Journal of Research in Philosophy and History
Vol. 1, No. 2, 2018
www.scholink.org/ojs/index.php/jrph
ISSN 2576-2451 (Print) ISSN 2576-2435 (Online)

Original Paper

Anxiety, Phobias, Treatment and Associated Costs: A Review

David D. Gray[1*]

[1] Fielding Graduate University, Santa Barbara, CA., United States

[*] David D. Gray, Fielding Graduate University, Santa Barbara, CA., United States

Received: November 15, 2018 Accepted: November 20, 2018 Online Published: November 22, 2018

doi:10.22158/jrph.v1n2p125 URL: http://dx.doi.org/10.22158/jrph.v1n2p125

Abstract

Anxiety disorders are the most commonly occurring mental disorders and understanding them is important. Learning theorists suggest that phobias, a type of anxiety disorder, are conditioned responses to unconditioned stimuli. Research supports the theory that extinction of these conditioned responses may actually be the learning of a new memory rather than the unlearning of an old memory. Mounting evidence also points to sleep as an important factor in learning and memory and research suggests that sleep plays a role in phobia-extinction. However, while the majority of evidence is supportive, it is far from all inclusive. Future research should be conducted to clarify the role that sleep plays in phobia-extinction. Sleep roles such as sleep latency, sleep duration, and sleep staging may all play a part in the process.

Keywords

memory formation, memory consolidation, sleep, exposure, virtual reality

1. Introduction

The National Institute of Mental Health, citing data from the Collaborative Psychiatric Epidemiology Surveys (CPES), estimates that over 19.1% of the adult population in the United States suffers from an anxiety disorder at some point during a 12-month period (Alegria, Jackson, Kessler, & Takeuchi, 2016). Anxiety disorders are also comorbid with substance abuse disorders and research suggests that these comorbidity rates may be as high as 33%-45% (Grant et al., 2006; Regier et al., 1990). Most of those suffering from a mental health condition remain untreated (Wang et al., 2005). Despite most not seeking or receiving treatment, the estimated cost of anxiety disorders to the United States was estimated to be over $42 billion dollars in 1999 (Greenberg et al., 1999; Kirk & Rouf, 2004). Inflation calculators suggest that $42 billion dollars in 1999 was equivalent to over $61 billion dollars in 2017. Research suggests that the numbers are much higher. Understanding of anxiety disorders and

efficacious treatment options are important to both provide services to those in need, and to contain rapidly expanding costs of mental health treatment.

2. Anxiety Disorders

Anxiety disorders are defined as "disorders that share features of excessive fear and anxiety and related behavioral disturbances" by the Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition (DSM-5; American Psychiatric Association, 2013, p. 189). Anxiety disorders are distinct from normal developmental fear due to their persistence beyond normal developmental timeframes. For example, a young child might be appropriately afraid of a common house spider and run off. An adult that refuses to enter a room because there is a spider in it is more likely to suffer from a specific phobia. Due to subjective levels of fear and danger, it is often necessary for the clinician to determine if fear and behaviors are proportionate to the level of danger.

The DSM-5 differs slightly from the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition—Text Revision (DSM-IV-TR) regarding anxiety disorders. The DSM-5 counts neither Obsessive-Compulsive Disorder (OCD) nor Posttraumatic Stress Disorder (PTSD) as anxiety disorders as the DSM-IV-TR did. Other changes have been made in the DSM 5; however, for the scope of this paper, only changes in specific phobias will be discussed below.

2.1 Prevalence

Kessler et al. (2005), using data from face-to-face, household surveys across a nationally representative sample (n = 9,282), found that anxiety disorders were the most common type of disorder (24.8%). The lifetime prevalence for specific phobias ranked third (12.5%) only behind major depression (16.6%) and alcohol abuse (13.2%). Kessler et al. (2005) stated that the numbers are likely "conservative" due to potential biases (p. 6). A possible limitation in this study was an unwillingness to participate in the surveys due to potential histories of mental illness or embarrassment.

As previously stated, estimates suggest that 18.1% of the adult population in the United States suffers from an anxiety disorder at some point during a 12-month period (Kessler et al., 2005). The most prevalent 12-month disorder is specific phobias. During a 12-month period, specific phobias (8.7%) surpass even major depressive disorders (6.7%; Kessler et al., 2005). Again, this data was considered conservative by the authors due to the same potential biases reported in their study previously, namely unwillingness to participate (Kessler et al., 2005).

A major limitation is the age of the studies. Since their publication, diagnostic criteria have changed. It is possible that attitudes towards mental health have changed as well. Perhaps more people are seeking treatment; perhaps fewer are. Unfortunately, these studies are based upon a rather large and expensive dataset. Collecting data with structured interviews and surveys is costly and it is unreasonable to expect more frequent data collections of this scale. However, more recent research using the same National Comorbidity Survey Replication (NCS-R) data was provided with negligible change noted (Kessler,

Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). The National Institute of Mental Health (NIMH) uses this data to date.

2.2 Health Care Costs

As previously stated, it is believed that over 18% of the population suffers from an anxiety disorder during the course of a year (Kessler et al., 2005, 2012). However, the personal burden of the disability is often overlooked (Baxter, Vos, Scott, Ferrari, & Whiteford, 2013). The US Burden of Disease Collaborators (2013) found that in the period between 1990 and 2010, two of the top five contributors to Years Lived With Disability (YLDs) in the United States were major depressive disorder (#2) and anxiety disorders (#5). Globally, anxiety disorders were the sixth leading cause of disability (Baxter et al., 2013). YLDs are measurements of the burden of disease and are computed by multiplying the disorder's prevalence by the loss of health associated with the disorder (Baxter et al., 2013; US Burden of Disease Collaborators, 2013). In 1990, anxiety disorders accounted for over 1.5 million YLD's (95% UI 1.1-2.0 million), or just over five percent of the overall disease burden due to disability in the United States (US Burden of Disease Collaborators, 2013). By comparison, in 2010, anxiety disorders accounted for over 1.8 million YLD's (95% UI 1.3-2.6 million), or over six percent of the overall disease burden due to disability in the United States, a 21.3% median change (US Burden of Disease Collaborators, 2013). The increase can largely be accounted for by population growth and the increasing age of the United States population (US Burden of Disease Collaborators, 2013). The costs of mental health treatment are also on the rise.

In 2013, spending on mental health exceeded all other medical spending (Roehrig, 2016). Mental health spending accounted for $201 billion, a value significantly higher than the remaining top five medical conditions: heart conditions ($147 billion), trauma ($143 billion), cancer ($122 billion), and pulmonary conditions ($95 billion). Of that $201 billion dollars spent for mental health, over 40 percent is spent on institutionalized populations (Roehrig, 2016). During the time-period 2002-2012, mental health was reported as accounting for the largest increase in medical spending, with spending increasing from $58.6 billion in 2002 (adjusted for 2012 inflation rate) to $83.6 billion in 2012 for civilian, noninstitutionalized populations (Soni, 2015). However, it should be noted that information from this source was contradictory. In a chart embedded in the Soni article, cancer expenditures increased by $27.7 billion while mental health expenditures increased by $25 billion. According to J. Rhoades (personal communication, April 10, 2018), the article was in error, making mental health the second largest expenditure in 2012. Mental health also saw the largest increase of people with associated expenditures. The number of people with mental health expenditures rose from 31.1 million to 45.2 million in 2002 to 2012 respectively (Soni, 2015).

Anxiety disorders are the most often occurring mental disorder in the United States, yet there has been little research into the annual costs of anxiety disorders. Data from the 2009-2010 Medical Expenditure Panel Survey (MEPS) suggests that over 30 million people report an anxiety disorder diagnosis (Shirneshan, 2013). Direct costs for anxiety disorders were greater than $33.7 billion dollars in 2013.

Indirect costs were calculated by morbidity costs (the lost productivity of individuals with anxiety disorders) plus mortality costs (lost productivity calculated by subtracting age at death from life expectancy). Direct costs ($33.7 billion) plus indirect costs (morbidity, $12.7 billion; mortality, $2.3 billion) equated annual costs in excess of $48 billion to society in the United States in 2013 (Shirneshan, 2013).

As stated, indirect costs were calculated by adding morbidity and mortality costs. Direct costs consist of medication prescriptions, in- and out- patient stays and visits, and emergency room visits (Shirneshan, 2013). As an example of direct costs, workers diagnosed with anxiety disorders were nearly five times as likely to see a psychiatrist and nearly fifteen times more likely to see a psychologist when compared to their peers without an anxiety disorder diagnosis (Marciniak, Lage, Landbloom, Duanayevich, & Bowman, 2004). Workers with diagnosed anxiety disorders were also admitted as inpatients for mental illness nearly seven times more often. In addition, workers with anxiety disorder diagnoses were more likely to see a gastroenterologist and to utilize hospital emergency rooms than their non-diagnosed peers (Marcinak et al., 2004). Utilization of services were not the only differences. Workers with anxiety had nearly twice as many unofficial absences, were two and a half times more likely to collect short-term disability and had one-and-a-half times the financial expenses of their peers (Marcinak et al., 2004). The above reported costs were broken down from mental health to anxiety disorders. Phobias are a type of anxiety disorder. However, the annual costs of phobias, particularly specific phobias, are unknown.

3. Phobias

A phobia is an intense, irrational fear. The DSM-IV-TR criteria for specific phobias included, (a) "marked and persistent fear that is excessive or unreasonable," (b) "exposure to the phobic stimulus" that "provokes an immediate anxiety response," (c) "the person recognizes that the fear is excessive and unreasonable," (d) "the phobic situation(s) is avoided or else endured with intense anxiety or distress," (e) the situation "interferes significantly" with the individual's life, (f) "in individuals under age 18 years, the duration is at least 6 months," and (g) the disturbance is not the result of "another mental disorder" (APA, 2000, pp. 449-450). The core criteria of specific phobias in the DSM-5 are largely the same. The DSM-5 removed the criteria requiring the subject to be aware that their fear and anxiety are excessive and, as stated, the clinician often determines if the fear is proportionate to the level of danger. A second change is that the 18 year-old age limit is now applicable to all ages rather than under eighteen (APA, 2013).

There are five different types, or specifiers, of specific phobias. The first is a fear of animals. The animal category is broad and encompasses all animals, i.e., spiders, insects, mammals. The second category is the natural environment. This may include fear of storms, etc. The third is a fear of "blood-injection-injury", i.e., a fear of needles (APA, 2013, p. 198). The fourth category is situational,

i.e., fear of flying, or public speaking. The fifth and final category is a general "Other" category which includes such things as a fear of clowns or a fear of loud sounds (APA, 2013, p. 198).

3.1 Treatment Options

There are multiple treatment options for phobias. Hofmann (2008) states that the most efficacious treatments include "exposure therapy with or without cognitive strategies" and psychopharmacology (p. 200). Alpers (2010) states that exposure therapy without relaxation is "clearly" the gold standard treatment for specific phobias (p. 212). Otte (2011) stated that the gold standard treatment method for phobias is Cognitive Behavioral Therapy (CBT). Spiegel (2014), citing treatment failures/resistance and noncompliance with scheduled interventions, suggests that treatment of phobia could be improved with hypnosis. For purposes of this paper, exposure therapy will be the treatment modality discussed.

The goal of exposure therapy is to extinguish the fear response to phobic stimuli. Exposure therapy is a cognitive intervention that changes the expectation of harm from phobic stimuli (Hofmann, 2008). Extinction is likely not forgetting one's fear, but rather the learning of a new memory in which the previously feared stimuli does not engage the fear response (Hoffmann, 2008). In exposure therapy, new memories are learned by challenging existing harm expectations such as threat of physical or psychological harm in a controlled environment. Control, or lack thereof, in the presence of an aversive stimuli may be a factor in the development of a phobia with less control equating to more severe psychopathy. Conversely, control may be a mediating variable between psychopathology and treatment, and may be a key component involved in extinction, exposure therapy and CBT (Hoffmann, 2008).

Imaginal exposure therapy involves confronting fear through visualization. Using the fear of public speaking as an example, a client using imaginal exposure would visualize themselves in front of and addressing a crowd. *In vivo* exposure therapy involves a client and a therapist in a largely controlled situation in which a patient directly confronts their fear in actual live situations via flooding (rapid exposure to a feared stimulus) or systematic desensitization (gradual exposure to a feared stimuli). For example, using the previous example of public speaking, an individual would address their fear by speaking in front of a crowd. *In vivo* exposure therapy often involves a gradual exposure to aversive stimuli under the care of their therapist. A client suffering from a fear of flying may learn techniques to manage their anxiety about flying, i.e., breathing and other relaxation techniques; they may receive psychoeducation about air travel, i.e., common occurrences such as turbulence, etc. Some clients and therapists may even meet at airports and work towards a flight at the end of treatment. Throughout all, the therapist is often present, acts as a model and provides a degree of control. However, *in vivo* therapy cannot be completely controlled. A spider may bite an arachnophobic patient that finally worked towards handling a spider; an elevator may breakdown after a client worked up the courage to enter the elevator; or, a client suffering from PTSD after a motor vehicle accident may be involved in another accident.

A third method of exposure, virtual reality, or *in virtuo* exposure, allows the clinician to provide treatment in the safety of an office or a laboratory rather than exposing the client to the risks that may

be involved with *in vivo* exposure. A client with a fear of public speaking using *in virtuo* exposure would be immersed into a computer simulation in which they would see a virtual crowd of people before them. The client would then interact with the crowd virtually (Wiederhold & Wiederhold, 2014).

4. Virtual Reality

Virtual Reality (VR) is a tool that allows users to immerse themselves in a real time, 3D computer-generated simulation allowing interactions between themselves and a digital environ in which the imagery changes according to the user's actions (Bouchard, 2011). For example, if users turn their head to look around a room, the image changes to accommodate the changed view. VR has long been used for training situations. However, it is only recently that the equipment has become affordable to clinical psychologists and clinical practice. Virtual Reality Exposure Therapy (VRET) has been found to be effective as a therapeutic tool (Perpina et al., 2013; Rus-Calafell, Gutierrez-Maldonado, & Ribas-Sabate, 2014) for a wide variety of psychological problems and disorders (Perpina et al., 2013) such as acute pain, anxiety disorders, attention-deficit disorders, autism spectrum disorders, changing maladaptive habits, cognitive impairments, eating disorders, Posttraumatic Stress Disorder (PTSD), rehabilitation, sex offending, and social skills intervention specific phobias (Bouchard, St-Jacques, Robillard, & Renaud, 2007; Bouchard, 2011; Cárdenas & De La Rosa, 2012; Cesa et al., 2013; Perpina et al., 2013; Rizzo et al., 2013; Rothbaum & Hodges, 1999; Rothbaum, Ruef, Litz, Han, & Hodges, 2003; Rus-Calafell et al., 2014). In 2006, no studies of virtual reality and exposure therapy were found to be ineffective; in fact, only three studies at the time were found with weak effects (Bouchard, Côté, & Richard, 2006). There are studies that indicate that VRET works equally as well as traditional treatments (Bouchard & Wiederhold, 2014). Others indicate that VR provides optimal outcomes when used in conjunction with traditional treatments (Cesa et al., 2013; Perpina et al., 2013) while other studies show that *in virtuo* treatments work better than traditional therapies (Mühlberger, Wiedemann, & Pauli, 2003).

4.1 Advantages

Perhaps VRET's greatest advantage is that it is under direct therapist control (Bouchard et al., 2007; Perpina et al., 2013). Unlike *in vivo* exposure, *in virtuo* exposure lessens or negates the risk of breaching confidentiality; it also lessens or negates the risk of an unforeseen exposure. For example, an elevator malfunction during *in vivo* exposure could traumatize a client that is being seen for claustrophobia or fear of heights. As the technology progresses and virtual reality becomes more affordable, VRET may become a more financially feasible method of treatment. A virtual environment would cost much less than *in vivo* exposure for clients that are being treated for fear of flying in addition to the added benefit of reducing the risk of potential harm that air travel adds.

Another advantage of VRET is its ability to make individuals feel present in the virtual environment (Rothbaum & Hodges, 1999; Perpina et al., 2013). VRET participants can be engaged using all five of their senses thus making the simulation seem real (Perpina et al., 2013; Riva, Mantovani, & Bouchard,

2014). This immersion is what allows the participant to feel active and present within the environment recognizing the environment at meaningful rather than viewing the simulation from a third person perspective (Riva, Mantovani, & Bouchard, 2014). Participants not suffering from a phobia have also found that the virtual environments seem real. Studies have found that non-phobic individuals immersed into a phobic virtual environment have self-reported levels of arousal while phobic individuals immersed into the phobic environment have more intense fear reactions (Bouchard, Côté, & Richard, 2006). Motion tracking and physiological measures have also been used to record the fear response of non-phobic individuals (Bouchard, Côté, & Richard, 2006).

4.2 Efficacy of VRET and Anxiety Disorders

As previously stated, anxiety disorders are one of the most prevalent mental health disorders (Bouchard, 2011; Rus-Calafell, Gutierrez-Maldonado, & Ribas-Sabate, 2014; Wiederhold B. & Wiederhold M., 2014a). There are many subset conditions of anxiety disorders such as panic disorders, generalized anxiety disorders, and specific phobias (Satcher, 2000). Post-traumatic stress disorders, though no longer in the diagnostic manual as an anxiety disorder, do have features of anxiety and have been found to respond favorably to treatment for anxiety disorders. Estimates suggest that 8-9.1% of the adult population will be affected by at least one specific phobia over the course of a year (NIMH, 2017; Satcher, 2000). Studies of aviophobia, the fear of flying, have found strong support for VRET, particularly when distal effects were measured (Mühlberger, Wiedemann, & Pauli, 2003; Wiederhold, Bouchard, & Loranger, 2014). Acrophobia, the fear of heights, is believed to be the second most common phobia behind animal phobias (Bouchard, Wiederhold, & Bossé, 2014). In a between-groups study of *in vivo* exposure therapy versus *in virtuo* exposure therapy, researchers in Amsterdam built exact likenesses of three environments in Amsterdam: a four-story mall, a 50 ft fire escape, and a roof top garden on a university building. Researchers found that virtual reality exposure was equally as affective as *in vivo* exposure (Emmelkamp et al., 2002), which not only highlights the efficacy of *in virtuo* exposure, but suggests promising implications in regards to the affordability of the equipment and the ease of use in clinical settings with limited access to environments to meet a range of client's needs.

One of the most exciting aspects of *in virtuo* exposure is its potential use for treating posttraumatic stress disorder due to the ability to tailor the environment to meet a client's particular need (Wiederhold B. & Wiederhold M., 2014b). As an example, virtual reality has been used to treat PTSD in war veterans, survivors of the September 11, 2001 terrorist attacks at the World Trade Center, earthquake survivors, terrorist bus bombings, violent crime victims and/or witnesses, and motor vehicle accidents (Cárdenas & De La Rosa, 2012; Wiederhold B. & Wiederhold M., 2008). Recent conflicts have seen an increase in the number of overseas deployments for the military. Due to the military presence in Iraq and Afghanistan over the last 14 years, the United States military has looked at VRET as possible treatment for PTSD. In a clinical trial of virtual Iraq and Afghanistan, 20 active duty members completed VRET and achieved positive results (Rizzo et al., 2013). In fact, 80% of the members

treated no longer met criteria of PTSD at the follow-up assessment three months later (Rizzo et al., 2013).

Motor vehicle accidents affect millions of American drivers and are the most common cause of PTSD in the general population (Beck & Coffey, 2007; Blanchard & Hickling, 2004). In one study, VRET was offered over ten sessions to drivers involved in a motor vehicle accident within the last six months that were experiencing symptoms of PTSD such as intense fear and helplessness. The participants were assessed at pre-treatment and one month post-treatment with the CAPS, the Posttraumatic Stress Scale-Self Report (PSS-SR), the Impact of Event Scale-Revised, and the Beck inventories of anxiety and depression (BAI and BDI respectively). All of the scores were reduced from pre- to post-treatment (Beck & Coffey, 2007) again suggesting the efficacy of *in virtuo* exposure. As with many of the aforementioned studies, *in virtuo* exposure allows the clinician to provide treatment in the safety of an office or a laboratory rather than exposing the client to the risks that would be involved with *in vivo* exposure.

A meta-analysis of 21 studies was conducted on the efficacy of VRET in treating anxiety and specific phobias that met their inclusion criteria. Inclusion criteria consisted of the use of interval or ratio data, symptoms present before and after VRET, use of an affective assessment instrument and results that included means and standard deviations to allow for calculating effect sizes. Many of the studies cited above were included in this meta-analysis. While noting some limitations such as small sample sizes and non-randomized trials, the author's findings suggest that VRET is an effective tool for clinical psychologist (Parsons & Rizzo, 2007).

It seems logical that the more one senses a virtual environment, the more likely one will feel immersed or present. As technology progresses, digital simulations improve subsequently enhancing sight and sound senses. Hardware improvements allow deeper immersion into the simulation with haptic feedback providing a sense of touch. Scent is now being introduced into VR providing an even more immersive setting.

The "Proust phenomenon" is the theory that memories brought about by odors are more emotional than other memories. The Proust phenomenon is named after the French author, Marcel Proust, who described the feelings and memories that the smell of a favorite treat evoked (Herz, Eliassen, Beland, & Souza, 2004; Munyan III, Neer, Beidel, & Jentsch, 2016). Using functional Magnetic Resonance Imaging (fMRI), Herz and colleagues (2004) found greater amygdala and hippocampal activation in the presence of an odor that individuals related to personally. Another study found that verbal cues of Odor Evoked Autobiographical Memories (OEAMs) were found to activate areas of the brain associated with emotional processing even in the absence of a physical odor (Arshamian et al., 2013). Regarding the application of scent to virtual reality, researchers have found that self-reported levels of immersion and presence were higher with the introduction of scents and lower when scents were withheld (Munyan III et al., 2016). Research supports the efficacy of virtual reality as a medium for exposure

therapy. However, virtual reality research is largely conducted by a relatively small group of researchers.

Possibly due to the relatively short time that virtual reality has been studied, or perhaps due to the small niche that it occupies, the research on virtual reality thus far has largely been carried out by select group of researchers. One only needs to look at the reference list in most of the articles to see the "big names" in virtual reality therapy. This tight group suggests the possible presence of allegiance; it is possible that the results were affected by the researcher's allegiance to VRET. It would not be irrational to consider the financial benefits of some of the more prolific VRET researchers either. For example, two of the researchers have co-authored a book about virtual reality while another two researchers are the founders and co-owners of a virtual reality company that provides workshops and sells products related to virtual reality. However, the allegiance effect is likely very small, and research does suggest that virtual reality may be useful in forming new memory.

5. Memory, Learning and Sleep

As previously stated, extinction is believed to be the formation of a new memory rather than the unlearning of an old memory. Due to the ability of a phobia to be acquired in one encounter, along with its resistance to extinction, and likely non-cognitive component, phobias may be a prepared learning process with a potential evolutionary purpose. For example, fear or snakes, spiders and/or heights are common phobias that relate to survival and may thus be more easily acquired and readily learned. Seligman (1971) wrote that phobias are "highly prepared to be learned by humans", "are probably non-cognitive" and stated that phobias are often "resistant to extinction" (p. 312). Unprepared learning (i.e., a loud noise or shock paired with the presentation of a light or color) often involves multiple trials to develop a fear response and is relatively easy to extinguish in a laboratory setting. Seligman's *Phobias and Preparedness* (1971) led to a plethora of anxiety research including the acquisitions of fear pathways.

According to research, fears and/or phobias may be acquired via (1) classical conditioning, (2) vicarious observation/learning (observing how one's parents react towards a fear stimuli), (3) verbal transmission (one's caregiver communicating danger regarding a fear stimuli), and (4) non-associative means (individual responses of varying degrees on a first encounter with a fear stimuli; McNally, 2016). Evolution may play a role in phobic acquisition, but it must be noted that not all who have suffered a spider or snake bite have acquired a phobia; conversely not all who suffer from an animal phobia have been harmed by their feared stimuli. Stress and/or emotion at the time of acquisition may play a role.

During periods of stress, memory systems become less cognitive based and more rigid (Schwabe, Wolf, & Oitzl, 2010). Phobias are irrational fears and a kind of closed mind thinking; perhaps this is why phobias may be more resistant to extinction. The more profound the stress is, the more inflexible or rigid the memory may become. Stress is believed to affect memory encoding, memory consolidation and memory retrieval. Though there is variability in memory encoding research, the effects of stress on

memory encoding suggests that emotion accompanying the event can preserve or enhance memory encoding.

Memory consolidation research suggests that hormones released through emotional arousal strengthen memories. The glucocorticoid cortisol is associated with stress and may interfere with memory and learning. However, the presence of glucocorticoids with basolateral amygdala activity, may produce memory enhancing effects. In the absence of co-occurring basolateral amygdala activity, memory consolidation is impaired (Schwabe et al., 2010). A study by Abercrombie, Speck and Monticelli (2006) found that only participants with a change in situational negative affect in conjunction with cortisol levels demonstrated improved recall; recall was not affected by baseline negative affect and cortisol levels suggesting that emotional arousal is necessary to facilitate memory consolidation.

Research suggests a negative correlation between stress and memory retrieval. As stress rises, memory recall declines. Glucocorticoids and the basolateral amygdala are implicated in memory retrieval as well as in memory consolidation. However, in memory retrieval, inhibiting the basolateral amygdala improves memory retrieval. Corroborating studies have found that beta blockers also inhibit the negative effect of stress on memory retrieval (Schwabe et al., 2010).

Memory theory has long held that the hippocampus and the amygdala are involved in memory and has been predominant since the epileptic surgery of Henry Molaison in the 1950s. During the surgery, Mr. Molaison's hippocampus was damaged and he was unable to form new memories. Memories predating the surgery were still intact. Thus, the theory was that memory is formed in the hippocampus and then stored in the amygdala. However, research suggests that this theory is not entirely accurate. A recent study by Kitamura and colleagues (2017) found that the brain makes two memories of an event. Using mice in the study and optogenetics (light used to control neuronal activity), Kitamura et al. (2017) watched memories form in reaction to a shock. Rather than the memory forming in the hippocampus and transferring to the cortex, the hippocampus appeared to generate engram cells (cells that account for a permanent change in the brain) in the prefrontal cortex. The prefrontal memory did not appear to be active as it matured, and researchers were able to stop maturation of the engram cells if the connection between the hippocamps and the prefrontal cortex were blocked. However, researchers were able to switch the memories on and off, definitively showing its presence.

Memory formation and consolidation are also affected by sleep. Sleep has been found to be beneficial to both conscious (declarative) and unconscious memory (procedural) processes; there is little to no empirical evidence that suggests sleep in any way impairs memory. In fact, research suggests that sleep deprivation impairs the memory formation. Sleep is believed to be especially vital to the consolidation of emotional memory. Naps as short as six minutes aid with memory retention with increased benefits for longer sleep duration (Diekelmann & Born, 2010). There are multiple theories about sleep and memory.

The active system consolidation theory believes that newly encoded memories are repeatedly reactivated during Slow Wave Sleep (SWS). A sleep cycle consists of three Non-Rapid Eye Movement

(NREM) sleep stages (N1, N2, and N3) and a Rapid Eye Movement (REM) phase (Stage R; American Academy of Sleep Medicine, 2018). Sleep stage N1 marks a transition from wakefulness to sleep. Sleep stage N2 sleep is marked by a reduction in breathing and heart rate, and accounts for nearly half of an individual's total sleep time. Sleep stage N3 is marked by SWS and is a regenerative period of sleep. REM sleep follows and is where dreaming occurs. The brain becomes very active during REM sleep, but the muscles are still relaxed. Periods of REM sleep become longer as sleep progresses, and a healthy sleeper will cycle through the four sleep stages and REM four to five times per night. Continually cycling through the stages of sleep allows for the continued reactivation of newly encoded memories thus strengthening the memory (Diekelmann & Born, 2010).

The synaptic homeostasis hypothesis is a second theory that posits: (a) wake periods are connected to synaptic strengthening of previously used synapses (potentiation); (b) synaptic potentiation is a homeostatic function of slow wave activity (SWA); and (c) SWA is related to synaptic reduction, and 4) synaptic reduction is tied to benefits of sleep (Tononi & Cirelli, 2003, 2006). The theory holds that Slow Wave Activity (SWA) is related to synaptic processes that occurred during waking periods. Specifically, the more synaptic processes were active during waking periods, the more active SWA will be during sleep counteracting waking synapse activity, pruning what is not important but keeping what is important. There is controversy concerning the exact mechanisms involved surrounding the synaptic homeostasis hypothesis (Blanco et al., 2015; Born & Feld, 2012). Other studies have suggested that REM sleep may be involved, and further studies should include REM sleep.

6. Conclusion

Anxiety disorders are the most commonly occurring mental disorders and are estimated to be over $61 billion dollars at today's rate of inflation with most affected individual not seeking treatment. Due to shame, embarrassment and/or an unwillingness to participate in surveys, it is believed that that the number of individuals in the United States affected by an anxiety disorder may actually be much higher than estimated.

Phobias, a common anxiety disorder, are intense, irrational fears that are often resistant to extinction. There are treatment options for phobias however. Exposure therapy is often considered a gold standard treatment modality for phobias and other anxiety disorders. Exposure therapy may be imaginal exposure, *in vivo* exposure or *in virtuo* exposure. *In virtuo*, or virtual reality, studies have shown that VRET may be as efficacious as other types of exposure. VRET allows for immersion and presence in a digitally simulated environment. This allows greater therapeutic control of the exposure session.

Exposure therapy's goal is to lead to extinction of the irrational fear. Extinction is the learning of a new memory rather than forgetting an old memory. Sleep enhances memory, particularly emotional memory.

References

Abercrombie, H., Speck, N., & Monticelli, R. (2006). Endogenous cortisol elevations are related to memory facilitation only in individuals who are emotionally aroused. *Psychoneuroendocrinology*, *31*(2), 187-196. https://doi.org/10.1016/j.psyneuen.2005.06.008

Alegria, M., Jackson, J. S., Kessler, R. C., & Takeuchi, D. (2016). *Collaborative psychiatric epidemiology surveys (CPES), 2001-2003 [United States]*.

Alpers, G. W. (2010). Avoiding treatment failures in specific phobias. In M. Otto, & S. Hoffman (Eds.), *Avoiding treatment failures in the anxiety disorders, Series in anxiety and related disorders* (pp. 209-227). New York, NY: Springer. https://doi.org/10.1007/978-1-4419-0612-0_12

American Academy of Sleep Medicine. (2018). *The AASM manual for the scoring of sleep and associated events: Rules, terminology and technical specifications* (Version 2.5). Darien, IL.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC.

Baxter, A., Vos, T., Scott, K., Ferrari, A., & Whiteford, H. (2014). The global burden of anxiety disorders in 2010. *Psychological Medicine*, *44*(11), 2363-2374. https://doi.org/10.1017/S0033291713003243

Blanco, W., Pereira, C. M., Cota, V. R., Souza, A. C., Rennó-Costa, C., Santos, S. ... Ribeiro, S. (2015). Synaptic homeostasis and restructuring across the sleep-wake cycle. *PLoS Computational Biology*, *11*(5), e1004241. https://doi.org/10.1371/journal.pcbi.1004241

Born, J., & Feld, G. (2012). Sleep to upscale, sleep to downscale: Balancing homeostasis and plasticity. *Neuron*, *75*(6), 933-935. https://doi.org/10.1016/j.neuron.2012.09.007

Bouchard, S. (2011). Could virtual reality be effective in treating children with phobias? *Expert Rev Neurother*, *11*(2), 207-213. https://doi.org/10.1586/ern.10.196

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues for field settings*. Chicago: Rand McNally College Pub. Co.

Diekelmann, S., & Born, J. (2010). The memory function of sleep. *Nature Reviews Neuroscience*, *11*(2), 114. https://doi.org/10.1038/nrn2762

Grant, B., Stinson, F., Dawson, D., Chou, A., Dufour, M., Compton, W., ... Kaplan, K. (2006). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: Results from the National Epidemiolgic Survey on Alcohol and Related Conditions. *Alcohol Research & Health*, *29*(2), 107-120.

Greenberg, P. E., Sisitsky, T., Kessler, R. C., Finkelstein, S. N., Berndt, E. R., Davidson, J. R. T., ... Fyer, A. J. (1999). The economic burden of anxiety disorders in the 1990s. *The Journal of Clinical Psychiatry*, *60*(7), 427-435. https://doi.org/10.4088/JCP.v60n0702

Hofmann, S. (2008). Cognitive processes during fear acquisition and extinction in animals and humans: Implications for exposure therapy of anxiety disorders. *Clinical Psychology Review*, *28*(2), 199-210. https://doi.org/10.1016/j.cpr.2007.04.009

Kessler, R. C., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Wittchen, H. (2012). Twelve-month and lifetime prevalence and lifetime morbid risk of anxiety and mood disorders in the United States. *International Journal of Methods In Psychiatric Research*, *21*(3), 169-184. https://doi.org/10.1002/mpr.1359

Kirk, J., & Rouf, K. (2004). Specific phobias. In J. Bennett-Levy, G. Butler, M. Fennell, A. Hackmann, M. Mueller, & D. Westbrook (Eds.), *Oxford guide to behavioural experiments in cognitive therapy*. Oxford University Press. https://doi.org/10.1093/med:psych/9780198529163.003.0008

Kitamura, T., Ogawa, S. K., Roy, D. S., Okuyama, T., Morrissey, M. D., Smith, L. M., … Tonegawa, S. (2017). Engrams and circuits crucial for systems consolidation of a memory. *Science* (New York, N.Y.), *356*(6333), 73. https://doi.org/10.1126/science.aam6808

Marciniak, M., Lage, M., Landbloom, R., Dunayevich, E., & Bowman, L. (2004). Medical and productivity costs of anxiety disorders: Case control study. *Depression and Anxiety*, *19*(2), 112-120. https://doi.org/10.1002/da.10131

McNally, R. (2016). The Legacy of Seligman's "Phobias and Preparedness" (1971). *Behavior Therapy*, *47*(5), 585-594. https://doi.org/10.1016/j.beth.2015.08.005

Nadel, L., Hupbach, A., Gomez, R., & Newman-Smith, K. (2012). Memory formation, consolidation and transformation. *Neuroscience and Biobehavioral Reviews*, *36*(7), 1640-1645. https://doi.org/10.1016/j.neubiorev.2012.03.001

Otte, C. (2011). Cognitive behavioral therapy in anxiety disorders: Current state of the evidence. *Dialogues in clinical neuroscience*, *13*(4), 413.

Regier, D., Farmer, M., Rae, D., Locke, B., Keith, S., Judd, L., & Goodwin, F. (1990). Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area (ECA) Study. *Journal of The American Medical Association*, *264*(19), 2511-2518. https://doi.org/10.1001/jama.1990.03450190043026

Roehrig, C. (2016). Mental disorders top the list of the most costly conditions in the United States: $201 Billion. *Health Affairs*, *35*(6), 1130-1135. https://doi.org/10.1377/hlthaff.2015.1659

Schacter, D. L. (1999). The seven sins of memory: Insights from psychology and cognitive neuroscience. *American Psychology*, *54*, 182-203. https://doi.org/10.1037/0003-066X.54.3.182

Schwabe, L., Wolf, O., & Oitzl, M. (2010). Memory formation under stress: Quantity and quality. *Neuroscience and Biobehavioral Reviews*, *34*(4), 584-591. https://doi.org/10.1016/j.neubiorev.2009.11.015

Seligman, M. (1971). Phobias and preparedness. *Behavior Therapy*, *2*(3), 307-320. https://doi.org/10.1016/S0005-7894(71)80064-3

Shirneshan, E. (2013, January 1). *Cost of illness study of anxiety disorders for the ambulatory adult population of the United States*. ProQuest Dissertations Publishing. Retrieved from http://search.proquest.com/docview/1490996808/

Soni, A. (2015). Statistical brief #470: Trends in the five most costly conditions among the U.S. civilian noninstitutionalized population, 2002 and 2012. In *Agency for Healthcare Research and Quality*. Retrieved April 7, 2018, from https://meps.ahrq.gov/data_files/publications/st470/stat470.shtml

Tononi, G., & Cirelli, C. (2003). Sleep and synaptic homeostasis: A hypothesis. *Brain Research Bulletin*, *62*(2), 143-150. https://doi.org/10.1016/j.brainresbull.2003.09.004

Tononi, G., & Cirelli, C. (2006). Sleep function and synaptic homeostasis. *Sleep Medicine Reviews*, *10*(1), 49-62. https://doi.org/10.1016/j.smrv.2005.05.002

US Burden of Disease Collaborators. (2013). The state of US health, 1990-2010: Burden of diseases, injuries, and risk factors. *JAMA, The Journal of the American Medical Association*, *310*(6), 591. https://doi.org/10.1001/jama.2013.13805

Wang, P. S., Lane, M., Olfson, M., Pincus, H. A., Wells, K. B., & Kessler, R. C. (2005). Twelve-month use of mental health services in the United States: Results from the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*(6), 629-640. https://doi.org/10.1001/archpsyc.62.6.629

Wiederhold, B. K., & Wiederhold, M. D. (2014). Introduction. In B. K. Wiederhold, & S. Bouchard (Eds.), *Advances in Virtual Reality and Anxiety Disorders* (pp. 3-7). New York: Springer. https://doi.org/10.1007/978-1-4899-8023-6_1