend to produce AM deficits, such as Overgeneral Memory (OGMs), than their healthy counterparts when presented with an emotionally charged word cue in an autobiographical memory test (AMT). Preliminary studies have suggested that there is an individualized aspect to the emotion, stress, and memory relationship; however, this individualized component has not yet been studied extensively. Additionally, there is a lack of knowledge about how these variables relate to pandemic-related stress, specifically. National and international disasters are known to elicit significant psychological impairments in those who are exposed to them; however, the literature on how the current Coronavirus pandemic affects AM recall and whether a participant's sex affects how they

respond to pandemic-related stress is hugely insufficient. Therefore, this study aims to provide crucial information to help fill this gap.

**What will happen if you take part in this study?**

If you agree to take part in this study, you will be asked to put on a wristband at the beginning of the study and to keep it on during the entire study. You will begin with online versions of the Coronavirus Questionnaire on Perceived Threat, Experiences, and Impacts (CQ-PTEI) (e.g., "2. I am afraid of Coronavirus.") to provide your perception and feelings towards the Coronavirus pandemic, and the State-Trait Anxiety Inventory for Adults (STAI-AD) Form Y-1 (e.g., "1. I feel calm." and "13. I feel jittery.") to provide your baseline anxiety level (Spielberger, et al., 1983). Then the actual testing will commence with the first Autobiographical Memory Test (AMT) (e.g., "Recall a special autobiographical memory associated with the word *mean*") (Williams & Broadbent, 1986). Next, you will participate in the Mannheim Multicomponent Stress Test (MMST), which is a five-minute test designed to elicit stress (Kolotylova, et al., 2009). This test will include a picture identification task (raise your hand when you see a repeated picture) and an arithmetic task, where you will be instructed to add the two previous single digit numbers together (e.g., if the first and second number presented is 5 and 7, respectively, you would say 12. If the third number presented is 2, then you would say 9 because 7+2 is 9). Immediately after, you will complete the second AMT (e.g., "Recall a special autobiographical memory associated with the word *loyal*"). At the end of the study, you will take the STAI-AD Form Y-1 again (e.g., "3. I feel tense." and "6. I feel upset.") and a short demographic questionnaire (e.g., "What is your date of birth?", "With what gender do you identify?", "How many people, do you know, have received a positive Coronavirus (COVID-19, SARS-CoV-2) result?", and "Have you ever been clinically diagnosed with a trauma- or stress-related disorder (i.e., Post-traumatic Stress

Disorder (PTSD) or Acute Stress Disorder (ASD))?"). You are encouraged to answer the questions from the demographics questionnaire; however, you are not required to answer them all. We expect this to take about 45 minutes. You will only be asked to come in for one testing session. All information that you provide will remain confidential, be stored on a password-protected computer, and will not be associated with your name.

**Reasons for Early Termination by the PI**

There are three main reasons why the study's PI may terminate your participation early. All of these are to ensure your safety and well-being. The first way is from the Coronavirus Questionnaire on Perceived Threat, Experiences, and Impacts (CQ-PTEI). A threshold of ≥80 has been set for this self-report questionnaire, as a score ≥80 suggests that the COVID-19 pandemic may be a topic that is too emotionally salient and stressful for you. Due to the study's main stressor being pandemic-related stress, a CQ-PTEI score of ≥80 would subsequently cause the PI to terminate your participation early to ensure your safety. The second way is from the State-Trait Anxiety Inventory (STAI-AD). A threshold of ≥60 has been set for this self-report questionnaire, as a score of ≥60 suggests that you are currently experiencing a very high level of anxiety (Delgado, Freire, Wanderley, & Lemos, 2016). Due to the study's inclusion of the Mannheim Multicomponent Stress Test (MMST), the PI will terminate your participation if the STAI-AD threshold is reached, so that your safety and well-being can be protected. The third way is if you are experiencing too much stress and anxiety from the MMST. The PI will be monitoring your physiological markers (heart rate, galvanic skin response, and heart rate variability) during the entire study. If your heart rate and/or heart rate variability deviate from normal (safe) range (heart rate: 50-170bpm, heart rate variability: 46.3-72.0), the PI will immediately terminate the study as a safety measure (American Heart Association, 2015; Urzeală, et al., 2020).

If you have any questions about possible situations of early termination, please ask the study's PI.

**How could you benefit from this study?**

There will be no direct benefits to you. However, members of the Connecticut College community might benefit from the study's results because stress is a very relevant variable for college students.

**Compensation**

You will receive a monetary compensation for your participation consistent with the Connecticut College Human Subjects Payment Policy. This will be rewarded at the conclusion of the study's entire testing period.

**What risks might result from being in this study?**

There are some risks you might experience from being in this study. Primary risks from this study include COVID-19 exposure and slightly elevated anxiety and stress levels.

**COVID-19 related risks**

We appreciate your willingness to participate in the present study. We want you to know that your safety and health matters to us. The study team has adapted the present study in order to ensure the safety of all participants. However, this means that your participation in the study may be terminated by the PI if you do not follow all of the regulations specified on the COVID-19 Pre-Study Agreement Form. Additionally, your participation may be postponed or canceled in

the event that the college returns to an Orange or Red Alert Level, as data collection will only occur in Yellow and Green Alert Levels. All objects will be sanitized by the study's PI before AND after each testing period. These objects include, but are not limited to, the Empatica E4 Wristband, desks, chairs, and doorknobs. Additionally, all doors and windows in Bill Hall room 307 will be open. A bottle of hand sanitizer will be available in the testing room for your use. You will be required to comply with Connecticut College's Camel Care Pledge mask wearing and social distancing policies for the duration of your participation. You are also asked to not touch anything that you are not instructed to (e.g., the speaker) and to bring your own electronic device (e.g., computer). If you have questions about how an object is being sanitized and/or what the study team has implemented into the present study to decrease the risk of you contracting COVID-19, please feel free to ask the study's PI.

We do acknowledge that we cannot confirm that you will not contract COVID-19. The risks of COVID-19 can vary from mild flu-like symptoms to death. People with certain underlying medical conditions can be at an increased risk if COVID-19 is contracted. It is important for you to know that you have the right to terminate your participation in this study for any reason and at any time. You will not have to specify your reason(s) for termination, nor will you receive any type of penalties for it. To learn more, visit Connecticut College's Recommendations for Off-Campus Learning Activities during Fall 2020.

**Other risks**

Other risks from this study include elevated anxiety and stress levels and confidentiality breaches. Self-assessment anxiety questionnaires will be conducted pre- and post-treatment and your physiological variables will be monitored through the Empatica E4 Wristband to identify

individuals who may be experiencing this adverse reaction. If you are experiencing this adverse reaction at any point during the study, please tell the study's PI Elle Kass. Please understand that if your heart rate variability (HRV) and/or heart rate (HR) data deviates from the standard range, the PI will end your participation and take the appropriate steps to ensure your safety and well-being. These steps may include an immediate appointment with Connecticut College's Student Health Services or with Student Counseling Services. If a serious and/or life-threatening medical emergency occurs, the study's PI will contact Connecticut College Campus Safety so that the person on call can come assess the situation and provide you with a wellness check. If appropriate, an ambulance will be called for you. If you find yourself experiencing these reactions after the study, please contact the study's PI Elle Kass at mkass@conncoll.edu, Connecticut College's Student Health Services at shs@conncoll.edu and/or Connecticut College's Student Counseling Center at scs@conncolll.edu. Additionally, at least one faculty advisor will be reachable by text or phone call during your participation period, if an emergency or issue arises, or if you would like to speak to them.

Another possible risk is an information risk (e.g., those involving breach of confidentiality). None of the questionnaires will ask for your name or any other identifying information (e.g., student identification number). Instead, participants' information, including audio recordings, will be stored using a numerical identification system to ensure anonymity. You can also decline the use of the audio recording during the AMT. Additionally, all information will be kept confidential and on a password-protected computer. If a confidentiality breach occurs, the study team will contact you and deal with it ethically and appropriately. I do not foresee any other risks that are not listed here.

## Trigger Warnings

The Mannheim Multicomponent Stress Test (MMST) involves a picture identification task. Some of the pictures may cause you increased stress based on your past and current experience with the Coronavirus pandemic. It is important for you to take a moment to think about your relationship with the current international pandemic; the first questionnaire that you completed (CQ-PTEI) can help you with this. This study also includes topics related to suicide, death, and dying. If you feel like these may be topics that are particularly upsetting or stressful for you, please let the study's PI know that you have decided to terminate your participation in the study. You will still receive the minimum of $25. You will not have to disclose any information to the study's PI nor will you be asked any questions regarding your decision.

If you have any further questions or concerns, please feel free to ask the study's PI.

## How will we protect your information?

I plan to publish the results of this study. To protect your privacy, I will not include any information that could directly identify you. If the study team decides to include quotations from the autobiographical memory test in a publication or presentation of the study, you will be contacted by the researcher with a separate formal written permission document. At this time, the researcher will indicate the exact quotation(s) of yours that the study team desires to use. They will also remind you that the quotation(s) will be included anonymously. The researcher will ask for your permission for each quotation that they desire to include. Agreeing to the use of one quotation does not mean that you are agreeing to the use of all quotations. Refusing to give your permission will not result in any form of punishment.

Further, consenting to the study does not mean that you are consenting to being recorded with a recording device during the AMT or that you are consenting to having quotations from your participation be published. I will protect the confidentiality of your research records by using a numerical identification system, keeping the data on a password-protected computer, and stripping the data from any identifying features. The study's PI Elle Kass will be the only person who has access to this data and to this computer. Only one document will exist that attaches your name with its respective numerical identification code. This document will be password-protected and only accessible to the study's PI and it will only be accessed *if* the PI needs to contact you for quotation approval. It is possible that the study's faculty advisors may need to see the data, but only after it has been anonymized. Your name and any other information (e.g., the recordings) that can directly identify you will be stored separately from the data collected as part of the project. The recordings will only be accessed to score the autobiographical memory test. It is possible that other people may need to see the information we collect about you. These people work for Connecticut College and government offices that are responsible for making sure the research is done safely and properly.

**What will happen to the information we collect about you after the study is over?**

I will not keep your research data to use for future research or for any other purpose. Your name and other information that can directly identify you will be kept secure and stored separately from the research data collected as part of the project. If the occasion arises, I may share your research data with other investigators without asking for your consent again, but it will not contain any information that could directly identify you.

**How will we compensate you for being part of the study?**

You will receive up to $40 for your participation in this study (the exact sum of money is determined by the Mannheim Multicomponent Stress Test). If you withdraw from the study before or during the Mannheim Multicomponent Stress Test, you will receive $25 in the form of a check for your participation. If you withdraw from the study after the Mannheim Multicomponent Stress Test, you will receive the full amount that you were promised based on your performance of the Mannheim Multicomponent Stress Test (minimum of $28.35 and maximum of $40). Please understand that the PI will need to keep a log of your name and the amount that you were provided with according to the Connecticut College Human Subjects Payment Policy.

**What are the costs to you to be part of the study?**

There are no costs to you for participating in this study.

**Your Participation in this Study is Voluntary.**

It is totally up to you to decide to be in this research study. Participating in this study is voluntary. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer. If you decide to withdraw before this study is completed, your data will be erased from all sources (e.g., the password-protected computer). The subject's participation may be terminated by the PI without the consent of the subject if the PI notices that the participant is exhibiting abnormally high levels of anxiety or stress during the study. This is to protect the participant. If this situation arises, the study's PI will contact the appropriate resources, e.g., Connecticut College's Student Counseling Services, to ensure the participant's safety, health, and well-being.

**Contact Information for the Study Team and Questions About the Research**

If you have questions about this research, you may contact the study's PI Elle Kass by phone at +1-408-888-6077 or by email at mkass@conncoll.edu. You may also contact any of the study's faculty advisors: Professor Joseph Schroeder at jasch@conncoll.edu, Professor Ruth Grahn at regra@conncoll.edu, and Dean Jefferson Singer at jasin@conncoll.edu.

**Contact Information for Questions About Your Rights as a Research Participant**

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher, please contact the following:

Kira Phillips, IRB Administrator

Ann Devlin, IRB Chairperson

Connecticut College Institutional Review Board

270 Mohegan Avenue

New London, CT 06320

Phone: (860) 439-2330

Email: irb@conncoll.edu

**Your Consent**

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. I will provide you with an electronic and/or hard copy of this document for your records. I will keep a copy with the study records. If you have any questions

about the study after you sign this document, you can contact the study team using the information provided above.

*I understand what the study is about and my questions so far have been answered. I am at least 18 years of age and I agree to take part in this study.*

If you answered "yes" to the above statement, please enter your full name here.

_____

If you answered "yes" to the above statement, please enter today's date here.

_____

If you answered "yes" to the above statement, please sign your name here.

_____

**COVID-19 Consent**

*I understand the risks of COVID-19 that are included by my participation in this study.*

YES_____ NO_____

*I understand that my identity in this study will remain confidential, unless contact tracing is required.* YES_____ NO_____

If you answered "yes" to the above COVID-19 consent statements, please sign your name here.

_____

**Consent to be Audio Recorded**

*I agree to be audio recorded.*

YES_____ NO_____

If you agree to be audio recorded, please sign your name here.

_____

## Appendix J

## Main Study: Coronavirus Questionnaire on Perceived Threat, Experiences, and Impacts (CQ-PTEI)

(Conway III, Woodard, & Zubrod, 2020)

**Directions**: A number of statements about the Coronavirus (COVID-19, SARS-CoV-2) pandemic are included below. Read each statement and then circle the number that best describes that statement's relevance to you, with a score of "1" corresponding to "not true of me at all" and of "7" corresponding to "very true of me." There are no right or wrong answers. Do not spend too much time on any one statement but choose the answer that best describes your position. Please note that your answers to the questions below will not be linked to you in any way (including for contact tracing). Additionally, you are encouraged to answer all 16 items; however, this is not mandatory. If you choose to refrain from answering a statement, please leave that statement and response section blank.

### Perceived Coronavirus Threat Questionnaire (Short)

| | Statement | Not true of me at all | Moderately not true of me | Slightly not true of me | Neutral | Slightly true of me | Moderately true of me | Very true of me |
|---|---|---|---|---|---|---|---|---|
| 1. | Thinking about coronavirus (COVID-19) makes me feel threatened. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. | I am afraid of coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. | I am stressed around other people because I worry I'll catch the coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

### Coronavirus Impacts Questionnaire (Short)

| | Statement | Not true of me at all | Moderately not true of me | Slightly not true of me | Neutral | Slightly true of me | Moderately true of me | Very true of me |
|---|---|---|---|---|---|---|---|---|
| 4. | The Coronavirus (COVID-19) has impacted me negatively from a financial point of view. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. | I have lost job-related income due to the Coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. | I have had a hard time getting needed resources (food, toilet paper) due to the Coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7. | It has been difficult for me to get the things I need due to the Coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. | I have become depressed because of the Coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. | The Coronavirus (COVID-19) outbreak has impacted my psychological health negatively. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

**Coronavirus Experiences Questionnaire (Short)**

| | Statement | Not true of me at all | Moderately not true of me | Slightly not true of me | Neutral | Slightly true of me | Moderately true of me | Very true of me |
|---|---|---|---|---|---|---|---|---|
| 10. | I have been diagnosed with coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. | I have had coronavirus-like symptoms at some point in the last two months. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. | I have been sick with something other than the coronavirus in the last two months. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 13. | I have been in close proximity with someone who has been diagnosed with coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14. | I have been in close proximity with someone who has had coronavirus-like symptoms in the last two months. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 15. | I watch a lot of news about the Coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 16. | I spend a huge percentage of my time trying to find updates online or on TV about Coronavirus (COVID-19). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

## Appendix K

### Main Study: State-Trait Anxiety Inventory for Adults (STAI-AD) Form-Y-1

(Spielberger, et al., 1983)

**Directions:** A number of statements which people have used to describe themselves are given below. Read each statement and then choose the number at the end of each statement that best indicates how you feel ***right*** now, that is, ***at this moment***. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

| | Statement | Not at all | Somewhat | Moderately so | Very much so |
|---|---|---|---|---|---|
| 1. | I feel calm. | 1 | 2 | 3 | 4 |
| 2. | I feel secure. | 1 | 2 | 3 | 4 |
| 3. | I am tense. | 1 | 2 | 3 | 4 |
| 4. | I feel strained. | 1 | 2 | 3 | 4 |
| 5. | I feel at ease. | 1 | 2 | 3 | 4 |
| 6. | I feel upset. | 1 | 2 | 3 | 4 |
| 7. | I am presently worrying over possible misfortunes. | 1 | 2 | 3 | 4 |
| 8. | I feel satisfied. | 1 | 2 | 3 | 4 |
| 9. | I feel frightened. | 1 | 2 | 3 | 4 |
| 10. | I feel comfortable. | 1 | 2 | 3 | 4 |
| 11. | I feel self-confident. | 1 | 2 | 3 | 4 |
| 12. | I feel nervous. | 1 | 2 | 3 | 4 |
| 13. | I am jittery. | 1 | 2 | 3 | 4 |
| 14. | I feel indecisive. | 1 | 2 | 3 | 4 |
| 15. | I am relaxed. | 1 | 2 | 3 | 4 |
| 16. | I feel content. | 1 | 2 | 3 | 4 |
| 17. | I am worried. | 1 | 2 | 3 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| 18. | I feel confused. | 1 | 2 | 3 | 4 |
| 19. | I feel steady. | 1 | 2 | 3 | 4 |
| 20. | I feel pleasant. | 1 | 2 | 3 | 4 |

## Appendix L

### Main Study: Autobiographical Memory Test (AMT)

(Anderson, 1986; McNally, Lasko, Macklin, & Pitman, 1995; Williams & Broadbent, 1986)

The following instructions will be read to the participant:

> This is an autobiographical memory experiment, and the procedure is very straightforward, and goes as follows. I'll be showing you a series of 10 words. Each word is printed on a separate card. Each word is the name of a trait or personal characteristic. Most of us exhibit or display each of these traits at one time or another. When I show you each trait word, what I'd like you to do is to think of a time when you exhibited or displayed the trait in question. The memory you retrieve should be very specific. That is, it should refer to a particular occurrence, lasting no longer than a day, when you displayed the trait. So, for example, if the trait word were *excitable*, you might say "I was really excited last Sunday when I was watching the football game on TV." That would be a specific personal memory because it referred to a particular event on a particular day when you displayed the trait. If you had said, "I always get excited when I watch football on TV" you would not have stated a *specific* personal memory because the memory did not refer to any *specific* event but rather to "watching football games in general." So, for each word, we want you to think of a specific personal memory — a time when you displayed the trait in question. Although we want you to answer as quickly as you can, the most important thing is to answer with a specific memory, not a general memory. As soon as you think of a specific instance, I want you to describe it out loud, briefly. I'll be timing how quickly you can recall a specific memory. I'll be giving you up to 60 seconds for each word. I'll also record your responses using my phone. Before we begin with the experimental words, I'll give you two words for practice. Any questions?

The experimenter will present each word to the participant, begin timing, stop the stopwatch once the participant has retrieved a specific memory, and then ask the participant to date the episode. If the participant retrieved only a general memory, the experimenter would continue timing, but prompt the participant to attempt to retrieve a specific episode. If the participant fails to retrieve a specific memory within 60 sec, the experimenter will present the next word.

| **Word List A** | **Word List B** |
|---|---|
| 1. Unlucky (practice) | 1. Strict (practice) |
| 2. Inexperienced (practice) | 2. Rebellious (practice) |
| 3. Honest (P) | 3. Understanding (P) |
| 4. Mean (N) | 4. Dishonest (N) |
| 5. Loyal (P) | 5. Truthful (P) |
| 6. Rude (N) | 6. Selfish (N) |
| 7. Friendly (P) | 7. Kind (P) |
| 8. Self-centered (N) | 8. Offensive (N) |
| 9. Thoughtful (P) | 9. Happy (P) |
| 10. Unkind (N) | 10. Obnoxious (N) |

**Scoring** (Griffith, et al., 2009; Williams, Ellis, Tyers, Healy, Rose, & Macleod, 1996)

Results will be quantified by:

1) Duration of Memory Retrieval (exact time if ≤ 60 seconds, or *failed* if ≥ 60 seconds).

2) Memory Specificity:

4 points = *specific* (specific time and place, lasting ≤ 1 day),

3 points = *extended* (specific time and place, lasting ≥ 1 day),

2 points = *semantic associate* (verbal response driven by general semantic knowledge, e.g., “I might feel calm when traveling to a new place”),

1 point = *OGM + specific/extended/semantic associate* (1st retrieved =OGM, 2nd retrieved = specific, extended, or semantic associate recalled ≤ 60 seconds),

0.5 point = *OGM* (summary/categorical memory; does not indicate a specific time or place),

0.5 points = *OGM + OGM* (1st retrieved =OGM, 2nd retrieved = OGM, recalled ≤ 60 seconds),

0.25 points = *OGM + failed* (1st retrieved = OGM and participant failed to recall a second memory ≤ 60 seconds),

0 points = *failed* (no memory retrieved in ≤ 60 seconds).

3) Affective Response to the Memory: *positive* = +1, *neutral* = 0, *negative* = -1

## Appendix M

### Main Study: Mannheim Multicomponent Stress Test (MMST)

(Kolotylova, et al., 2009)

The following instructions will be read to the participant:

> This is a five-minute test designed to cause heightened levels of stress by the simultaneous use of four different modalities of stressors (cognitive, emotional, acoustic, and motivational). You will have one minute to relax. Then the five minutes of stress induction will begin. Once each stressor is introduced, it will be sustained until the end of the test. The first minute will consist of the presentation of a white noise played through this speaker and of pandemic-related photographs of positive and negative affective value. Some of these pictures will repeat. If you see a repeated photo, please indicate it by raising your hand. Each photo will be presented for 3 seconds. After the first minute, the arithmetic task will begin. Single digit numbers will be presented sequentially on the screen in front of you. You are to add the most recent number to the previous one and repeat this task consecutively, not provide a running total. For example, if the first two numbers are '5' and '7,' you would say '12.' Then if the third number is '3,' you would say '10,' because '7+3.' If the next number is '2,' what would you say? (wait until they say '5.' If they say anything else, give the correct answer and explain why their answer was wrong.) While you do this, the pictures and white noise will continue. You will receive a maximum of $40 at the end of the study for your participation. This sound will be used to tell you that you've made a mistake in the arithmetic task (*play sound*). Each time a mistake is made, you will receive 35 cents less. Any questions?

Acoustic stressors: White Noise: (Tmsoft, 2008); Error Noise: (Swift Fox Software, LLC, 2009).

MMST Presentation:

https://docs.google.com/presentation/d/12oIrPYdCn8sfjDqt2GI2HV35XFnd1CFKOcOCz2K6xDw/edit?usp=sharing

## Appendix N

## Main Study: Demographics Questionnaire

**Directions:** Please answer the following questions to the best of your abilities. You are encouraged to answer questions 3 and 4, since gender is a key variable to the study's key outcomes; however, all questions are optional and you do not have to answer any question that you don't want to.

1. What month were you born? Month: _____
2. What year were you born? Year: _____
3. What class grade are you in at Connecticut College?

   Select one: 2021 2022 2023 2024
4. *With what gender do you identify?

   Select one: Male Female Other: _____ Prefer Not to Answer
5. *What sex were you assigned at birth?

   Select one: Male Female Other: _____ Prefer Not to Answer
6. With what race/ethnicity do you identify? Select all that apply:

   Asian Black/African White/Caucasian Hispanic/Latino

   Native American Pacific Islander Other:_____ Prefer Not to Answer
7. What is your major or intended major? _____
8. What political party do you identify with?

   Select one: Democratic Party Republican Party Other:_____

   Prefer Not to Answer
9. Have you ever received a positive Coronavirus (COVID-19, SARS-CoV-2) test result?

   Select one: Yes No Prefer Not to Answer

   If yes, were you hospitalized? Select one: Yes No Prefer Not to Answer

10. How many people, do you know, have received a positive Coronavirus (COVID-19, SARS-CoV-2) result?

    Select one: 0 1-3 4-6 7-9 10+ Prefer Not to Answer

11. Were any of these individuals hospitalized for Coronavirus (COVID-19, SARS-CoV-2)? (Rees, et al., 2020)

    Select one: Yes No Prefer Not to Answer

    (If "Yes") How many were hospitalized?: 1-3 4-6 7-9 10+

    Prefer Not to Answer

    (If "Yes") How many were hospitalized for ≥ 4 days? 1-3 4-6 7-9 10+

    Prefer Not to Answer

12. Did any of these individuals die from Coronavirus (COVID-19, SARS-CoV-2)?

    Select one: Yes No Prefer Not to Answer

    (If "Yes") How many people?: 1-3 4-6 7-9 10+ Prefer Not to Answer

13. Have you ever experienced a trauma, as defined by the DSM-5 as an event with "actual or threatened death, serious injury, or sexual violence?" (American Psychiatric Association, 2013)

    Select one: Yes No Prefer Not to Answer

14. Have you ever been clinically diagnosed with a trauma- or stress-related disorder (i.e., Post-traumatic Stress Disorder (PTSD) or Acute Stress Disorder (ASD))?

    Select one: Yes No Prefer Not to Answer

15. Have you ever been clinically diagnosed with an Anxiety Disorder (i.e., Generalized Anxiety Disorder (GAD), Panic Disorder, Phobia-related Disorder, Social Anxiety Disorder (SAD), Agoraphobia, or Separation Anxiety Disorder)?

    Select one: Yes No Prefer Not to Answer

16. Did any picture(s), topic(s), and/or theme(s) from the Mannheim Multicomponent Stress Test seem especially significant, stressful, or relevant to you? If so, please describe the picture(s), topic(s), and/or theme(s) to the best of your ability.

    Select one: Yes No Prefer Not to Answer

    If yes, please describe: _____

# Appendix O

## Parent Study: Debriefing Statement

### Debriefing Statement

First of all, thank you for participating in this research dealing with pandemic-related stress, gender, and memory. In this research, I am examining a person's autobiographical memory recall in a stressed condition compared to an unstressed condition. In addition, this study is especially relevant at Connecticut College in particular as stress is very commonly observed in college students and its effect on memory recall is relevant to the college student population. Further, autobiographical memories (AMs) and self-defining memories (SDMs) are used to aid in the development of a person's identity and studies have shown that this process occurs around the ages of 18-25, which is the age range of the study's sample group and of all Connecticut College students. Additionally, the study aims to look specifically at pandemic-related stress, which is especially relevant to our current situation. Male and female undergraduate students at Connecticut College. One of the issues in the current literature on deficits of memory recall is that it primarily focuses on severe traumatic events that are linked to Post-traumatic Stress Disorder (PTSD) diagnoses and fails to speak about other stressful events that may not be perceived as a trauma at first glance. Another gap in current literature is that, although preliminary studies have all supported an individualized component of emotion, stress, and memory, this relationship has not been studied extensively. Typically, researchers have focused on the relationship of stress and memory by solely studying memory recall in those with a *diagnosis* of PTSD. These studies fail to examine or acknowledge the emotional connotation associated with their respective studies' word cues, despite previous literature suggesting that this variable produces a statistically significant effect. To the author's knowledge, there is very little research on how the current COVID-19 pandemic impacts AM recall, and close to no

research on pandemic-related stress, sex, and AM recall in college-students. Therefore, the current study aims to shed some light on this relationship.

In addition to AM recall performance between stressed and unstressed conditions, this research also assessed whether or not a participant's sex affects their performance on the autobiographical memory test or their response to the induced stressor (MMST). To the author's knowledge, the amount of research on the effect of gender on AM recall and on stress response is quite limited and fails to conclude any significant trend.

Please continue to check your email, as you will be contacted by the study's PI upon completion of the study's entire testing period to collect your monetary compensation.

If you have any questions or concerns about the manner in which this study was conducted, please contact the IRB Chairperson Professor Ann S. Devlin (asdev@conncoll.edu).

If you are at all worried about your mental, emotional, and/or physical well-being, please contact Connecticut College Student Counseling Services (SCS) and/or Connecticut College Student Health Services (SHS). Information regarding after-hours care and outside care is located below for your convenience.

| | Connecticut College SCS | Connecticut College SHS |
|---|---|---|
| Hours: | Monday-Thursday: 8:30am-6:00pm | Monday-Friday: 8:30am-5:00pm |
| | Friday: 8:30am-5:00pm | |
| | Saturday & Sunday: Closed | Saturday & Sunday: Closed |

| | |
|---|---|
| (860)439-4587 | (860)439-2275 |
| scs@conncoll.edu | shs@conncoll.edu |

After Hours Care:

24 Hour Nurseline, Sponsored by SHS: (800)634-7629

Free Transportation via Uber Health: (860)439-2222

Hartford Healthcare-GoHealth Urgent Care: (860)865-0934

Local Hospitals/ Emergency Rooms:

| William H. Backus Hospital | Pequot Medical Center | Lawrence and Memorial Hospital (L&M) |
|---|---|---|
| 24 Hours | 7:00am-11:00pm | 24 Hours |
| (860)889-8331 | (860)446-8265 | (860)442-0711 |

If you are interested in this topic and want to read the literature in this area, you might enjoy the following articles:

Charles, N. E. (2020). Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. https://doi.org/10.31234/osf.io/rge9k

Gibbs, B. R., & Rude, S. S. (2004). Overgeneral autobiographical memory as depression vulnerability. *Cognitive Therapy and Research*, *28*(4), 511–526.

Ono, M., Devilly, G. J., & Shum, D. H. K. (2016). A meta-analytic review of overgeneral memory: The role of trauma history, mood, and the presence of posttraumatic stress disorder. *Psychological Trauma: Theory, Research, Practice, and Policy*, *8*(2), 157–164.

If you are interested in information about Coronavirus and mental health specifically, please check out the resources below:

The Jed Foundation: https://www.jedfoundation.org/covid-19-and-managing-mental-health/

Ten Percent Happier: https://www.tenpercent.com/coronavirussanityguide

You may also contact me at mkass@conncoll.edu for additional resources.

# Appendix P

## Parent Study: Early Termination Debriefing Statement

### Debriefing Statement

First of all, thank you for your interest in the present study on pandemic-related stress, gender, and autobiographical memory. Your participation in the study has ended early because at least one safety measure has been triggered, suggesting that continuation of the study might compromise your safety and well-being. The Mannheim Multicomponent Stress Test (MMST) was intended to induce a heightened, yet controlled, level of stress in you. Throughout the study, the PI has been monitoring your heart rate, heart rate variability, and galvanic skin response levels — three physiological markers that convey how much stress you are experiencing in a given moment. To ensure your safety and well-being, the study team has decided to immediately conclude the study for any participant whose physiological markers of stress deviate from the "safe" threshold. Although you may desire to continue, the termination of your participation is required according to the approved study protocol, as your health and well-being are of the utmost importance.

If you have any questions about why your participation was terminated early, please ask the PI.

Please continue to check your email, as you will be contacted by the study's PI upon completion of the study's entire testing period to collect your monetary compensation.

We encourage you to reach out to the Connecticut College Student Counseling Services (SCS) and/or the Connecticut College Student Health Services (SHS) upon leaving the study room. Contact information and hours of operation are listed below:

| | Connecticut College SCS | Connecticut College SHS |
|---|---|---|
| Hours: | | |
| | Monday-Thursday: 8:30am-6:00pm | Monday-Friday: 8:30am-5:00pm |
| | Friday: 8:30am-5:00pm | |
| | Saturday & Sunday: Closed | Saturday & Sunday: Closed |
| Contact Information: | | |
| | (860)439-4587 | (860)439-2275 |
| | scs@conncoll.edu | shs@conncoll.edu |

If your physiological markers of stress reached concerning levels or if you or the PI suspects that your health and well-being may be in danger, Connecticut College Campus Safety will be contacted, and you will be encouraged to partake in a Wellness Check with the person on call.

Connecticut College Campus Safety

24 Hours

(860)439-2222

Resources on managing Coronavirus-related stress and general stress/anxiety is provided for you below.

Coronavirus and Mental Health:

The Jed Foundation: https://www.jedfoundation.org/covid-19-and-managing-mental-health/

Ten Percent Happier: https://www.tenpercent.com/coronavirussanityguide

General Stress/Anxiety:

Mental Health Foundation: https://www.mentalhealth.org.uk/publications/how-manage-and-reduce-stress

Anxiety Grounding Techniques: https://www.therapistaid.com/worksheets/grounding-techniques.pdf

Purdue University's College Student Stress Management Guide: https://www.purdueglobal.edu/blog/student-life/college-students-guide-to-stress-management-infographic

If you have any questions or concerns about the manner in which this study was conducted, please feel free to contact the IRB Chairperson Professor Ann S. Devlin (asdev@conncoll.edu), the study's PI Elle Kass at mkass@conncoll.edu, and/or any of the study's advisors: Professor Joseph Schroeder at jasch@conncoll.edu, Professor Ruth Grahn at regra@conncoll.edu, and Dean Jefferson Singer at jasin@conncoll.edu.

If you are interested in this topic and want to read the literature in this area, you might enjoy the following articles:

Charles, N. E. (2020). Increased mood disorder symptoms, perceived stress, and alcohol use among college students during the COVID-19 pandemic. https://doi.org/10.31234/osf.io/rge9k

Gibbs, B. R., & Rude, S. S. (2004). Overgeneral autobiographical memory as depression vulnerability. *Cognitive Therapy and Research*, *28*(4), 511–526.

Ono, M., Devilly, G. J., & Shum, D. H. K. (2016). A meta-analytic review of overgeneral

memory: The role of trauma history, mood, and the presence of posttraumatic stress disorder. *Psychological Trauma: Theory, Research, Practice, and Policy, 8*(2), 157–164.

You may also contact me at mkass@conncoll.edu for additional resources.

## Appendix Q

## Main Study: Memory Consent Form

### Exploring the Relationship of Gender, Stress, and Autobiographical Memory

### Memory Consent Form

Date: _____

Dear_____

I am writing you to ask whether or not you consent to the study's use of your autobiographical memory, recalled during the study's autobiographical memory test, listed below. All identifiable information has been redacted and your personal, identifiable information will not be listed in conjunction with the memory. If you consent to the use of the memory listed below, please sign your name and return the document to the study's PI Elle Kass. If you have any questions about how your memory will be used, please contact the study's PI at 408-888-6077 or at mkass@conncoll.edu.

[memory]

❑ I do not consent to the use of the memory listed above.

❑ I consent to the use of the memory listed above.

If you consent, please sign and date below:

_____