ABSTRACT

Test Anxiety and the Attention Training Technique (ATT): A Feasibility Study

Channing J. Cochran, Psy.D.

Mentor: Thomas Fergus, Ph.D.

Approximately one out of four students report experiencing high test anxiety, which has been shown to negatively affect cognitive processes, such as attentional control, often leading to impaired academic performance and heightened emotional distress. Prior interventions (i.e., skills training, relaxation training, and cognitive modification) have been unsuccessful in reducing long-term test anxiety and improving test performance. It has been suggested that the attention training technique (ATT), an auditory-listening technique aimed at increasing attentional control, may be beneficial in reducing test anxiety in an undergraduate student population. ATT can be easily administered electronically, making it an eHealth intervention with considerable reach for students with limited resources who experience debilitating test anxiety. However, no study to date has examined the feasibility of an eHealth version of ATT for test anxiety administered solely in electronic form. The present study aimed to investigate 1) the feasibility and 2) the effectiveness of an eHealth version of ATT in reducing test anxiety in an undergraduate student population. Study design included randomization of 51 undergraduate students who self-reported high levels of test anxiety to one of two

intervention groups: ATT (n = 23) and an active control group (music listening; n = 28). Participants were asked to listen to a 12-minute audio recording (ATT or classical music) daily for two-weeks. Self-reported measures of test anxiety, metacognitive beliefs, and attentional control were completed before and after the two-week period. Nineteen participants (83%) completed the ATT intervention and listened to the audio recording an average of 10 out of 14 days. Participants perceived the ATT intervention to be user-friendly and helpful in reducing test anxiety. Additionally, study results indicate that both interventions led to significant reductions in test anxiety and metacognitive beliefs, as well as an increase in attentional control, with there being no significant differences in measures across the two groups. These results provide evidence for the feasibility of an eHealth version of ATT within an undergraduate student population, yet further research is needed to investigate if ATT leads to more robust long-term changes in test anxiety compared to other active treatments.

Test Anxiety and the Attention Training Technique (ATT): A Feasibility Study

by

Channing Cochran, B.S., M.S.C.P.

A Dissertation

Approved by the Department of Psychology and Neuroscience

_____

Charles A. Weaver III, Ph.D., Chairperson

Submitted to the Graduate Faculty of
Baylor University in Partial Fulfillment of the
Requirements for the Degree
of

Doctor of Psychology

Approved by the Dissertation Committee

_____

Thomas A. Fergus, Ph.D., Chairperson

_____

Sara L. Dolan, Ph.D.

_____

Christine C. Limbers, Ph.D.

_____

Charles A. Weaver III, Ph.D.

_____

Christopher M. Rios, Ph.D.

Accepted by the Graduate School

August 2019

_____

J. Larry Lyon, Ph.D., Dean

Page bearing signatures is kept on file in the Graduate School.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to Dr. Thomas Fergus who has been an exceptionally supportive, patient, and dedicated mentor to me over the past five years. His willingness to share his wisdom with me throughout my graduate studies has been the reason for much of my success. Additionally, I am very grateful to my dissertation committee, including Dr. Sara Dolan, Dr. Christine Limbers, Dr. Charles Weaver, and Dr. Chris Rios. Thank you for providing me thoughtful feedback and encouragement throughout the dissertation process.

To my close friends and cohort, thank you for inspiring me, commiserating with me, and celebrating successes with me. It is because of the supportive community and loving friendships that I was able to persevere through the hardships that graduate school ultimately brings. Lastly, I am forever grateful to my incredible family who continues to believe in me and lift me up when I need it the most. I am especially appreciative of my sister, Dr. Christina Cochran, who has been my role model for pursuing a doctoral degree. You continually show me that life is more than just the successes of school or work, but is made more valuable when we serve others with unconditional love. Thank you.

To my grandfather, Lt. Col. (Ret.) Royal Cole Lewis, who lived a life of gratitude, love, and happiness, and will always be an inspiration to me

CHAPTER ONE

Introduction

Test Anxiety

In the past half-century, there has been a surge of interest in test anxiety research and its impact on academic achievement. Mandler and Sarason (1952) were among the first researchers to investigate how anxiety in testing situations influences performance outcomes. They compared 21 highly anxious undergraduates to 21 low anxiety undergraduates and found that high anxiety generally has a negative impact on test performance, including higher task completion times. This study had significant implications for the impact of anxiety in educational settings and how one might seek to target anxiety in the service of reducing negative testing outcomes. Leading up to the end of the twentieth century, test anxiety was labeled a "universal phenomenon" experienced by students of all ages (Beidel, Turner, & Taylor-Ferreira, 1999; Kyriacou & Butcher, 1993; Sung, Chao, & Tseng, 2016; Turner, Beidel, Hughes, & Turner, 1993). To date, research indicates that more than one-third of U.S. students experience elevated levels of test anxiety (Methia, 2004) and, as the amount of testing requirements increases in the U.S., the number of students experiencing elevated levels of test anxiety is expected to rise (Casbarro, 2005). Prior to describing the current study, I will first present an operational definition of test anxiety and the components that constitute test anxiety. Then, I will discuss the evolution of high-stakes testing, its impact on the prevalence of test anxiety, and conceptual models proposed to account for the development and

maintenance of test anxiety. I will next discuss treatment interventions for test anxiety and gaps in the current treatment literature. Lastly, I will introduce the current study that investigates the feasibility and treatment efficacy of an attentional training task on the reduction of test anxiety in an undergraduate population through use of an eHealth-based protocol.

Test anxiety can be distinguished from other related symptom presentations, specifically social anxiety and specific phobia (Bogels et al., 2010; LeBeau et al., 2010). The *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (*DSM-5*) does not include test anxiety as a disorder; however, test anxiety was considered for inclusion in the development of the *DSM-5* (LeBeau et al., 2010). LeBeau et al. (2010) noted that test anxiety has been suggested as a subtype of specific phobia due to the fact that it can be described as an intense fear of tests (i.e., a specific object), yet they argue that test anxiety extends beyond solely an irrational fear associated with an object or situation. LeBeau et al. provided evidence from previous research indicating individuals who endorse high levels of test anxiety are not solely preoccupied by an intense fear of tests, but endorse elevated negative cognitions and fears of how their performance will be evaluated.

Although this evidence suggests that test anxiety should not likely be considered a subtype of specific phobia, researchers speculate test anxiety could be a subtype of social anxiety due to the similarity that fear of negative evaluation is a core feature of both symptom presentations. Lowe and Lee (2008) found individuals who endorsed high levels of test anxiety also reported a high fear of negative social evaluation, as is the case in social anxiety. Beidel et al. (1994) found that 54% of children who were classified as test-anxious also met diagnostic criteria for an anxiety disorder, with social anxiety

disorder being among the most prevalent comorbid diagnosis. Yet, Hall (2005) found no significant differences in social anxiety symptomology between high and low test-anxious college students. In conclusion, authors suggest that fear of negative evaluation and social humiliation are common features of both test anxiety and social anxiety, with a key difference being that test-anxious individuals also fear underperformance in testing situations that presumably will lead to *non*-social consequences. A non-social consequence may include job and/or academic placement, selection, and classification. Overall, research conducted thus far has not supported the conclusion that test anxiety is a subtype of another anxiety disorder and supports distinctive features of test anxiety from other anxiety disorders. Given the current literature described above, the proposed study will examine test anxiety as a unique construct independent from other related symptom presentations.

Definitional Components and Impact on Performance

The definition of test anxiety has broadened from being defined solely by a physiological aroused state (Spielberger & Vagg, 1995), to encompassing both cognitive and emotional components (Liebert & Morris, 1967), to a more contemporary biopsychosocial definition that considers cognitive, behavioral, physiological, and affective domains (Lowe et al., 2008; Sarason, 1984; Zeidner, 1998). As the definition of test anxiety has evolved over the past several decades, a recent review of the construct of test anxiety, by Putwain (2008), notes that most definitions of test anxiety include two key components: (a) anxiety that occurs during an evaluative setting based on a performance assessment and (b) fear of how others will judge their performance. Furthermore, as will be discussed in more detail below, the cognitive (e.g., excessive

worry, low self-worth) and emotionality (e.g., physiological responses such as increased heart rate, nausea, feelings of panic) components remain the main focus of test anxiety research.

Prior studies have shown inconsistencies as to which component of test anxiety has a stronger relationship with exam performance, or if both components have a similar impact on performance. Multiple studies have shown that the cognitive component of test anxiety has the strongest relationship to exam performance outcomes (Cassady, 2004; Cassady & Johnson, 2002; Putwain, Connors, & Symes, 2010). For example, a study by Cassady and Johnson (2002) assessed levels of emotionality and negative thoughts experienced by participants in examination settings. These researchers found that negative cognitions regarding test evaluation were related to performance outcomes, whereas levels of emotionality were not. In contrast, Putwain et al. (2010) found an association between test performance and both worry and bodily sensations (i.e., physiological responses). Inconsistencies in the literature regarding the degree to which components of test anxiety are associated with performance outcomes (Keogh, Bond, French, Richards, & Davis, 2004; McIlroy, 2000) suggest that further research is needed in order to determine the extent of cognitive and physiological components of test anxiety association with examination performance outcomes. For the purposes of the current study, the construct of test anxiety will be defined by both cognitive and emotionality/physiological components specific to evaluative settings.

Although researchers of test anxiety tend to focus on cognitive and emotionality components of test anxiety, more recently researchers have argued that additional factors should be considered when assessing test anxiety, such as societal influences and

situational stressors (Sung & Chao, 2015). For example, research has begun to highlight the role of high-stakes testing in students' future in our society (Au, 2011; Richman, Brown, & Clark, 1987; Sung & Chao, 2015). In a critical analysis, Berliner (2011) discussed the negative effects high-stakes testing has on students, the educational system, and society as a whole. Included in Berliner's list of negative effects of high-stakes testing were elevated anxiety both teachers and students experience due to increased pressures to perform at a certain standard. Berliner argued that the emphasis on learning to achieve growth and knowledge is replaced by a pressure to meet certain standards. Indeed, Segool, Carlson, Goforth, von der Embse, and Barterian (2013) conducted a study that assessed levels of test anxiety experienced by elementary students in high-stakes, standardized test settings compared to low-stakes, classroom test settings. Although over half (55%) of the students experienced moderate to high levels of test anxiety in a low-stakes, classroom testing setting, two-thirds of the students exhibited moderate to high levels of test anxiety in a high-stakes testing setting. This study suggests that test anxiety is experienced in a majority of elementary students in both low-stakes testing and high-stakes testing, yet the prevalence and severity of test anxiety is particularly elevated when the examination is perceived to have more immediate and severe consequences.

One can dispute whether a classroom setting should be considered a high-stakes testing setting, due to the implications course tests can have on one's overall grade point average (GPA) and subsequent academic career. Yet, Segool et al.'s (2013) study was conducted in elementary schools where classroom testing has less consequences on future academic performance. More precisely, there is a greater emphasis on the immediate

negative effects of standardized testing in elementary schools (Segool et al., 2013). As a student progresses in their studies, each examination they approach will have a greater effect on their future leading to an increase in reports of debilitating test anxiety. This hypothesis may be supported by evidence of higher levels of test anxiety reported in college-aged students leading to lower test scores and overall academic success (Cassady & Johnson, 2002). In conclusion, testing is widely used in various academic settings in order to determine placement, selection, and classification. These determinations have great impact on an individual's future. Taking into account how society utilizes testing results, it is not surprising that individuals experience anxiety when approaching a high-stakes, scholastic examination (Zeidner, 1998). As Sarason (1959) noted, "we live in a test-conscious, test-giving culture in which the lives of people are in part determined by their test performance" (p. 26).

Due to the potential negative impact test anxiety can have on one's ability to perform, research on test anxiety has continued to be an interest in the field of psychology. Sarason (1978) showed that individuals who scored high on a self-report measure of test anxiety also reported higher levels of being preoccupied with performing poorly, how others were evaluating their performance, and how the examiner was evaluating them compared to low and moderate scorers. These results were consistent with previous findings demonstrating that individuals experiencing test anxiety exhibit greater frequency of self-blame for poor performance (Doris & Sarason, 1955), low self-confidence in perceptual judgments (Meunier & Rule, 1967), and have lower expectations for their performance (Kausler & Trapp, 1958). Even more interesting were findings that in a non-evaluative setting, participants showed little differences in

cognitive interference and performance (Kurosawa & Harackiewicz, 1995; Naveh-Benjamin, McKeachie, & Lin, 1987). Those study findings suggest impairments are possibly specific to evaluative settings, further emphasizing potential distinct relationship between test anxiety, evaluative settings, and performance outcomes.

Further evidence supporting an association between heightened test anxiety and negative effects on performance stems from studies showing that individuals with heightened test anxiety might experience impaired ability to focus, scholastic underachievement, and physiological distress (Gaudry & Spielberger, 1971; Hembree, 1988; Powers, 1986; Zeidner, 1990). A meta-analysis conducted by Seipp (1991) suggested that the impact of test anxiety on test performance was equivalent to a half standard deviation difference in exam performance outcomes between low and high-test anxious students. Seipp reported that the significant negative relationship (r = -.21) between test anxiety and test performance was indicative that approximately 61% of students experiencing heightened test anxiety were likely to fail an examination compared to 39% of students experiencing low levels of test anxiety assuming similar academic abilities. Chapell et al. (2005) conducted a study specific to undergraduate/graduate student population and found a small, yet significant, negative association (r = -.18) between test anxiety and poor academic outcomes among female and male student groups. For female undergraduate students, there were significant differences in overall GPAs among the top 5% of students experiencing elevated test anxiety, as measured by scores on a self-report measure of test anxiety, and the lowest 5% test-anxious students. Graduate female students also showed significant differences between overall GPAs and endorsed test anxiety. Undergraduate male students showed

similar significant differences, yet graduate male students did not show significant differences between overall GPAs in students with high levels of test anxiety versus students with low levels of test anxiety.

These results indicate that undergraduate and graduate students reporting heightened levels of test anxiety averaged a B GPA, whereas, students reporting low levels of test anxiety averaged a B+ GPA. Due to the competitive nature of academic and occupational settings and emphasis on overall achievement scores, as discussed in more detail below, this small difference may be associated with important implications. Further, students experiencing heightened test anxiety endorse elevated worries and embarrassment regarding the consequences of performing poorly on exams (Sarason & Sarason, 1990). Individuals reporting heightened test anxiety tend to experience poor concentration/easily distracted, difficulty comprehending information, and/or difficulty retrieving previously learned material (Zeidner, 1998). Such consequences of test anxiety have implications for both academic and emotional well-being. In a recent meta-analysis of 238 studies spanning the previous 30 years, von der Embse, Jester, Roy, and Post (2018) found a consistent negative relationship of high test anxiety and low levels of academic performance, such as GPA, standardized tests, and university entrance exams. Further, they found a pattern of higher reports of test anxiety among students on high stakes evaluations compared to traditional classroom examinations. The magnitudes of these relationships were small (r = -.13) to moderate (r = -.40) across students in primary school through post-secondary school. Noteworthy to this current study, von der Embse et al.'s review demonstrated an increase in the strength of relationship between test anxiety and impaired performance within undergraduate and graduate student

populations. Overall, von der Embse et al.'s findings offer further evidence for the prevalence and impact of test anxiety among student populations and testing conditions.

Proposed Conceptual Models

Heightened awareness on the impact of test anxiety has led to the development of conceptual models of test anxiety, including multiple models that fall within an information-processing framework (Naveh-Benjamin, McKeachie, & Lin, 1987). Models of test anxiety falling within an information-processing framework include the cognitive interference model (Schwarzer & Jerusalem, 1992; Tobias, 1985), motivational enhancement model (Struthers, Perry, & Menec, 2000), the processing efficiency model (Eysenck & Calvo, 1992), and the self-regulatory executive functioning (S-REF; Wells & Matthews, 1996) model. Alternatively, some researchers have argued that poor test performance is a result of poor study skills and/or poor test-taking skills, as opposed to a result of cognitive and emotional reactions stemmed from elevated test anxiety (Culler & Holahan, 1980; Kirkland & Hollandsworth, 1979, 1980; Tobias, 19850. Yet, meta-analytic reviews of study skills training interventions consistently find non-significant effects on improved performance suggesting poor study skills alone do not account for poor performance (Ergene, 2003; Hembree, 1988). As a result of a lack of empirical evidence supporting a significant relationship between poor study skills and elevated test anxiety, it appears more promising to investigate causes of test anxiety from an information-processing framework.

Although multiple models of test anxiety have been proposed, there is little existing research on the central tenets of those models despite a proliferation of studies examining effects of test anxiety on performance outcomes. This scarcity of theory

testing has left a gap in the literature in explicating potential mechanisms underlying test anxiety and, consequently, the development of effective interventions. Nonetheless, previously proposed models of test anxiety remain informative of potential processes underlying the relationship between test anxiety and poor performance. As the majority of proposed test anxiety models fall within an information-processing framework and it is these models that have the most empirical support (Cassady & Johnson, 2002; Eysenck & Calvo, 1992; Naveh-Benjamin, McKeachie, Lin, & Holinger, 1981; Naveh-Benjamin, McKeachie, & Lin, 1987; O'Carroll & Fisher. 2013), the overarching information-processing theory will first be described before outlining specific models.

An information-processing theory suggests that not only do negative cognitions interfere with an individual's ability to retrieve learned information, but negative cognitions also interfere with the encoding and organization of new material (Naveh-Benjamin et al., 1987). Researchers supporting this model have suggested that highly test anxious students not only experience cognitive impairments during testing situations, but also are not able to encode and/or organize the test information prior to the examination (Naveh-Benjamin, 1991). Naveh-Benjamin et al. (1987) showed that highly test-anxious students could be categorized into two groups depending on their abilities to encode, organize, and/or retrieve learned information. The first group endorsed impairment in retrieval of previously learned information, whereas the second group endorsed impairment in all stages of information processing. Highly test-anxious students who demonstrated good study skills performed just as well as low test-anxious students in non-evaluative settings. Yet, these highly test-anxious students performed significantly worse than low test-anxious students. These results support proposals that even when

highly test anxious students are able to encode and organize information pre-examination, they have difficulties retrieving this information when taking an evaluative examination (Kurosawa & Harackiewicz, 1995; Naveh-Benjamin et al., 1987). Importantly, this study showed that there is another group of test-anxious students that not only have difficulties with retrieval processes, but also with encoding and organizing new material. This second category of students was described as having poor study skills in addition to test anxiety. Tobias (1985) suggested that students who lack efficient study and/or test-taking skills might become more test anxious when they become increasingly aware that they are underprepared for the examination. As a result, the student's ability to focus on task-relevant information is impaired. An information-processing theory has provided a framework for multiple test anxiety models and these models will now be discussed.

The cognitive interference model proposes that an individuals' inability to suppress task-irrelevant thoughts leads to performance deficits. Easterbrook (1959) proposed that when an individual is in a heightened state of arousal, the body adapts by restricting the individual's attention to relevant cues. This adaptive behavior is intended to aid the individual in focusing all of his/her effort on the task at hand. Yet, in individuals who endorse high levels of test anxiety, it has been proposed that these individuals are restricted to task-irrelevant cues or are not capable of restricting cues leading to an influx of cognitions in high arousal, evaluative settings. In support of this model, test anxious individuals tend to endorse higher levels of negative cognitions, such as worrying about the outcome of the test, comparing themselves to others, and believing they are not fully prepared for the test (Sarason, 1984; Schwarzer & Jerusalem, 1992). Upon taking a test or being evaluated on a skill-set, it is these negative cognitions that the

cognitive interference model suggests hinders the individual's ability to perform maximally. The cognitive interference model therefore suggests a negative relationship between test anxiety and performance outcomes (Cassady & Johnson, 2002; Hembree, 1988; Sarason, 1984; Zeidner, 1998).

However, not all models of test anxiety suggest a negative relationship with performance outcomes. The motivational enhancement model proposes that test anxiety can actually enhance performance leading to more positive outcomes (Struthers, Perry, & Menec, 2000). Some research has shown a positive correlation between test anxiety and positive performance outcomes, leading to questions of whether experiencing test anxiety is always is related to diminished performance (Struthers et al., 2000; Sung et al., 2016). The motivational enhancement model suggests that when individuals encounter a stressful, evaluative situation their motivation increases, which leads to a greater focus of attention and enhanced performance outcomes. With this model in mind, McDonald (2001) proposed that students who do not experience elevated stress in evaluative situations might lack the motivation to have successful performance outcomes. In order to make sense of the research that shows test anxiety as leading to both negative and positive performance outcomes, some researchers have suggested combining the cognitive interference and motivational enhancement models. Based on the Yerkes-Dodson law (1908) stating moderate amounts of stress enhance performance, the cognitive interference and motivational enhancement mixed model propose there is a critical level in which test anxiety becomes impairing on performance outcomes. Nonetheless, there is limited research supporting such a combined model (Muse, Harris, & Field, 2003; Sung & Chao, 2015).

The processing efficiency model was proposed by Eysenck and Calvo (1992) in order to further identify cognitive processes associated with elevated anxiety. Eysenck and Calvo noted that previous test anxiety models were too broad and did not account for the, at least sometimes, commensurate performances of highly anxious students when compared to low anxiety students. Furthermore, they cited specific evidence of the relationship between task performance and task difficulty (Calvo & Ramos, 1989; Eliatamby, 1984; Eysenck, 1989; Hamilton, 1978), arguing that previous models have not taken into account this meaningful relationship. As a result, the processing efficiency theory makes a distinction between processing effectiveness and processing efficiency, stating that anxiety has a greater negative impact on processing efficiency. This distinction suggests that individuals experiencing elevated anxiety have to put forth more effort and resources in order to achieve the same performance levels as an individual who does not experience elevated anxiety (i.e., their processing efficiency is reduced). If an individual does not possess the compensatory resources to reduce anxiety, his/her processing effectiveness will also be impaired. This conceptualization helps account for research that has shown that highly test anxious individuals at times perform similarly to individuals that report low anxiety during a performance (Naveh-Benjamin et al., 1987; Struthers et al., 2000; Sung et al., 2016).

In addition to distinguishing between processing effectiveness and processing efficiency, Eysenck and Calvo (1992) aimed to narrow previous test anxiety models by specifically focusing on the impact of worry on the central executive. The central executive is the main component of the working memory system involved in planning and decision-making (Baddeley, 1986). Specifically, the central executive fulfills at least

five cardinal functions: switching attention, planning in order to achieve goals, selective attention and inhibition, working memory, and coding representations in working memory (Smith & Jonides, 1999). When an individual experiences elevated worry regarding performance on a demanding task, the central executive experiences greater demands from both the task and the worry affecting its allocation of resources to the task-at-hand. Yet, an individual can overcome this demand on central executive processes through appropriate self-regulation and awareness of negative cognitions. An individual who is able to identify the effect worry is having on task performance can implement compensatory strategies that allow for an allocation of additional cognitive processes to the task-at-hand. In this way, worry has at least two effects on the central executive: (a) consuming processing and storage resources from the relevant task and (b) motivation to make up for the reduction in resources by recruiting other cognitive processes to complete the task.

As literature on the influence of test anxiety on cognitive processes continued to accumulate, clear gaps in the processing efficiency theory emerged. For example, the model failed to specify which cognitive executive processes, as noted above, are directly affected by anxiety. Additionally, the processing efficiency model does not consider how distracting and/or threat-related stimuli affect performance differently in students experiencing heightened test anxiety compared to those experiencing low test anxiety. Due to the limitations associated with the processing efficiency theory, Eysenck et al. (2007) proposed the attentional control theory, which focuses on how anxiety specifically affects attentional control processes. They base their theory on research that has shown that anxiety is a product of a goal being threatened (Power & Dalgleish, 1997), an

individual perceiving that threat, and then attending to the threat in order to determine how to respond to it. By attending to the threat-stimuli, an individual's attention may become increasingly biased and s/he can have difficulty switching attention back to task-relevant stimuli. While attending to threatening stimuli can be an adaptive and, at times, life-saving strategy, if the threat is perceived and not actually present, an attentional bias towards the perceived threat can impair optimal performance.

Eysenck et al. (2007) suggest that two central executive functioning centers are affected by anxiety: inhibition and shifting. Executive functioning refers to the set of cognitive processes that guide an individual in planning, regulating, controlling, and executing behaviors in order to achieve goals. When individuals experience elevated levels of anxiety, their goal-directed attentional system is putatively inhibited and their ability to shift their attention to task-relevant stimuli is inhibited as well. In other words, attentional control is inhibited and therefore individuals are unable to voluntarily control what they choose to pay attention to, leading to difficulties concentrating on the task at hand. Eysenck et al. suggest that by increasing an individual's compensatory strategies (i.e., attentional control skills), the negative effects of anxiety can be reduced and performance enhanced.

Further support for Eysenck et al.'s (2007) attentional control theory comes from studies investigating the relationship between test anxiety and working memory. Working memory has been shown to have a strong relationship with both performance outcomes (Alloway, 2011) and attentional control abilities (McVay & Kane, 2012). Using an attentional control framework, researchers hypothesized that there would subsequently be a correlation between working memory and test anxiety. Mowbray

(2012) conducted a review investigating the relationship between working memory and test anxiety with suggestions for targeted-interventions. Similarly to how anxiety has been found to have a negative relationship with performance outcomes (r = -.33; Vitasari et al., 2011), researchers have shown a positive correlation between working memory and academic outcomes (r = .45; Alloway & Alloway, 2010). Further investigation of working memory has shown a strong relationship with attentional control abilities (r = .73; McVay & Kane, 2012). McVay and Kane (2012) showed that undergraduates who had difficulties attending to relevant thoughts performed worse on working memory and reading comprehension tasks, suggesting that attentional control could mediate the relationship between working memory and reading comprehension, leading to worse academic performance.

Attentional control theory suggests that when individuals experience test anxiety, they are unable to flexibly attend to or retrieve test-relevant information that they have previously consolidated (Eysenck et al., 2007). Furthermore, theorists suggest that anxiety "overwhelms" the working memory system, resulting in a bias towards bottom-up processes and attention towards threat-relevant stimuli (Eysenck et al., 2007; Power & Dalgleish, 1997). Individuals may respond to the effects of their anxiety through compensatory means, such as exerting greater effort and "auxiliary resources" to offset the deficit. For example, an individual experiencing heightened anxiety during an examination may become internally focused on the anxiety, leading to less attention allocated to completing the examination. As the individual recognizes the negative impact anxiety is having on test performance, they may begin to try and suppress the anxiety, leading to a greater focus and rumination on the anxious thoughts. Ultimately,

this strategy leads to greater deficits as more effort is being allocated to suppressing the anxiety instead of completing the task at hand. As noted above, these compensatory strategies are not always the most efficient or beneficial. Research has shown that individuals high in test anxiety generally take more time to complete tasks (Elliman, Green, Rogers, & Finch, 1997; Naveh-Benjamin et al., 1981). Furthermore, several dual paradigm studies have shown that individuals experiencing heightened test anxiety performed worse compared to those who experienced low levels of test anxiety (Beilock, Kulp, Holt, & Carr, 2004; Darke, 1988; Johnson & Gronlund, 2009). Taken together, the above research provides evidence of the negative effects test anxiety has on executive functioning processes, including attentional control, that may lead to impaired performance efficiency.

As extant literature indicates, there have been multiple proposed models of test anxiety aiming to better understand the contributing and maintaining factors leading to test anxiety. Using an information-processing theory as a framework, the majority of proposed models underscore the important role of cognitive processes in the regulation of anxiety experienced in an examination setting. Specifically, test anxiety models have highlighted how negative cognitions interfere with both retrieval of information and the encoding and organization of new material. The cognitive-interference model suggested that this interference was due to an individual's inability to suppress task-irrelevant cognitions when experiencing heightened anxiety in an examination setting (Easterbrook, 1959; Schwarzer & Jerusalem, 1992; Tobias, 1985). This model describes the effects of test anxiety as "restricted attention" that impairs an individual in performing optimally due to not attending to relevant information. However, some studies indicate that

individuals experiencing moderate levels of test anxiety perform similarly to individuals that report no test anxiety. In order to reconcile this inconsistency in the data, the processing efficiency model was proposed, focusing on the amount of cognitive resources highly test-anxious individual was having to use up in order to perform at a commensurate level to a low test-anxious individual. Eysenck and Calvo (1992) highlighted worry as the main disruptive component leading to impaired performance, with higher difficulty tasks having the worst deficits. The processing efficiency model provided increased insight into how the relationship between test anxiety and performance deficits, yet failed to specify which executive functioning processes are involved in the disruption of abilities. The attentional control model aimed to fill in the gaps of the processing efficiency model by focusing on anxiety's effect on both the goal-oriented attentional system and the stimulus-driven attentional system.

As the understanding of test anxiety and its impact on cognitive functioning has evolved over the past half century, the models for test anxiety have become increasingly more sophisticated in their focus on specific cognitive processes involved, with a specific focus on the role of attentional control. These findings have led researchers to target attentional control processes that might prove to be beneficial in treatment of test anxiety. The attentional control theory provides support for treatments that target attentional control processes in order to reduce test anxiety and improve performance outcomes. These attentional control-targeted interventions, specifically a metacognitive treatment based upon the self-regulatory executive functioning (S-REF) model, will be discussed below, but first a review of previous test anxiety interventions will be discussed.

Proposed Interventions and S-REF Model

Historically, research has shown that the cognitive component of test anxiety has the strongest relationship to exam performance outcomes (Cassady, 2004; Cassady & Johnson, 2002; Putwain, Connors, & Symes, 2010); therefore, many interventions thus far have aimed to challenge and reduce negative cognitions associated with test anxiety. Yet, researchers have also explored behavioral and skills-training approaches to reducing test anxiety. A meta-analysis conducted by Hembree (1988) reviewed 562 studies assessing psychological and educational interventions in university students. Results showed a large effect size for cognitive-behavioral therapy (Cohen's $d = 0.87$), as well as large effect sizes for both cognitive therapy ($d = 0.96$) and behavioral therapy ($d = 1.21$) at a 6-week follow-up. Hembree concluded that these intervention methods only act as compensatory strategies and do not target the underlying mechanisms behind test anxiety. Hembree challenged future research to investigate more effective and focused interventions that aid an individual in prevention and long-term reduction of test anxiety. Therefore, there is a need to identify which specific components of these interventions is leading to greatest reductions in test anxiety. Interventions can then be streamlined to incorporating solely the most effective components targeting the underlying mechanisms of test anxiety.

Given the recent literature on the role of attentional control in test anxiety, it seems likely that attentional control would be an area to target in future interventions. Although various studies investigating the relationship between attentional control and test anxiety have suggested a need for interventions targeting the attentional control system (Huntley, Young, Jha, & Fisher, 2016; Mowbray, 2012; O'Carroll & Fisher,

2013; Spada, Georgiou, & Wells, 2010), there has been limited research on the development of these interventions. Consequently, researchers have investigated more-targeted treatments for test anxiety (Huntley et al., 2016; Mowbray, 2012; O'Carroll & Fisher, 2013; Spada et al., 2010). Specifically, researchers have established findings that support the self-regulatory executive functioning (S-REF) model as a coherent framework for explaining the maintenance of anxiety (Wells & Matthews, 1996).

The S-REF model theorizes that emotional distress stems from dysfunctional patterns of self-regulation and self-monitoring of maladaptive thoughts, feelings, and beliefs (Wells, 2009; Wells & Matthews, 1996). Central to the S-REF model is metacognition, which represents individuals' awareness and appraisal of cognitions. In the context of the S-REF model, metacognitive beliefs can lead to subsequent attempts to control or manipulate cognitions as a form of self-regulation (Wells, 1995). More precisely, metacognitive beliefs are fundamental to an individual's self-appraisal, based on self-beliefs the individual holds in long-term memory, of both internal and external stimuli. Metacognitive beliefs often guide self-regulative patterns, such as worry and rumination, apparent in individuals who experience heightened anxiety. An essential construct of the S-REF model, worry is conceptualized as both a monitoring and control strategy individuals utilize in response to experienced distress (Matthews, Hillyard, & Campbell, 1999). Paradoxically, worry often enhances awareness of negative cognitions and leads to heightened perseveration on distressing thoughts. For example, an individual that holds the metacognitive belief that "worry is uncontrollable and dangerous" might respond to worrisome thoughts by trying to control them, leading to undesirable consequences, such as perseveration on negative cognition, selectively

attending to threat stimuli, and/or implementing maladaptive coping styles (O'Carroll & Fisher, 2013; Wells, 2009; Wells & Matthews, 1996). As a result, the S-REF model theorizes that maladaptive metacognitive beliefs ultimately prevent an individual from allotting essential executive functioning processes to task-relevant goals.

Prior research has provided support for the S-REF model, particularly regarding associations between metacognitive beliefs, attentional control, and anxiety (Wells, 2013). For example, Spada et al. (2010) found that metacognitive beliefs about thoughts concerning uncontrollability and danger, cognitive confidence, and beliefs about the need to control thoughts positively correlated with state anxiety (*r*s = .65, .37, and .36). Furthermore, metacognitive beliefs about thoughts concerning uncontrollability and danger and beliefs about the need to control thoughts were negatively correlated with attentional control (*r*s ranging from -.20 to -.32). Regression analyses indicated that both metacognitive beliefs and attentional control uniquely contribute to state anxiety. In other words, both an individual's awareness and appraisal of their cognitions along with his/her ability to flexibly attend to internal and external stimuli could lead to disruptions in the regulation of emotional states. This dysfunctional self-regulation may lead to elevated anxiety and subsequent distraction from achieving the goal at hand (Spada et al., 2010).

In relation to test anxiety, O'Carroll and Fisher (2013) provided further support of the S-REF model by investigating the role of metacognitive beliefs specifically concerning performance test anxiety. Based on the S-REF model, O'Carroll and Fisher hypothesized that metacognitive beliefs may guide an individual's self-regulatory and attentional control processes leading to a decrease in test performance. Their study

findings indicated that performance test anxiety was significantly positively correlated with metacognitive beliefs about the uncontrollability and danger of worry (r = .61), cognitive confidence beliefs (r = .28), need to control beliefs (r = .33), and cognitive self-conscious beliefs (r = .29). Additionally, performance test anxiety was negatively correlated with attentional focus (r = -.27). These results are congruent with Spada et al.'s (2010) results discussed above demonstrating a link between metacognitive beliefs, attentional control, and anxiety.

Overall, results from these studies suggest that psychological interventions aiming to strengthen attentional control processes could lead to improvements in an individual's ability to attend to task-relevant stimuli. Ultimately, this improved ability to attend could mitigate test anxiety. Following from such a possibility, a metacognitive therapy intervention strategy—known as the attention training technique (ATT; Wells, 1990)—aimed at altering focus of attention in the service of improving metacognitive control will be discussed next as a possible efficacious intervention for test anxiety.

Attention Training Technique (ATT)

A component of metacognitive therapy (MCT; Wells, 2009), ATT has most recently been conceptualized as a potential standalone neurobehavioral therapy for anxiety disorders (Fergus & Bardeen, 2016). Neurobehavioral therapies aim to modify biological processes via behavioral methods and therefore differ from more conventional psychological interventions in that they do not necessarily target symptoms change (Siegle, Ghinassi, & Thase, 2007). Researchers have suggested that neurobehavioral therapies may help to address difficulties with relapse prevention and treatment-resistant individuals since these treatments target the underlying biological mechanisms (Siegle,

Carter, & Thase, 2006; Siegle et al., 2007; Thase et al., 1996; Thase, Simons, Cahalane, McGeary, & Harden, 1991). Furthermore, neurobehavioral therapies tend to be easily administered by clinicians with limited training and/or resources available (Siegle et al., 2007), which may be beneficial in settings that have limited access to mental health resources, yet demonstrate a need for mental health care. A prime example is a college setting where there has been noted to be an increasing student need for mental health care, yet limited resources (Eisenberg, Hunt, & Speer, 2012; Gallagher, 2005).

ATT is categorized as a neurobehavioral treatment as a result of its aims to modify the neurobiological processes associated with elevated anxiety (Fergus & Bardeen, 2016). More specifically, as described above, ATT targets attentional control processes with the goal of strengthening individuals' ability to flexibly attend to stimuli that better serves their goals. Prior evidence has supported ATT as a standalone intervention for the reduction of anxiety (Papageorgiou & Wells, 2000; Wells, White, & Carter, 1997). As described above, the theoretical basis for ATT is the S-REF model, which highlights the role of inflexible patterns of self-regulation and internally focused attention that lead to sustained emotional distress. ATT aims to disrupt this dysfunctional process and strengthen attentional control allowing the individual to disengage attention from maladaptive forms cognition, such as worry (Wells, 2009, 2013). The way in which ATT is hypothesized to achieve alterations in attentional control processes is via an auditory monitoring task that includes selective attention, attention switching, and divided attention exercises (Wells, 2007, 2009).

By strengthening these attentional control processes through practicing of the auditory monitoring task, ATT aids individuals in achieving a more flexible and

functional approach to maladaptive cognitions (e.g., improved ability to shift their focus to task-relevant stimuli). Several studies have utilized an automated version of ATT and seen significant reductions in frequency of intrusive thoughts and/or improved attentional control abilities (Callinan, Johnson, & Wells, 2015; Donald, Abbott, & Smith, 2014; Fergus & Hiraoka, 2018; Fergus, Wheless, & Wright, 2014; Nassif & Wells, 2014). Recently, a pilot study investigating a group format delivery of an automated version of ATT demonstrated a reduction in maladaptive metacognitive beliefs and a reduction in test anxiety among adolescent students (Fergus & Limbers, in press). This study is the first of its kind to provide preliminary data on the viability of automated ATT for the reduction of test anxiety, yet the student population was limited to eighth-grade students.

The automated version of ATT consists of a 12-minute audio recording in which individuals are asked to selectively attend to various competing auditory stimuli (Wells, 2007). As the audio-recording progresses, more auditory stimuli are introduced and individuals are asked to switch their attention to various sounds at a faster rate with the intent of increasing imposed attentional demands. The automated version of ATT offers a practical and standardized approach to treatment (Wells, 2007). Given the empirical evidence supporting the efficacy and user-friendly format of the automated version of ATT, it is reasonable to explore broader applications of its use. Recently, there has been an increasing interest in electronically-based interventions in an effort to reach a wider population of individuals suffering from emotional disorders, such as depression and anxiety (Cuijpers et al., 2009; Teachman, 2014). Specifically, it is estimated that less than half of individuals suffering from depression and/or anxiety seek care from a mental health professional (Andrews, Issakidis, Sanderson, Corry, & Lapsley, 2004).

Furthermore, Lovell and Richards (2000) noted that for those individuals that do seek treatment, they are often put on a long waiting list. Factors, such as lack of adequately trained clinicians (Weissman et al., 2006), time and travel constraints, and limited financial resources (Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010), have contributed to low adherence rates and a shortage of delivery options for effective treatment. As a result, researchers have suggested electronic-based treatments as a practical and feasible alternative to face-to-face therapy, leading to the development of various electronic-based interventions, also known as *eHealth* (Teachman, 2014).

A mirage of eHealth interventions have been developed in an attempt to increase the speed at which individuals can access mental health care, reduce the reliance on therapist-patient interaction, and reduce cost and travel time (Bennet & Glasow, 2009; Kazdin & Rabbit, 2013; Teachman, 2014). Although eHealth has been defined in numerous ways (Oh, Rizo, Enkin, & Jadad, 2005), the term generally refers to technologies used to improve mental health care (Riper et al., 2010). Furthermore, eHealth interventions are defined as treatments delivered via electronic technologies, such as the Internet, video games, or virtual reality (Thomas, 2012). For the purposes of this proposal, a focus will be placed on interventions administered via the Internet, with the majority being accessed through a computer or mobile device. Following from this focus, the term *eHealth* will be used to refer to the broad range of interventions that are hosted over the internet and require minimal, if any, direct therapist contact.

With the increase in development of eHealth interventions, researchers have investigated the feasibility and efficacy of this new avenue for treatment. eHealth interventions have demonstrated high compliance rates and patient satisfaction, with the

majority of patients highlighting the convenience, privacy, and low cost of these interventions (Andrews et al., 2010). Additionally, meta-analyses have investigated the efficacy of eHealth interventions for emotional disorders (Anderson & Cuijpers, 2009; Andrews et al., 2010; Cuijpers et al., 2009). Andrews et al. (2010) reviewed twenty-two randomized control studies comparing treatment outcomes of an eHealth CBT group to a control group. Important to note, some of the studies included in the meta-analysis included a therapist support component in conjunction with the eHealth version of CBT, yet Andrews et al. (2010) noted that the maximum therapist contact time was less than one hour for these studies. The eHealth CBT group demonstrated significantly greater symptom reduction across a variety of emotional disorders (Hedges' $g = 0.88$). These study results suggest that eHealth versions of CBT are effective despite limited, if any, direct contact with a clinician.

Potentially more promising were preliminary findings that eHealth CBT was just as effective when compared to face-to-face CBT (Andrews et al., 2010). These results were further supported by Cuijpers et al.'s (2009) meta-analysis of twenty-three randomized controlled studies investigating eHealth psychotherapies for anxiety. Results demonstrated no significant differences between eHealth interventions compared to traditional, therapist-administered interventions on reduction of anxiety symptoms. Although eHealth interventions demonstrate promising preliminary efficacy and provide a feasible, yet practical, delivery of mental health treatments, some challenges remain to be addressed in future research (e.g., small sample size, limited active controls; Cuijpers et al., 2009; Griffiths, Farrer, & Christensen, 2010; Teachman, 2014). Despite areas for future growth as described above, the extant literature supports eHealth interventions as

possible efficacious treatments for anxiety that may help to combat existing barriers to treatment.

The college student population appears to be a potential promising population for eHealth interventions due to students' heightened access to and familiarity of electronic technologies (Davies, Morriss, & Glazebrook, 2014). Furthermore, previous reports show elevated reports of mental health concerns among college-aged students, yet only a minority of these students actually seek mental health treatment and/or support (Blanco et al., 2008; Pedrelli, Nyer, Yeung, Zulauf, & Wilens, 2015). Specifically, Blanco et al. (2008) found that only 16% of college students with a diagnosis of an anxiety disorder sought mental health treatment. Several factors leading to college students not accessing traditional mental health services have been proposed, such as lack of time, stigma, knowledge regarding services, financial constraints, and personal preference for self-management of mental health care (Eisenberg et al., 2012; Eisenberg, Hunt, Speer, & Zivin, 2011; Gulliver, Griffiths, & Christensen, 2010; Komiya, Good, & Sherrod, 2000; Mowbray et al., 2006). A fear of what others will think of those seeking mental health care along with time constraints were two of the largest contributing factors reported by students for not seeking treatment for mental health concerns in prior studies (Eisenberg, Golberstein, & Gollust, 2007).

In order to overcome these barriers to seeking treatment, professionals have suggested eHealth interventions as a potential remedy for this specific college-aged population (Davies et al., 2014; Ryan, Shochet, & Stallman, 2010). Previous literature suggests that college students possess positive attitudes towards electronically administered mental health care (Linvedt, Sorensen, Ostvik, Verplanken, & Wang, 2008).

Interestingly, a study by Ryan et al. (2010) showed that although students who reported higher levels of emotional distress were less likely to seek face-to-face psychological treatment, these students reported they were more likely to seek Internet interventions. A meta-analysis on studies investigating the efficacy of eHealth interventions in college student populations demonstrated strong evidence for high enrollment rates, with up to 240 participants enrolled in studies and the majority of studies having an enrollment rate of 80% and above of contacted prospective participants (Chiauzzi, Brevard, Thurn, Decembrele, & Lord,, 2008; Sethi, Campbell, & Ellis, 2010). Attrition rates have ranged from 7.2% (Arpin-Cribbie, Irvine, & Ritvo, 2012) to 44.2% (Cavanagh et al., 2013), with an average attrition rate across college eHealth interventions of approximately 25% (Davies et al., 2014). However, it is important to underscore that the majority of reported attrition rates were calculated based on completion of post-intervention questionnaires, as opposed to completion of intervention tasks per se. For this reason, it was unclear whether participants were completing the intervention modules, yet not participating in post-task measures, or if high attrition rates were present throughout intervention implementation. Day, McGrath, and Wojtowicz (2013) reported an adherence rate of 61% for participants who completed all five modules of an eHealth program for emotional distress in college students. It should be noted that this study utilized weekly emails and/or telephone calls to participants to check-in on participant progress throughout the program intervention.

Another consistently cited barrier for seeking mental health treatment in a college-aged population is personal time constraints (Eisenberg et al., 2012). Current literature suggests that the majority of effective eHealth interventions contain between

five and nine sessions, with each session often not extending more than thirty minutes (Andrews et al., 2010). Supporters of eHealth interventions note that this duration is smaller than the suggested number of sessions for effective traditional CBT, which can range from 10 to 20 one-hour long sessions (Beck, 2011; Davies et al., 2014). Although previous studies have implemented various ATT session numbers and therefore optimal dosage is unknown, a systematic review on ATT by Knowles et al. (2016) concluded that six to nine sessions appears to be an optimal length of ATT practice to produce treatment effects that are maintained at 6-12 months follow-ups. This proposed treatment duration is similar to the suggested eHealth treatment duration.

There are multiple potential benefits to implementing ATT via an electronic format. An eHealth version of ATT is cost effective, user-friendly, and portable, which could aid in filling the gaps where mental health resources are scarce (Fergus & Bardeen, 2016). Additionally, ATT can be self-implemented by individuals and is brief, leading to possible higher compliance rates. Furthermore, it is a standardized approach to treating test anxiety and therefore can be replicated and evaluated in future studies (Fergus & Bardeen, 2016). Recently there have been a few studies that have investigated the benefits of an eHealth version of ATT for anxiety disorders (Moritz, Wess, Treszl, and Jelinek, 2011; Fergus & Hiraoka, 2018). Moritz et al. (2011) utilized a self-generated version of ATT as an intervention for individuals diagnosed with obsessive-compulsive disorder (OCD), yet found that less than half of participants adhered to the ATT practice protocol. This shed doubt on the feasibility of an eHealth version of ATT, at least for the self-generated version. Fergus and Hiraoka's (2018) study investigated an automated, eHealth version of ATT and modified Moritz and colleagues' study by implementing an

initial in-person practice session and weekly check-in telephone calls for all participants. During the initial practice session, a rationale for ATT was provided and the participants were oriented to how to access ATT via an electronic device. Results of this study demonstrated no attrition and strong adherence to ATT practice protocol; therefore, providing preliminary evidence for an eHealth version of ATT as a viable intervention to reduce test anxiety. In order to meet the specific needs of college students, the current study aims to build upon Fergus and Hiraoka's study by investigating an eHealth version of ATT with no face-to-face contact through the intervention period. As described previously, college students often report time constraints, stigma, and preference for self-management of mental health care (Eisenberg et al., 2012; Gulliver et al., 2010; Komiya et al., 2000; Mowbray et al., 2006), therefore investigation of an intervention that can be accessed completely via electronic means at any time of day might be of specific importance for the college student population.

In summary, current literature supports a need for a practical and effective intervention to be utilized in a college-aged setting. Given the evidence described above in providing support for the viability of an eHealth version of ATT and ATT as an effective intervention for the reduction of anxiety symptoms, with one study investigating test anxiety reduction specifically (Fergus & Limbers, in press), an eHealth version of ATT could be a feasible and effective intervention for test anxiety in college students. The current study is the first to our knowledge to investigate the benefits of an eHealth version of ATT specifically targeting heightened test anxiety within a college student population.

Purpose of the Present Study

Given the empirical support behind an effective automated version of ATT in the reduction of anxiety symptoms and with current literature supporting the delivery of eHealth interventions in college settings, ATT could be implemented as a type of eHealth intervention to treat test anxiety within this population. To date, there have been no previous studies examining ATT as an eHealth intervention within a college student population. Therefore, the primary aim of this study was to assess the feasibility of ATT as a completely electronically administered intervention for college students who self-report elevated test anxiety. A secondary aim of this study was to assess the efficacy of an eHealth version of ATT in treatment of test anxiety in a college-aged population. In order to investigate these aims, the current study examined attrition rates and self-reported reductions in test anxiety symptoms, as well as changes in related variables (i.e., attentional control, metacognitive beliefs), across two study groups: an ATT group and a music-listening control group.

A music-listening control group was selected because it has been demonstrated to be easily administered and perceived to be a non-burdensome, non-invasive intervention (Guetin et al., 2009). Additionally, music listening can be matched to the length of ATT, ensuring that participants in both groups are being exposed to the same lengths of auditory listening time. Further, it is hypothesized that listening to music acts as a distractor to listeners, guiding their focus away from negative stimuli, thereby, at least temporarily, reducing anxiety (Burns, Labbé, Williams, & McCall, 1999; Nilsson, 2008; Panteleeva, Ceschi, Glowinski, Courvoisier, & Grandjean, 2017). As such, music listening could be perceived as an active control. According to Rounsaville et al. (2001),

there are currently no established recommendations for control interventions for feasibility studies. They suggest that the earlier stages of behavioral therapy research focus on developing treatment procedures, building upon the theory the intervention is based on. As such, the beginning stages of behavioral intervention research are the building blocks upon which further research can investigate the efficacy of the intervention using randomized control trials. Provided the primary aim of the current study was to investigate the feasibility of an eHealth version of ATT, a music listening group is considered to be an appropriate control group for this study that allows for a time-matched procedure with expected small effects on test anxiety.

Hypotheses

Given the user-friendly, electronically based format of ATT, it was predicted that participants would adhere to the intervention and demonstrate motivation to complete the study in its entirety. It was hypothesized that the attrition rate for this study would not exceed 25 percent, as based on the average attrition rate found in a previous review of eHealth interventions for college students (Davies et al., 2014). Additionally, perceived feasibility and credibility of interventions was assessed via self-report questions. Based on previous literature, several concepts, such as perceived intervention usability, accessibility, and usefulness are thought to be important to measuring intervention credibility and feasibility (Kreuter, Farrell, Olevitch, & Brennam, 2000; Prochaska, Zabinski, Calfas, Sallis, & Patrick, 2000; Tones & Tilford, 2001; Vandelanotte & De Bourdeaudhuji, 2003; Weinreich, 1999). Self-report questions aimed to target these concepts. It was expected that ATT might have higher ratings in helpfulness in reducing test anxiety compared to the music listening group. Furthermore, it was predicted that the

ATT group would show a significantly greater reduction in test anxiety symptoms and maladaptive metacognitive beliefs compared to the music listening group. Additionally, it was hypothesized that the ATT group would demonstrate a significantly greater increase in self-reported attentional control compared to the music listening group.

CHAPTER TWO

Methods

Participants

A total of 821 undergraduate students were screened for eligibility. Of those students screened, 246 were eligible and invited to participate in the intervention study, and, 51 individuals participated in the study. The majority of participants who completed the study self-identified as female (94.1%) and White (45.1%), with an average age of 19.0 (*SD* = 1.40) years. Students who were eligible for the study but did not participate also predominantly identified as female (82.7%) and White (59.4%), with an average age of 19.0 (*SD* = 1.11) years. There were no differences in race ($\chi^2_{(6)} = 7.83$, $p = .251$), age ($t_{(244)} = -0.14$, $p = .890$), or year of schooling (i.e., freshman, sophomore, junior, senior, or other) ($\chi^2_{(4)} = 0.96$, $p = .916$) between those who were eligible and invited but did not participate versus those who participated. There were significantly more females who enrolled in the intervention study compared to males ($\chi^2_{(1)} = 4.13$, $p = .042$). Further, there were no significant differences in self-reported test anxiety symptoms ($t_{(244)} = 0.31$, $p = .758$) between those who were eligible and invited but did not participate versus those who participated. Participants in the study had a mean TAI of 60.0 (*SD* = 7.73); whereas, those who were eligible but did not participate had a TAI mean of 59.6 (*SD* = 8.39).

Of the initial sample of 51 participants, 23 participants were randomized to the ATT group and 28 were randomized to the music listening group. Ten out of the 51 participants (19.61%) did not complete the two-week intervention or the post-study

measures and therefore were not included in the final analysis. See Table 1 for descriptive statistics of the ATT and music listening groups.

Table 1. *Demographic characteristics of study participants*

Variable	ATT $n = 19$		Music Listening $n = 22$		*Statistics*
	Mean	*SD*	*Mean*	*SD*	
Age (years)	19.11	1.63	19.00	1.20	$t_{(39)} = 0.24$, $p = .813$
Gender	*N*	%	*N*	%	$\chi^2_{(1)} = 1.82$, $p = .178$
Male	0	0%	2	9.10%	
Female	19	100%	20	90.9%	
Race/Ethnicity	*N*	%	*N*	%	$\chi^2_{(6)} = 2.38$, $p = .882$
Caucasian/White	8	42.0%	8	36.4%	
Asian	3	15.7%	4	18.2%	
African-American/Black	1	5.30%	2	9.10%	
Hispanic/Latino	4	21.2%	5	22.7%	
Native American	0	0%	1	4.50%	
Bi-racial, Multi-racial	2	10.5%	2	9.10%	
Other	1	5.30%	0	0%	
Year in College	*N*	%	*N*	%	$\chi^2_{(4)} = 3.07$, $p = .546$
Freshman	10	52.6%	10	45.5%	
Sophomore	6	31.6%	7	31.8%	
Junior	2	10.5%	3	13.6%	
Senior	0	0%	2	9.10%	
Other	1	5.3%	0	0%	

Measures

Test Anxiety

The Test Anxiety Inventory (TAI; Spielberger et al., 1980) was administered to an online subject pool as a screening measure to determine study eligibility. The TAI is a 20-item self-report measure assessing test anxiety on an ordered-category scale ranging from 1 (almost never) to 4 (almost always). Higher scores indicate greater test anxiety. The TAI assesses both worry (e.g. "Thinking about my grade in a course interferes with

my work on tests") and emotionality (e.g. "My heart beats faster when I am taking a test") components of test anxiety. The TAI is one of the most widely used measures for assessing test anxiety in college students (Chapell et al., 2005) and has been validated in a series of studies. For example, psychometric studies indicate excellent internal consistency (α = .96) for scores on the TAI and strong three-week test-retest reliability (*r* = .80). Furthermore, the TAI demonstrated strong convergent validity (*r* = .82) with another measure of test anxiety (Ali & Mohsin, 2013; Spielberger et al., 1980).

Metacognitive Beliefs

Metacognitive beliefs were assessed using the Metacognition Questionnaire-30 (MCQ-30; Wells & Cartwright-Hatton, 2004). The MCQ-30 is a 30-item self-report questionnaire that assesses metacognitive beliefs on five separate dimensions: (a) positive beliefs about worry (e.g. "I need to worry in order to work well"); (b) negative beliefs about thoughts concerning uncontrollability and danger (e.g. "My worrying is dangerous for me"); (c) cognitive confidence (e.g. "I have a poor memory"); (d) beliefs about the need to control thoughts (e.g. "It is bad to think certain thoughts") ; and (e) cognitive self-consciousness (e.g. "I constantly examine my thoughts"). Individuals respond on a 4-point ordered-category scale ranging from 1 (do not agree) to 4 (agree very much). The MCQ-30 demonstrates good internal consistency for both the full scale and five subscales (αs ranging from .72-.93), as well as moderate-to-strong convergent validity with indices of anxiety (*r*s ranging from .25 to .73; Spada, Mohiyeddini, & Wells, 2008; Wells & Cartwright-Hatton, 2004). Test-retest correlations, after a period of upwards of four months, was reported as .75 for the total MCQ-30 scale and ranging from .59 to .87 for the subscales (Wells & Cartwright-Hatton, 2004; Myers & Wells, 2005). The MCQ-30

items appear best represented through a general metacognitive belief factor and five specific metacognitive belief factors, with the general factor accounting for the overwhelming amount of variance in MCQ-30 item scores (Fergus & Bardeen, 2019). Following from those findings and the lack of predictions regarding the differential performance of the separate MCQ-30 scales, a MCQ-30 total score was used for the present study.

Attentional Control

Attentional control was measured by the Attentional Control Scale (ACS; Derryberry & Reed, 2002), a 20-item self-report measure assessing individual differences in attentional control. Specifically, the ACS measures abilities of attention shifting (e.g. "I can quickly switch from one task to another") and attention focus (e.g. "My concentration is good even if there is music in the room around me"). Individuals responded on a 4-point ordered-category scale ranging from 1 (almost never true) to 4 (always true). Higher scores indicate greater attentional control. Previous psychometric studies have supported a two-factor structure for the ACS (Derryberry & Reed, 2002; Judah, Grant, Mills, & Lechner, 2014; Ólafsson et al., 2011). The ACS has demonstrated good internal consistency ($\alpha = .84$) and strong convergent validity with measures of attentional control (*r*s ranging from .40-.88; Derryberry & Reed, 2002; Judah, Grant, Mills, & Lechner, 2014; Ólafsson et al., 2011). The test-retest correlation, after a period of one month, is strong ($r = .61$) for the total score (Fajkowska & Derryberry, 2010). For this study, the total score was used to investigate study predictions.

Intervention Credibility Questions

Perceived feasibility and credibility of interventions was assessed by asking participants to self-report on perceived burdensome and ease of use of interventions: (a) "How burdensome was it to listen to the audio recording daily?"; (b) "Did you find the audio recording to be easy to use?." Participants were also asked whether they would recommend the intervention to others and if they believed it to be helpful in reducing test anxiety: (a) "How confident would you be in recommending this treatment to a friend?"; (b) "How successful do you think this treatment was in reducing your test anxiety?." Participants responded to these questions on a 4-point rating scale from 1 (do not agree) to 4 (agree very much).

Procedures

See Figure 1 for an overview of the procedures for the present study. The TAI was administered as a screening measure to an unselected online subject pool in order to determine study eligibility. Participants who scored high on test anxiety (i.e., a score of 49 or higher for females and a score of 43 or higher for males; Spielberger, 1980) were invited to participate in the intervention portion of the study. Eligibility cut-off scores were determined based on a standardized distribution of established TAI *T* scores and represent a standard deviation above the mean score (Spielberger, 1980). One standard deviation from a normative mean score is often used to indicate moderate symptom severity (Cella et al., 2008; Choi, Schalet, Cook, & Cella, 2014). As part of the screening process, participants were asked if they would like to be contacted about participating in future studies. Only participants that met eligibility criteria and consented to future contact were sent an e-mail asking if they would like to participate in the proposed study.

Due to the study being administered electronically and risks were considered minimal with no adverse effects reported in previous studies (Callinan et al., 2015; Donald et al., 2014; Fergus et al., 2014; Nassif & Wells, 2014; Papageorgiou & Wells, 1998; Wells et al., 1997), a waiver of written documentation of informed consent was requested and granted from Baylor University's Institutional Review Board (IRB). This document waived the requirement to obtain a signed consent form from study participants. Participants still provided informed consent by reading the consent documents via Qualtrics and indicated consent by selecting an "I agree" button. Consenting participants were then asked to complete an online pre-intervention battery of questionnaires. The pre-intervention battery included the TAI, MCQ-30, and ACS.

After pre-intervention questionnaires were completed, participants were randomly assigned to an ATT group or an active control, music listening group. For the ATT group, participants listened to a 12-minute recording developed by Wells (2009) that provided a brief rationale of the technique, followed by five minutes of selective attention, five minutes of attention switching, and two minute of divided attention while being presented with auditory stimuli. Participants in the music listening group were presented with a brief rationale and then listened to a 12-minute audio recording consisting of Antonin Dvořák's "Largo" from "Symphony No. 9 in E Minor", a slow-paced, classical music song used in previous studies (Dillman Carpentier & Potter, 2007; Labbe, Schmidt, Babin, & Pharr, 2007). Both interventions were accessed through an online link provided to each participant. Instructions for each intervention were explained through an email that guided participants through the specific task they would be practicing throughout the duration of the study.

After participants were presented with their respective audio recordings, they were asked to complete the technique one time per day for the following two weeks. Participants were informed that they would receive a daily email via Qualtrics with the intervention link and instructions. Reminder emails were sent to participants who had not accessed the daily intervention link. Participant progress, including number of times participant logged in and time spent logged in, was tracked online via Qualtrics. Participants were asked to contact the principal investigator of this study if they encountered technology difficulties and/or had not received the daily emails.

At the completion of the two weeks, participants were sent an email with a link asking them to complete post-intervention questionnaires. The post-intervention battery included the TAI, MCQ-30, ACS, and credibility questions assessing perceived burdensomeness and feasibility of interventions.

Data Analytic Strategy

A chi-square test was used to analyze differences in attrition rates between the two study groups. Based on the average attrition rate found in a previous review of eHealth interventions for college students, it was hypothesized that the attrition rate in the ATT group would not exceed 25% (Davies et al., 2014). Further, it was expected that attrition rates would be equivalent between the ATT group and music listening group based on the hypothesis that the two interventions are perceived to be equally burdensome. Independent samples *t*-tests were used to examine differences in credibility items between the two study groups. It was predicted that both groups (ATT, music listening) would have equivalent credibility scores as perceived by the participants, yet

ATT might have higher ratings in helpfulness in reducing test anxiety compared to music listening group.

Independent samples *t*-tests were used to examine pre-task group differences in sociodemographic variables, test anxiety, metacognitive beliefs, and attentional control. A series of repeated-measures analysis of variance (ANOVAs) were used to examine differential changes in the study variables across the two groups. In these analyses, measures of test anxiety, metacognitive beliefs, and attentional control were the within-subjects variable (pre-task, post-task) and group (ATT or music listening) was the between-subjects variable. It was predicted that there would be a significant within-subjects by between-subjects interaction on test anxiety, metacognitive beliefs, and attentional control. It was predicted that ATT would produce a greater change in study variables (test anxiety, metacognitive beliefs, and attentional control) compared to the music listening group. Paired sample *t*-tests were used to examine changes within each study group. The expected pattern was that test anxiety and metacognitive beliefs would significantly decrease from pre-task to post-task in ATT, yet no changes in study variables would be observed in the music listening group. Additionally, it was expected that attentional control would significantly increase from pre-task to post-task in ATT and no changes in this study variable would be observed in the music listening group. A significance level of .05 (two-tailed) was used for all analyses.

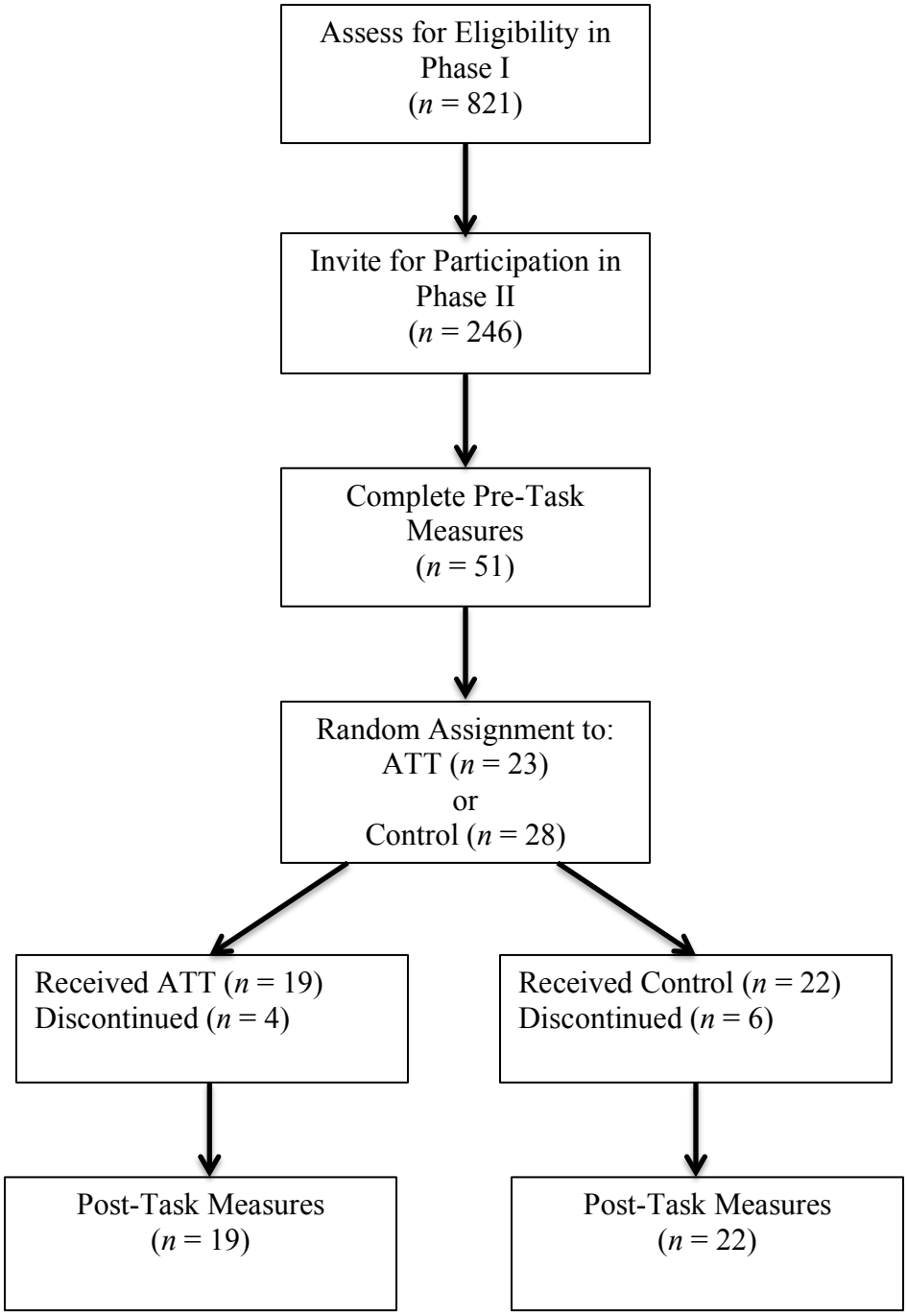

Figure 1. Study flow diagram. ATT = attention training technique. Control = music listening.

CHAPTER THREE

Results

Preliminary Statistics

The final sample consisted of 41 undergraduate students who reported elevated test anxiety symptoms. At baseline, there were no significant differences in self-report measures between the ATT and music listening groups. Pre-intervention measures statistics are provided in Table 2.

Table 2. *Independent samples t-test for pre-intervention measures*

Variable	ATT $n = 19$		Music Listening $n = 22$		*Statistics*
	Mean	*SD*	*Mean*	*SD*	
TAI	60.74	10.34	60.14	6.55	$t_{(39)} = 0.23,\ p = 0.817$
MCQ	76.47	16.51	73.27	9.12	$t_{(39)} = 0.78,\ p = 0.439$
ACS	44.42	8.92	42.14	6.86	$t_{(39)} = 0.93, p = 0.360$

Feasibility and Credibility

The attrition rate for the study as a whole was 19.2%. The ATT group had an attrition rate of 17.4%, which is significantly less than the a-priori comparison attrition rate of 25% ($t_{(22)} = 7.13, p < .001$). The music listening group had an attrition rate of 21.4%. There was not a significant difference in attrition rates between the ATT and music listening group ($\chi^2_{(1)} = 0.13, p = .718$). On average, participants in the ATT group listened to the audio recording a total of 10.32 days ($SD = 3.56$) out of 14 days. The participants in the music listening group listened to the audio recording a total of 11.00 days ($SD = 2.23$) out of 14 days. When looking at the non-completers, within the ATT

intervention they completed an average of 3.75 sessions (*SD* = 4.19) and within the music listening group an average of 4.5 sessions (SD = 2.81).

Independent samples *t*-test and descriptive statistics for credibility and feasibility self-report questions are presented in Table 3. There was no significant difference between groups on perceived helpfulness of either ATT or music listening. Furthermore, there were no significant differences between condition groups on ease of use of study intervention links or likelihood to recommend treatment to a friend. There was a significant difference in perceived burdensome of listening to the audio-recording daily ($t_{(39)} = 2.50$, $p = .017$; $d = 0.81$), with those in the ATT group reporting higher perceived burdensomeness.

Table 3. *Independent samples t-test for credibility and feasibility self-report questions*

Variable		*Mean (SD)*	*Statistics*
It was burdensome to listen to the audio recording daily.	ATT	2.58 (0.96)	$t_{(39)} = 2.50,\ p = 0.017$
	Music Listening	1.91 (0.75)	
The audio recording link was easy to use.	ATT	3.74 (0.65)	$t_{(39)} = -0.72,\ p = 0.475$
	Music Listening	3.86 (0.47)	
I would recommend this treatment a friend.	ATT	2.63 (0.90)	$t_{(39)} = -0.51,\ p = 0.612$
	Music Listening	2.77 (0.87)	
This treatment was successful in reducing my test anxiety.	ATT	2.16 (0.90)	$t_{(39)} = -0.71,\ p = 0.483$
	Music Listening	2.36 (0.95)	

Main Study Predictions

Descriptive statistics for pre- and post-measures are provided in Table 4. Repeated measures ANOVA results for the changes in study variables after study intervention are presented in Table 5. In the analyses, the within-subjects factor was time (baseline and post-study intervention) and the between-subjects factor was group (ATT and music listening). There was a main effect of time for TAI, MCQ, and ACS, indicating that there were statistically significant changes in self-reported test anxiety (d = 0.73), metacognitive beliefs (d = 0.45), and attentional control (d = 0.29) across both interventions. There was no interaction between time and group for TAI, MCQ, or ACS, indicating that the rate of change in self-reported test anxiety, metacognitive beliefs, or attentional control from pre- to post-intervention did not differ between the two groups.

Table 4. *Pre- and Post- Intervention Descriptive Statistics*

Variable		Condition		
		ATT	Music Listening	Total
		n = 19	n = 22	n = 41
		Mean (SD)	*Mean (SD)*	*Mean (SD)*
TAI				
	Pre-Intervention	60.74 (10.34)	60.14 (6.55)	60.41 (8.41)
	Post-Intervention	53.89 (12.83)	51.32 (13.21)	52.51 (12.94)
MCQ				
	Pre-Intervention	76.47 (16.51)	73.27 (9.12)	74.76 (13.00)
	Post-Intervention	71.11 (18.49)	65.41 (15.00)	68.05 (16.74)
ACS				
	Pre-Intervention	44.42 (8.92)	42.14 (6.86)	43.20 (7.87)
	Post-Intervention	46.00 (10.39)	45.18 (6.99)	45.56 (8.63)

Table 5. *Repeated Measures ANOVA, Post-Intervention*

Variable	Effect	
	Time	Time*Group
	Statistics	*Statistics*
TAI	$F_{(1, 39)} = 26.97$, $p = <.001$	$F_{(1, 39)} = 0.43$, $p = .516$
MCQ	$F_{(1, 39)} = 12.86$, $p = .001$	$F_{(1, 39)} = 0.46$, $p = .503$
ACS	$F_{(1, 39)} = 6.96$, $p = .012$	$F_{(1, 39)} = 0.70$, $p = .408$

Follow-up analyses indicated that self-reported symptoms of test anxiety significantly decreased from pre- to post-intervention in both groups: ATT ($t_{(18)} = 3.09$, $p = .006$, $d = 0.60$); music listening ($t_{(21)} = 4.31$, $p < .001$, $d = 0.87$). Additionally, self-reported metacognitive beliefs also significantly decreased from pre- to post-intervention in both groups: ATT ($t_{(18)} = 2.21$, $p = .040$, $d = 0.31$); music listening ($t_{(21)} = 2.90$, $p = .009$, $d = 0.65$). There was no significant changes in self-reported attentional control from pre- to post-intervention in the ATT group ($t_{(18)} = -1.18$, $p = .254$), yet there was a significant change in self-reported attentional control in the music listening group ($t_{(21)} = -2.66$, $p = .015$, $d = 0.45$).

CHAPTER FOUR

Discussion

Overview

The present study sought to investigate the feasibility of an eHealth version of ATT for college students who self-report elevated test anxiety. It was hypothesized that participants would adhere to the ATT intervention, with an attrition rate that does not exceed 25 percent. Furthermore, this study investigated the credibility of the ATT intervention through analyses of self-report questions of helpfulness of intervention. It was hypothesized that the ATT intervention would be perceived as more helpful in reducing test anxiety symptoms compared to an active control group (i.e., music listening group).

A secondary aim of this study was to assess potential changes in test anxiety in college-aged students who report high levels of test anxiety after completing an eHealth intervention over a two-week period. Specifically, it was hypothesized that ATT would cause significant reductions in test anxiety symptoms and metacognitive beliefs compared to the music listening group. Further, it was hypothesized that the ATT group will demonstrate a significantly greater increase in self-reported attentional control compared to the music listening group.

Feasibility and Credibility

As predicted, the attrition rate for the ATT group did not exceed 25%, which is an average attrition rate based on prior eHealth intervention studies (Davies et al., 2014).

Although the present study's attrition rate is acceptable when compared to other eHealth interventions, it had a notably higher attrition rate compared to a recent pilot study utilizing an eHealth-based protocol of ATT, which demonstrated no attrition (Fergus & Hiraoka, 2018). Differences in methodology may account for the disparity in attrition rates between the two studies. For example, Fergus and Hiraoka's study utilized in-person sessions at the beginning and end of the intervention along with brief, weekly phone check-ins. The present study utilized solely electronic means (i.e., emails via Qualtrics) to contact participants and did not have weekly check-ins with participants as they progressed through the intervention. In-person contact and brief check-in sessions may lead to less attrition. In fact, Wells (2009) recommends that the rationale behind ATT should be presented by a clinician and then practiced with a clinician before individually applied. A prior study by Moritz et al. (2011) investigated the feasibility of a completely eHealth version (i.e., no in-person or telephone sessions) of ATT that was self-generated by the participants. They found that less than half of their participants reported consistent practice of ATT. This study shed doubt on the application of an eHealth version of ATT, yet noted that it did not follow recommendations by Wells (2009) to have a therapist explain rationale of ATT and practice with individual before treatment begins. Additionally, Fergus and Hiraoka (2018) noted that a self-generated version of ATT may increase patient burden compared to an automated version; therefore, leading to increase in attrition. Taken together, the present study sheds further light on the feasibility of a completely electronic, automated version of ATT, providing evidence that low attrition rates can be achieved with this version, although adding in-

person sessions and/or telephone check-ins may decrease attrition rates further. Future research is needed to investigate this possibility.

Prior research on a 4-week eHealth ATT protocol (Wells, 2009) provided evidence for adherence to the recommended practice benchmarks (Fergus & Hiraoka, 2018). Yet, there has been a call to investigate the feasibility of a 2-week eHealth ATT protocol to see if the recommended six to nine sessions for optimal treatment effects can still be acquired (Knowles et al., 2016). On average, participants completed 10.3 (*SD* = 2.2, range 2-14) ATT sessions within a 14-day period, with the overwhelming majority of participants (84.2%) completing at least six sessions of ATT. Taken together with the low attrition rate, this study provides evidence for the feasibility of a 2-week eHealth ATT protocol with no face-to-face interaction with a clinical provider.

It is also important to consider the student population who choose to engage in the eHealth interventions, as those who willingly participate in treatment for test anxiety might be more motivated to engage in an intervention, despite delivery modality. The enrollment rate for this study was approximately 21%, suggesting that the wide majority of undergraduate students self-reporting high levels of test anxiety chose not to engage in an eHealth intervention in order to help reduce their symptoms. This pattern of results is inconsistent with prior studies providing evidence for high enrollment rates around 80% for eHealth interventions (Chiauzzi et al., 2008; Sethi, Campbell, & Ellis, 2010). Both of the prior studies actively recruited participants by either disseminating advertisements during lectures and/or setting up booths in student common areas; thereby, potentially increasing enrollment rate. For the current study, no active recruitment process was used and there was no incentive (e.g., class credit or monetary reward) for completing the

eHealth intervention in this study. Therefore, the current methodology may have reduced the enrollment rate. In addition, even though students may be self-reporting high levels of test anxiety, they may not perceive it as affecting their daily functioning or academic success and therefore may be less interested in engaging in treatment for test anxiety. Prior research has shown that college students are more likely to engage in treatment if they perceive the importance of their problem as high (i.e., negatively impacts current functioning; Geers, Wellman, Seligman, Wuyek, & Neff, 2009). Future research should therefore look to investigate the impact of participants' perceived importance of test anxiety on functioning as it is related to their motivation to enroll in eHealth interventions for test anxiety.

Participants in both the ATT and music listening group reported that the link was easy to use. No participants experienced difficulties accessing the link, providing further support for the practicability and user-friendliness of the eHealth delivery modality. Analyses of self-report questions of perceived burdensome of the ATT intervention suggest that participants in the ATT group found the audio recording to be significantly more burdensome compared to the perceived burdensomeness of the classical music audio recording, with an effect size indicating a large magnitude of difference. One reason for this difference could be that the ATT audio recording requires more active attention from the listener, as the listener is suppose to follow the directions provided by the voice in the audio recording. In contrast, listening to classical music is a relatively passive activity and no instructions are suggested during the recording. Interestingly, an increase in perceived burdensomeness did not appear to effect adherence rates between the two interventions. Therefore, perceived burdensomeness may not influence

adherence to an extent initially hypothesized, or potentially this select population reporting high test anxiety may be more motivated for treatment despite moderate levels of intervention burden. As noted above, prior research has demonstrated a positive relationship between perceived importance of problem and motivation to engage in treatment (Geers et al., 2009). Future research should assess participants' perception of test anxiety's impact on their functioning and if reducing test anxiety is of value to them, an subsequently, how these variables are related to motivation to engage in treatment.

In terms of credibility, there was no significant difference between perceived helpfulness in reducing test anxiety between the two treatment groups. On average, participants in both conditions reported "agreeing slightly" with the statement that the treatment was successful in reducing test anxiety. Participants were asked to provide feedback about their experience in the study. Following that feedback, participants in the ATT group reported they felt the intervention would have been more helpful if it has been a different recording everyday as opposed to the same recording. One participant stated, "Listening to [the recording] every day got tiresome and the recording got boring." Additionally, two participants in the ATT group reported difficulty distinguishing the different sounds of the ATT recording. Overall, participants in the music group reported feeling "more at ease" when taking tests after listening to the recording; although, one participant reported an increase in nervousness after completing the music listening intervention. Further, participants in both groups reported they would recommend the treatment to a friend.

Evidence for the feasibility and perceived credibility of an eHealth version of ATT is of importance as there has been a recent push to develop more electronically

based interventions in order to overcome treatment dissemination barriers (e.g., lack of adequately trained clinicians, time and travel constraints, and mental health stigma). It has been estimated that more than half of individuals suffering from an emotional disorder do not seek care from a clinical provider (Andrews et al., 2004) and a majority of those who do seek mental health care are put on a waiting list (Lovell & Richards, 2000). eHealth services may serve as a way to meet the growing demands of mental health needs, as well as reduce workout burnout and reduce waiting times for individuals who are best served with face-to-face clinical care (e.g., individuals needing specialized treatment). Further, eHealth services may be beneficial in meeting the needs of those who are reluctant to seek mental health care services. Reluctance to seek mental health services could be a cause of a variety of factors, including stigma surrounding mental health, time and financial restrictions, and preference for self-management of psychological difficulties (Eisenberg et al., 2007). College students may be specifically impacted by these dissemination barriers, and therefore effective eHealth services may benefit this population greatly.

Changes in Test Anxiety

Compared to a control group, eHealth ATT did not lead to significantly greater reductions in test anxiety or metacognitive beliefs, nor did it lead to a significantly greater increase in attentional control. Several factors could account for the similar outcomes between the two intervention groups. Music listening has been shown to have small, yet significant impacts on acute anxiety reduction; however, evidence is lacking for support of long-term anxiety reduction after music listening intervention (Panteleeva et al., 2017). It could be that differences between the two groups would be evident if

follow-up measures were implemented in the current study. A recent study investigating ATT among eighth-grade students demonstrated a significant reduction in test anxiety at three-weeks post intervention compared to a music listening group (Fergus & Limbers, in press). The utility of follow-up measures is discussed in more detail below. Additionally, lack of differences between the two intervention groups may be a result of the two-week practice duration and differences between groups may emerge after longer practice durations. Although investigation of prior studies evaluating ATT have led to a recommendation of six to nine ATT sessions for long-term effects of ATT, the majority of the studies were single-case and case study designs that did not compare ATT to an active control group. Therefore it may be that a longer ATT practice duration is needed in order for differences between ATT and an active control group to emerge. One recent study implementing four-week long practice duration of ATT demonstrated a large effect size on the reduction of anxiety symptom severity, yet there was no control group (Fergus & Hiraoka, 2018). Lastly, it cannot be overlooked that this study implemented an entirely eHealth version of ATT which might have attenuated the potency of the intervention. For example, no interactions with a clinical provider may have led to a reduction in ATT effectiveness. Future research should look to examine treatment outcomes comparing different versions of ATT to an active control group.

As predicted, ATT caused significant reductions in test anxiety. This finding is the first to provide evidence that ATT can help to reduce test anxiety in undergraduate students. This is especially important as research is predicting an increasing rise in test anxiety as high-stakes testing becomes more prevalent within our society (Berliner, 2011). Further, in recent years, university counseling centers have been requesting an

increase in resources in order to treat the rising number of students presenting with mental health and/or academic difficulties (Benton, Robertson, Tseng, Newton, & Benton, 2003; Xiao et al., 2017). An eHealth version of ATT that is effective in reducing test anxiety might serve as a useful tool for mental health providers to utilize in order to meet these growing demands.

Congruent with study predictions, ATT also caused significant reduction in metacognitive beliefs. As hypothesized by O'Carroll and Fisher (2013), metacognitive beliefs may guide an individual's self-regulatory and attentional control processes leading to a decrease in test performance. ATT appears to be helpful in reducing maladaptive metacognitive beliefs about worry, which may in turn aid to decrease test anxiety. Although proposed to strengthen attentional control through practicing of the auditory monitoring task, an eHealth version of ATT did not lead to a significant increase in self-reported attentional control in this study. This was unexpected based on the S-REF model. One possible explanation is that although participants did not report subjective changes in ability to concentrate, objective changes may have occurred. As discussed below, the current study did not include objective measures of attentional control, which limits interpretation of results. Further, the S-REF model suggests that metacognitive beliefs and attentional control uniquely contribute to anxiety, therefore it may not be surprising to only see significant changes in metacognitive beliefs, and not a significant increase in attentional control, yet still observe significant reductions in test anxiety among the study sample. Additionally, prior research has demonstrated that negative cognitions have the strongest impact on test anxiety and exam performance outcomes (Cassady & Johnson, 2002; Cassady, 2004; Putwain et al., 2010); therefore, it might be

posited that the reduction of maladaptive metacognitive beliefs alone will lead to a decline in test anxiety despite no changes in attentional control being observed.

Interestingly, although ATT did not lead to a significant change in self-reported attentional control, there was a significant increase in self-reported attentional control within the music listening group. Prior research has suggested that music listening acts as a distractor from negative stimuli, thereby helping individuals to disengage from anxious thoughts (Burns et al., 1999; Nilsson, 2008; Panteleeva et al., 2017). It is possible that disengagement from maladaptive thoughts increases an individual's perceived sense of attentional control. Preliminary research has demonstrated that music listening, specifically classical music, leads to enhanced attention, yet it is uncertain whether these effects only occur acutely during the music listening period or have long lasting outcomes on attention (Diaz, 2013; Pêcher, Lemercier, & Cellier, 2009). Additionally, perceived burdensome of ATT may have impacted participants' ability to fully engage with the stimuli presented in the ATT recording, thereby resulting in no change in perceived attentional control. The music listening intervention was perceived as less burdensome, which may have allowed for participants to more fully engage in the intervention, thereby increasing perceived attentional control. Ultimately, the rate of change in attentional control did not differ between the two groups, therefore caution should be drawn when considering whether music listening is better in facilitating attentional control compared to ATT.

Limitations and Conclusions

Limitations of the study must be acknowledged. Although daily access to audio recording was tracked via Qualtrics, there was no way of ensuring that participants were

actively listening to the audio-recordings. As part of the emailed suggestions for listening to the audio recording, participants were recommended to listen to the audio recording in a location and at a time of day that would allow for limited distractions. Yet, it was not assessed whether or not participants adhered to this suggestion. This methodological barrier spans across investigations of eHealth interventions as a whole, as there are limited ways to determine if participants are actively participating in treatment without increasing clinical provider's participation in the intervention. As such, although this limitation applies to the current study, it also relates to the real world application of eHealth interventions that decrease clinical provider's involvement in eHealth treatments. The results of the current study provide preliminary data to support an eHealth version of ATT as a viable intervention that helps expand mental health services and reduce clinician burden. Further, this ATT protocol was delivered with minimal cost and with flexibility in that participants could listen to the audio recording at a time and location of their choosing.

As noted above, the present results cannot speak to the long-term benefits of an eHealth version of ATT. Although the current study followed the recommended dosage of sessions required to yield long-term benefits over a six to twelve month period (Knowles et al., 2016), this suggestion was based off of single-case trials. Therefore, it has been suggested that future research should utilize randomized control trials with follow-up data to investigate the long-term benefits of ATT.

Another study limitation is that the participants only represent a portion of the students who endorsed high test anxiety; therefore, study results cannot necessarily be generalized to other student populations. It is possible that students who endorsed high

test anxiety and engaged in the intervention differed in unknown ways from students who endorsed high test anxiety but did not agree to participate in the study in ways that made them more likely to adhere to treatment and/or respond well to the intervention. For example, treatment goals, level of insight into difficulties, and motivation have all been shown to effect engagement in eHealth interventions (Geers et al., 2009), yet these variables were not assessed between the high test anxiety students who participated in the study and those who did not. Further, the overwhelmingly majority of the study participants were female and therefore study results cannot necessarily be generalized to male college students. A strength of the current methodology is that both study conditions could be considered an active intervention and participants were blind to condition enrollment, suggesting that desirability of a specific intervention would not impact treatment adherence. Further, all participants were randomized to an intervention.

There were further limitations with the study methodology. Specifically, the use of self-report questionnaires to assess feasibility, credibility, and efficacy of an eHealth version of ATT introduces subjective bias. Future studies might benefit from including multi-method assessment measures in order to obtain objective data on efficacy of an eHealth version of ATT to reduce test anxiety. Seeing that test anxiety has been demonstrated to negatively impact academic achievement (Chapell et al. 2005; von der Embse et al., 2018), obtaining academic achievement scores, such as test scores and changes in GPA, would provide further insight into efficacy of ATT intervention. Further, it was not assessed whether students had examinations during the intervention periods. It is possible that reduction in test anxiety may have been the result of testing situations occurring during the intervention period. For example, if a student had begun

the intervention during a period of time where more examinations were incurred (e.g., midterms or final examinations) and then completed the study (i.e., post-study measures) during a time of fewer examinations, then a reduction in test anxiety may be a result of a reduction in examinations incurred as opposed to the intervention itself. Future research would benefit from tracking frequency of examinations participants encountered during intervention period, as well as measuring test anxiety immediately before, during, and after examinations in order to better account for external factors that may be impacting changes in test anxiety.

Although the current study offers preliminary support for ATT as a feasible intervention to reduce test anxiety, other potentially relevant outcomes were not investigated. As noted in the previous paragraph, future research should investigate the impact ATT has on academic performance (i.e., grade point average, standardized tests, and university examinations), and if so, whether reduction in test anxiety accounts for improvements in achievement. Further, recent research has shown a consistent negative relationship between test anxiety and self-concept (e.g., self-esteem and self-efficacy; Raufelder & Ringeisen, 2016; von der Embse et al., 2018). Seeing as these intrapersonal variables appear to be strongly related to test anxiety, future research should investigate whether ATT leads to an increase in positive self-concept, or if differences in an individual's perceived self-concept leads to differences in benefits following ATT intervention.

Despite the limitations stated above, the current study had several strengths that built on previous research, shedding light on the applicability of an eHealth version of ATT. With a recent push towards development of eHealth interventions, the current

study, the first to investigate an eHealth version of ATT with no face-to-face contact for test anxiety, adds to the evidence supporting the feasibility of ATT as an eHealth intervention. eHealth interventions have many advantages compared to traditional face-to-face services, including increasing accessibility, reducing health care costs, and decreasing clinical provider burden (Davies et al., 2014; Ryan et al., 2010). eHealth has also been described as a valuable modality in which to increase patient engagement and potentially leading to more robust treatment outcomes (Barello et al., 2016). Given the empirical support thus far for feasibility of an eHealth version of ATT in conjunction with the proclaimed need for more accessible mental health interventions, future research should aim to continue investigating the efficacy of an eHealth version of ATT across mental health disorders and sample populations.

APPENDICES

APPENDIX A

Test Anxiety Inventory (TAI)

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then indicate how you *generally* feel by writing the appropriate number **(1 to 4)** on the line next to each statement.

1	2	3	4
Almost Never	Sometimes	Often	Almost Always

Response
(1 to 4)

_____ 1. I feel confident and relaxed while taking tests.

_____ 2. While taking examinations I have an uneasy, upset feeling.

_____ 3. Thinking about my grade in a course interferes with my work on tests.

_____ 4. I freeze up on important exams.

_____ 5. During exams I find myself thinking about whether I'll ever get through school.

_____ 6. The harder I work at taking a test, the more confused I get.

_____ 7. Thoughts of doing poorly interfere with my concentration on tests.

_____ 8. I feel very jittery when taking an important test.

_____ 9. Even when I'm well prepared for a test, I feel very nervous about it.

_____ 10. I start feeling very uneasy just before getting a test paper back.

_____ 11. During important tests I feel very tense.

_____ 12. I wish examinations did not bother me so much.

_____ 13. During important tests I am so tense that my stomach gets upset.

_____ 14. I seem to defeat myself while working on important tests.

_____ 15. I feel very panicky when I take an important test.

_____ 16. I worry a great deal before taking an important examination.

_____ 17. During tests I find myself thinking about the consequences of failing.

_____ 18. I feel my heart beating very fast during important tests.

_____ 19. After an exam is over I try to stop worrying about it, but I can't.

_____ 20. During examinations I get so nervous that I forget facts I really know.

Citation: Spielberger, C. D. (1980). *Test Anxiety Inventory ("Test Attitude Inventory") (TAI)*. Consulting Psychologists.

APPENDIX B

Metacognition Questionnaire-30 (MCQ-30)

Instructions: This questionnaire is concerned with beliefs people have about their thinking. Listed below are a number of beliefs that people have expressed. Please read each item and indicate how much you *generally* agree with it by writing the appropriate number **(1 to 4)** on the line next to each statement.

1	2	3	4
Do not agree	Agree slightly	Agree moderately	Agree very much

Response
(1 to 4)

_____ 1. Worry helps me to avoid problems in the future.

_____ 2. My worrying is dangerous for me.

_____ 3. I think a lot about my thoughts.

_____ 4. I could make myself sick with worrying.

_____ 5. I am aware of the way my mind works when I am thinking through a problem.

_____ 6. If I did not control a worrying thought, and then it happened, it would be my fault.

_____ 7. I need to worry in order to remain organized.

_____ 8. I have little confidence in my memory for words and names.

_____ 9. My worrying thoughts persist no matter how I try to stop them.

_____ 10. Worrying helps me to get things sorted out in my mind.

_____ 11. I cannot ignore my worrying thoughts.

_____ 12. I monitor my thoughts.

_____ 13. I should be in control of my thoughts all of the time.

_____ 14. My memory can mislead me at times.

_____ 15. My worrying could make me go mad ("crazy").

_____ 16. I am constantly aware of my thinking.

_____ 17. I have a poor memory.

_____ 18. I pay close attention to the way my mind works.

_____ 19. Worrying helps me cope.

_____ 20. Not being able to control my thoughts is a sign of weakness.

_____ 21. When I start worrying, I cannot stop.

_____ 22. I will be punished for not controlling certain thoughts.

_____ 23. Worrying helps me to solve problems.

_____ 24. I have little confidence in my memory for places.

_____ 25. It is bad to think certain thoughts.

_____ 26. I do not trust my memory.

_____ 27. If I could not control my thoughts, I would not be able to function.

_____ 28. I need to worry in order to work well.

_____ 29. I have little confidence in my memory for actions.

_____ 30. I constantly examine my thoughts.

Citation: Wells, A., & Cartwright-Hatton, S. (2004). A short form of the Metacognitions Questionnaire: Properties of the MCQ-30. *Behaviour Research and Therapy, 42*, 385-396.

APPENDIX C

Attentional Control Scale (ACS)

Instructions: This survey consists of a number of statements that describe attention or concentration. Read each statement and then mark the answer to the right that best describes how much or how often that statement applies to you in general. Use the following scale:

1	2	3	4
Almost never true for you	Sometimes true for you	Often true for you	Always true for you

Response **(1 to 4)**

_____ 1. It's very hard for me to concentrate on a difficult task when there are noises around.

_____ 2. When I need to concentrate and solve a problem, I have trouble focusing my attention.

_____ 3. When I am working hard on something, I still get distracted by events around me.

_____ 4. My concentration is good even if there is music in the room around me.

_____ 5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.

_____ 6. When I am reading or studying, I am easily distracted if there are people talking in the same room.

_____ 7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.

_____ 8. I have a hard time concentrating when I'm excited about something.

_____ 9. When concentrating I ignore feelings of hunger or thirst.

_____ 10. I can quickly switch from one task to another.

_____ 11. It takes me a while to get really involved in a new task.

_____ 12. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures.

_____ 13. I can become interested in a new topic very quickly when I need to.

_____ 14. It is easy for me to read or write while I'm also talking on the phone.

_____ 15. I have trouble carrying on two conversations at once.

_____ 16. I have a hard time coming up with new ideas quickly.

_____ 17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before.

_____ 18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.

_____ 19. It is easy for me to alternate between two different tasks.

_____ 20. It is hard for me to break from one way of thinking about something and look at it from another point of view.

Citation: Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of abnormal psychology*, *111*(2), 225.

APPENDIX D

Feasibility and Credibility Questions

Instructions: Please read each statement below and indicate how much you *generally* agree with it by writing the appropriate number **(1 to 4)** on the line next to each statement.

1	2	3	4
Do not agree	Agree slightly	Agree moderately	Agree very much

Response
(1 to 4)

_____ 1. It was burdensome to listen to the audio recording daily.

_____ 2. The audio recording link was easy to use.

_____ 3. I would recommend this treatment to a friend.

_____ 4. This treatment was successful in reducing my test anxiety.

.

REFERENCES

Ali, M. S., & Mohsin, M. N. (2013). Test Anxiety Inventory (TAI): Factor analysis and psychometric properties. *Journal of Humanities and Social Science*, *8*, 73-81.

Alloway, T. P. (2011). A comparison of working memory profiles in children with ADHD and DCD. *Child Neuropsychology*, *17*, 483-494.

Alloway, T. P., & Alloway, R. G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology*, *106*, 20-29.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.

Andersson, G., & Cuijpers, P. (2009). Internet-based and other computerized psychological treatments for adult depression: A meta-analysis. *Cognitive Behaviour Therapy*, *38*, 196-205.

Andrews, G., Cuijpers, P., Craske, M. G., McEvoy, P., & Titov, N. (2010). Computer therapy for the anxiety and depressive disorders is effective, acceptable and practical health care: A meta-analysis. *PloS One*, *5*, 70-78.

Andrews, G., Issakidis, C., Sanderson, K., Corry, J., & Lapsley, H. (2004). Utilising survey data to inform public policy: Comparison of the cost-effectiveness of treatment of ten mental disorders. *The British Journal of Psychiatry*, *184*, 526-533.

Arpin-Cribbie, C., Irvine, J., & Ritvo, P. (2012). Web-based cognitive-behavioral therapy for perfectionism: A randomized controlled trial. *Psychotherapy Research*, *22*, 194-207.

Au, W. (2011). Teaching under the new Taylorism: High‐stakes testing and the standardization of the 21st century curriculum. *Journal of Curriculum Studies*, *43*, 25-45.

Baddeley, A. (1986). Working memory. *Oxford psychology series, No. 11*. New York, NY: Clarendon Press/Oxford University Press.

Barello, S., Triberti, S., Graffigna, G., Libreri, C., Serino, S., Hibbard, J., & Riva, G. (2016). eHealth for patient engagement: A systematic review. *Frontiers in Psychology*, *6*, 1-13.

Beck, J. S. (2011). *Cognitive behavior therapy: Basics and beyond*. Guilford Press.

Beidel, D. C., Turner, S. M., & Taylor-Ferreira, J. C. (1999). Teaching study skills and test-taking strategies to elementary school students. *Behavior Modification*, *23*, 630-646.

Beidel, D. C., Turner, M. W., & Trager, K. N. (1994). Test anxiety and childhood anxiety disorders in African American and White school children. *Journal of Anxiety Disorders*, *8*, 169-179.

Beilock, S. L., Kulp, C. A., Holt, L. E., & Carr, T. H. (2004). More on the fragility of performance: Choking under pressure in mathematical problem solving. *Journal of Experimental Psychology: General*, *133*, 584-600.

Bennett, G. G., & Glasgow, R. E. (2009). The delivery of public health interventions via the Internet: Actualizing their potential. *Annual Review of Public Health*, *30*, 273-292.

Benton, S.A., Robertson, J.M., Tseng, W.C., Newton, F.B., & Benton, S.L. (2003). Changes in counseling center client problems across 13 years. *Professional Psychology: Research and Practice, 34,* 66-72.

Berliner, D. (2011). Rational responses to high stakes testing: The case of curriculum narrowing and the harm that follows. *Cambridge Journal of Education*, *41*, 287-302.

Blanco, C., Okuda, M., Wright, C., Hasin, D. S., Grant, B. F., Liu, S. M., & Olfson, M. (2008). Mental health of college students and their non–college-attending peers: Results from the national epidemiologic study on alcohol and related conditions. *Archives of General Psychiatry*, *65*, 1429-1437.

Bögels, S. M., Alden, L., Beidel, D. C., Clark, L. A., Pine, D. S., Stein, M. B., & Voncken, M. (2010). Social anxiety disorder: Questions and answers for the DSM‐V. *Depression and Anxiety*, *27*, 168-189.

Burns, J., Labbé, E., Williams, K., & McCall, J. (1999). Perceived and physiological indicators of relaxation: As different as Mozart and Alice in chains. *Applied Psychophysiology and Biofeedback*, *24*, 197-202.

Callinan, S., Johnson, D., & Wells, A. (2015). A randomised controlled study of the effects of the attention training technique on traumatic stress symptoms, emotional attention set shifting and flexibility. *Cognitive Therapy and Research*, *39*, 4-13.

Calvo, M. G., & Ramos, P. M. (1989). Effects of test anxiety on motor learning: The processing efficiency hypothesis. *Anxiety Research*, *2*, 45-55.

Casbarro, J. (2005). *Test anxiety and what you can do about it: A practical guide for teachers, parents, and kids.* Port Chester, NY: Dude.

Cassady, J. C. (2004). The influence of cognitive test anxiety across the learning–testing cycle. *Learning and Instruction*, *14*, 569-592.

Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, *27*, 270-295.

Cavanagh, K., Strauss, C., Cicconi, F., Griffiths, N., Wyper, A., & Jones, F. (2013). A randomised controlled trial of a brief online mindfulness-based intervention. *Behaviour Research and Therapy*, *51*, 573-578.

Cella, D., Choi, S., Rosenbloom, S., Surges Tatum, D., Garcia, S., Lai, J. S., & Gershon, R. (2008). A novel IRT-based case-ranking approach to derive expert standards for symptom severity. *Quality of Life Research*, *17*, A-32.

Chapell, M. S., Blanding, Z. B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of Educational Psychology*, *97*, 268-274.

Chiauzzi, E., Brevard, J., Thurn, C., Decembrele, S., & Lord, S. (2008). MyStudentBody–Stress: An online stress management intervention for college students. *Journal of Health Communication*, *13*, 555-572.

Choi, S. W., Schalet, B., Cook, K. F., & Cella, D. (2014). Establishing a common metric for depressive symptoms: Linking the BDI-II, CES-D, and PHQ-9 to PROMIS depression. *Psychological Assessment*, *26*, 513-527.

Cuijpers, P., Marks, I. M., van Straten, A., Cavanagh, K., Gega, L., & Andersson, G. (2009). Computer‐aided psychotherapy for anxiety disorders: A meta‐analytic review. *Cognitive Behaviour Therapy*, *38*, 66-82.

Culler, R. E., & Holahan, C. J. (1980). Test anxiety and academic performance: The effects of study-related behaviors. *Journal of Educational Psychology*, *72*, 16-20.

Darke, S. (1988). Anxiety and working memory capacity. *Cognition and Emotion*, *2*, 145-154.

Davies, E. B., Morriss, R., & Glazebrook, C. (2014). Computer-delivered and web-based interventions to improve depression, anxiety, and psychological well-being of university students: A systematic review and meta-analysis. *Journal of Medical Internet Research*, *16*, 130-152.

Day, V., McGrath, P. J., & Wojtowicz, M. (2013). Internet-based guided self-help for university students with anxiety, depression and stress: A randomized controlled clinical trial. *Behaviour Research and Therapy*, *51*, 344-351.

Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology*, *111*, 225-236.

Diaz, F. M. (2013). Mindfulness, attention, and flow during music listening: An empirical investigation. *Psychology of Music*, *41*, 42-58.

Dillman Carpentier, F. R., & Potter, R. F. (2007). Effects of music on physiological arousal: Explorations into tempo and genre. *Media Psychology*, *10*, 339-363.

Donald, J., Abbott, M. J., & Smith, E. (2014). Comparison of attention training and cognitive therapy in the treatment of social phobia: A preliminary investigation. *Behavioural and Cognitive Psychotherapy*, *42*, 74-91.

Doris, J., & Sarason, S. (1955). Test anxiety and blame assignment in a failure situation. *The Journal of Abnormal and Social Psychology*, *50*, 335-338.

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review*, *66*, 183-201.

Eisenberg, D., Golberstein, E., & Gollust, S. E. (2007). Help-seeking and access to mental health care in a university student population. *Medical Care*, *45*, 594-601.

Eisenberg, D., Hunt, J., & Speer, N. (2012). Help seeking for mental health on college campuses: Review of evidence and next steps for research and practice. *Harvard Review of Psychiatry*, *20*, 222-232.

Eisenberg, D., Hunt, J., Speer, N., & Zivin, K. (2011). Mental health service utilization among college students in the United States. *The Journal of Nervous and Mental Disease*, *199*, 301-308.

Eliatamby, A. (1984). *Anxiety and anagram solving.* Unpublished manuscript.

Elliman, N. A., Green, M. W., Rogers, P. J., & Finch, G. M. (1997). Processing-efficiency theory and the working-memory system: Impairments associated with sub-clinical anxiety. *Personality and Individual Differences*, *23*, 31-35.

Ergene T. (2003). Effective interventions on test anxiety reduction: A meta-analysis. *School Psychology International*, *24*, 313–328.

Eysenck, M.W. (1989). Stress, anxiety, and intelligent performance. In D. Vickers & P.L. Smith (Eds), *Human information processing: Measures, mechanisms and models.* Amsterdam: North-Holland.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition & Emotion*, *6*, 409-434.

Eysenck MW, Derakshan N, Santos R, & Calvo MG. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion*, *7*, 336-353.

Fajkowska, M., & Derryberry, D. (2010). Psychometric properties of Attentional Control Scale: The preliminary study on a Polish sample. *Polish Psychological Bulletin*, *41*, 1-7.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191.

Fergus, T. A., & Bardeen, J. R. (2016). The attention training technique: A review of a neurobehavioral therapy for emotional disorders. *Cognitive and Behavioral Practice*, *23*, 502-516.

Fergus, T. A., & Hiraoka, R. (2018). A Pilot Study of a 4-Week eHealth-Based Protocol of the Attention Training Technique Component of Metacognitive Therapy Among Patients With Anxiety Disorders. *Journal of Cognitive Psychotherapy*, *32*, 140-152.

Fergus, T. A., Wheless, N. E., & Wright, L. C. (2014). The attention training technique, self-focused attention, and anxiety: A laboratory-based component study. *Behaviour Research and Therapy*, *61*, 150-155.

Gallagher, R. (2005). *National survey of counseling center directors*. Alexandria, VA: International Association of Counseling Services.

Gaudry, E., & Spielberger, C. D. (1971). *Anxiety and educational achievement*. New York, NY: J. Wiley & Sons Australasia.

Geers, A. L., Wellman, J. A., Seligman, L. D., Wuyek, L. A., & Neff, L. A. (2010). Dispositional optimism, goals, and engagement in health treatment programs. *Journal of Behavioral Medicine*, *33*, 123-134.

Griffiths, K. M., Farrer, L., & Christensen, H. (2010). The efficacy of internet interventions for depression and anxiety disorders: A review of randomised controlled trials. *Medical Journal of Australia*, *192*, 4-11.

Guetin, S., Portet, F., Picot, M. C., Pommié, C., Messaoudi, M., Djabelkir, L., ... & Touchon, J. (2009). Effect of music therapy on anxiety and depression in patients with Alzheimer's type dementia: Randomised, controlled study. *Dementia and Geriatric Cognitive Disorders*, *28*, 36-46.

Gulliver, A., Griffiths, K. M., & Christensen, H. (2010). Perceived barriers and facilitators to mental health help-seeking in young people: A systematic review. *BMC Psychiatry*, *10*, 113-122.

Hall Brown, T. S. (2005). *Is test anxiety a form of specific social phobia?* (Doctoral dissertation).

Hamilton, V. (1978). *The cognitive analysis of personality related to information-processing deficits with stress and anxiety.* Paper presented at the British Psychological Society meeting, London.

Hembree, R. (1988). Correlates, causes, effects, and treatment of test anxiety. *Review of Educational Research*, *58*, 47-77.

Huntley CD, Young B, Jha V, & Fisher PL. (2016). The efficacy of interventions for test anxiety in university students: A protocol for a systematic review and meta-analysis. *International Journal of Educational Research*, *77*, 92-98.

Johnson, D. R., & Gronlund, S. D. (2009). Individuals lower in working memory capacity are particularly vulnerable to anxiety's disruptive effect on performance. *Anxiety, Stress, & Coping*, *22*, 201-213.

Judah, M. R., Grant, D. M., Mills, A. C., & Lechner, W. V. (2014). Factor structure and validation of the attentional control scale. *Cognition & Emotion*, *28*, 433-451.

Kausler, D. H., & Trapp, E. P. (1958). Achievement motivation and goal-setting behavior on a learning task. *Journal of Experimental Psychology*, *55*, 575-578.

Kazdin, A. E., & Rabbitt, S. M. (2013). Novel models for delivering mental health services and reducing the burdens of mental illness. *Clinical Psychological Science*, *1*, 170-191.

Keogh, E., Bond, F. W., French, C. C., Richards, A., & Davis, R. E. (2004). Test anxiety, susceptibility to distraction and examination performance. *Anxiety, Stress & Coping*, *17*, 241-252.

Kirkland, K., & Hollandsworth Jr, J. G. (1979). Test anxiety, study skills, and academic performance. *Journal of College Student Personnel*, *20*, 431-435.

Kirkland, K., & Hollandsworth, J. G. (1980). Effective test taking: Skills-acquisition versus anxiety-reduction techniques. *Journal of Consulting and Clinical Psychology*, *48*, 431-439.

Knowles, M. M., Foden, P., El‐Deredy, W., & Wells, A. (2016). A systematic review of efficacy of the attention training technique in clinical and nonclinical samples. *Journal of Clinical Psychology*, *72*, 999-1025.

Komiya, N., Good, G. E., & Sherrod, N. B. (2000). Emotional openness as a predictor of college students' attitudes toward seeking psychological help. *Journal of Counseling Psychology*, *47*, 138-143.

Kreuter, M., Farrell, D., Olevitch, L. and Brennam, L. (2000) *Tailoring health messages: customizing communication with computer technology*. Lawrence Erlbaum, Mahwah, NJ.

Kurosawa, K., & Harackiewicz, J. M. (1995). Test anxiety, self‐awareness, and cognitive interference: A process analysis. *Journal of Personality*, *63*, 931-951.

Kyriacou C & Butcher B. (1993). Stress in year 11 school children. *Pastoral Care in Education*, *11*, 19–21.

Labbé, E., Schmidt, N., Babin, J., & Pharr, M. (2007). Coping with stress: The effectiveness of different types of music. *Applied Psychophysiology and Biofeedback*, *32*, 163-168.

LeBeau, R. T., Glenn, D., Liao, B., Wittchen, H. U., Beesdo‐Baum, K., Ollendick, T., & Craske, M. G. (2010). Specific phobia: A review of DSM‐IV specific phobia and preliminary recommendations for DSM‐V. *Depression and Anxiety*, *27*, 148-167.

Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, *20*, 975-978.

Lintvedt, O. K., S∅rensen, K., Østvik, A. R., Verplanken, B., & Wang, C. E. (2008). The need for web-based cognitive behavior therapy among university students. *Journal of Technology in Human Services*, *26*, 239-258.

Lovell, K., & Richards, D. (2000). Multiple Access Points and Levels of Entry (MAPLE): Ensuring choice, accessibility and equity for CBT services. *Behavioural and Cognitive Psychotherapy*, *28*, 379-391.

Lowe, P. A., & Lee, S. W. (2008). Factor structure of the Test Anxiety Inventory for Children and Adolescents (TAICA) scores across gender among students in elementary and secondary school settings. *Journal of Psychoeducational Assessment*, *26*, 231-246.

Lowe, P. A., Lee, S. W., Witteborg, K. M., Prichard, K. W., Luhr, M. E., Cullinan, C. M., ... & Janik, M. (2008). The Test Anxiety Inventory for Children and Adolescents (TAICA) examination of the psychometric properties of a new multidimensional measure of test anxiety among elementary and secondary school students. *Journal of Psychoeducational Assessment*, *26*, 215-230.

Mandler, G., & Sarason, S. B. (1952). A study of anxiety and learning. *The Journal of Abnormal and Social Psychology*, *47*, 166-173.

Matthews, G., Hillyard, E. J., & Campbell, S. E. (1999). Metacognition and maladaptive coping as components of test anxiety. *Clinical Psychology & Psychotherapy*, *6*, 111-125.

McDonald, A. S. (2001). The prevalence and effects of test anxiety in school children. *Educational Psychology*, *21*, 89-101.

McIlroy, D. (2000). An evaluation of the factor structure and predictive utility of a test anxiety scale with reference to students' past performance and personality indices. *British Journal of Educational Psychology*, *70*, 17-32.

McVay, J. C., & Kane, M. J. (2012). Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and executive attention. *Journal of Experimental Psychology: General*, *141*, 302-320.

Methia, R. A. (2004). *Help your child overcome test anxiety and achieve higher test scores.* College Station, TX: Virtual Bookwork.com Publishing.

Meunier, C., & Rule, B. G. (1967). Anxiety, confidence, and conformity. *Journal of Personality*, *35*, 498-504.

Moritz, S., Wess, N., Treszl, A., & Jelinek, L. (2011). The attention training technique as an attempt to decrease intrusive thoughts in obsessive–compulsive disorder (OCD): From cognitive theory to practice and back. *Journal of Contemporary Psychotherapy*, *41*, 135-143.

Mowbray T. (2012). Working memory, test anxiety, and effective interventions: A review. *The Australian Educational and Developmental Psychologist*, *29*, 141-156.

Mowbray, C. T., Megivern, D., Mandiberg, J. M., Strauss, S., Stein, C. H., Collins, K., ... & Lett, R. (2006). Campus mental health services: Recommendations for change. *American Journal of Orthopsychiatry*, *76*, 226-237.

Muse, L. A., Harris, S. G., & Feild, H. S. (2003). Has the inverted-U theory of stress and job performance had a fair test?. *Human Performance*, *16*, 349-364.

Myers, S. G., & Wells, A. (2005). Obsessive-compulsive symptoms: The contribution of metacognitions and responsibility. *Journal of Anxiety Disorders*, *19*, 806-817.

Nassif, Y., & Wells, A. (2014). Attention training reduces intrusive thoughts cued by a narrative of stressful life events: A controlled study. *Journal of Clinical Psychology*, *70*, 510-517.

Naveh-Benjamin, M. (1991). A comparison of training programs intended for different types of test-anxious students: Further support for an information-processing model. *Journal of Educational Psychology*, *83*, 134-139.

Naveh-Benjamin, M., McKeachie, W. J., & Lin, Y. G. (1987). Two types of test-anxious students: Support for an information processing model. *Journal of Educational Psychology*, *79*, 131-136.

Naveh-Benjamin, M., McKeachie, W. J., Lin, Y. G., & Holinger, D. P. (1981). Test anxiety: Deficits in information processing. *Journal of Educational Psychology*, *73*, 816-824.

Nilsson, U. (2008). The anxiety-and pain-reducing effects of music interventions: A systematic review. *AORN journal*, *87*, 780-807.

O'Carroll, P. J., & Fisher, P. (2013). Metacognitions, worry and attentional control in predicting OSCE performance test anxiety. *Medical Education*, *47*, 562-568.

Oh, H., Rizo, C., Enkin, M., & Jadad, A. (2005). What is eHealth (3): A systematic review of published definitions. *Journal of Medical Internet Research*, *7*, 1-5.

Ólafsson, R. P., Smári, J., Guðmundsdóttir, F., Ólafsdóttir, G., Harðardóttir, H. L., & Einarsson, S. M. (2011). Self reported attentional control with the Attentional Control Scale: Factor structure and relationship with symptoms of anxiety and depression. *Journal of Anxiety Disorders*, *25*, 777-782.

Panteleeva, Y., Ceschi, G., Glowinski, D., Courvoisier, D. S., & Grandjean, D. (2017). Music for anxiety? Meta-analysis of anxiety reduction in non-clinical samples. *Psychology of Music*, *46*, 473-487.

Papageorgiou, C., & Wells, A. (2000). Treatment of recurrent major depression with attention training. *Cognitive and Behavioral Practice*, *7*, 407-413.

Pêcher, C., Lemercier, C., & Cellier, J. M. (2009). Emotions drive attention: Effects on driver's behaviour. *Safety Science*, *47*, 1254-1259.

Pedrelli, P., Nyer, M., Yeung, A., Zulauf, C., & Wilens, T. (2015). College students: Mental health problems and treatment considerations. *Academic Psychiatry*, *39*, 503-511.

Power, M. J., & Dalgleish, T. (1997). *Cognition and emotion: From order to disorder.* Hove, England: Psychology Press.

Powers, D. E. (1986). *Test anxiety and the GRE general test*. Princeton: Educational Testing Service.

Prochaska, J. J., Zabinski, M. F., Calfas, K. J., Sallis, J. F. and Patrick, K. (2000) PACE+: Interactive communication technology for behavior change in clinical settings. *American Journal of Preventative Medicine* , *19*, 127–131.

Putwain, D. W. (2008). Deconstructing test anxiety. *Emotional and Behavioural Difficulties*, *13*, 141-155.

Putwain, D. W., Connors, L., & Symes, W. (2010). Do cognitive distortions mediate the test anxiety–examination performance relationship?. *Educational Psychology*, *30*, 11-26.

Raufelder, D., & Ringeisen, T. (2016). Self-perceived competence and test anxiety: The role of academic self-concept and self-efficacy. *Journal of Individual Differences*, *37*, 159-167.

Richman CL, Brown K, & Clark M. (1987). Personality changes as a function of minimum competency test success or failure. *Contemporary Educational Psychology*, *12*, 7–16.

Riper, H., Andersson, G., Christensen, H., Cuijpers, P., Lange, A., & Eysenbach, G. (2010). Theme issue on e-mental health: A growing field in internet research. *Journal of Medical Internet Research*, *12*, e74.

Ryan, M. L., Shochet, I. M., & Stallman, H. M. (2010). Universal online interventions might engage psychologically distressed university students who are unlikely to seek formal help. *Advances in Mental Health*, *9*, 73-83.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: Reactions to Tests. *Journal of Personality and Social Psychology, 46*, 929–938.

Sarason, I.G. (1978). The test anxiety scale: Concept and research. In C.D. Spielberger & I. G. Sarason (Eds.), *Stress and anxiety* (pp. 193-216). New York, NY: Halsted-Wiley.

Sarason, I. G., & Sarason, B. R. (1990). Test anxiety. In *Handbook of social and evaluation anxiety* (pp. 475-495). Boston, MA: Springer US.

Schwarzer, R., & Jerusalem, M. (1992). Advances in anxiety theory: A cognitive process approach. *Advances in Test Anxiety Research, 7*, 2-31.

Segool, N. K., Carlson, J. S., Goforth, A. N., von der Embse, N., & Barterian, J. A. (2013). Heightened test anxiety among young children: Elementary school student's anxious responses to high-stakes testing. *Psychology in the Schools*, *50*, 489-499.

Seipp, B. (1991). Anxiety and academic performance: A meta-analysis of findings. *Anxiety Research*, *4*, 27-41.

Siegle, G. J., Ghinassi, F., & Thase, M. E. (2007). Neurobehavioral therapies in the 21st century: Summary of an emerging field and an extended example of cognitive control training for depression. *Cognitive Therapy and Research*, *31*, 235-262.

Siegle, G. J., Carter, C. S., & Thase, M. E. (2006). Use of FMRI to predict recovery from unipolar depression with cognitive behavior therapy. *American Journal of Psychiatry*, *163*, 735-738.

Sethi, S., Campbell, A. J., & Ellis, L. A. (2010). The use of computerized self-help packages to treat adolescent depression and anxiety. *Journal of Technology in Human Services*, *28*, 144-160.

Smith, E. E., & Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science*, *283*, 1657-1661.

Spada MM, Georgiou GA, & Wells A. (2010). The relationship among metacognitions, attentional control, and state anxiety. *Cognitive Behaviour Therapy*, *39*, 64-71.

Spada, M. M., Mohiyeddini, C., & Wells, A. (2008). Measuring metacognitions associated with emotional distress: Factor structure and predictive validity of the metacognitions questionnaire 30. *Personality and Individual differences*, *45*, 238-242.

Spielberger, C. D., & Vagg, P. R. (Eds.). (1995). *Test anxiety: Theory, assessment, and treatment*. Taylor & Francis.

Spielberger, C. D., Gonzalez, H. P., Taylor, C. J., Anton, E. D., Algaze, B., Ross, G. R., & Westberry, L. G. (1980). *Manual for the Test Anxiety Inventory ("Test Attitude Inventory")*. Redwood City, CA: Consulting Psychologists Press.

Struthers, C. W., Perry, R. P., & Menec, V. H. (2000). An examination of the relationship among academic stress, coping, motivation, and performance in college. *Research in Higher Education*, *41*, 581-592.

Sung YT & Chao TY. (2015). Construction of the examination stress scale for adolescent students. *Measurement and Evaluation in Counseling and Development*, *48*, 44–58.

Sung YT, Chao TZ, & Tseng FL. (2016). Reexamining the relationship between test anxiety and learning achievement: An individual-differences perspective. *Contemporary Educational Psychology, 46*, 241-252.

Teachman, B. A. (2014). No appointment necessary: Treating mental illness outside the therapist's office. *Perspectives on Psychological Science*, *9*, 85-87.

Thase, M. E., Dube, S., Bowler, K., Howland, R. H., Myers, J. E., Friedman, E., & Jarrett, D. B. (1996). Hypothalamic-pituitary-adrenocortical activity and response to cognitive behavior therapy in unmedicated, hospitalized depressed patients. *American Journal of Psychiatry*, *153*, 886-891.

Thase, M. E., Simons, A. D., Cahalane, J., McGeary, J., & Harden, T. (1991). Severity of depression and response to cognitive behavior therapy. *American Journal of Psychiatry*, *148*, 784-789.

Thomas, H. (2012). The use of technology in mental health: applications, ethics and practice. *British Journal of Guidance and Counseling, 40*, 177-178.

Tobias, S. (1985). Test anxiety: Interference, defective skills, and cognitive capacity. *Educational Psychologist*, *20*, 135-142.

Tones, K. and Tilford, S. (2001) *Health promotion: effectiveness, efficiency and equity*. Cheltenham, England: Nelson Thornes.

Turner BG, Beidel DC, Hughes S, & Turner M W. (1993). Test anxiety in African American school children. *School Psychology Quarterly*, *82*, 140–152.

Vandelanotte, C., & De Bourdeaudhuij, I. (2003). Acceptability and feasibility of a computer-tailored physical activity intervention using stages of change: Project FAITH. *Health Education Research*, *18*, 304-317.

Vitasari, P., Wahab, M. N. A., Herawan, T., Sinnadurai, S. K., Othman, A., & Awang, M. G. (2011). Assessing of physiological arousal and cognitive anxiety toward academic performance: The application of catastrophe model. *Procedia-Social and Behavioral Sciences*, *30*, 615-619.

von der Embse, N., Jester, D., Roy, D., & Post, J. (2018). Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *Journal of Affective Disorders*, *227*, 483-493.

Weinreich, N. K. (1999) *Pretesting hands-on social marketing: A step-by-step guide.* Thousand Oaks, CA: Sage Publications.

Weissman, M. M., Verdeli, H., Gameroff, M. J., Bledsoe, S. E., Betts, K., Mufson, L., ... & Wickramaratne, P. (2006). National survey of psychotherapy training in psychiatry, psychology, and social work. *Archives of General Psychiatry*, *63*, 925-934.

Wells, A. (1990). Panic disorder in association with relaxation induced anxiety: An attentional training approach to treatment. *Behavior Therapy*, *21*, 273-280.

Wells, A. (1995). Meta-cognition and worry: A cognitive model of generalized anxiety disorder. *Behavioural and Cognitive Psychotherapy*, *23*, 301-320.

Wells, A. (2007). The attention training technique: Theory, effects, and a metacognitive hypothesis on auditory hallucinations. *Cognitive and Behavioral Practice*, *14*, 134-138.

Wells A. (2009). *Metacognitive therapy for anxiety and depression*. New York, NY: Guilford Press.

Wells, A. (2013). Advances in metacognitive therapy. *International Journal of Cognitive Therapy*, *6*, 186-201.

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the metacognitions questionnaire: properties of the MCQ-30. *Behaviour Research and Therapy*, *42*, 385-396.

Wells A & Matthews G. (1996). Modeling cognition in emotional disorder: The S-REF model. *Behavior Research and Therapy*, *12*, 881–888.

Wells, A., White, J., & Carter, K. E. P. (1997). Attention training: Effects on anxiety and beliefs in panic and social phobia. *Clinical Psychology and Psychotherapy, 4,* 226-232.

Xiao, H., Carney, D.M., Youn, S.J., Janis, R.A., Castonguay, L.G., Hayes, J.A., & Locke, B.D. (2017). Are we in crisis? National mental health and treatment trends in college counseling centers. *Psychological Services, 14*, 407-415.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit‐formation. *Journal of Comparative Neurology*, *18*, 459-482.

Zeidner, M. (1998). *Test anxiety: The state of the art*. Springer Science & Business Media.

Zeidner, M. (1990). Does test anxiety bias scholastic aptitude test performance by gender and sociocultural group? *Journal of Personality Assessment*, *55*, 145-160.