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Decreased Attentional Abilities are Related to Dissociation in Undergraduates: An Exploratory Study of Dissociation, Cognition, Sleep and Mood

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Abstract

Relationships between trait dissociation, attention, sleep and mood were explored using self-report surveys and neurocognitive assessments in undergraduate students. Individuals scoring higher on the amnesia and derealization subscales of the Dissociative Experiences Scale performed worse on selective and divided attention tasks. In general, individuals scoring higher on total dissociation scored less well on attention tasks. Sleep experiences as measured by the ISES were related to dissociation, but this relationship was not significant when controlling for mood. Affect was found to be more strongly correlated with dissociation and cognitive dimensions than sleep. Together, these findings indicate that dissociation is related to difficulty in processing multiple stimuli and that the approaches used most often to study dissociation must be critically examined.

Keywords: dissociation, cognition, attention, sleep, mood, undergraduate

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Defining Dissociation

The term *dissociation* has been used to describe an array of phenomena ranging from the everyday experience of daydreaming to inter-identity amnesia among alters in dissociative identity disorder (DID). These perplexing and varying experiences have challenged theorists and researchers to establish a coherent theory of dissociation. Over the past century, many researchers have grappled with the construct of dissociation, but they have yet to reach a consensus on its definition, etiology, or cognitive correlates.

The latest edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V) defines dissociation as, "a disruption and/or discontinuity in the usually integrated functions of consciousness, memory, identity, emotion, perception of the environment, body representation, motor control, and behavior" (American Psychiatric Association, 2013). While not all dissociative experiences are considered pathological, the DSM-V describes five distinct dissociative disorders. The most widely known among these is dissociative identity disorder (DID), in which an individual coexists alongside personality "alters" and often has no memory of what his or her alters have done or awareness that they exist in the first place. Other dissociative disorders include dissociative fugue, in which individuals suddenly forget their identity, depersonalization disorder, in which individuals frequently feel a detachment from themselves or their environment, and dissociative amnesia, in which individuals experience forgetting of major life events or aspects of their lives (Lynn, Lilienfeld, Merckelbach, Giesbrecht, & Kloet, 2012). Additionally, the DSM-V includes a category for dissociative disorder not otherwise specified

(APA, 2013). However, the inclusion of any dissociative disorders in the DSM is contested as some believe that because there is no well understood etiology or consistent definition of these phenomena, diagnoses are extremely subjective and carry negative implications for the individuals diagnosed (Gharaibeh, 2009). Despite these concerns, the general consensus among researchers, reflected in the DSM-V, is that these phenomena and disorders are legitimate and that understanding them is important for both prevention and treatment (e.g., Elzinga et al., 2007; Gingrich, 2009; Sierra & Berrios, 1998).

Additionally, the latest version of the DSM published in May of 2013, added a dissociative subtype of posttraumatic stress disorder (PTSD; APA, 2013). This change reflects the assertions of many researchers that a significant number of PTSD sufferers experience derealization and amnesia that could be classified as dissociative, and thus have a qualitatively different disorder than PTSD without such experiences (Dalenberg & Carlson, 2012). These revisions mark a movement among the psychiatric community toward acceptance of dissociation both as a construct and as an independently occurring facet of common psychiatric disorders.

The other authoritative manual for diagnostics, the ICD-10, categorizes dissociative disorders rather differently than the DSM-V. In addition to the categories of dissociative amnesia, fugue, and motor disorders, the ICD-10 also includes pseudo-neurological symptoms like conversion disorders, in which individuals experience physical symptoms such as seizures or motor or sensory loss (WHO, 1992). While the DSM-V has dissociative identity disorder as its hallmark dissociative disorder, the ICD-10 calls DID by its historical name, multiple personality disorder, and categorizes it under the generic “Other dissociative disorders category” (WHO, 1992). Unlike the ICD-10, the DSM-V’s separation of somatoform disorders from dissociative disorders aims to separate those disorders that may have a more organic and biological basis

from more psychogenic conditions (Holmes et al., 2005). These discrepancies between the two most widely accepted diagnostic tools illuminate the difficulty theorists and researchers face in trying to articulate a definition of dissociation (Holmes et al., 2005). The disagreement over a conclusive diagnostic categorization of dissociative disorders reflects the enormous challenges associated with understanding the phenomenon on both a theoretical and empirical level.

Historically, research has explored dissociation from a clinical standpoint. Beginning in the 19th century, Pierre Janet, often considered the father of dissociation, framed dissociation as a component of hysteria, and noted that it was often paired with sleepwalking and other abnormal sleep experiences (Bob, 2003). Little research was done after Janet until World War II, when new interest in dissociation as it related to traumatic combat experiences led to the inclusion of dissociative disorders in the DSM-III (3rd ed.; DSM-III; American Psychiatric Association, 1980).

The DSM-V and ICD-10 both describe a multitude of dissociative disorders, including dissociative amnesia, dissociative fugue, and dissociative identity disorder (Holmes et al., 2005). These pathologies are marked by extreme disruption in cognitive systems and reflect a drastic departure from normal behavior. According to many theorists, these disorders are characterized by five symptoms— depersonalization, derealization, amnesia, identity confusion and identity alteration (SCID-D; Steinberg, 1994). Among these, *depersonalization* refers to detachment, automatisms, and out of body experiences, and *derealization* refers to a change in perception of the outside world, so that the surroundings seem to be disconnected from reality (APA, 2013). Although dissociative disorders take many forms and have serious implications, research on clinical populations is extremely limited because of the low prevalence rate, around 1.7%, with only 0.4% prevalence of DID (Akyuz, Dogan, Say, Yargic, & Tutkun, 1999).

In addition to the dissociative disorders, dissociative experiences are implicated in several other disorders. As noted above, researchers and clinicians advocated for the inclusion of a dissociative subtype of post-traumatic stress disorder in the DSM-V (Bryant, 2007; Dalenberg & Carlson, 2012; Lanius et al., 2010). Proponents of this change argued that among PTSD patients, those with dissociative symptoms have a unique presentation, and require different treatment from those without dissociative experiences (Bryant, 2007). Given that dissociation is causally linked with trauma, it is not surprising to see that dissociation is involved in this disorder defined by severely traumatic experiences. Dissociation has also been implicated in disorders such as schizotypy, borderline personality disorder, and sleep disorders (Giesbrecht & Merckelbach, 2008; Pec, Bob, & Raboch, 2014; Koffel & Watson, 2009). Although dissociation may be a symptom of some serious psychological abnormalities, there is no clear understanding of the role dissociation plays in various psychopathologies.

While research focusing on dissociation has direct clinical implications, studies of non-clinical samples can reveal underlying patterns of common dissociative experiences and help build a theoretical understanding of the phenomena. Studies using non-clinical samples suggest that most individuals experience some degree of dissociation (Ross, Joshi, & Curri, 1991), although some argue that specific types of dissociation are strongly associated with pathology (Rodewald, Dell, Wilhelm-Gossling, & Gast, 2011). Further, many researchers argue that dissociative experiences fall along a continuum, with pathologies resulting when individuals very high in dissociative tendencies experience these events to such an extent that they are interfering with normal function. This continuum model also assumes that the types of dissociation do not differ between the general population and those with dissociative pathologies, but what differentiates them is the frequency and degree of these experiences as well as the ability to

willfully stop dissociating (Giesbrecht, Lilienfeld, Lynn, & Merckelbach, 2008). The continuum model allows for the possibility that pathological dissociation, like mood or intelligence, is a matter of degree rather than quality of dissociative experiences. In contrast, some researchers assert that the types of dissociation experienced by the general population are qualitatively different than the experiences of psychiatric patients (Rodewald et al.), and some factor analytic studies of clinical vs. non-clinical samples lend support to these contentions (Olsen, Slapp, Parra and Beck, 2013). The degree to which dissociation exists on a single continuum or consists of multiple but distinct dissociative tendencies continues to be debated.

History of Dissociation Research

Pierre Janet first used the term "dissociation" in his *Psychological Automatism* (Janet, 1890; Bob, 2003). His main concerns were hysteria and hypnosis, situations in which an individual's consciousness is controlled either partially or completely by previous experience instead of the present environment (Bob). In his view, dissociation was a coping mechanism adopted after the experience of intense traumatic events (Giesbrecht et al., 2008). Additionally, Janet was interested in somnambulism and other abnormal forms of consciousness, and he considered these phenomena to be the result of weakened mental states (Bob). Subsequent theorists built their understanding of dissociation around Janet's trauma model, assuming that dissociation is a maladaptive coping mechanism following severe trauma.

Although less influential in the early literature, Jackson's (1835-1911) model of the mind and self also created a framework for early theorizing about dissociation. He believed that the prefrontal cortex was responsible for creating and maintaining a sense of self and that dissociation was a disruption of the most recent evolutionary advances, namely prefrontal cortical activity and its role in sense of self (Meares, 1999). He proposed that dissociative events

could be related to selective attention and disconnections of memory (Meares). As most of his contemporaries were interested in psychodynamic explanations of dissociation, Jackson's brain-based view was decades ahead of his time, but failed to attract followers.

While dissociation been observed in patients for nearly a hundred years (e.g., Allen, 1932), dissociative disorders were not formally recognized until the publication of the 3rd edition of the DSM. Following World War II, resurgence in interest in dissociative experiences, especially related to combat fatigue, fueled research and acceptance of dissociative disorders (Bob, 2003). This mid-century diagnostic manual marked the beginning of widespread acceptance of dissociation and included the diagnoses of multiple personality disorder, depersonalization disorder, and psychogenic fugue (APA, 1980).

Recent Theories of Dissociation

Following Janet, many theorists have continued to work with trauma-based models for dissociation. According to the *trauma model*, dissociation is the direct result of a traumatic experience, often childhood sexual abuse, and mediated by biological and psychological vulnerabilities, age, life stress and social support (Dalenberg et al., 2012). Essentially, these theorists assert that dissociation is a coping strategy adopted by some who experience severe trauma and that disorders occur when the mind extends this strategy to other areas.

These trauma models often incorporate the concepts of cognitive compartmentalization and detachment (Holmes et al., 2005). In these theories, *compartmentalization* refers to a dis-integration of psychological processes, and *detachment* refers to the experience of being separated from the present and self (Holmes et al.). According to these theorists, traumatized individuals may cope by separating the traumatized self, which includes all memories and emotions related to the traumatic experience, from the rest of consciousness. Dissociation itself

can be thought of as a psychological response to a serious threat that enables detachment from potentially harmful memories and attempts to preserve some part of the healthy self (Dalenberg et al.). By separating the vulnerable self from a traumatic memory, the individual attempts to preserve function as much as possible.

Evidence for the trauma model is based mostly on cross-sectional data of traumatized individuals (Lynn et al., 2014). A meta-analysis on over 100 studies reported a moderately strong relationship between self-reported dissociation and trauma history in many samples, including those from clinical, undergraduate, and general populations (Dalenberg et al., 2012). Additionally, most patients with diagnosed dissociative disorders report a previous traumatic event (Forrest, 2001). Data consistently indicate a relationship between trauma and dissociation, but are limited by the inherent subjectivity of self-reports and the ethical obstacles to any experimental approach.

Critics of this trauma model argue that the cross-sectional data do not provide enough empirical evidence and that suggestibility may be causing the observed relationship between self-reported trauma and dissociation (Spanos, 1994; Lynn et al., 2014). The individuals reporting trauma may in fact be highly suggestible and fantasy-prone, and it could be one or both of these traits leading to increased dissociative tendencies as well as false reports of traumatic experiences (Merckelbach & Muris, 2011). A final criticism of the trauma model is that if trauma is a necessary antecedent to dissociation, then people without a history of trauma would never experience dissociative events. However, data from numerous studies indicate that dissociation is present at non-clinical levels in the general population (Giesbrecht et al., 2008). While trauma theory may be appropriate for individuals with severe dissociative disorders, it fails to explain the commonplace dissociative occurrences that many people experience.

Another approach, the *sociocognitive model*, identifies dissociative identity disorder not as a result of trauma, but instead as a result of cueing and reinforcement by therapists and media (Spanos, 1994). According to this model, during sessions, therapists encourage spontaneous role-playing as one imagines oneself as another person, and eventually these alternate selves become so engrained in the individual's self-concept they display the symptoms of dissociative identity disorder (Sarbin & Coe, 1972). This theory is supported by a rise in DID cases in the late 20th century--as media portrayal of the disorder increased, therapists using hypnosis as a treatment in suggestible clients, unintentionally induced these dissociative coping mechanisms, according to this theory (Lilienfeld et al., 1999).

While this model explains the sudden rise in DID cases, it does not offer an explanation for dissociative experiences in the general population. Notably, if dissociation only occurs following a therapist cue or in specific social contexts, there should be populations in the world where the rates of dissociative experiences are much lower or even nonexistent due to a lack of Western influence. However, cross-cultural studies from many countries including Turkey, the Philippines, and others (Yargic, Sar, Tutkun, & Alyanak, 1998; Gingrich, 2009) indicate that non-clinical dissociative phenomena occur naturally around the world. Faced with these objections to the sociocognitive model, theorists searched once again for an explanation for dissociative phenomena.

An alternative, which will be referred to as the *fantasy proneness model*, proposes that dissociation is a process that can occur without traumatic antecedent or therapeutic encounters in any person based on a trait-like predisposition to dissociate (Giesbrecht et al., 2008). Instead of being directly caused by trauma, extreme cases of dissociation such as dissociative amnesia or dissociative identities are caused by suggestion and its increased effect on highly suggestible

individuals (Lynn et al., 2014). Proponents of the fantasy proneness model assert that individuals high in the traits of suggestibility and fantasy proneness are more likely to dissociate and to report a history of trauma, real or imagined (Giesbrecht et al.). Researchers have observed a correlation between fantasy proneness scales and trait scales of dissociation (Merckelbach & Muris, 2001), and this fantasy proneness may explain reports of both dissociative experiences and traumatic history. The more fantasy-prone and suggestible an individual is, the more likely the suggestion of traumatic history will create a false memory or fantasy. Even without any reports of trauma, fantasy proneness may be connected to a tendency to dissociate as individuals engage in more daydreaming and fantastical thinking (Giesbrecht et al.,). For understandable reasons, this theory is controversial among those who research dissociative disorders and believe they are the result of trauma (e.g., Dalenberg et al., 2012).

Fantasy proneness theorists propose that there is a common mechanism underlying both high trait dissociation and increased suggestibility and fantasy proneness (Giesbrecht et al., 2008). The idea that there exists an underlying natural propensity to dissociate could explain how otherwise healthy individuals without any social pressure or traumatic events can still have significant dissociative experiences (Merckelbach, Rassin, & Muris, 2000). In addition to offering a possible explanation for DID, this model frames dissociation as a natural process that allows for theoretical integration of dissociative experiences in the general population (Giesbrecht et al.). While both the trauma and sociocognitive models require a distinct antecedent event for dissociative experiences, only the fantasy proneness model presents the possibility of a natural tendency to dissociate under normal circumstances, and is thus the most useful of the three theories for any study focusing on non-clinical samples.

Diagnostic Instruments

Based on the DSM-IV, the Standardized Clinical Interview for DSM-IV Dissociative Disorders (SCID-D; Steinberg, 1994) is the authoritative diagnostic tool for dissociative disorders. The SCID-D identifies five main components of dissociation: depersonalization, derealization, amnesia, identity confusion and identity alteration. In this context, depersonalization refers to feeling as though one is living outside of their own body and derealization refers to a feeling that one is operating as if in a movie or not in control of one's own actions (van der Kloet, Merckelbach, Giesbrecht, & Lynn, 2012). This interview has served as the standard for interview-based dissociative disorder diagnosis, but it is still difficult for clinicians to discriminate these disorders from others such as borderline personality disorder and schizotypy based on the interview alone (Giesbrecht et al., 2008). Further, since the SCID-D is rather lengthy, only a limited number of studies have used this interview as a primary dissociative measure. Studies using small clinical samples often use the interview (e.g., Rivera-Velez, 2014), but most studies using undergraduate or nonclinical samples use self-report measures or briefer interviews.

Most published studies use a self-report diagnostic screening tool, the Dissociative Experiences Scale (DES), as their primary measure for trait dissociation. This 28-item scale was first developed in 1986 by Bernstein and Putnam to assess the frequency with which individuals experienced a number of dissociative symptoms (Bernstein & Putnam, 1986). These items range from rather common experiences such as, "Some people find that sometimes they are listening to someone talk and they suddenly realize that they did not hear part or all of what was said" (Item 2) to more pathological items such as "Some people sometimes find writings, drawings, or notes among their belongings that they must have done but cannot remember doing" (Item 26).

Although this tool has been used in hundreds of studies as a measure of dissociation, it is important to note that it is only a screening tool to measure the frequency of dissociative experiences and not meant to diagnose individuals with dissociative disorders.

Analyses of the DES items in both clinical and general populations have led researchers to identify distinct components of dissociation. Factor analyses of the DES have generated various models, ranging from single-factor to four-factor solutions, depending on the population studied (Olsen et al., 2013). In a recent study Olsen, Slapp, Parra and Beck, (2013) proposed a 2-factor model, with one factor emphasizing less pathological experiences, like absorption, and the other assessing more significant symptoms like amnesia and depersonalization. In contrast, a factor analysis of 1,055 non-clinical participants completed by Ross in 1991 indicated that the DES has three distinct components: absorption, amnesia and depersonalization (Ross et al., 1991). The absorption factor includes 12 items that are generally benign and refer to experiences such as "Some people have the experience of finding themselves in a place and having no idea how they got there" (Item 3). The second factor, amnesia, refers to dissociated states that one would expect to see more in pathological cases of dissociative identity disorder. The amnesia factor includes four items and includes statements such as "Some people have the experience of finding themselves dressed in clothes that they don't remember putting on" (Item 4). The last component, depersonalization-derealization, consists of five items including "Some people have the experience of feeling that their body does not seem to belong to them" (Item 13). Interestingly, this three-factor solution for the DES combines depersonalization and derealization, while the SCID-D separates the two as discrete.

The various outcomes of factor analysis for the DES have led to controversy over the measure's effectiveness to detect pathological dissociation. Some argue that the absorption

component of the DES should be separated from the other items due to its overlap with the trait dimension openness to experience (Rauschenberger & Lynn, 1995). This approach is consistent with the recently proposed two-factor model (Olsen et al., 2013). In general, studies of nonclinical populations find that scores for the absorption component are higher than the remaining items (Ross et al., 1991), indicating that these items may reflect more commonplace dissociative experiences. Since this inclusion of a more conventional trait related to dissociation makes it more difficult to distinguish between the pathological and non-pathological, some researchers use a modified version of the DES, called the DES-Taxon, or DES-T, to assess levels of pathological dissociation. This modified version includes only the eight items encompassing derealization, depersonalization, and psychogenic amnesia (Waller, Putnam, & Carlson, 1996). As a result of removing the absorption items, this version of the DES is more effective at identifying pathological levels of dissociation. For this reason, the DES-T is often used instead of the DES in clinical populations (e.g., Irwin, 1999; Simeon, Guralnik, Schmeidler, Sirof & Knutelska, 2001).

Finally, a third category of assessment instruments involves clinician-administered measures, most notably, the CADSS, a 19-item assessment of dissociation conducted in person (Bremner et al., 1998) and used in some previous sleep research (e.g., van Heugten-van der Kloet, Giesbrecht, & Merckelbach, 2015). In a recent study (Condon and Lynn, 2015), the CADSS had good reliability and demonstrated both convergent and discriminatory validity when correlated with other measures of dissociation or negative affect. The benefit of the CADSS is that it includes both self-report items and clinician observer ratings to assess dissociative tendencies.

As evidenced by the various measures and assessment approaches, defining and measuring "dissociation" may be problematic. One additional approach separates dissociative experiences into two categories—detachment and compartmentalization. In this model, detachment encompasses the experiences defined by derealization such as feeling as though one is moving like an automaton as well as depersonalization, including out-of-body experiences. Compartmentalization includes the amnesia and more conversion-like experiences such as hallucinations and sensory loss (Holmes et al., 2005). While compartmentalization encompasses a broad variety of psychological and somatic experiences, detachment seems to offer insight into the neuropsychological processes underlying dissociation. Researchers have suggested that this detachment, marked by increased vigilance and widening of focus, is due to frontal inhibition of the limbic system as well as activation of the right prefrontal cortex (Sierra & Berrios, 1998).

Despite the variety of ways to cluster dissociative experience, many still believe that dissociative experiences~~on~~ fall on a single continuum. Although the DES has often been factor analyzed, its high internal consistency ($\alpha = .92$; Bernstein & Putnam, 1986) supports the contention that dissociation can be viewed as a single continuum. Additionally, some factor analyses (e.g., Holtgraves & Stockdale, 1997) have found that outcomes in non-clinical samples reveal only the single factor of dissociation, instead of the three-fold absorption, amnesia and derealization factors that are commonly accepted. Controversy continues over whether or not dissociative processes are actually a single construct expressed to varying degrees or a constellation of qualitatively different experiences. Regardless of these debates, the DES is the standard self-report tool for measurement of dissociation, and the three-factor model is widely employed in research.

Dissociation and Cognition

While theorists have argued about the antecedents of dissociative disorders, there has been limited discussion about what these theories imply in terms of cognition and underlying brain function. Trauma and sociocognitive theories both propose that specific events trigger the creation of dissociative pathways in the brain, potentially between the limbic system and prefrontal cortex that are absent in the general population (Sierra & Berrios, 1998). However, the fantasy proneness model suggests that individuals have a natural underlying propensity for fantasy unrelated to trauma or sociocognitive context, which suggests biological differences may make individuals vulnerable to dissociation. Two separate theories, the trauma theory and the construction hypothesis, approach dissociation from a cognitive diathesis-stress perspective to explain why certain individuals develop these dissociative tendencies.

de Ruiter's *construction hypothesis* describes dissociation as the result of enhanced attentional capacity that leads to elaborated encoding of traumatic events and increased dissociative experiences in traumatized individuals (de Ruiter, Phaf, Elzinga, & van Dyck, 2004). Researchers defending this theory argue that heightened cognitive vigilance is correlated with increased working memory, levels of attention, and episodic memory (de Ruiter, Elzinga, & Phaf, 2006). This connection between dissociation and increased attentional abilities seems contradictory at first, as the primary signs of dissociation are amnesia related to important events and depersonalization. However, these theorists argue that it is in fact the greater memory and attentional capacity in these individuals that leads to their enhanced ability to encode memories (de Ruiter et al., 2006). They argue that the heightened memory for traumatic events often seen in dissociative individuals reflects these enhanced cognitive functions.

On the other side of the argument, the betrayal trauma theory posits that dissociation is a result of a decrease in executive functioning due to the inability of individuals to selectively attend to relevant information and inhibit irrelevant information (Giesbrecht, Meckelbach, Geraerts, & Smeets, 2004; DePrince & Freyd, 1999). In the context of trauma theory, this failure of inhibition means that individuals are unable to block the intrusion of memories, especially those of the traumatic event itself, especially in stressful or emotional contexts (Freyd, Martorello, Alvarado, Hayes, & Christman, 1998). According to this model, dissociation is always a result of some sort of trauma, mental or physical, and is used to maintain necessary attachment with a caregiver or trusted adult after he or she has betrayed the individual (Saidel-Goley, Albiero, & Flannery, 2012). Proponents of this account could say that the variability in cognition leads to traumatic events having differential effects, and the more affected individuals are more likely to experience dissociation. However, this traumatic effect could be explained by either enhanced cognition over-representing an event or decreased ability to appropriately process the experience. With so many potential theoretical explanations for cognition and dissociation, it is difficult to narrow our research focus and understand what is happening on the most basic cognitive level.

Learning more about the directionality of the relationships between dissociation and the most fundamental cognitive processes may lead to identification of brain differences in dissociative individuals and offer explanations of how those differences lead to dissociative experiences. Additionally, understanding the cognitive profiles of dissociative individuals can provide information about what is occurring in the brain during these experiences. Although the most striking symptom of dissociation is often episodic memory loss, understanding the fundamentals of how the brain can go “off-line” entails an exploration of basic attention.

Dissociation and Attention

In a dissociative event, an individual is either failing to process part of what is going on in the environment around them or is not encoding in a way that facilitates future retrieval. This basic model of dissociation points to a cognitive failure in attention. Attention can be defined as "the differential allocation of information processing resources" (Lawrence & Klein, 2012). Attention can be modeled in four parts: arousal, vigilance, selective, and divided (Banich & Compton, 2011). At the most basic level, attention refers to the arousal and ability of an individual to take in any information or to process information from the environment. Another aspect of attention, called either vigilance or sustained attention, refers to the ability to attend to a certain aspect of the stimulus or environment for an extended amount of time. Selective attention refers to the brain only attending to relevant stimuli while ignoring everything else in the environment. Last, divided attention refers to attending to multiple separate stimuli concurrently (Banich & Compton). This four-fold model of attention provides a useful framework for considering dissociative events.

Let's use an example of a dissociative experience that occurs while attending a lecture in which you suddenly realize that you have no idea what has been said for the past few minutes. If we start with the first category of attention, we would explore if you were awake and capable of processing information. Perhaps this dissociative event is best characterized by a state of consciousness somewhere in between wakefulness and sleep in which it is impossible to attend to information. Another potential explanation is that this dissociative event was a failure of sustained attention. Perhaps you were originally able to attend to the lecture, but the ongoing lecture simply depleted your attentional capacity. In this case, it seems as though dissociation may be a failure to remain attentive for an extended amount of time. Another possibility is that

your selective attention abilities are to blame. If the brain is not capable of selective attention, you could have been processing information about the lawnmower outside or the pattern of stains on the carpet instead of paying attention to the lecture. The last option, divided attention, could account for the dissociative event if you were only able to pay attention to the visual slides and failed to encode the auditory message of what the professor was actually saying.

Alternatively, increased attentional abilities may also explain what is happening when the mind dissociates. According to this theory, an individual with higher attentional capacity may only attend when the stimulus is demanding enough to fully engage the individual's attention. If the stimulus requires little cognitive capacity, the individual may attend to more interesting things such as daydreaming (de Ruiter et al., 2006). This theory also can be applied to all aspects of attention. An individual with extremely high working memory capacity may "tune out" in a task requiring them to remember only a few numbers or letters but actually perform better than average on a demanding and entertaining working memory task. Similarly, the brain well-equipped for selective attention may find a simple task like short Stroop paradigms less engaging, and other more complex tasks more interesting.

Additionally, working memory, typically defined as the ability to retain and manipulate information for a short amount of time (Banich & Compton, 2011) offers a potential explanation of dissociative events. Numerous studies have provided evidence of a strong link between working memory and various types of attentional processes (de Ruiter et al., 2006). Deficits in working memory are related to a problem with general arousal in that an affected individual is unable to take in the necessary information. Working memory can be thought of as the gateway for information; if the messages aren't even passing through the gate, then there is no way that information processing can occur. Storing memories requires that information be processed on

this initial level. If someone's working memory capacities aren't functioning properly, then their ability to encode long term memories is also compromised, which could account for the apparent memory loss in dissociative events (Dorahy, McCusker, Colbert, & Mulholland, 2006). In fact, if working memory is impaired, then the memory of the event is not so much lost as never created in the first place (Baddeley, 1984). Alternatively, enhanced working memory also offers a potential explanation of dissociative events (de Ruiter et al., 2004). When the task is not demanding, someone with higher capacity will likely attend to more interesting tasks instead, thus dissociating from the present environment (de Ruiter et al.).

Both attention and working memory appear to be controlled primarily by the prefrontal cortex (PFC). Working memory in particular is related to activity in the dorsolateral prefrontal cortex (DLPFC; Banich & Compton, 2011). This area, particularly in the right hemisphere, also seems to be very active in sustained (Sarter, Givens, & Bruno, 2001) and divided attention (Corbetta, Miezin, Dobmeyer, Shulman, & Petersen, 1991). Selective attention, on the other hand, appears to require activity from several other parts of the brain, including the thalamus, superior colliculus, and the medial prefrontal cortex (Banich & Compton, 2011). Most importantly, all of these functions seem to be governed by the prefrontal cortex, which reflects the executive nature of attentional control.

Studies of Dissociation and Cognition

Over the past 15 years, researchers have explored the relationship between these various cognitive functions and dissociative tendencies in both clinical and non-clinical samples. Although research into the cognitive profiles of individuals with PTSD had been studied for decades, this movement marked the first exploration of the cognitive underpinnings of dissociation.

The first of these researchers, Jennifer Freyd, was a proponent of the betrayal trauma theory and asserted that dissociative individuals exhibit decreased cognitive abilities, especially in emotional contexts (Freyd et al., 1998). Two experiments using standard and emotional versions of the Stroop paradigm found that high dissociators showed more interference, indicating decreased selective attention abilities and increased dual-attention abilities (Freyd et al.; DePrince & Freyd, 1999). The authors concluded that dissociation is connected to attention and memory, and that since dissociative individuals are better at divided attention than selective attention, they may habitually attend to multiple stimuli instead of focusing on one. This strategy of dividing the consciousness, according to Freyd, may be what explains the development of dissociative tendencies in traumatized individuals (DePrince & Freyd). Freyd also proposes that the decreased selective attentional abilities of dissociative individuals indicate a generalized difference in attentional control, which may lead to the dissociated cognitions (Freyd et al.). These first two studies in the area of dissociation and cognition asserted an inverse relationship between dissociation and attention and established the framework for future research.

In a subsequent study exploring cognitive inhibition and interference in individuals with dissociative identity disorder, Dorahy and his colleagues found that in a stressful situation, dissociative individuals experienced weakened inhibition and high levels of negative priming effects, which are indicative of lower selective attention capabilities (Dorahy et al., 2006). This result was consistent with Freyd's findings, furthering the argument that dissociation is linked to attentional deficits.

In contrast, a subsequent study analyzed the working memory of dissociative participants using fMRI and found that higher levels of dissociation were linked to increased activation of the DLPFC as well as to better performance on simple working memory tasks (de Ruiter et al.,

2006). This marks the first point of contradiction in the field; Dorahy had predicted that dissociative individuals would show decreased working memory capacity, especially in high anxiety situations, in line with their decreased attentional abilities (Dorahy et al, 2006). Since working memory and selective attention are believed to be linked, these conflicting studies cast doubts on the betrayal trauma theory and led to the creation of the construction hypothesis, which proposes that dissociation is related to enhanced encoding of events, resulting in more potent memories that in turn are associated with dissociative symptoms.

The first proponents of the construction hypothesis, de Ruiter and colleagues, found that among undergraduates, individuals with higher trait dissociation performed better on a working memory task than those who scored in the low range on the DES (de Ruiter et al., 2004). In particular, their findings indicated that high dissociators showed superior performance when the task demands were higher. In their view, this high working memory capacity is necessary for an individual to engage in dissociation in the first place, as dissociation itself demands extra capacity. The increased working memory then leads to enhanced encoding, particularly for traumatic experiences, which results in increased strength of memories (de Ruiter et al.).

In another study, de Ruiter and his colleagues focused on the attentional abilities of nonclinical dissociative individuals. In this experiment, the authors expected to see heightened attentional abilities as measured by ERP in dissociative individuals, especially in negative valence contexts, because the emotional context behind dissociation is so often traumatic (de Ruiter, Phaf, Veltman, Kok, & Van Dyck, 2003). The study found that high dissociators scored better on emotionally neutral selective and divided attention tasks, but valence only had an effect on divided attention, with high dissociators showing enhanced divided attention. The theory posited that these increases in working memory span and attentional abilities in response to

trauma occurred in those who were predisposed to dissociative tendencies (de Ruiter et al.). The same group conducted a similar study examining high dissociative and low-dissociative healthy individuals using fMRI and two simple working memory tasks. The results of this study also indicated that increased dissociation is linked to higher working memory capacity, and the researchers localized this difference to increased activity in the dorsolateral prefrontal cortex (Veltman et al., 2005). Once again, the enhanced working memory of highly dissociative healthy individuals indicated that dissociation could be an information processing style that occurs independent of trauma history.

A later review (de Ruiter et al., 2006) of fMRI and ERP studies of higher attention and working memory capacity in pathological and nonpathological individuals supported the construction hypothesis (de Ruiter et al.). A year later, the same team published data from fMRI of individuals with pathological dissociation (Elzinga et al., 2007). In this follow up study, dissociative individuals showed higher working memory capacity in comparison to the healthy controls as well as increased use of left anterior prefrontal cortex (PFC), dorsolateral PFC, and the parietal lobe, all of which are implicated in working memory (Elzinga et al.). The observed patterns serve as evidence that dissociative tendencies in both pathological and nonpathological individuals are related to enhanced attention and working memory.

Some researchers have explored a greater variety of executive functions in relation to dissociation. In an experiment using a Random Number Generation task, researchers hoped to find a connection between dissociation and overall executive functioning in undergraduate students (Giesbrecht et al., 2004). The study showed only modest correlations (r =.20 and .23) between executive functions, measured by failure of inhibition for wrong answers, and the amnesia subscale of the DES. The authors concluded that this relationship supported a

connection between dissociative tendencies and overall prefrontal cortical function (Giesbrecht et al.). Importantly, this study stands alone in the literature in using a correlational design and a larger sample size (185 undergraduates). Most studies examining non-clinical samples employ extreme group approaches using a highly dissociative group (DES>20) and a low dissociative group (DES<10). This methodology provides distinct comparisons between the groups, but also ignores the majority of the population whose dissociative tendencies are somewhere in the middle. If dissociation truly exists on a continuum, then a correlational model may be the most appropriate way to analyze associations between dissociation and cognitive dimensions.

This body of research has not developed much since 2007, with Freyd continuing to focus on attachment theory, Dorahy researching decreased working memory and attentional abilities, and de Ruiter exploring enhanced working memory and attention in dissociative individuals. To date, no single theory has reconciled the conflicting outcomes in studies of memory and attention and their association with dissociation.

Several studies have explored aspects of these competing theories. In one study, undergraduates completed the DES and several measures of executive function, including the Dysexecutive Questionnaire, a self-report measure of executive difficulties (Bruce, Ray, Bruce, Arnett, & Carlson, 2007). Although highly dissociative individuals reported having more difficulties with executive function, there was no significant difference in the actual performance on executive tasks between high and low dissociators. The increased complexity of tasks in this study compared to the relatively simple tasks used in de Ruiter's imaging studies may explain the results. Instead of examining a specific capacity such as selective attention, Bruce et al. used the Iowa Gambling Task and Wisconsin Card Sorting Task, activities which recruit many brain areas, making it more difficult to identify specific cognitive differences in dissociators.

In one study that excluded those with a history of trauma, high and low dissociators completed tasks examining working memory, long-term memory, and executive control (Amrhein, Hengmith, Maragkos & Hennig-Fast, 2008). The results indicated that high dissociators had significantly worse performance in visuospatial working memory and executive control functions as measured by perseveration errors (Amrhein et al.). The authors suggested that the observed difference from the expected pattern may have been related to the fact that the tasks were not difficult enough to elicit superior performance in the highly dissociative individuals or that the study employed visual rather than verbal stimuli. Since this study excluded participants with any trauma history, the pattern of poorer cognitive performance in dissociators may be the most representative of the general, nonclinical population (Amrhein et al.).

Another study using twelve women with histories of childhood sexual abuse and twelve women without such a history reported similar results. Although this study primarily focused on the differences between these two groups, the resulting negative correlations between the DES and verbal memory, visual memory, executive functioning and attention (Rivera-Velez et al., 2014) follow the patterns seen in the Amrhein study and the theories proposed by both Dorahy and Freyd. Importantly, this study found a strong correlation between the DES and PTSD, which means that any cognitive effects may not be due to dissociation alone. The authors point out that the women who participated in the abused group in the study had more troubled childhoods and a higher likelihood of general pathology than those from non-clinical populations (Rivera-Velez et al.). Given the small sample size and the complicated history of the participants, the results cannot be generalized, but do provide more evidence that dissociation may be related to decreased attentional abilities.

Recent research has also explored dissociation induced by a mirror-gazing task and its association with cognitive dimensions (Brewin, Ma & Colson, 2013; Brewin & Mersaditabari, 2013). In one of these studies, the DES was not correlated with any cognitive domain. However, individuals who were experimentally induced to dissociate did exhibit temporarily decreased working memory and attentional abilities, particularly in the verbal modalities (Brewin, Ma, & Colson). A subsequent study by the same group found that the extent of these cognitive deficits was not related to the length of the dissociative induction (Brewin & Mersaditabari). These results are particularly difficult to generalize to the general population because experimental approaches, which examine cognitive abilities after a dissociation induction, are distinctly different from exploring trait dissociation and its association with cognitive abilities. Nonetheless, these results are consistent with theories proposing deficits in cognitive function and are contrary to de Ruiter's construction hypothesis.

Research on cognition and dissociation has failed to reveal any consistent patterns between memory, attention, executive function and dissociative tendencies. Studies have provided evidence for both betrayal trauma theory and the construction hypothesis with no obvious explanation for the conflicting outcomes. Notably, most of the research has focused solely on working memory and selective attention. Importantly, divided and sustained attention also seem to be conceptually implicated in dissociative phenomena and could help untangle contradictory results. Moreover, research has not explored more complex potential relationships between dissociation and cognition, including the possibility of curvilinear associations between aspects of attention, memory and dissociative tendencies. It could also be the case that both high and low working memory and attentional abilities are associated with dissociation, and that the methodologies used in the extant research have not allowed for exploration of this possibility.

Sleep, Cognition and Dissociation

Sleep has also been implicated in dissociation. 19th century dissociation research was linked to studies of hypnosis, which in turn, included sleep (Fassler, Knox, & Lynn, 2006). The earliest conceptualizations of dissociation focused not on the trauma-induced compartmentalization, but instead emphasized the intrusion of sleep states during waking hours. In both dissociative events and dreams, people often experience depersonalization—feeling like they are outside of their bodies, and have limited or no memory of the event subsequently. In fact, some theorists propose that the alter personalities seen in DID may be explained best by comparing alters to a dream character (Barrett, 1995). Could examining sleep's relationship to dissociation clarify the cognitive aspects of the phenomenon and advance our clinical understanding of these disorders?

Sleep itself constitutes a massive area of psychological and biological research, most of which is beyond the scope of this study. However, a basic overview provides a framework for thinking about potential connections between dissociative phenomena, cognition and sleep. Scientists have divided consciousness into three main categories—wake, REM (rapid eye movement), and NREM (non rapid eye movement)—defined by the frequency and shapes of the electrical brain activity (Mahowald & Schenck, 2001). Dreaming is highly associated with REM sleep, although there is some evidence that there may be dreaming involved in NREM sleep as well (Solms, 1997). Studies using PET scans have revealed that during REM sleep, individuals show decreased activity in the primary visual cortex, the motor cortex, and the DLPFC (Braun et al., 1998; Maquet et al., 1996). This connection to the DLPFC offers initial insight into the sleep-dissociation relationship, as this part of the prefrontal cortex seems to be involved in both sleep and attentional functions.

Instead of viewing the three states of consciousness as entirely discrete and separate identities, some researchers view them more as a continuum with in-between states that may explain many complex phenomena (Mahowald & Schenck, 2001). Wakefulness and REM sleep appear to have similar brain functions, and some theorists explain experiences such as lucid dreaming, out of body experiences and hypnagogic/hypnopompic hallucinations as a result of the transition between these two states (Mahowald & Schenck). Since REM usually comes immediately after wakefulness or immediately before, overlap between NREM and wake is thought to be less common. However, this transition state could explain various arousal disorders as well dissociation (Mahowald & Schenck).

This connection between NREM sleep and dissociation is evidenced by the high frequency of dissociative experiences among patients with sleep disorders, especially those that are related to NREM sleep. As early as 1932, researchers were associating somnambulism, more commonly known as sleep-walking, with dissociative events (Allen, 1932). Many of these cases included a history of trauma, which researchers argued explained both the dissociation and sleep disturbances (Allen). Various sleep-related abnormalities, including somnambulism, narcolepsy, and wakeful dreaming have all been associated with dissociative events (Mahowald & Schenck, 2001). More recent studies have looked specifically into nightmare disorder, which is characterized by recurrent nightmares, especially about a recent trauma (Agargun et al., 2003a; Agargun et al., 2003b). Such studies have found that childhood abuse is correlated both with DES scores and frequency of nightmare experiences. This research seems to support theories about trauma and dissociation, since the character of nightmares seems to be highly related to the traumatic event. However, this study like many mentioned before, only offers an explanation for dissociative events and nightmares in a particular subset of people, and not in the general

population. This research does not explain the possible association of nightmares and dissociative events independent of trauma.

Research also explores the various ways that sleep disturbances affect cognition. Sleep abnormalities come in three major categories: sleep loss, reduction, and fragmentation, all which are known to affect the frontal lobe and overall executive function (Jones & Harrison, 2001). In fact, one study found that after one night of disturbed sleep, participants showed impaired vigilance (sustained attention), selective attention, and overall arousal (Santhi, Horowitz, Duffy, & Czeisler, 2007). By decreasing overall arousal, sleep has an effect on nearly all brain functions, including working memory and attention. Perhaps the cognitive differences observed in highly dissociative individuals are actually a result of abnormal sleep. Given the contradictory literature on dissociation and cognitive dimensions, the role of sleep abnormalities in each of these areas deserves further examination.

In the last twenty years, instead of exploring sleep duration and quality, some research has studied dissociation and experiences such as sleep paralysis, hypnagogic and hypnopompic hallucinations, waking dreams, and lucid dreaming using the Iowa Sleep Experiences Scale (ISES; Watson, 2001). Importantly, this scale includes items that are common in the general population and do not presume trauma. The first study using this instrument reported that the ISES had correlations between .30 and .52 with trait dissociation among the general population, indicating that there is some sort of connection between these rather perplexing sleep experiences and dissociative phenomena (Watson).

Dutch researchers Giesbrecht and Merckelbach continued the work on abnormal sleep and dissociation, adding a morning-eveningness scale to explore sleep-wake cycles. They too found that the DES was correlated with the ISES (r = 0.37), supporting Watson's earlier findings

(Giesbrecht & Merckelbach, 2004). These studies together seem to indicate some sort of association between sleep-wake disturbances or sleep abnormalities and dissociative experiences. The researchers propose that these nightmares, hallucinations, and lucid dreams occur during a state of sleep somewhere closer to a waking state than Stage 3 or 4 sleep, and dissociative events may occur during wakefulness but closer to a sleep state than is normal (Giesbrecht & Merckelbach, 2004). This theoretical view offers an explanation not just for the cognitive differences in dissociation but also for why they may be independent of trauma, as sleep-wake cycle disturbances or sleep abnormalities may have various causes.

Koffel, Watson and their colleagues argued that the connection between the ISES and DES may indicate that dissociative events are related to disruptions in sleep and wake states (Koffel & Watson, 2009). By conducting a thorough review looking at both clinical and nonclinical samples, they posited a plausible connection between these measures and offer three possible theories explaining the associations. First, Mahowald's theory of labile sleep states offers an explanation related to disorders characterized by an active motor cortex and inhibited attentional abilities, such as somnambulism (Koffel & Watson). Dissociators may be experiencing a novel form of something like somnambulism. Second, Koffel and Watson posit that trauma may lead to these sleep disturbances, which in turn result in dissociative events. Last, the authors argue that personality traits such as absorption and fantasy proneness may result in increased dissociative experiences, abnormal sleep experiences, or false self-reports on measures (Koffel & Watson). While offering some of the first theories linking sleep and dissociation, the authors acknowledge that further studies are necessary to determine which, if any, of these possibilities actually accounts for dissociative phenomena.

A major review on this sleep-dissociation connection supported the relationship of labile sleep-wake states and dissociative events (van der Kloet et al., 2012). Van der Kloet and colleagues also argue that the correlation between the ISES and DES in reviewed studies is only weakly influenced by the lucid dreaming subscale, indicating that dissociation is more likely related to general sleep experiences. The authors pointed out that the sleep experiences that are most difficult to control (e.g. hallucinations and very vivid dreams) are most correlated with dissociation, and perhaps these experiences could be characterized as those that occur in labile sleep-wake states. In the review and in a subsequent path analysis, the authors concluded that the predisposition to lability in the sleep-wake cycle leads to both sleep states intruding into waking state and disruptions in cognition, including memory and attention (van Heugten-van der Kloet, Merckelbach, Giesbrecht, & Broers, 2014; van der Kloet et al.).

Further studies from the same group have investigated disturbances in sleep cycles in both clinical and nonclinical samples. In assessing baseline and post-treatment mood, sleep, and dissociation, researchers found that normalized sleep patterns were associated with a decrease in dissociative symptoms and that this effect was mediated by mood and general psychopathology (van der Kloet, Giesbrecht, Lynn, Merckelbach, & de Zutter, 2011). Although the authors focused on narcolepsy and general psychopathology, they did find significant positive correlations between the DES and both the BDI and BAI, two of the most commonly used measurements of mood (van der Kloet et al.) A later study by some of the same researchers compared sleep quality with sleep experience in DID and PTSD patients. Once again, they found a significant correlation between the ISES and DES ($r = .63$), and additionally found that the ISES predicts membership to the dissociative group, while the PSQI, which measures more general sleep quality, predicts membership to the PTSD group (van Heugten-van der Kloet,

Huntjens, Giesbrecht, & Merckelbach, 2014). Together, these results support the notion that in clinical samples, specific abnormal sleep patterns maybe associated with different dissociative experiences.

In their most recent study, the same researchers shifted focus and experimentally manipulated the sleep of healthy undergraduates through 36 hours of sleep deprivation in lab while measuring dissociation, mood, sleepiness, and executive functioning throughout (van Heugten-van der Kloet et al., 2015). They once again found a connection between baseline dissociation and the ISES and saw increased dissociative symptoms after sleep deprivation. Additionally, they found that changes in mood, measured by the Profile of Mood States (POMS)~~OMS~~, mimicked the changes in dissociation, and they suggested that mood may be interacting with sleep and dissociation (van Heugten-van der Kloet et al.). Additionally, they found that highly dissociative individuals showed more dramatic deterioration of executive functioning as their sleepiness increased, but this effect only reached marginal significance (van Heugten-van der Kloet et al.). This study marks an important shift to experimental research on sleep and dissociation in non-clinical samples that may provide more generalizable findings.

These new theories relating sleep abnormalities to dissociation are the first to integrate many seemingly incompatible areas of research. Betrayal trauma theory, sociocognitive theory, and fantasy proneness theory may be explained by these theoretical associations. If dissociation can be explained by sleep/wake abnormalities, then it could be the case that traumatic events cause a disruption in this cycle and thus link sleep and dissociation (van der Kloet et al., 2012). Moreover, increased time spent in between the sleep and wake states and overall disrupted sleep may be related to increased suggestibility and difficulty distinguishing fantasy from reality, which could in turn cause an increased influence of clinician suggestion, supporting the

sociocognitive theory. Last, increased lability in the sleep-wake cycle may similarly increase fantasy-proneness as individuals experience dream-like states, thus providing a theoretical explanation for connections between sleep, dissociation, and fantasy proneness (van der Kloet et al., 2012). Clearly, this sleep angle offers a promising way to integrate competing explanations and understand dissociative experiences.

Although this new sleep explanation has potential for unifying theories, the cognitive aspects of dissociation need to be understood more thoroughly. Previous sleep research appears to indicate that any disturbance in sleep leads to a decrease in attention and working memory capacity. However, data on dissociation is inconclusive in this regard. If there is truly a connection between sleep abnormalities and dissociation, we would expect that all types of attention, including working memory, would be worse for highly dissociative individuals. However, if these cognitive functions and dissociative tendencies actually follow a curvilinear relationship, then these sleep results offer a distinct pathway for the inverse relationships between attention and dissociation observed by Freyd and Dorahy, while also explaining de Ruiter's contention about higher cognitive abilities. For example, both very low and very high dissociators may have reduced cognitive capacity, but only the high dissociators would have positive correlations with sleep variables.

While sleep theories offer a possible reconciliation of the trauma, sociocognitive, and fantasy proneness theories, they do not align the betrayal trauma theory with the construction Hypothesis. These two theories propose fundamentally opposite associations between dissociation and cognitive functions, with the former arguing that dissociation is the result of decreased cognitive and executive function, and the latter positing an increase in those capacities. Theories about the role of abnormal sleep in dissociation could only be used in

support of the betrayal trauma theory because of the inverse relationship between abnormal sleep and cognitive abilities.

Considerations in the Current Study

In order to study the connections between dissociation, sleep and cognition, I will adopt the continuum model of dissociation. Since there is natural variation in general sleep experiences in both the clinical and general populations, it is appropriate to assess both sleep and dissociation on a continuum. Such an approach may provide more information about the nature of the relationship between dissociative experiences and both sleep and cognitive abilities, and is appropriate for a non-clinical sample. Additionally, a correlational method may be better suited than an extreme-groups approach for data that is moderatelyy- right-skewed, which is typical of DES scores in undergraduate samples.

Although a handful of studies have looked at the cognitive correlates of dissociation, no study to date has explored the various types of attention—sustained, selective, and divided—in a non-clinical sample. Further, no extant research has investigated the possible role of sleep disturbances in the cognition-dissociation relationship or the potential for sleep to reconcile competing theories about dissociation and cognition. As a result, attention and memory as well as sleep are of primary interest in the present study of dissociation. Although research on episodic memory and emotional content is important in the field of dissociation, it is beyond the scope of this research. Using completely neutral stimuli such as the Spatial Span and Conner's CPT should avoid confounding emotional effects. Examining working memory and types of attention also isolates the DLPFC as a specific brain region of interest. Because these capacities are so fundamental to all cognition, examining these foundational capacities in detail is a first priority.

Comment [HW1]: MS: "When you say that the DES is typically skewed inundergrad samples, you should specify the direction, just to be clear."
HW: done.

Hypothesis of the Current Study

The current research will use extant definitions and measures of dissociation to explore the associations between dissociative experiences, neurocognitive dimensions and sleep. At its core, dissociation is a lack of connection between the conscious mind and either the self or the environment. This decoupling can take many forms and ranges in degree, but is characterized by a lack of normally integrated awareness. By assessing the full range of dissociation in a non-traumatized sample, this study explores the phenomenon and its correlates as they occur in the general population.

Because dissociation is related to perception and awareness, I will explore working memory and attention, two foundational aspects of cognitive processing. Previous research has supported links between dissociation and both higher and lower capacities in these areas. No previous research has studied divided and sustained attention in relation to dissociation, and to date, research has not reported on the possibility of curvilinear associations between dissociation and cognitive outcomes. The present research will also investigate the role of sleep in these associations, as sleep disturbance has been implicated in both dissociative experiences and in decreased cognitive performance, and it has the potential to reconcile competing theories about cognitive correlates of dissociation.

For example, if we assume a linear relationship between cognitive function and dissociation, the sleep disturbance explanation for dissociation would suggest that there should be concomitant deficits in cognitive function in highly dissociative individuals due to sleep disturbances. However, if we posit a curvilinear relationship between dissociation and cognitive ability that would be reflective of the mixed directionality of previous studies,- it could be the case that low dissociators may have poorer cognitive performance independent of sleep. Either

Comment [HW2]: In response to Koven: "This needs further explanation. For example a finding that low dissociators have poor cognition independent of sleep could simply portray an inverse but linear relationship and not a curvilinear one.

I am somewhat confused by her comment. I was thinking that we were fitting the sleep explanation to the two existing possibilities. I don't understand how/why I need to bring up the inverse relationship possibility.

approach, curvilinear or linear, still begs the question of the directionality of these relationships. The present study is a preliminary exploration of the relationships between sleep, dissociation and specific aspects of attention and memory. By controlling for sleep in correlational analyses, the present study can determine if the association between cognitive performance and dissociation is a byproduct of sleep disturbance.

Method

Participants

76 undergraduates from Bates College in Lewiston, Maine (26 males, 50 females, 73.6 % Caucasian, age M = 19.4 years (SD = 1.32)) were recruited through psychology classes and emails to receive either course credit or $10 for participating. Exclusion criteria included left-handedness, history of severe trauma, current use of psychoactive medication, and history of learning disorders such as dyslexia.

Surveys and Questionnaires

Participants first provided informed consent and then completed a battery of surveys and questionnaires at their own pace in the laboratory. This battery began with a demographics questionnaire that provided a general overview of basic information. Participants indicated their age, gender, years of education, handedness, history of learning disorder and any current medications in blank spaces. Additionally, they indicated whether or not they had ever experienced a severely traumatic event.

Participants next filled out the Profile of Mood States 2-Y (POMS 2-Y), to assess their general mood over the week preceding testing. This scale includes 60 items on that are scored on subscales of anger-hostility, confusion-bewilderment, depression-dejection, fatigue-inertia, tension-anxiety, vigor-activity, ~~and~~ friendliness, and a total score measuring overall mood

disturbance, with higher scores indicating more positive mood. All subscales and the total mood disturbance were adjusted to gender norms. ~~and adjusted to gender norms.~~ The measure is widely used to assess overall affect and has high internal ~~validity~~ consistency (α = .78-.95; Lin, Hsiao, & Wang, 2014). Scoring provided individual subscale scores adjusted to gender norms as well as a total score corresponding to overall mood, with higher numbers indicating ~~elevated~~less distressed mood in that area (Heucher & McNair, 2012). Since several mood disorders, such as depression, are known to have an impact on neuropsychological tests as well as sleep (McAllister-Williams et al., 1998), POMS scores will be used to control for mood.

Next, participants completed the Dissociative Experiences Scale II (DES II), which is widely used to assess the degree to which samples, both clinical and non-clinical, dissociate (Bernstein & Putnam, 1986). Participants indicated to what extent they experienced 28 different items such as "Some people have the experience of finding themselves dressed in clothes that they don't remember putting on. Select a number to shown what percentage of the time this happens to you" (item 4) by circling an answer on an 11-point Likert scale ranging from 0% (never) to 100% (all the time; α = .92). The mean of answers on these measures was calculated as the total DES score. In accordance with factor analyses by Ross et al. (1991), scores were computed for subscales of absorption, amnesia, and derealization. Of these factors, absorption measures such as "Some people find that when they are watching television or a movie they become so absorbed in the story that they are unaware of other events happening around them" (item 17) appear to be non-pathological in nature. Amnesia (e.g., "Some people find evidence that they have done things that they do not remember doing" (item 25)) and derealization (e.g., "Some people sometimes have the experience of feeling as though they are standing next to themselves or watching themselves do something as if they were looking at another person"

Comment [HW3]: MS: Also, your description of how the POMS is scored is ambiguous. What does "elevated mood" mean? Is it more positive (i.e. elevated positive mood")

HW: I think adding the total in the subscales list should help with this.

Instead of "positive", I've made it "less distressed" since the POMS does only measure negative moods.

Comment [HW4]: MS: "At the bottom of p. 40, you give other researchers' Cronbach's alphas for the POMS, but unless I missed it, you don't report yours. Why?

HW: I used NK's program to score this and truthfully don't know how it works. If we really want to, I could figure it out. Is this necessary?

(item 7)) are much less common in the general population and are believed to be more indicative of dissociative pathology (Giesbrecht et al., 2008). While the DES officially provides a total score on a range from 0 to 100, most sample distributions evidence a floor effect, with scores above 30 being considered high (Carlson & Putnam, 1993). Although this floor effect is reflective of skew, very few researchers appear to take this into account when performing their analyses. For the total scale and three subscales, higher scores indicate a greater degree of trait dissociation.

Next, participants completed the Iowa Sleep Experiences Scale (ISES), which consists of 18 items that analyze general sleep experiences as well as lucid dreaming experiences. Participants answer items such as "I have a dream that is so vivid it influences how I feel the following day" on a 7-point scale from 1 (never) to 7 (several times a week). The average of all scores on the general subscale was used to measure sleep experience, with higher numbers indicating more abnormal sleep ($\alpha = .86$). The questions on this measure are qualitatively unique from the more typical sleep scales (Watson, 2001).

Next, participants completed the Pittsburgh Sleep Quality Index (PSQI), which measures the overall quantity and quality of sleep. Scores covered seven domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction over the last month. Additionally, a total score is calculated to represent the overall quality of sleep (Buyesse et al., 1989).

Cognitive Measures

The WRAT-4 reading subtest requires participants to read aloud a list of 55 words as a proxy measure of crystallized verbal ~~measure of fluid~~ intelligence. Comparing the total number

Comment [HW5]: Response to Koven: Actually, the Reading subtest is a proxy measure of crystallized verbal intelligence rather than fluid intelligence.

of correctly pronounced words to age-appropriate norms provided a final standardized score, with higher scores indicating higher overall intelligence (Wilkinson & Robertson, 2006).

The Conners CPT3 and CATA are computerized tests of sustained attention in which participants monitor a screen or sounds from headphones for fourteen minutes. For the CPT-3, participants were instructed to press the space bar on the keyboard in front of them for all letters except "X". For the CATA, participants were instructed to press the space bar when they heard a high tone that had been immediately preceded by a low tone. The program provided standardized and raw scores for inattentiveness, impulsivity, sustained attention, vigilance, and subscales within each of those categories for types of errors (Conners, 2014). Additionally, after completing the final task, which was either the CPT-3 or CATA, participants responded to the prompt "Please estimate the duration of the task you just completed at the computer beginning with the first trial after the practice and ending with the completion of the test" by filling out blanks for minutes and seconds. The resulting error between their estimate and the actual length, 14 minutes, was used as an objective measure of dissociation. Experiments have shown that dissociation is related to poorer time estimation (Brewin, Ma, & Colson, 2012), so it was expected that individuals scoring higher on the DES would display greater error in time estimation.

Participants also completed both the forward and backward versions of the WAIS-III Digit Span task to assess verbal working memory. In the forward condition, participants listened to the experimenter and repeated back increasingly long sequences of numbers. In the backward condition, participants similarly heard lists of numbers and repeated them in the reverse order. For each condition, the total number of sequences correctly answered before termination

determined the raw score, and WAIS-III software calculated the normalized scores, with higher scores indicating greater verbal working memory (Wechsler, 1997b).

As in Digit Span, participants underwent both forward and backward versions of the WAIS-III Spatial Span task to assess nonverbal working memory. The experimenter tapped a specific series of blocks on the testing stimulus and the participant repeated the sequence of tapping or reversed it in the backward condition. The overall scored was determined by the number of correct sequences tapped before the test was terminated, and WAIS-III software calculated the normalized scores, with higher scores indicating better spatial working memory (Wechsler, 1997b).

For the WAIS-III Letter-Number Sequencing Test, a more complex verbal working memory task, participants heard a series of alternating letters and numbers and repeated the sequences with the numbers first in numeric order, followed by the letters in alphabetical order. The total number of correct responses was used as a raw score, and WAIS-III software calculated the normalized scores, with higher scores indicating better verbal working memory (Wechsler, 1997a).

Participants also completed a computerized E-Prime task created for the purpose of this study that was based on the 1982 experiment by Somberg and Salthouse to measure divided attention. After introductory slides presenting each sound for five seconds and 20 practice trials with feedback, pParticipants monitored a computer screen for 60 trials of 1 s length. Each trial consisted of the presentation of three shapes evenly spaced on a line. Each shape could take one of five forms: circle, triangle, square, star, plus. Additionally, each slide was accompanied with either no sound or a high, medium or low frequency pitch. Participants were instructed to monitor for whether or not a circle appeared and whether or not the medium frequency sound

Comment [HW6]: In response to Koven: when you are describing the divided attention task, did you provide the subject with training trials and/or practice trials? If so please, include these details.

was present. For each slide, participants indicated the presence of both conditions by pressing one of four keys on the number pad: 1 (incorrect sound, no circle present), 3 (correct sound, no circle present), 7 (incorrect sound, circle present), or 9 (correct sound, circle present). Accuracy and reaction time were recorded for each trial. The overall percent of trials correctly answered was used to assess divided attention ability.

To measure selective attention, participants completed the Color Naming, Word Reading, and Color-Word Interference conditions of the DKEFS Color-Word Naming Task. In the Color-Word Interference condition, participants recited only the word that is written while inhibiting a response to the color in which the word appears. The overall time taken to complete the task and the number of errors in each condition were used as raw scores, and DKEFS software provided scaled scores for inhibition and errors as well as contrast scores which compared the scaled scores on the inhibition task to the scores on the two simpler tasks (MacLeod, 1991).

Procedure

Participants completed all self-report measures before beginning the neuropsychological batteries. After completing the demographic questionnaire, POMS-2, DES, ISES, and PSQI, participants began the neuropsychological testing with the WRAT-4. Following the WRAT, participants completed either the CPT-3 or CATA, which was determined by whether the participant ID number was odd or even. Following the first sustained attention task, participants completed Digit Span Forward and Backwards and then Spatial Span Forward and Backward. Participants then completed the divided attention task, Letter-Number Sequencing, DKEFS Color-Word Interference, and then the sustained attention task that they had not yet completed. Immediately following completion of the final sustained attention task, participants answered the time estimation question.

Results

Descriptives

The mean DES score of the sample was *M* = 15.18 (*SD* = 10.58), and the mean ISES general score was *M* = 2.88 (*SD* = 0.92). Means for sub-scales of the DES, sleep variables and neurocognitive dimensions are summarized in Table 1. Preliminary analyses to test for gender differences on key dimensions were carried out. Aside from verbal intelligence, measured by WRAT (Male *M* = 115.3 (*SD* = 8.5), Female *M* = 110.6 (*SD* = 9.2)), there were no gender differences on any of the measures (see Table 1). A one sample t-test showed that the sample mean for WRAT (*M* = 112.2 (*SD* = 9.2) was significantly greater than the standardized norm (*M* = 100, *SD* = 15), $t(75) = 11.59$, $p < .001$, indicating that this undergraduate sample had higher intelligence scores than the general population.

Because dissociative phenomena are rare in the general population, p~~P~~rior to running analyses, the distributions of the variables were examined. Skew of the total DES scores was 1.11, and the Shapiro-Wilk statistic was .887, *p*. < 001, indicating that the distribution of scores was not normal. To test the impact of the skew on analyses, we ran analyses both with square root transformed and untransformed DES scores. There were no significant differences in outcomes using the transformed scores. Further, Spearman correlations were also run with total DES scores, and produced similar results. As a result, and consistent with previous research using the DES, subsequent analyses were run using the untransformed scores. Skew for the three subscales of absorption, amnesia, and derealization was also tested (absorption skew = 1.1, amnesia skew = 0.96, derealization skew = 2.5.), and indicated that derealization scores were highly skewed. Correlational analyses involving the absorption and amnesia sub-scales, like total scores, were not transformed. For derealization data, a square root transformation was used

Comment [HW7]: MS: Results felt a little too much like a list of a lot of analyses. It didn't feel like a story. It would have been more compelling if you'd made the broader conceptual purpose and meaning of each analysis clear. Perhaps, briefly indicating what each analysis told us (e.g, "contrary to the betrayal trauma account)

HW: I'll add these in as seems appropriate.

Comment [HW8]: Koven comment: Can you give a brief justification of the choice of the Shapiro-Wilks test over other tests to assess normality of distribution (e.g., Kolmogorow-Smirnov test)? The Shapiro-Wilks test is not ideal when your data are likely to have many tied scores among participants (i.e., subjects having identical values). It seems to me that it's very possible your data have a lot of tied scores for several variables. You may ultimately decide that there is no good alternative to the Shapiro-Wilks test; this is fine, but it would be good to briefly acknowledge this known downside to the test.

HW: I don't know anything about this. Your thoughts?

Comment [HW9]: NK: "You mention having tried square root transformation of the DES data (total score and then derealization subscale score). Did that successfully bring the distribution to normality? It would be good to see some after-the-transformation details such as skew, kurtosis, and Shapiro-Wilks statistic. This could be done parenthetically.

HW: I don't really know how to get these statistics? Would this be addressed by just listing the skew for the regular and transformed data?

to normalize the distribution before running correlations with sleep or neurocognitive variables. Comparisons of correlations of the raw and transformed derealization scores are shown in Table 2.

Correlational Analyses

An initial correlational analysis of all self-report measures and intelligence indicated a significant relationship between affect as assessed by the POMS Total Mood Disturbance (TMD) and trait dissociation as measured by the DES, $r(76) = -.41$, $p < .01$ (Figure 1). As in previous studies, the DES scores were also significantly positively correlated with the general subscale of the ISES, $r(76) = .24$, $p < .05$ and was marginally correlated with the PSQI, $r(76) = .21$, $p = .10$ (Figure 2). Dissociation was only marginally correlated with ~~sleep quality and~~ intelligence~~, $r(76) = .21$, $p < .10$ and~~ $r(76) = -.19$, $p < .10$~~, respectively~~. When controlling for affect using the POMS TMD, the relationship~~s~~ between the DES and ISES decreased and the association and was no longer significant, $r(76) = .19$, $p = .10$. Similarly, the relationship between DES scores and qualitative sleep as measured by the PSQI was no longer significant when affect was controlled for, $r(76) = .02$, $p = .82$, suggesting mediation (Table 3). A variety of analyses, including multiple regressions that also controlled for gender, indicated that the association between sleep and dissociation was almost entirely explained by negative affect. Because the relationship between sleep and dissociation appeared to be explained by mood, further analyses concerning dissociation and neuropsychological measures did not include sleep variables.

Contrary to expectations, d~~D~~issociation and time estimate error, an objective measure of attention which asked participants to estimate the length of time associated with a specific task,

Comment [HW10]: NK: "When referring to the correlation between the POMS and DES total score, you don't indicate which of the possible POMS scores you are using. Since you are reporting only one POMS variable, I am assuming you are using the TMD (total mood disturbance) score when you say "the POMS". It would be good to make this clear throughout by, for example, calling the variable POMS TMD

Comment [HW11]: MS noted that DES and PSQI corr. was reported twice.

were not significantly related, $r(76) = .19$, $p = .11$ (Table 4), but the amnesia subscale of the DES was marginally significantly positively related to time estimate error, $r(76) = .22$, $p < .10$.

Vigilance/Working Memory

Working memory and dissociation had no significant relationship, as shown in Table 5. Although only approaching significance, verbal working memory as measured by both Digit Span and Letter Number was inversely related to DES scores, $r(76) = -.18$, $p = .12$ and $r(76) = -.10$, $p = .38$, respectively, thus contradicting de Ruiter's construction hypothesis.

Based on previous research, DES scores were recoded into three groups to assess the degree to which those low and high on in dissociation might differ on aspects of working memory (low, DES <10 (N=29); medium,10<= DES < 20 (N=29); high, DES>20 (N=18)). These cutoffs were used in accordance with the majority of the literature because most healthy adults have scores below 10, and scores above 20 are considered indicative of potential dissociative disorders (Carlson & Rosser-Hogan, 1993). An omnibus MANOVA run on digit span forward, digit span backward, spatial span forward, spatial span backward, and letter-number sequencing was not significant ($\lambda = .817$, $F(10, 138) = 1.47$, $p = .16$). Despite the non-significant MANOVA, subsequent univariate ANOVAs of working memory were examined to provide exploratory information about these dependent memory variables and in order to compare data with previous literature. These analyses showed that the differences in digit span forward scores between the low ($M = 10.59$, $SD = 2.13$), medium, ($M = 11.76$, $SD = 2.10$), and highly dissociative groups ($M = 9.83$, $SD = 1.82$) were statistically significant, $F(2, 76) = 5.30$, $p = .01$ (Table 6, Figure 3). Tukey's HSD tests indicated that the medium DES group scored significantly higher than the low and high dissociative groups. The high and low dissociative groups were not found to be significantly different on any of the working memory measures.

Comment [HW12]: NK: Can you briefly provide a rationale for these specific cut-off values other than that previous researchers have also used them? Why have previous researchers settled on these cutoffs? Also, using these cut-offs, how many of your subjects fell into the low, medium, and high groups?

This result indicates that individuals scoring in the mid-range for dissociation had better working memory scores than both highly dissociative individuals and those who scored very low on dissociation.

Selective Attention

In support of the betrayal trauma theory, c~~C~~orrelational analysis of selective attention and dissociation, shown in Table 7, revealed only a marginal inverse relationship between overall DES score and the error contrast score, which indicates the relationship of errors made in the incongruent condition with errors made in the color-naming and word-reading conditions of the DKEFS Color-Word Naming task, $r(76) = -.19$, $p < .10$. The DES subscale of amnesia was significantly inversely related to the scaled time contrast score, $r(76) = -.23$, $p < .05$. This scaled time contrast score compares the scaled score of an individual's time to complete reading in the condition where the word and color were mismatched to their standardized scores measuring the amount of time taken to complete reading the conditions with only colors or only words, thus helping to control for factors such as general processing speed.

MANOVA was run to test for differences in selective attention as measured by DKEFS Color-Word interference task measures of total errors, a contrast scaled score, and the scaled score of just the inhibition condition between low, medium, and high DES score participants. Wilks' Lambda was not significant ($\lambda = .90$, $F(10,138) = 1.29$, $p = .27$). Univariate analyses were examined for exploratory purposes and are shown in Table 8 and Figure 4. For both the scaled total error score and scaled inhibition condition, those with medium levels of dissociation scored the highest. On all measures, there was a pattern of low dissociators performing better than high dissociators, although the differences did not reach significance.

Divided Attention

Correlational analysis of divided attention and dissociation, shown in Table 9, revealed no significant relationship between total DES score and divided attention accuracy scores, $r(75) = -.13$, $p = .26$. The DES subscales of amnesia and derealization were both significantly inversely related to accuracy in the divided attention task, $r(75) = -.26$, $p < .05$ and $r(75) = -.27$, $p < .05$, respectively. These results indicate that as individuals score higher on dissociative amnesia and derealization, their ability to accurately respond to stimuli requiring attention in multiple modalities decreases.

A MANOVA was run to test for differences in divided attention as measured by accuracy and reaction time in the computerized task between low, medium, and high DES score participants. Wilks' Lambda was not significant ($\lambda = .92$, $F(10,138) = 1.50$, $p = .21$). Although the results fail to reach significance, Tukey's HSD indicated that highly dissociative individuals had the slowest reaction time ($M = 2.34$, $SD = 1.03$), while those in the medium dissociation group had the fastest reaction times ($M = 1.88$, $SD = 0.51$), shown in Figure 5. Tukey's HSD also revealed that overall accuracy on the divided attention task mimicked the pattern between dissociation and divided attention, with low dissociators performing best and high dissociators performing worst, but this failed to reach significance in the between-groups analyses (Table 10).

Sustained Attention

Correlational analysis of sustained attention and dissociation, shown in Table 11, revealed no significant relationship between total DES score and sustained attention measures. The amnesia subscale of the DES was marginally correlated with CATA detectability, $r(75) = .21$, $p < .10$, in the direction of more dissociative participants having lower auditory attention over extended periods of time.

A MANOVA was run to test for differences in sustained attention as measured by the overall accuracy and change in performance over time in the both the CATA and CPT between low, medium, and high DES score participants. Wilks' Lambda was not significant (λ = .90, $F(10,138) = 0.97$, $p = .46$). No consistent pattern between groups was observed across the four dependent variables, so univariate ANOVAs were not run (Figure 6).

Suppression Effect of Affect

Because controlling for affect weakened the relationship between sleep and dissociation and because previous studies ~~have explored mood as a mediator between dissociation and cognition~~connected worse mood with decreased cognitive abilities, partial correlations were run controlling for affect as measured by the POMS ~~total~~ TMD ~~score~~ (see Table 12).~~.~~ After controlling for mood, the correlations between dissociation and selective and divided attention, in particular, increased slightly in magnitude. These results suggest that because negative affect is related to higher rates of dissociative experiences as well as worse cognitive performance, mood may weaken the correlation between dissociation and attentional endpoints, acting as a suppressor variable.

Curvilinear Analyses

Because associations between dissociation (DES total) and sleep were non-significant once negative affect was controlled for (POMS TMD), curvilinear associations between dissociation and sleep variables were not explored. In the case of dissociation and neurocognitive dimensions, memory and Color-Word Naming selective attention tasks were tested in curvilinear regression models based on previous analyses. Of the memory variables, digit span total, which assesses verbal working memory, was a marginally significant predictor of DES score when a quadratic curve was fit ($F(2,73) = 2.44$, $p = .094$), with low and high

dissociators having lower memory scores. Quadratic models were not preferable for any other memory variables. The selective attention measures were also tested in quadratic models, and none of the models were significant.

Discussion

Contrary to expectations, correlational analyses did not indicate a meaningful relationship between sleep and dissociation independent of mood. Because the relationship between sleep and dissociation as measured both by a more typical qualitative sleep measure, the PSQI, and an experiential measure, the ISES, was non-significant after controlling for mood, it was not meaningful to explore the relationships between sleep, dissociation and cognition as initially proposed. Subsequent analyses tested the relationships between dissociative tendencies as assessed by the DES and specific neurocognitive dimensions. The correlations between dissociation, specifically the derealization and amnesia subscales, and several attentional measures, namely those of selective and divided attention, did reach significance. The present study provides the first evidence that divided and selective attention may be important neurocognitive correlates of dissociative phenomena. While the original hypotheses concerning sleep's mediating role in dissociation and cognition were not supported, several interesting and novel results arose from the research.

Affect, Sleep, Dissociation, and Cognition

Previous research has reported associations between sleep and DES scores. Because both sleep and dissociation may be correlated with negative affect, in the present study, mood was also assessed using the POMS. As seen in Table 3, we found the expected significant relationship between the DES and ISES, but the strength of this relationship was less than that between the POMS and the DES, and when the analyses controlled for mood, the relationship

between sleep and dissociation no longer reached significance. The present study is one of a few to control for affect when assessing the relationships of various personality and neurocognitive measures with dissociation. The present study's finding that sleep and dissociation are not associated when mood is controlled for conflicts with previous research that has posited a strong theoretical relationship between sleep disturbances and dissociation.

While there is research on affect and sleep, very few studies have connected the POMS, ISES, and DES specifically. Like the present study, van Heugten-van der Kloet et al. used the ISES and POMS in an experimental study of sleep and dissociation in undergraduates (2015). In addition, the authors use the SLEEP-50 scale, a more extensive measure of pathological sleep. In these analyses, change in sleepiness did not predict dissociative experiences once mood was controlled for in the early phases of the experiment. After significant sleep deprivation, there were modest associations between sleep and dissociation, but the correlations between mood and dissociation continued to be stronger. While these analyses had methodological shortcomings related to multicollinearity, the findings support the possibility that in studies of participants who have relatively normal sleep cycles, the effect of sleep on dissociation can be accounted for by affect.

Previous literature on sleep and dissociation often includes the Beck Depression Inventory and Beck Anxiety Inventory, especially in clinical samples (e.g., Elizinga et al., 2007; Dorahy et al., 2006). As the POMS is a more general measure of negative affect that measures not only anxiety and depression, but also confusion, fatigue, anger, and vigor, (Heucher & McNair, 2012) it represents mood in general, not clinical depression or anxiety. Importantly, the present study does not suggest that any specific mood disorders are related to dissociation.

Dissociation and Cognition

As previous research provides evidence of dissociation being linked both to enhanced and decreased levels of attentional ability, the present study did not have directional hypotheses for the posited relationships between DES scores and various neurocognitive measures. However, although not always reaching significance, the data do show a tendency for low dissociators to have better working memory than high dissociators, which is consistent with some previous clinical data (Dorahy et al., 2006), but contradicts most published findings (e.g., de Ruiter et al., 2004; Elzinga et al., 2007; Giesbrecht et al., 2004). Notably, no pattern was apparent when measuring sustained attention. Although the present study found no relationship between sustained attention and dissociation, future studies could assess state dissociation during even longer sustained attention tasks and explore the possibility of a causal relationship between boredom or cognitive fatigue and dissociation.

While the correlations between total dissociation and working memory did not reach significance, correlations of the amnesia and derealization subscales with selective attention and divided attention did indicate an inverse relationship between these specialized forms of attention and dissociation. This inverse relationship is consistent with the very earliest research in the field (Freyd et al., 1998). However, the methods used in the two studies are very different, as Freyd used emotional Stroop paradigms and measured types of error, whereas the present study used a neutral DKEFS Color-Word Naming test and measured time and total errors in contrast with control conditions. Additionally, no other study has analyzed selective attention in relation to the three sub-types of dissociation or reported that only the more pathological factors, amnesia and derealization, appear to be associated with selective attention capacity.

Like selective attention, divided attention had an inverse correlation with both amnesia and derealization. The experimenter-designed divided attention task was totally novel in the

literature. While it is hard to draw conclusions about a new assessment tool such as the computerized task designed for the present study, the fact that it was significantly positively correlated with measures of selective attention and working memory provides convergent validity. The results in regard to divided attention are very similar to those of selective attention—accuracy in the divided attention task was inversely correlated with the amnesia and derealization scales of the DES.

Put together, the results of the selective and divided attention analyses indicate a much stronger association between these specialized attentional capacities and dissociation than with working memory. In both of these tasks, higher dissociation scores were related to poorer performance on tests that required attention to more than one stimulus or task. It could be the case that dissociation is linked to decreased capacity for simultaneous processing. This would explain poorer performance on both tasks, as in the selective attention task, participants balanced the inputs of the printed word and the actual color that the word was printed in, and in the divided attention task, participants paid attention to both the shapes on the screen and the sound that came from the headphones. Recent research has suggested that selective attention may be affected by high load on frontal cognitive control processes, which increases distractor processing (Lavie, 2005). If dissociation is an attentional problem in complex situations, and distractibility is high in dissociators, then more complex tasks like the novel divided attention test may elicit reduced performance in dissociators. It could also be the case that these results indicate a reduced cognitive flexibility in dissociators, as higher degrees of dissociation were related to worse ability to accurately process auditory and visual stimuli simultaneously. Future studies could assess this by including the Inhibition/Switching condition of the DKEFS Color-Naming task that requires shifting between two rules while processing the color-word

combinations. Additionally, it could be the case that shifting between modalities, such as vision and audition in the divided attention task, is related to dissociation. Researchers can further explore the relationship between dissociation and multimodal processing by adapting more tasks to include visual and auditory components. It could also be the case that highly dissociative individuals performed worse on these tasks due to the complexity of the task rules and failure to attend to instructions. However, this seems unlikely, as the correlation between the dissociative measures and Letter-Number Sequencing, another task with complex instructions, was non-significant.

Another possibility is that the association between dissociation and the attentional tasks are somehow related to overall psychopathology. As the experiences captured by the amnesia and derealization subscales are less common than those experiences included in the absorption scale, perhaps the findings are a reflection of general pathology and not just dissociative tendencies. For example, some previous research has linked dissociation to schizotypy (Knox & Lynn, 2014), a disorder that may have cognitive implications. However, if that were the case, we would expect other variables that have strong relationships with psychopathology, like mood and sleep measures, to be correlated with the attentional tasks, which is not the case. Additionally, this explanation seems unlikely as the population was not clinical and was screened for severe trauma or use of psychoactive medications.

Combining attentional results, the data show a consistent trend of higher levels of dissociation being related to poorer attentional abilities. This result fits most neatly with Freyd's betrayal trauma theory, which asserts that traumatic experiences lead to decreased selective attentional abilities and ultimately to dissociative experiences (Freyd et al., 1998). However, all participants in the present study explicitly denied having a history of trauma, making the

application of Freyd's theory inappropriate. As dissociation was not found to be positively correlated with working memory, the data are not consistent with the construction hypothesis, which asserts that dissociation is a product of enhanced memory encoding caused by increased attentional and memory abilities (de Ruiter et al., 2004). Instead, our results would be most consistent with the fantasy proneness model, which asserts that dissociation is related to increased suggestibility and tendencies to have fantastical thoughts (Giesbrecht et al., 2008). Based on this theory, it could be the case that individuals have background fantasy or daydreaming cognitions at all times. Weaker divided attention and selective attention in dissociative individuals might make them less able to successfully juggle these multiple information-streams when processing cognitive tasks. In this case, everyone experiences some degree of fantasy, but as people have worse attentional abilities, they are more likely to become immersed in the fantasy and therefore display dissociative phenomena. It could also be the case that immersing in fantasy leads people to reduce their attention to cognitive tasks, especially those that would introduce large cognitive loads and potentially interfere with the ongoing fantasy. While we cannot conclude any causal relationships, it is entirely possible that decreased attention and fantasy proneness are connected.

In terms of localizing a specific brain structure associated with dissociative phenomena, it seems that the prefrontal cortex is implicated in dissociation, as this study and others have found significant correlations between trait dissociation and executive functions that are specific to the prefrontal cortex, specifically the dorsolateral prefrontal cortex (DLPFC; Elzinga et al., 2007). While all the cognitive functions that were correlated with dissociation seem to be subject to prefrontal cortex control, it is impossible to draw firm conclusions about the locus of dissociative phenomena without accompanying imaging.

Limitations and Considerations of the Current Study

Assessment of dissociation is a significant challenge in the literature on sleep and dissociative experiences, and in particular, the non-normal distribution of the DES total and sub-scale scores in non-clinical samples presents analytic challenges. This problem was addressed in an early article by Wright and Loftus (1999) which proposed an alternative scoring approach using "comparisons with others" as the metric for assessing dissociation instead of "what percentage of the time." However, none of the recent publications reporting associations between sleep and dissociation have employed this alternate scoring method.

In the present study, there was significant positive skew in total scores and the extreme skew in derealization scores. Previous research on sleep and DES does not report on the normality of DES score distributions, nor does it appear to address skew with either transformations or non-parametric approaches. For the present study, the skew of the derealization sub-scale scores was normalized using a square root transformation. Key analyses were also re-run with Spearman correlations, with no impact on results. Future research should address the skew in DES scores, either by using the DES-C as proposed by Wright and Loftus, or by employing transformations or non-parametric analytic strategies.

One purpose of the present study was to use continuous DES scores for analyses, rather than the "extreme groups" approach often employed in the research on dissociation. Although researchers are not explicit about the motivations for using extreme groups, one explanation may be that analysis of variance is mistakenly perceived as relatively robust in situations where data are skewed (Khan & Rayner, 2003). The risk of the between groups approach is that analyses may miss curvi-linear or other complex associations between variables. As seen in Figures 3, 4

and 5, often, the middle group actually showed the highest attentional abilities, which had not previously noted in research and suggests the possibility of curvilinear associations.

Finally, there continue to be a variety of questions about the DES (see Stockdale, 2002; Ruiz et al, 2008). In a recent study using advanced factor analytic techniques in a sample of psychology students, Olsen et al. proposed a two-factor solution for the DES: absorption and a combined amnesia/depersonalization scale (Olsen et al., 2013). Most researchers have identified absorption as a non-pathological aspect of dissociation (Olsen et al.), but the factor structure has varied depending on the sample surveyed and history of trauma. Olsen et al. contend that the two factor structure has greater utility and validity across samples, and that the amnesia/depersonalization factor is more strongly associated with pathological aspects of dissociation. Analyses in the present study were re-run with Olsen's proposed two factor structure, and produced similar outcomes.

Further, when used in non-clinical samples, the DES tends to be positively skewed due to a floor effect. Moreover, although the measure has been shown to have high convergent validity with measures such as the SCID-D and CADSS (Condon and Lynn, 2015), as well as formal diagnoses of dissociative disorders (Bernstein & Putnam, 1986), the components of dissociation, such as absorption, are not well understood, especially for participants from non-clinical samples. Additionally, this measure is entirely based on self-reports of dissociative experiences. If in fact dissociative individuals are more suggestible and fantasy-prone, as some research indicates (Giesbrecht et al., 2008), then the reliability of a self-report measure for dissociation might be questionable. Before drawing conclusions based on DES results, researchers should consider using more objective measures, such as the CADSS (Bremner et al., 1998; van Heugten-van der Kloat et al., 2015), or interview-based approaches. Future research on

dissociation and neurocognitive dimensions should employ both self-report and objective measures of the phenomenon.

The sleep-related results of this study were quite surprising. Unlike many previous studies, the relationship between ISES and DES scores was not strong, and the relationship was non-significant when mood was controlled for statistically. While this sample of undergraduates could be in an environment that leads them to be distinct from the general population in terms of sleep experiences, it seems unlikely that the observed differences are due to sampling alone. It could be the case that the ISES, which allegedly assesses atypical aspects of sleep, is instead measuring some aspect of dissociation or psychopathology. This possibility is supported by the fact that in the present sample, there is no significant correlation between ISES scores and the PSQI, a well-accepted sleep measure. Convergent validity would require correlations of other sleep measures and the ISES, but the majority of the published studies only correlate the ISES with the DES or other measures of dissociation (Watson, 2001). In van Heugten-van de Kloat et al., the SL50 and the ISES are correlated, but the ISES and the Stanford Sleepiness Scale under conditions of sleep deprivation are not (2015). The SL50 contains 50 items and measures sleep disorders and sleep complaints (Spoormaker et al., 2005). These relationships could suggest that the ISES measures sleep disorders or sleep-wake disturbance rather than general sleep experiences or sleepiness. Without adequate evidence of convergent validity, it is difficult to determine what aspects of sleep, if any, the ISES measures. Although many studies are adopting this measure as an indicator of sleep experiences in dissociation research, there is little evidence in the published literature that the ISES assesses well-accepted aspects of sleep or the sleep-wake cycle.

Another important consideration is that the divided attention task was made specifically for this study, and has not undergone extensive psychometric testing. Positive relationships with measures of working memory and selective attention support the convergent validity of the measure, and the measure did not correlate with sleep measures or a sustained attention measure, which provide evidence of discriminant validity. Because some participants were confused or couldn't differentiate the various sounds in the auditory portion of the task, future studies should employ pitches that are more distinguishable. Additionally, the task should include trials that measure accuracy of identifying stimuli in each modality before presenting the stimuli simultaneously to provide contrast information about divided attention.

The present study used a time estimate for a specific task as a proxy for dissociation, with some success, as it was marginally correlated with the amnesia subscale of the DES and inversely correlated with both digit span and letter-number sequencing, indicating that it was associated with verbal working memory. As dissociation might be marked by a failure of working memory to encode events, this time estimation task could be assessing one aspect of the phenomena. A few previous studies have reported link between induced dissociation and time perception (Brewin & Ma, 2012). The present study used a slightly different task by having participants guess the duration of the test, and the task likely involved much more complex attentional processes than just those involved in dissociation (Zakay, & Block, 1996). While this specific task provided some insight into a connection between dissociation and memory, researchers should strive to find more innovative, objective ways to measure dissociation.

The present study also may have been subject to order effects because with the exception of switching the order of the CPT3 and CATA, all participants completed the items in the same sequence. This was done in order to have participants alternate between visual and auditory

modalities from task to task. Given the nature of these tasks, there could certainly be some fatigue effects that impacted performance on the later tasks. Future research might vary order of tasks to control for possible order effects.

Finally, because of the number of statistical tests run, this study may be subject to Type I error. When appropriate, we chose multivariate analyses to reduce the number of analyses run, but nonetheless, the possibility of Type I error remains. Given the exploratory nature of the present study and the modest sample size, a Bonferroni correction was not used because of the risk of a Type II error. Despite these concerns, the pattern of the results, including affect's mediating relationship and the inverse relationships between amnesia and derealization and selective and divided attention, are consistent and could make meaningful contributions to the literature. Future research should employ larger samples that would allow for statistical corrections for Type I error.

Future Directions

Most importantly, the present study demonstrates the importance of considering mood when exploring the connections between sleep and dissociation. While some studies have noted that a connection exists between dissociative events and affect when manipulating sleep, a variety of studies have reported strong associations between the ISES and DES without controlling for mood. Based on the present study, there is some preliminary evidence that mood may mediate the relationship between sleep and/or sleep disturbance and dissociation. This explanation is contrary to the theories that posit that dissociation may be directly linked to sleep-wake or sleep cycle disturbances (Koffel & Watson, 2009). Whether mood is assessed in terms of clinical measures such as the BDI or BAI or more general measures such as the POMS, future studies should consider mood when studying the sleep-dissociation link.

Further, future research should explore trait dissociation, affect, and selective and divided attention. In particular, replicating and extending the present study to include the Inhibition-Switching condition of the DKEFS Color-Naming task to provide information about cognitive flexibility or other measures of divided attention would be optimal. Depending on outcomes, results could strengthen the argument that higher levels of trait dissociation are related to a decreased ability to attend to two tasks simultaneously, or to less cognitive flexibility. This study was the first to explore divided attention explicitly, and the results suggest that this is a promising area of research. Further validating the divided attention task would also strengthen the research.

Assessment of dissociation also continues to be a challenge in the research. Studies should to strive to use more objective measures or multi-method assessment of dissociation instead of relying solely on the DES. The mirror gazing task used by Brewin and Ma (2012) seems promising, and more research should be done to develop methods to induce dissociative states and objectively measure whether an individual is experiencing dissociative phenomena.

For research continuing to explore the connection between sleep and dissociation, attention to both measures and analyses is critical. The skewed nature of DES data, the mediating effect of mood, and the fact that the ISES seems to capture only sleep pathology make it difficult to make definitive statements about the relationship between dissociation and sleep. More studies that experimentally manipulate sleep or use measures that do not rely on self-report would provide more meaningful evidence for the existence of any relationship between sleep and dissociation. Additionally, more research, especially in nonclinical samples, should test curvilinear models or use methodologies that include the middle-DES group to account for the

full spectrum of dissociative experiences. As observed in the present study, the medium-dissociators often displayed the best performance on cognitive dimensions.

Finally, research on dissociation as a construct should continue. Previous research has generated conflicting factor solutions for the DES, and the specific components of dissociation continue to be debated. As demonstrated by the fact that the amnesia and derealization subscales correlated with cognitive measures, but absorption did not, the DES may capture two related but distinct constructs. Because the nature of the absorption items is so qualitatively different from the amnesia and derealization items, and because the two seem to have different relationships with cognition, it seems possible that this measure is assessing at least two dimensions, as Olsen et al. (2013) suggest.

Finally, the question whether or not parametric approaches are appropriate seems an important one in studying dissociation. The observed positive skew and floor effects for the amnesia and derealization subscales suggest that non-parametric analyses might be more appropriate for non-clinical samples. It is surprising that more studies do not employ non-parametric tests or transformational strategies when analyzing DES scores. In sum, researchers should carefully consider appropriate measures and analyses when they are approaching pathological dissociation or absorption phenomena.

In conclusion, the present study provides support for an inverse relationship between dissociation and selective and divided attention tasks. While recent sleep research offers a tempting theoretical connection between dissociation and cognition, the mediating effect of mood must be considered and addressed. Finally, the challenges of defining and measuring dissociation suggest that the construct of dissociation continues to need attention, including the possibility of a two-factor solution for the DES that distinguishes pathological symptoms from

absorption. This distinction could provide a more consistent framework for approaching these experiences and better enable researchers to explore all the aspects of dissociation.

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List of Tables and Appendices

Tables

Table 1. Gender means and standard deviations and grand means and standard deviations for dissociative, sleep and neurocognitive measures.

	Male (26)[r]	Female (50)[t]	Grand Mean (75)[t]
DES Total	14.14 (9.16)	15.73 (11.29)	15.18 (10.58)
DES absorption	24.02 (15.58)	26.20 (18.40)	25.45 (17.41)
DES amnesia	7.26 (7.83)	8.03 (9.06)	7.76 (8.62)
DES derealization	4.94 (8.08)	6.10 (9.72)	5.70 (9.15)
ISES general	2.76 (0.90)	2.95 (0.93)	2.88 (0.92)
PSQI total	5.35 (2.92)	5.94 (3.16)	5.74 (3.07)
Hours of sleep	6.894 (1.16)	7.041 (1.11)	6.99 (1.12)
WRAT scaled*	115.27 (8.46)	110.58 (9.19)	112.18 (9.17)
Digit Span	10.69 (3.32)	10.68 (2.71)	10.68 (2.91)
Spatial Span	11.81 (2.43)	12.56 (2.00)	12.30 (2.17)
Letter Number Sequencing	11.27 (3.37)	11.88 (2.66)	11.67 (2.91)
Color-Word Time	10.38 (1.72)	10.66 (1.77)	10.57 (1.75)
Color-Word Errors	10.96 (2.39)	10.28 (2.89)	10.51 (2.73)
Divided Attention Acc.	83.40 (14.64)	85.32 (9.32)	84.65 (11.39)
CPT Block Change	47.92 (8.94)	50.24 (7.03)	49.45 (7.76)
CATA Block Change	50.24 (12.15)	50.88 (9.44)	50.67 (10.34)
POMS TMD	-0.16 (0.91)	-0.12 (0.98)	-0.13 (.95)
Time estimate error	-1.07 (6.00)	-2.94 (5.72)	-2.29 (5.85)

*p<.05
t= Sample size for females in the ISES, Divided attention measures, and time estimate were all 49. Total sample size for the same measures was 75.
r= one male participant's results on the CATA provided no HRT score.

Table 2. Pearson correlations and *p* values for DES derealization and DES transformed with neurogcognitive measures. (N = 76)

Measure	**DES dereal**		**DES dereal sqrt**	
	r	*p*	*r*	*p*
DES TOTAL	.71	.00	.73	.00
DES ABS	.51	.00	.56	.00
DES AMN	.51	.00	.50	.00
ISES GEN	.26	.03	.33	.00
PSQI TOTAL	.13	.27	.18	.13
Digit Span total	-.15	.20	-.09	.45
Spatial Span total	-.03	.80	-.03	.77
Letter Number Seq	-.11	-.35	-.09	.44
Color-Word time	-.14	.25	-.13	.26
Color-Word errors	-.25	.03	-.23	.05
Time Estimate error	.13	.28	.05	.70
Div Att Accuracy	-.32	.01	-.27	.02
CPT d	.18	.13	.20	.09
CPT HRT Change	.08	.49	.10	.41
CATA d	.01	.90	-.05	.70
CATA HRT Change	-.05	.70	-.02	.84

Table 3. Items below the axis represent the summary of correlations for DES, POMS TMD, ISES general subscale, PSQI, and WRAT. Items above the axis represent the correlations for DES, ISES general subscale, and WRAT when controlling for POMS. (N=76)

Measure	DES Total	POMS TMD	ISES Gen.	PSQI	WRAT
DES Total		----------	.19	.02	-.17
POMS TMD	-.41^{t}		----------	----------	----------
ISES Gen.	.24*	-.17		.01	-.10
PSQI	.21^{o}	-.45^{t}	.08		-.11
WRAT	-.19^{o}	.13	-.11	-.16	

^{o} p<=.10, * p<=.05, ^{t} p<=.01

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Table 4. Summary of correlations of DES total and subscales with sleep and neurocognitive variables. (N=76; 75 for ISES, Time estimate, Divided Attention, and CATA HRT Change)

Measure	1.DES Total	2. DES abs	3. DES amnesia	4. DES dereal (sq)	5. ISES	6. PSQI	7. Digit Span	8. Spatial Span	9. Letter Number Seq.	10. Color-Word time	11. Color-Word errors	12. Time estimate error	13. Divided attention	14. CPT d	15. CPT HRT change	16. CATA d	17. CATA HRT change
1.	-----																
2.	.93^{t}	-----															
3.	.76^{t}	.57^{t}	-----														
4.	.73^{t}	.56^{t}	.50^{t}	-----													
5.	.24*	.18	.11	.33^{t}	-----												
6.	.21^{o}	.25*	.11	.18	.08	-----											
7.	-.18	-.18	-.15	-.09	.09	-.05	-----										
8.	.01	.01	-.05	-.03	-.01	-.18	.24*	-----									
9.	-.10	-.10	-.11	-.09	.00	-.11	.63^{t}	.35^{t}	-----								
10.	-.06	-.15	-.23*	-.13	.01	.05	.07	.29*	.17	-----							
11.	-.19^{o}	-.10	-.23*	-.23*	-.01	.16	.14	.11	.12	.39^{t}	-----						
12.	.19	.16	.22^{o}	.05	-.13	-.07	-.26*	-.22^{o}	.09	.01	-.10	-----					
13.	-.13	.02	-.26*	-.27*	-.08	.32^{t}	.22^{o}	.13	.33^{t}	.24*	.24*	.21^{o}	-----				
14.	.08	.03	.08	.20^{o}	.13	.10	-.04	-.17	-.10	-.22^{o}	-.16	.00	-.23*	-----			
15.	.17	.18	.19	.10	.25*	-.05	-.09	.01	-.15	.15	.02	.08	-.04	.01	-----		
16.	.13	.12	.21^{o}	-.05	.05	.05	-.08	-.12	-.16	.02	-.13	.23*	-.02	.30^{t}	.04	-----	
17.	-.03	.00	.02	-.02	.02	-.19	-.01	-.02	.00	.13	.13	.04	.13	-.03	.32^{t}	-.03	-----

^{o} p<=.10, * p<=.05, ^{t} p<=.01

Table 5. Summary of correlations of dissociative, and working memory measures. (N=76)

Measure	1.	2.	3.	4.	5.	6.	7.
1. DES Total	-----						
2. DES abs	.93[t]	-----					
3. DES amn	.76[t]	.57[t]	-----				
4. DES dereal	.73[t]	.56[t]	.50[t]	-----			
5. Digit span	-.18	-.18	-.15	-.09	-----		
6. Spatial span	.01	.01	-.05	-.03	.24*	-----	
7. Letter number	-.10	-.10	-.11	-.09	.63[t]	.35[t]	-----

[o] p<=.10, * p<=.05, [t] p<=.01

Table 6. ANOVA of working memory measures by split groups of DES (0-9.99, 10-19.99, 20-50).

	Low DES (29)	**Med DES (29)**	**High DES (18)**	***F***	***p***
Digit Span F	10.59 (2.13)	11.76 (2.10)	9.83 (1.82)	5.30	.01
Digit Span B	7.62 (2.62)	7.93 (2.42)	6.67 (2.25)	1.51	.23
Spatial Span F	9.93 (1.75)	10.21 (1.72)	9.56 (1.20)	0.89	.41
Spatial Span B	9.76 (1.84)	9.45 (1.57)	9.56 (1.38)	0.27	.77
Letter Number	11.48 (2.82)	12.38 (3.04)	10.83 (2.73)	1.69	.19

Table 7. Summary of correlations of dissociative and selective attention measures. (N=76)

Measure	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**
1. DES Total	---					
2. DES abs	.93[t]	---				
3. DES amn	.76[t]	.57[t]	---			
4. DES dereal	.73[t]	.56[t]	.50[t]	---		
5. Color-Word time contrast	-.06	-.15	-.23*	-.13		
6. Color-word error contrast	-.19[o]	-.10	-.23*	-.23*	.39[t]	---

[o] p<=.1, * p <.05, [t] p<.01

Table 8. ANOVA of selective attention measures by split groups of DES (0-9.99, 10-19.99, 20-50)

	Low DES (29)	**Med DES (29)**	**High DES (18)**	***F***	***p***
Scaled Inhibition	10.62 (2.53)	10.93 (2.53)	9.67 (3.27)	1.24	.30
Scaled contrast	10.90 (1.84)	10.52 (1.68)	10.11 (1.68)	1.15	.32
Errors scaled	11.45 (2.29)	12.14 (1.90)	11.00 (2.17)	1.73	.19

Table 9. Summary of correlations of dissociative and divided attention measures. (N=76 for DES measures, 75 for Divided attention measures).

Measure	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**
1. DES Total	-----					
2. DES abs	.93[t]	-----				
3. DES amn	.76[t]	.57[t]	-----			
4. DES dereal	.73[t]	.56[t]	.50[t]	-----		
5. DIV ATT acc.	-.13	.02	-.26*	-.27*	-----	
6. DIV ATT r.t.	.04	.12	.06	-.11	-.10	-----

[o] p<=.10, * p<=.05, [t] p<=.01

Table 10. ANOVA analysis of divided attention measures by split groups of DES (0-9.99, 10-19.99, 20-50)

	Low DES (29)	**Med DES (28)**	**High DES (18)**	***F***	***p***
DIV ATT ACC	86.22 (9.44)	84.64 (12.96)	82.13 (11.39)	0.71	.49
DIV ATT R.T.	2.12 (0.61)	1.88 (0.51)	2.34 (0.72)	2.44	.09

Table 11. Summary of correlations of dissociative and sustained attention measures.(N=76 for DES measures, 75 for Sustained attention measures).

Measure	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**
1. DES Total	-----							
2. DES abs	.93[t]	-----						
3. DES amn	.76[t]	.57[t]	-----					
4. DES dereal	.73[t]	.56[t]	.50[t]	-----				
5. CPT detectability	.08	.03	.08	.20[o]	-----			
6. CPT HRT change	.17	.18	.19	.10	.25*	-----		
7. CATA detectability	.13	.12	.21[o]	-.05	.30[t]	-.03	-----	
8. CATA HRT change	-.03	.00	.02	-.02	-.03	.32[t]	-.03	-----

[o] p<=.10, * p<=.05, [t] p<=.01

Table 12. Select Pearson correlations of total dissociation and subscales with neurocognitive measures followed by Pearson correlation when controlling for affect as measured by POMS TMD in parentheses. (N=76; 75 for ISES, Time estimate, Divided Attention, and CATA HRT Change).

Measure	DES Total	DES abs	DES amn	DES dereal (sqrt)
DES Total	-----			
DES absorption	.93^{t} (.93^{t})	-----		
DES amnesia	.76^{t} (.73^{t})	.51^{t} (.57^{t})	-----	
DES dereal (sqrt)	.73^{t} (.68^{t})	.48^{t} (.56^{t})	.50^{t} (.44^{t})	-----
Digit Span	-.18 (-.17)	-.18 (-.18)	-.15 (-.14)	-.09 (-.07)
Spatial Span	.01 (.01)	.01 (.01)	-.05 (-.03)	-.03 (-.04)
Letter Number Seq.	-.10 (-.11)	-.11 (-.10)	-.11 (-.11)	-.09 (-.10)
Color-Word time	-.06 (-.22^{o})	-.16 (-.15)	-.23* (-.27*)	-.13 (-.15)
Color-Word errors	-.19^{o} (-.23*)	-.13 (-.10)	-.23* (-.27*)	-.23* (-.26*)
Time estimate error	.19 (.17)	.13 (.16)	.22^{o} (.20^{o})	.05 (.02)
Divided Attention	-.13 (-.17)	.00 (.02)	-.26* (-.32^{t})	-.27* (-.32^{t})
CPT d	.08 (.04)	-.01 (.03)	.08 (.06)	.20^{o} (.18)
CPT HRT change	.17 (.10)	.18 (.10)	.19 (.14)	.10 (.02)
CATA d	.13 (.06)	.05 (.12)	.21^{o} (.13)	-.05 (-.13)
CATA HRT change	-.03 (-.09)	.00 (-.06)	.02 (-.02)	-.02 (-.08)

^{o} p<=.10, * p<=.05, ^{t} p<=.01

Figures

Figure 1. Scatterplot and fit line of affect scores (POMS TMD~~otal~~) vs. trait dissociation scores (DES) for 76 undergraduate students. .

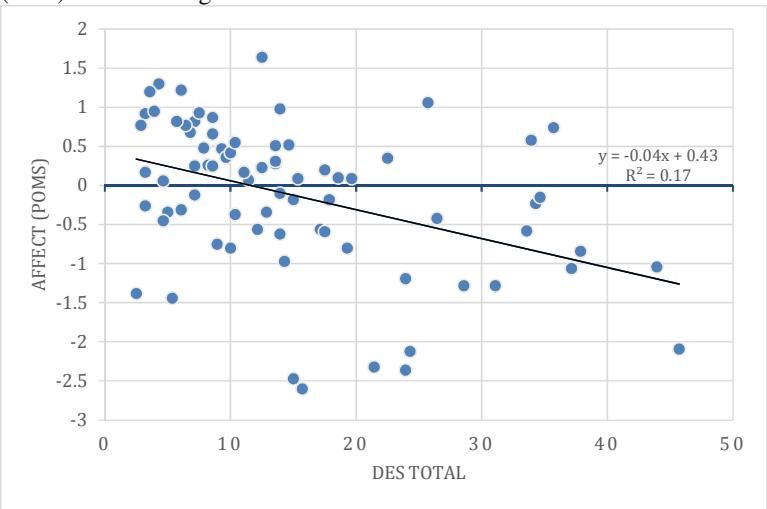


Figure 2. Scatterplot and fit line of trait dissociation (DES Total) and sleep experience (ISES General) for 75 undergraduate students.

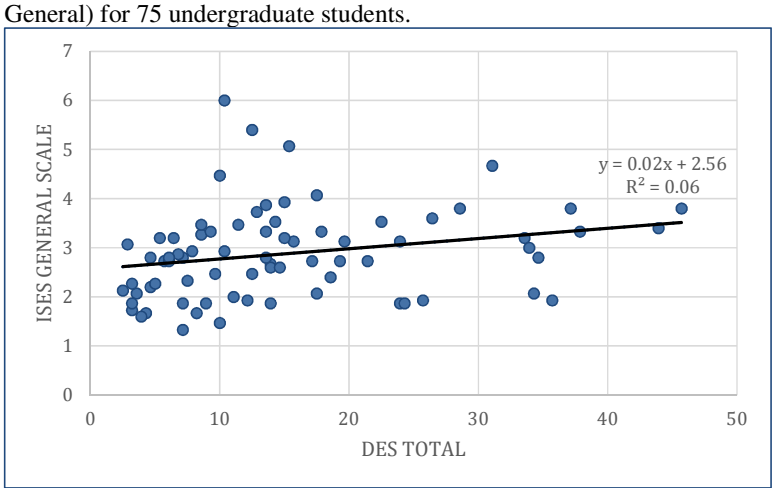
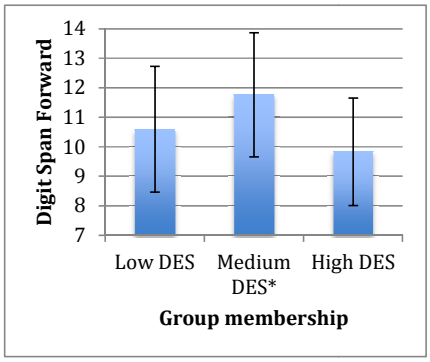
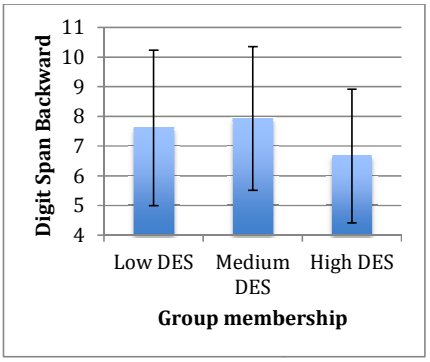


Figure 3. Means and standard deviations for individuals scoring as low-, medium-, and high-dissociators for working memory as measured by digit span forward (a), digit span backward (b), spatial span forward (c), spatial span backward (d), and letter-number sequencing (e).

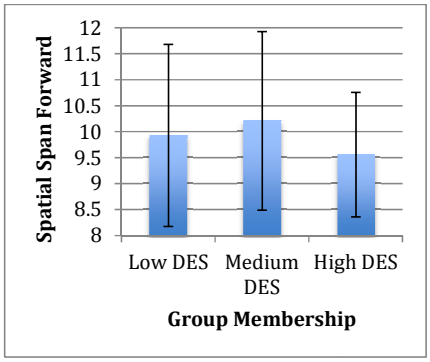
a.



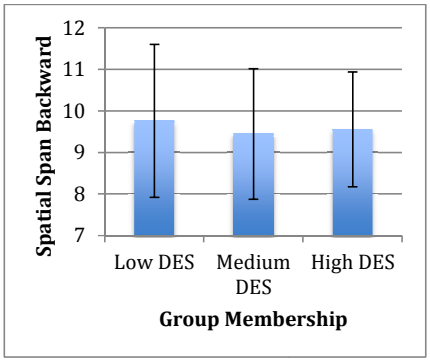
b.



c.



d.



e.

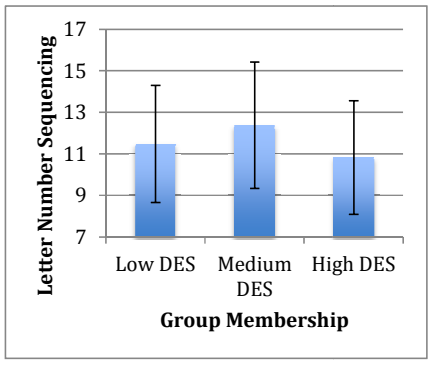
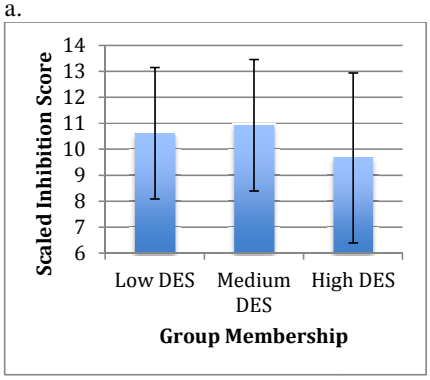
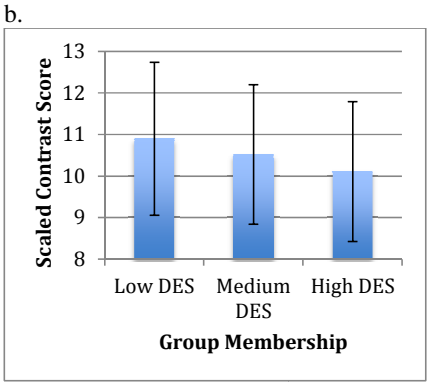


Figure 4. Means and standard deviation for individuals scoring in the low, medium, and high range of DES on selective attention as measured by the D-KEFS color-word task scores on scaled inhibition (a), scaled inhibition contrast (b), and contrast errors (c).

a.



b.



c.

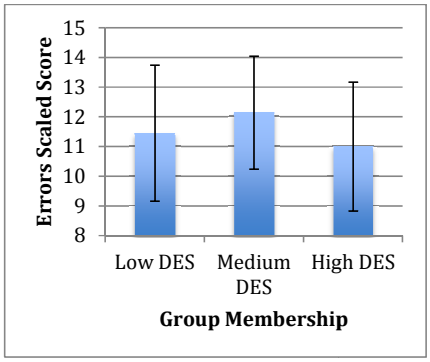
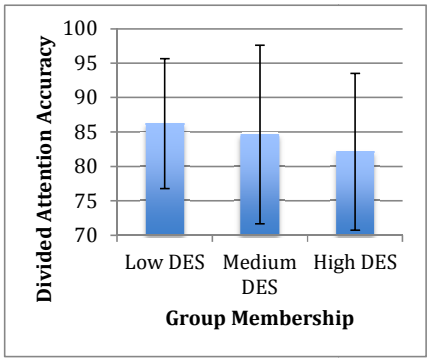


Figure 5. Means and standard deviations for individuals scoring in the low, medium, and high range of DES on divided attention as measured by the divided attention task variables of accuracy (a) and reaction time (b).

a.



b.

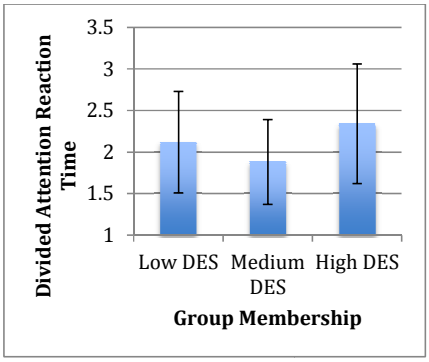
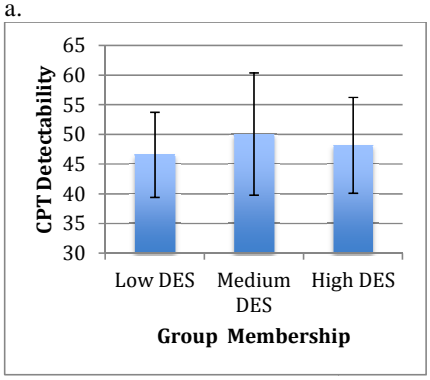
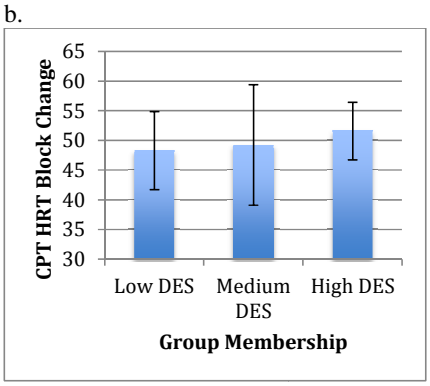


Figure 6. Means and standard deviations for individuals scoring in the low, medium, and high range of DES on sustained attention as measured by scores of CPT detectability (a), CPT HRT Block Change (b), CATA detectability (c), and CATA HRT Block Change (d).

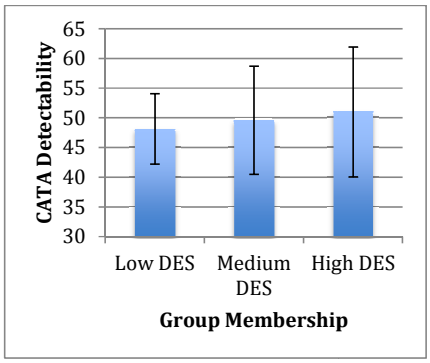
a.



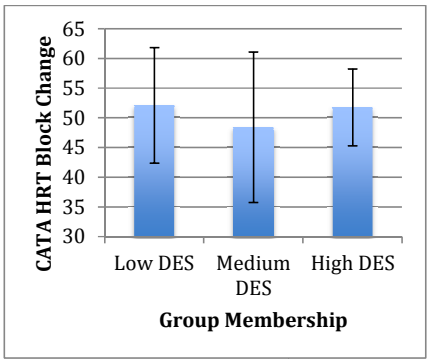
b.



c.



d.



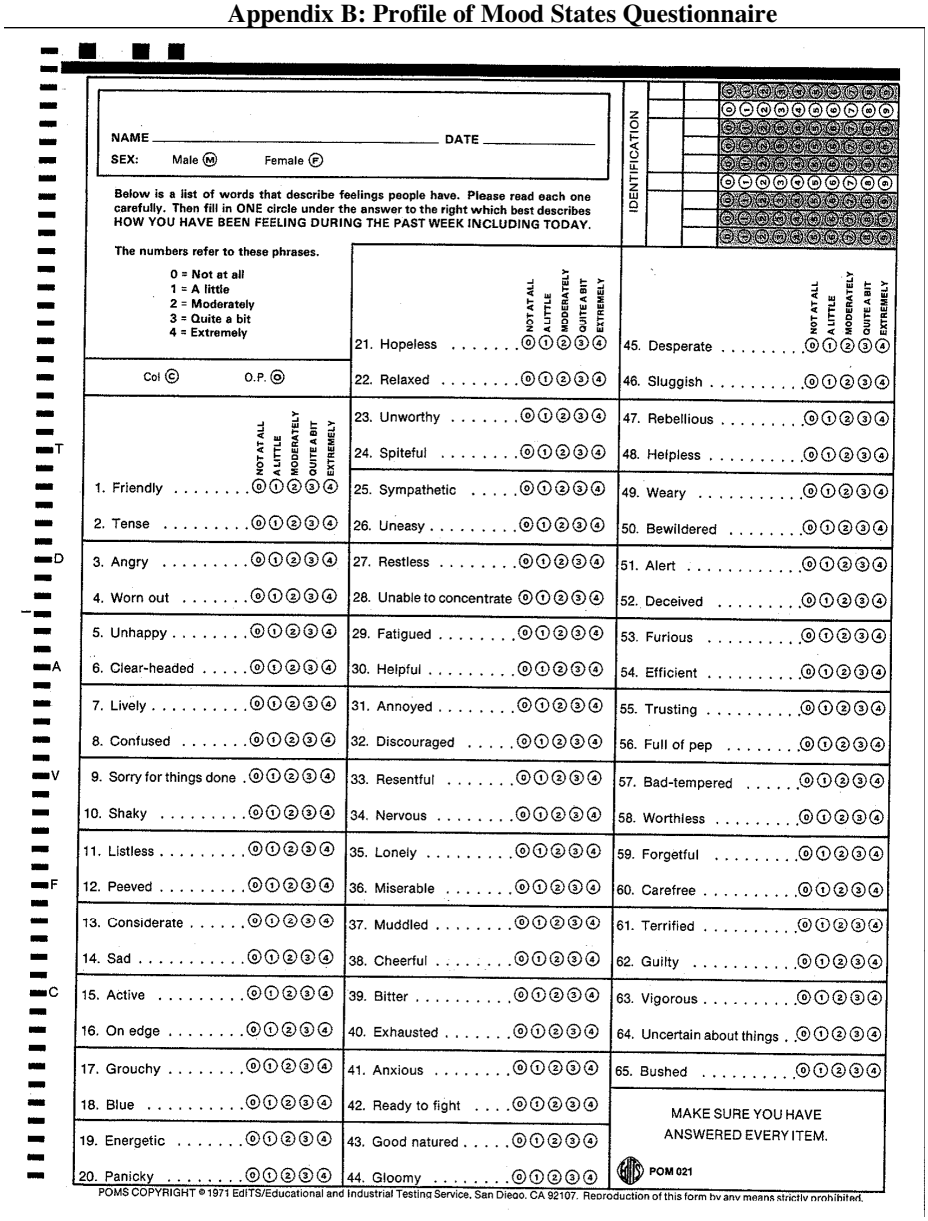
Appendix A: Demographic Information

Please do not write your name on this form. It will be stored separately from any other information that you complete during this study. The information will allow the researchers to provide an accurate description of the sample.

DEMOGRAPHIC INFORMATION
What is your date of birth?
What is your age in years?
What is your sex/gender?
What is your race/ethnicity?
What is your year in college?
How many years of school have you had in total (did you ever skip or repeat a grade?)
Is English your first language?
Are you right-handed?

Health Information
Have you ever been treated with a psychoactivative medication such as anti-anxiety or antidepressants? If yes, are you currently taking these? If not currently, approximately when in your life were you taking this medication?
Have you ever been diagnosed with a neurological or psychiatric condition or a learning disorder? (If yes, please list)
Do you have normal color vision?
Have you ever experienced a severely traumatic event where you feared for your life?

Appendix B: Profile of Mood States Questionnaire



NAME _____ DATE _____

SEX: Male (M) Female (F)

IDENTIFICATION

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

0 = Not at all
1 = A little
2 = Moderately
3 = Quite a bit
4 = Extremely

Col (C) O.P. (O)

	NOT AT ALL	A LITTLE	MODERATELY	QUITE A BIT	EXTREMELY
1. Friendly	0	1	2	3	4
2. Tense	0	1	2	3	4
3. Angry	0	1	2	3	4
4. Worn out	0	1	2	3	4
5. Unhappy	0	1	2	3	4
6. Clear-headed	0	1	2	3	4
7. Lively	0	1	2	3	4
8. Confused	0	1	2	3	4
9. Sorry for things done	0	1	2	3	4
10. Shaky	0	1	2	3	4
11. Listless	0	1	2	3	4
12. Peeved	0	1	2	3	4
13. Considerate	0	1	2	3	4
14. Sad	0	1	2	3	4
15. Active	0	1	2	3	4
16. On edge	0	1	2	3	4
17. Grouchy	0	1	2	3	4
18. Blue	0	1	2	3	4
19. Energetic	0	1	2	3	4
20. Panicky	0	1	2	3	4
21. Hopeless	0	1	2	3	4
22. Relaxed	0	1	2	3	4
23. Unworthy	0	1	2	3	4
24. Spiteful	0	1	2	3	4
25. Sympathetic	0	1	2	3	4
26. Uneasy	0	1	2	3	4
27. Restless	0	1	2	3	4
28. Unable to concentrate	0	1	2	3	4
29. Fatigued	0	1	2	3	4
30. Helpful	0	1	2	3	4
31. Annoyed	0	1	2	3	4
32. Discouraged	0	1	2	3	4
33. Resentful	0	1	2	3	4
34. Nervous	0	1	2	3	4
35. Lonely	0	1	2	3	4
36. Miserable	0	1	2	3	4
37. Muddled	0	1	2	3	4
38. Cheerful	0	1	2	3	4
39. Bitter	0	1	2	3	4
40. Exhausted	0	1	2	3	4
41. Anxious	0	1	2	3	4
42. Ready to fight	0	1	2	3	4
43. Good natured	0	1	2	3	4
44. Gloomy	0	1	2	3	4
45. Desperate	0	1	2	3	4
46. Sluggish	0	1	2	3	4
47. Rebellious	0	1	2	3	4
48. Helpless	0	1	2	3	4
49. Weary	0	1	2	3	4
50. Bewildered	0	1	2	3	4
51. Alert	0	1	2	3	4
52. Deceived	0	1	2	3	4
53. Furious	0	1	2	3	4
54. Efficient	0	1	2	3	4
55. Trusting	0	1	2	3	4
56. Full of pep	0	1	2	3	4
57. Bad-tempered	0	1	2	3	4
58. Worthless	0	1	2	3	4
59. Forgetful	0	1	2	3	4
60. Carefree	0	1	2	3	4
61. Terrified	0	1	2	3	4
62. Guilty	0	1	2	3	4
63. Vigorous	0	1	2	3	4
64. Uncertain about things	0	1	2	3	4
65. Bushed	0	1	2	3	4

MAKE SURE YOU HAVE ANSWERED EVERY ITEM.

EDITS POM 021

Appendix C: Dissociative Experiences Scale-Version II

This questionnaire consists of twenty-eight questions about experiences that you may have in your daily life. We are interested in how often you have these experiences. It is important, however, that your answers show how often these experiences happen to you when you **are not** under the influence of alcohol or drugs. To answer the questions, please determine to what degree the experience described in the question applies to you and circle the number to show what percentage of the time you have the experience.

Example: 0% (Never) 10 20 30 40 50 60 70 80 90 100% (Always)

1. Some people have the experience of driving or riding in a car or bus or subway and suddenly realizing that they don't remember what has happened during all or part of the trip. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

2. Some people find that sometimes they are listening to someone talk and they suddenly realize that they did not hear part or all of what was just said. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

3. Some people have the experience of finding themselves in a place and having no idea how they got there. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

4. Some people have the experience of finding themselves dressed in clothes that they don't remember putting on. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

5. Some people have the experience of finding new things among their belonging that they do not remember buying. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

6. Some people find that they are approached by people that they do not know who call them by another name or insist that they have met them before. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

7. Some people sometimes have the experience of feeling as though they are standing next to themselves or watching themselves do something and they actually see themselves as if they were looking at another person. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

8. Some people are told that they sometimes do not recognize friends or family members. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

9. Some people find that they have no memory for some important events in their lives (for example, a wedding or graduation). Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

10. Some people have the experience of being accused of lying when they do not think that they have lied. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

11. Some people have the experience of looking in a mirror and not recognizing themselves. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

12. Some people have the experience of feeling that other people, objects, and the world around them are not real. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

13. Some people sometimes have the experience of feeling that their body does not seem to belong to them. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

14. Some people have the experience of sometimes remembering a past event so vividly that they feel as if they were reliving the event. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

15. Some people have the experience of not being sure whether things that they remember happening really did happen or whether they just dreamed them. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

16. Some people have the experience of being in a familiar place but finding it strange and unfamiliar. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

17. Some people sometimes find that when they are watching television or a movie they become so absorbed in the story that they are unaware of other events happening around them. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

18. Some people sometimes find that they become so involved in a fantasy or daydream that it feels as though it were really happening to them. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

19. Some people find that they sometimes are able to ignore pain. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

20. Some people find that they sometimes sit staring off into space, thinking of nothing, and are not aware of the passage of time. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

21. Some people sometimes find that when they are alone they talk out loud to themselves. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

22. Some people find that in one situation they may act so differently compared with another situation that they feel almost as if they were two different people. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

23. Some people sometimes find that in certain situations they are able to do things with amazing ease and spontaneity that would usually be difficult for them (for example, sports, work, social situations, etc.). Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

24. Some people sometimes find that they cannot remember whether they have done something or have just thought about doing that thing (for example, not knowing whether they have mailed a letter or have just thought about mailing it). Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

25. Some people find evidence that they have done things they do not remember doing. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

26. Some people sometimes find writings, drawing, or notes among their belonging that they must have done but cannot remember doing. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

27. Some people sometimes find that they hear voices inside their head that tell them to do things or comment on things that they are doing. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

28. Some people sometimes feel as if they are looking at the world through a fog so that people and objects appear far away or unclear. Circle a number to show what percentage of the time this happens to you.

0% 10 20 30 40 50 60 70 80 90 100%

Appendix D: Iowa Sleep Experiences Scale

Directions. Indicate how often you experience each of the following statements by writing the number that corresponds to your choice on this line next to each item.

---

1 = never
2 = less than once a year
3= once or twice a year
4 = several times a year
5 = once or twice a month
6 = several times a month
7= several times a week

_____ **1.** Upon awakening during the night, I am unsure whether I actually experiences something or only dreamed about it.

_____ **2.** Lying in bed, I sense the presence of someone who actually isn't there.

_____ **3.** I experience intense, dreamlike images as I begin to fall asleep.

_____ **4.** I experience intense, dreamlike images as I begin to awaken.

_____ **5.** While awake, I experience a sudden weakness in my body muscles during states of strong emotion such as anger or excitement.

_____ **6**. I remember my dreams.

_____ **7**. I have a dream that is so vivid it influences how I feel the following day.

_____ **8**. I have nightmares.

_____ **9**. I have dreamed that I was falling.

_____ **10**. I have dreamed that I was flying.

_____ **11.** I have dreamed that I woke up (that is, waking up was part of the dream experience).

_____ **12.** I have recurring dreams.

_____ **13**. I have dreamed about something that later actually happened.

_____ **14.** I have died in a dream.

_____ **15.** A dream helped me to solve a current problem or concern.

_____ **16.** I am aware that I am dreaming, even as I dream.

_____ **17**. I am able to control or direct the content of my dreams.

_____ **18.** I am able to wake myself out of dreams that I find unpleasant or disturbing.

Appendix E: Pittsburgh Sleep Quality Index

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. When have you usually gotten up in the morning? _____
4. How many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed) _____

5. During the past month, how often have you had trouble sleeping because you…	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				
j. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s)				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)
9. During the last month, how would you rate your sleep quality overall?				

Component 1	#9 Score	C1 _____
Component 2	#2 Score (<=15=0,16-30=1, 31-60 min=2, >60 min=3)+5a score (if sum is equal 0=0, 1-2=1, 3-4=2, 5-6=3)	C2 _____
Component 3	#4 Score (>7=0, 6-7=1, 5-6=2,<5=3)	C3 _____
Component 4	(total # of hours asleep)/(total # of hours in bed) x 100	C4 _____
Component 5	Sum of scores #5b to #5j (0=0; 1-9=1; 10-18=2; 19-27=3)	C5 _____
Component 6	#6 score	C6 _____
Component 7	#7 score + #8 score (0=0; 1-2=1; 3-4=2; 5-6=3)	C7 _____

Add the seven component scores together _____Global PSQI Score _____

Appendix F: Time Estimate

Please estimate the duration of the task you just completed at the computer beginning with the first trial after the practice and ending with the completion of the test.

_____ minutes and