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Title: An Examination of the Relationship Between State Anxiety, Relaxation Response, and Digit Span Performance

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This study investigated the effects of relaxation response through guided imagery on working memory for highly anxious and low anxious participants. Participants were 80 students enrolled in psychology and human sexuality courses at Kansas Wesleyan University, Bethany College, and Wichita State University. A non-published guided imagery technique entitled "Falling Leaf" was utilized as a relaxation technique. The comparison condition utilized an excerpt entitled "Improving Your Study Habits." The digits backward portion of the digit span subtest of the WAIS-III was utilized as a measure of working memory. The Spielberger State Trait Anxiety Inventory was utilized as a measure of state and trait anxiety. Participants were assigned to treatment or comparison condition based upon their level of Trait Anxiety assuming those with high trait anxiety would also tend to have high State Anxiety. Results indicated no significant difference in digit span scores for highly anxious participants based upon relaxation or comparison conditions. State anxiety was significantly reduced in all participants, in both relaxation and comparison conditions. Significant gender differences were found in digits backward performance, finding men performed better than women. This result was statistically significant but not necessarily clinically significant as both males and females

scored close to the average of 25 to 34 year olds of 5 digits backward recalled. Results of this study suggest that high trait anxiety does not always indicate the presence of high state anxiety. Of interest in future studies would be to explore the ability of highly anxious participants to compensate for their ailment through extra effort.

AN EXAMINATION OF THE RELATIONSHIP BETWEEN STATE ANXIETY, RELAXATION RESPONSE, AND DIGIT SPAN PERFORMANCE

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CHAPTER 1

INTRODUCTION

At average levels, anxiety is a useful and often motivating factor in people's lives. Its purpose is to notify people of problems in their environment and allow them to act. However, at high levels it has been shown to interfere with working memory and can be detrimental to performance on tests, in completions of tasks, and functions completed in everyday life. At high levels, anxiety can prohibit a person from acting appropriately. Relaxation through guided imagery has been shown to reduce levels of state anxiety, therefore allowing working memory to appropriately function. Relaxation allows the body to tap into the parasympathetic nervous system, the natural brake of the body, to slow down the physical body resulting in reduction in blood pressure and heart rate and greater mental balance.

The purpose of this study was to examine the relationship between state anxiety and working memory. Further, this study examined the effectiveness of relaxation to reduce state anxiety and therefore free up activation to allow working memory to function appropriately. Working memory was examined through the use of the digits backward portion of the Digit Span subtest of the Wechsler Adult Intelligence Scale-III. State anxiety was examined through use of the Spielberger State-Trait Anxiety Inventory. The relaxation technique used incorporated the use of guided imagery.

Review of the Literature

Anxiety

Definition and type. Anxiety manifests itself in both a physical and a cognitive manner. Eysenck (as cited in Ikeda, Iwanaga, & Seiwa, 1996) commented on what he

called 'emotionality' as being made up of physiological arousal and cognitive self-concern. Physiological arousal is the portion of anxiety that deals with physical change to the body such as increased heart rate, changes in breathing, or feeling as though there is a knot in the stomach. Cognitive self-concern is another portion of anxiety and is composed of the negative thoughts and verbalizations associated with worry (Ikeda et al.).

Cattell and Scheier (as cited in Hodges & Durham, 1972, p. 401) referred to anxiety "as either a transitory state or relatively enduring personality trait." Anxiety has been divided into two specific types: state anxiety and trait anxiety. Spielberger (as cited in Hodges & Durham, 1972, p. 401) defined state anxiety as "subjective feelings of apprehension and tension." He defined trait anxiety as "anxiety proneness or the predisposition to respond with high levels of state anxiety" (Hodges & Durham, 1972, p. 401). Therefore, trait anxiety is deemed more of a personality characteristic, whereas state anxiety seems to be situational in nature (Hodges & Durham, 1972).

Theory. Biological mechanisms suggest that anxiety lends cognitive attention to danger to allow for organisms to adapt to environmental stress. Normal levels of anxiety allow for humans to function appropriately within the environment. When levels of anxiety are high or above normal in a non-threatening or non-dangerous environment, short term memory is adversely affected (Luu, Tucker, & Derryberry, 1998).

Taylor (as cited in Hodges & Durham, 1972) developed the Taylor Manifest Anxiety Scale based on anxiety as a drive state. A drive state is a state in which one characteristic elicits another, so increasing amounts of stress would elicit higher levels of state anxiety. Classical conditioning studies have focused on this drive function and have adequately described and predicted human behavior (Hodges & Durham, 1972). Such

studies include Pavlov's research involving learned helplessness and conditioned fear response. This research suggested that people have either "weak or strong nervous systems" and this is the reason that certain people tend to shut down in response to anxiety whereas others tend to act (Sawyer & Behnke, 1997, p. 211). This also would explain why certain people have an increase in blood pressure in response to stress while others do not. Hull (as cited in Sawyer & Behnke, 1997, p. 212) also contributed to this drive theory introducing his term "habit strength" that suggests that the "level of negative reinforcement" and the repeating of the response to that level of negative reinforcement strengthen the likelihood this response will be made in the future. Eysenck (as cited in Sawyer & Behnke, 1997) went on to develop his theory of introversion and extroversion based upon Hull's insights. Eysenck (as cited in Sawyer & Behnke, 1997) felt introverts had been punished too much and extroverts had lacked in punishment and this contributed to their tendencies to under-respond and over-respond in social situations respectively. Further studies found that other intervening variables also contributed to changes in emotional response other than anxiety such as ability to compensate for anxiety proneness and further learning opportunities (Hodges & Durham, 1972).

Studies of the brain have provided a greater understanding of the manner in which people act when in states of anxiety. States of panic seem to be related to the periacqueductal gray region (PAG) and it is this area that seems to be primarily responsible for the flight or fight response. Other areas then must act upon this area if a fight or flight response is not desired. Whereas states of panic seem to be related to the PAG and hypothalamus, states of anxiety seem to be related to the amygdala and the hippocampus (Luu et al., 1998). Gray (as cited in Weber, 1996) identified the Behavioral

Activation System located in the amygdala in the limbic system of the brain as primarily responsible for avoidance of anxiety provoking situations. He also located the Behavioral Inhibition System located in the hippocampus in the limbic system of the brain as primarily responsible for the tendency to have lack of gestures and movement, "deadpan facial expressions," and that 'frozen' appearance under conditions of extreme anxiety (Sawyer & Behnke, 1997, p. 212). Human behavior is inhibited in this sense because of a lack of impulsivity and a more cautious approach to one's environment. Other studies have supported Gray's (as cited in Luu et al.) findings and suggest that the amygdala is primarily responsible for the anticipatory response of a dangerous event thus producing anxiety due to waiting for something to happen. It is responsible for "conditioned fear related to discrete objects" (Luu et al., p. 581). The hippocampus seems to be responsible for continuously evaluating situations that must be entered and identifying possible danger. It is important to note that these two structures also receive information from and give information to the cortex and other brain structures, so anxiety is not a single structure phenomenon as is no aspect of human behavior (Luu et al.).

Cortisol is a hormone that is released shortly after periods of stress. Its purpose is to act as an anti-inflammatory agent and heal the underlying tissues. If one is under conditions of anxiety for extended periods of time, cortisol fails to dissipate in the system, and remains at high levels. At extended exposure to high levels, cortisol actually contributes to health problems such as ulcers, gastro-intestinal problems, and immune related responses. Many studies have been done in an attempt to reduce cortisol levels in an attempt to reduce anxiety and reduce stress related health conditions and these will be discussed in the relaxation section of this paper (Pawlow & Jones, 2002).

Spielberger StateTtrait Anxiety Iinventory. Spielberger (1983) developed the State-Trait Anxiety Inventory (STAI) based on his state-trait anxiety theory that emphasizes the two-factor basis of anxiety defined above. The STAI consists of two forms, one for State Anxiety (form Y-1) and one for Trait Anxiety (form Y-2). Form Y-1 is a 20-item scale and questions are answered on a 4-point scale. The scale takes approximately 6 minutes for a college student to complete. Test-retest reliability for form Y-2 range from .73 to .86. Form Y-1 is not expected to have good test-retest reliability because it is a situational based scale. Its test-retest reliability ranges from .16 to .62. Form Y-1 shows validity in that when situational stress variables resolve, the scores return to average levels. Form Y-2 does not appear to be affected by situational stress variables in that it stays the same through situations of stress and non-stress. The STAI is most often used by research and professionals for measurement of anxiety above other similar measures available and is the standard anxiety test used. The STAI shows concurrent validity with the Taylor Manifest Anxiety Scale, the IPAT Anxiety Scale with their correlations falling from .85 to .73 (Spielberger, 1983).

A study was completed by Spielberger in 1970 with college students under the following conditions of stress and non-stress: normal and exam conditions. Under normal conditions, the mean score on S-Anxiety was not significantly different for men and women, 40.02 and 39.36 respectively. However, under exam conditions the female students' scores were higher than the male students' scores, 60.51 and 54.99 respectively (Spielberger, 1983). Another study conducted by Spielberger provided varying levels of stress from most to least: movie, exam, normal, and relaxation. The study found that under normal conditions, men and women were nearly the same on S-Anxiety scores,

36.99 and 37.24 respectively. They were also nearly the same under exam conditions as well, 43.01 and 43.69 respectively. However, when female students responded to the stressful movie, their state anxiety scores were higher than male students' scores. However, under conditions of relaxation, women appeared to respond in a more relaxed manner than men. In this study, also of interest is the fact that internal consistency for the S-Anxiety scale was highest under highest conditions of stress, and least under lower conditions of stress. Therefore, gender effects are not completely understood, as two studies that have exam conditions revealed different results for men and women (Spielberger, 1983).

Another study found significant gender effects based on anxiety level in adolescents. In that Hawaiian study, female students scored significantly higher than male students on the STAI. However, cultural issues may have contributed to the results of the study (Hishinuma, Miyamoto, Nishimura & Nahulu, 2000). Thus, situation specific variables as well as cultural variables may influence gender effects on the STAI. Therefore, gender has been utilized as an independent variable in the present study.

Memory

Definition. Memory has been divided into two subcomponents, long-term memory and short-term memory. Long-term memory allows for storage and retrieval of memories or procedures learned that are distant in time (Strub & Black, 1993). Short-term memory has been described as a single structure phenomenon responsible for immediate recall of information. Baddeley proposed replacing the single concept of short-term memory with a three structure system called 'working memory' (Baddeley, 1999). Working memory was the type of memory focused on in this study. Following is a

discussion of two major theories in the field of working memory and how these theories relate to the manner in which people recall information. Of particular interest in this study, was the manner in which people recall digits on the digits backward subtest of the WAIS-III, a test of working memory.

Information processing theory. Baddeley (1999) developed a theory of information processing that focuses on the integral parts that work together to allow working memory to function properly. His is a three-part theory including central executive functioning, the phonological loop, and the visiospacial sketch pad. Phonological processing is "processing of the sound aspects of speech" (Conners, Carr & Willis, 1998, p. 1). The phonological loop is the portion of memory that "stores and rehearses serial speech based codes" (Conners et al., p. 2). These codes are utilized when a person tries to remember lists of letters or numbers or when "analyzing the underlying sound basis of printed words" (Conners et al., p. 2). Baddeley breaks down the phonological loop into the articulatory loop and the primary acoustic store. The articulatory loop holds verbal or speech information for a short period of time that may allow for manipulation of the information. The primary acoustic store holds information related to sounds other than verbal sounds for a short period of time (Ikeda et al, 1996, p. 1223-1224). These two subsystems explain sound aspects of memory (Ikeda et al.). The visual-spacial sketch pad processes information that is coded visually or spatially, and serves as a place where this information is held and worked through. Finally, the central executive functioning provides general processing information. If the phonological loop or the visiospacial scratch pad fall short of processing resources, the central executive functioning gives processing resources to them (Conners et al.).

Baddeley (1994) has provided research to suggest that all three concepts are well-developed. He reported that the phonological loop is the simplest of the three concepts and thus the most well researched. The longer the words are to be recalled, the more stress placed on the system, thus some languages other than English that have longer words, appear to be more difficult to recall in span tests. If sounds such as music or verbal sounds are present, the phonological loop appears to suffer. If one is required to say a word while recalling a list of digits, this repeating of a word takes up space in the articulatory loop and thus makes the phonological loop suffer (Baddeley, 1994).

Baddeley (1994) reported that the visual spacial sketchpad appeared to be the least explored of the three concept theory. A study utilizing spacial task requiring participants to be blindfolded and follow a sound shows that the visual spacial sketchpad can use a "spacial, non-visual storage system" (Baddeley, 1994, p. 500). Another study suggests that when objects are similar, the visual spacial sketchpad appears to have difficulty with processing. This is not fully understood. Thus, this area is complex and needs further development (Baddeley, 1994).

Finally, Baddeley (1994) reported that the central executive is the "most complex and least well understood component of working memory" (p. 502). Research with Alzheimer's patients suggests that central executive functioning may be primarily located in the frontal lobe (Baddeley, 1994). The function of the central executive is to mediate between the two simpler systems and provide that information to long-term memory (Baddeley, 2000). Other theorists have provided ideas contrary to Baddeley's theory. Following is a discussion of another prominent theory in the field of working memory.

Production based theory. This theory is defined by two long term memory areas: implicit and explicit. Implicit memories tend to exist in a manner that is seen in action, and more unconscious in nature. The implicit memory is divided into procedural memory and conditioning effects. Procedural memory involves how we produce or come to a finished product, instructions learned on how to complete tasks and how things work. Conditioning effects occur through the result of classical or operant conditioning. Explicit memory is divided into declarative and episodic memory. The declarative memory component allows people to recall facts, events, and associations. Episodic memory includes personal and autobiographical memories (Anderson, Reder, & Lebiere, 1996).

Production based systems generally define working memory by "the currently available information against which production rules match" (Anderson, Reder, & Lebiere, 1996, p. 221). In other words, working memory is the available declarative knowledge (information about facts, events, and associations) that matches the procedure to be used (how to arrive at a finished product). Improvement of short term memory recall occurs when people combine bits of information into meaningful units called 'chunks.' Chunks are schema-like structures that allow us to classify information into sets of beliefs (Anderson et al.).

Other theories have taken this production-based background and expanded to make it more inclusive. In Adaptive Control of Thought (ACT) theory, there is an activation-based process that relates the production system to the declarative memory. There is a maximum level or limit on activation and once this level is reached, if further stimulated, working memory suffers. This is similar to what Baddeley (as cited in

Anderson et al., 1996, p 226) called "memory load for a task." ACT sought to define working memory in terms of activation, and Adaptive Control of Thought-Revised (ACT-R) further developed this concept by defining terms and attempting to localize the activation limitations to a brain based model. Whereas Baddeley worked with a permanent collection of information as his concept of working memory, ACT theory worked with activation and limits therein as their working memory concept (Anderson et al.). Baddeley (1994) disagrees with this, however, stating that ACT theory fails to define a point of capacity, stating unlimited activation and only 'assumes' there is a limit. Baddeley reported that his theory defined this capacity at which the subsystems break down and rely on the central executive function (Baddeley, 1994). Both theories described above provide insight into working memory. Following is an introduction to the digit span, its history, and how the above theories relate to the underlying processes necessary to complete the digit span.

Digit Span

History of digit span. The digit span has a long history of use. It has been included in many of the major intelligence and memory scales of our time. The digit span was developed in 1887 by John Jacobs, a teacher, who desired to test the capacity of his students' memories (Baddeley, 1999). The digit span was first called Memory for Digits in the Wechsler scales. David Wechsler took the digit span subtest from the Stanford Binet Intelligence Scale. He felt that it was an easy test to administer and score, and provided clinically useful data, which was the major goal of his intelligence scale. The digit span contributes to the calculation of the Verbal Intelligence Quotient, and the Full

Scale Intelligence quotient. The results of the digit span provide data regarding learning disabilities, organic brain conditions, and general cognitive functioning (Wechsler, 1958).

Clinically useful data are provided by the digit span. The mean scaled score for 25-34 year olds on the digit span is 10. Raw scores of a forward digit span of 6 and backward digit span of 5 are average for the 25-34 year old age range (Wechsler, 1997b). Deviation from this norm is considered diagnostically significant. Individuals that cannot remember 5 digits forward and 3 digits backward in 90% of cases are mentally retarded or mentally disturbed, except where organic brain disease is indicated. A change in digit span forward or backward is often one of the first signs of "mental impairment" (Wechsler, 1958). People with learning disabilities have been shown to have low scores in the arithmetic, comprehension, information, and digit span subtests of the WAIS-III, the so-called ACID profile (Kaufman, 1990). The difference between the raw score of digits backward from the raw score of digits forward has important diagnostic implications including organicity (Ramsey & Reynolds, 1995).

Despite the clinically useful data provided by the digit span, it has been found to be a poor test of general intelligence (Wechsler, 1958). This information was considered in the revision of the WAIS and WAIS-R, and the digit span has been retained in all revisions (Wechsler, 1997b).

Administration information. The instructions to the digit span subtest of the WAIS-III are as follows: "I am going to say some numbers. Listen carefully, and when I am through, I want you to say them right after me. Just say what I say" (Wechsler, 1997a, p. 133-5). The examiner then reads a series of numbers at the rate of 1 number per second to the client. After the client fails two consecutive forward digit lists, the examiner

proceeds to the digits backward section of the test. The examiner reads the numbers, and requests that the client repeat them back backwards. The test ends after two consecutive failures on digits backward (Wechsler, 1997a).

The digit span subtest generates a raw score, scaled score, and a difference score. The raw score is simply the sum of correct repetition of the digit lists of both digits forward and digits backward. The scaled score is obtained from the administration manual based on the raw score. The difference score is digits forward raw score minus digits backward raw score (Wechsler, 1997a).

Reliability/validity. For a test to be of use in psychology it must be consistent and reliable over time. The digit span subtest of the WAIS-III has good test-retest reliability. The average test-retest stability coefficient for the digit span is .83 (Wechsler, 1997b).

A test must measure what it reports to measure. To determine this, the test must correlate with other measures of similar construct to have concurrent validity. The digit span is a test of working memory. It should correlate with other measures of working memory. The WAIS-III digit span correlates with the WAIS-R digit span at 0.82. The WAIS-III digit span correlates with the WISC-III digit span at 0.73. The digit span is part of a four-factor solution of the WAIS-III. The working memory index consists of the following subtests: arithmetic, letter number sequencing, and the digit span. The digit span correlates with both the arithmetic and letter number sequence subtests at 0.52 and 0.57 respectively. The working memory index correlates with the Wechsler Memory Scale-R's attention concentration index at 0.66 (Wechsler, 1997b).

Underlying processes. The digit span is easy to administer and score, yet its underlying processes seem to be complex. The digit span is a test of working memory.

Further, it is a test of phonological processing. Based upon information provided in Baddeley's memory theory we found that when phonological loop or visual spacial sketchpad fall short of resources the central executive functioning contributes resources to the process of memory. Therefore, in regard to the digit span, the central executive functioning would donate resources when the digit lists become longer, and resources of the phonological loop are exhausted (Conners et al., 1998).

Digits backward is related to measures of central executive functioning more so than digits forward (Groeger, Field, & Hammond, 1999). The phonological process is not significantly related to intelligence. However, central executive functioning accounts for much of the variance for intelligence based differences in the digit span (Conners et al., 1998).

Research has shown that phonological processes are helpful in permanent learning of new words because of the sound aspects of speech. Therefore, a deficit found in digit span could signify problems in learning new words, and therefore in the development of reading (Gathercole, Hitch, Service, & Martin, 1997).

With the development of the computer, the use of visual digit span testing has become quite popular. However, differences in presentation of the digit span, either visual or verbal, have been shown to measure different processes (Groeger et al., 1999). Therefore, in this study, traditional administration was used.

Individual differences. In all psychological testing it is of interest to understand how individual differences affect the outcome of scores. The digit span test is no exception. Differences in personality, intelligence, education level, gender, age, articulation rate, examiner variables, and ethnicity will be discussed.

Poor attention span, concentration problems, and anxiety can adversely affect digit span results. Wechsler (1958) found these problems seem have the most affect on digits backward. Thus, in the present study digit span backward was utilized, as the focus was on reduction in anxiety by experiencing relaxation by guided imagery. Also, in the present study, participants with history of attention deficit disorder or problems with concentration were excluded from the study.

Central executive functioning has the effect of improved performance on the digit span. Intelligence factors also increase performance on the digit span (Conners et al., 1998). Years of education have also been shown to positively correlate with digit span performance (Ryan, Lopez, & Paolo, 1996). However, the digit span is not a good test of general intelligence, and does not correlate significantly with other tests of general intelligence (Wechsler, 1958). In the present study, the variance in intelligence based differences was cared for by sample size and random assignment to treatment conditions.

Gender differences in the digit span are not fully understood. Wechsler found no significant gender difference in digit span (Wechsler, 1958). When the rate of presentation is changed from 1 second to 3 seconds, however, men tend to score higher on the digit span than women (Vitulli, Laconsay, & Shepard, 1996). Standard administration was utilized in the present study.

Wechsler found that digit span declines with age (Wechsler, 1958). Age also has been found to have a detrimental effect on retrieval efficiency (Fastenau, Denburn, & Abeles, 1996). Others have concluded that there are two processes tapped by the digit span: digit storage/recall, and serial/position storage-recall. Age differences occur in the serial-processing component (Jurden, Laipple, & Jones, 1993). However, other research

has found that there are no significant age declines on the digit span (Gegoire & Van der Londen, 1997).

Articulation rate has been found to positively correlate with the digit span. Those persons who can articulate at a fast rate tend to score higher on the digit span. It has also been found that the relationship between articulation rate and memory span may be mediated by general processing speed. Therefore, those that process information quickly, tend to score higher on the digit span (Smyth & Scholey, 1996). Processing speed has been shown to differ among individuals. Processing skills tend to develop at different rates and times in children. However, such skills tend to be developed by the time the child reaches fifth grade (Cowan et al., 1998).

Some examiner instruction differences have been shown to affect digit span performance. Performance is improved on the digit span if an examiner ends a digit series with a drop in intonation of voice. Digits forward improved more than digits backward in this condition (Thomas & Hutchens, 1990). Still other studies have found that certain examiner variables such as visual cues have no statistically significant influence on digit span performance (Fenwick & Holmes, 1993). Administration order of digits forward first versus digits forward second has been shown to have no affect on performance on the subtest (Dunn, Gaudia, Lowenherz & Barnes, 1990).

Digit span seems to be a good test for use with Americans of different ethnic and cultural backgrounds. No significant differences were found in African American versus Caucasian individuals in the digit span (Kaufman, 1990).

In summary, the digit span is a sound and reliable test with a long history of use and strong support for use in the research base. Administration information is useful

because standardized procedures must be utilized to have confidence in the reliability of the instrument. A further understanding of the underlying processes of the test may provide insight into the meaning of digit span results. The meaning of the results of the digit span may then be utilized in clinical practice. Finally, an analysis of individual differences can provide useful information that may enhance clinical practice and its use of the digit span.

Anxiety and Memory

Processing efficiency theory. This theory proposed by Eysenck and Calvo (as cited in Pine & Wasserman, 1999) found that at high rates, anxiety hinders processing function, but at low to moderate rates, anxiety aids to processing the task at hand. Therefore, those participants with low to moderate levels of state anxiety would be expected to perform better than those with high levels of state anxiety on the digits backward task. However, Eysenck also found that at times, high anxiety ridden participants would put forth more effort to complete the task to make up for their state of anxiety. The extra effort places an additional demand on activation upon working memory. Therefore, with participants such as these, their anxiety related decline will not appear until additional or more complex tasks are added. (Paulman & Kennelly, 1984). It is for this reason that in the present study the digits backward portion of the Digit Span subtest of the WAIS-III will be utilized as it is more complex and taps into central executive functioning more so than digits forward (Wechsler, 1958).

Also of interest to Eysenck (as cited in Ikeda et al., 1996, p. 1224) was the fact that "cognitive self concern" or negative thoughts internally verbalized in anxiety take from the available processing resources, and therefore limit the remaining processing

resources available to one with high levels of anxiety. Because the articulatory loop is responsible for all verbal material, it also processes the negative thoughts, and therefore if additional tasks are placed upon this system, its ability to follow-through is limited (Ikeda et al.).

The Yerkes Dodson law (as cited in Sjoberg, 1977), suggests there is a certain level of arousal at which execution of tasks is best. Too little arousal will lead to poor performance and too much arousal will lead to interference and thus poor performance. Thus, the best level of arousal is "mid-level" arousal. Thus, if one plotted this trend of performance based on level of arousal it would appear as an inverted U shape, suggesting poor performance at both low and high arousal and best performance with the medium level of arousal (Sjoberg, 1977). This would suggest that if someone with high arousal was exposed to a relaxation procedure that lowered the level of arousal down to medium range, performance would improve.

Examples in the literature. A study completed with hockey players assessed just prior to game time found that hockey players that had an increase in state anxiety prior to their games performed significantly lower on the digit span than those with average levels of anxiety (Jones & Cale, 1989). This is consistent with the activation theorists, indicating that high anxiety can take up activation resources and thus interfere with digit span performance.

Research on state and trait anxiety and their effect on digit span performance is extensive. Studies have found that state anxiety has a detrimental effect on participants' digit span results but trait anxiety had no effect (Hodges & Durham, 1972). Another study found that when the digit span falls significantly below the score for vocabulary on

the WAIS, anxiety is usually responsible for the difference. They further found that a reduction in test anxiety improved digit span performance, but not vocabulary performance. Test anxiety research has shown that attempts to reduce anxiety by presenting positive words significantly improved digit span performance in children (Parish, Buntman & Buntman, 1976).

Canadian college students were utilized in a study involving state anxiety and short term memory ability. There were two groups of students, one group was told that "their questionable performance in class tests, hopefully, would be clarified by a brief intelligence test" and the other group received standard instructions for the WAIS (Firetto & Davey, 1971, p. 98). After the test all participants were to self-report on their level of anxiety. Those participants that indicated they were anxious performed significantly lower on the digit span than those who reported not being anxious. There were no significant gender effects found. The results of this study suggest that state anxiety has a significant effect on short term memory performance (Firetto & Davey, 1971).

Ikeda et al. (1996) completed a study with a particular focus on Baddeley's theory (as cited in Ikeda et al.) of memory. The authors were interested in test anxiety and its effect on articulatory loop and spatial memory related tasks. They found that high anxious participants took more time to complete verbal memory tasks and had no difference in spacial memory tasks compared with low anxious participants. The authors suggested that anxiety may cause problems with memory in the articulatory loop in Baddeley's theory (as cited in Ikeda et al.) of memory due to the verbal deficit found. However, anxiety did not interfere with spacial information and therefore the visual

spacial sketchpad may be less affected by anxiety than the other subsystems in his theory (Ikeda et al.).

Relaxation

Definition. The nervous system is broken into two areas: the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS is composed of the brain and the spinal cord. The PNS includes the somatic (SNS) and autonomic nervous systems (ANS). The SNS is responsible for purposeful physical movement such as running or smiling. The ANS is responsible for the automatic functions of the body. The ANS is further divided into two areas: the sympathetic and parasympathetic nervous systems. The sympathetic nervous system is responsible for the fight or flight response in potentially dangerous environments. The parasympathetic nervous system is the natural brake of the body in that it slows the system down by lowering blood pressure and heart rate and increasing body temperature. Relaxation attempts to tap into this parasympathetic response. Relaxation is antagonistic to anxiety (Smith, 1999). Many different types of relaxation techniques exist including guided imagery, progressive muscle relaxation, deep breathing, and many others, and to this point none have proven more effective than any other (Rasid & Parish, 1998).

Theory. Studies have shown that relaxation techniques can in some individuals reduce blood pressure, respiratory rates, and heart rate, lower metabolism and increase body temperature. They also show that in some individuals relaxation can increase endorphins, a hormone that elicits a pleasurable response. The person credited with creating the term relaxation response was Herbert Benson and he was one of the first

individuals to provide the public with information concerning the benefits of relaxation, and the potential problems created by "overstress" (Weber, 1996, p. 197).

Benson published *The Relaxation Response* in 1975. He was a medical doctor who was influenced by both Eastern and Western philosophy and was one of the first in the field to suggest the need to focus on the mind-body connection. Benson (1975) commented in his book on B.F. Skinner's approach to manipulate the environment to "shape" human behavior, and how Dr. Neil Miller took this a step further with his concept of "biofeedback" in attempts to control the autonomic nervous system and thus affect involuntary physiological responses (p. 55). Benson (1975) further developed this concept of "attempting to control involuntary processes" in his relaxation response (p. 54-73). He presented information on transcendental meditation and Eastern concepts such as Yoga and Zen Buddhism that had produced similar responses hundreds of years earlier. He also presented information on a study conducted at Harvard completed on such techniques used suggesting the positive effects on the body. The research found that there were a wide diversity of methods used but all "sought a higher consciousness" (Benson, 1975, p. 60). Benson also presented his own research conducted at Harvard with the approval of a leader in the Transcendental Meditation Society, Maharishi Mahesh Yogi, who had developed a standard manner of teaching people to meditate that was utilized in the study. This research found the relaxation response elicited decreased levels of oxygen, increase in alpha waves, and a decrease in production of lactate. Lactate was thought to elicit an anxiety response in humans with neurosis. Thus, the relaxation response would reduce anxiety (Benson, 1975). Benson's work lead to further development of the area of relaxation particularly in the area of medicine (Weber, 1996).

Immune system function has been shown to be improved by relaxation. Thus, the field of medicine has completed research in this area and coined the term "psychoneuroimmunology" (Giedt, 1997, p. 112). This theory emphasizes the mind-body connection and suggests that the manner in which the system operates is one of "mental images" (Giedt, 1997, p. 112). It suggests that all stimuli, physical and psychological are "interpreted" by the body in image form (Giedt, 1997, p. 112). It is in this manner that guided imagery is useful, as positive images introduced to the person affect the current images, and thus result in changes in immune function. However, this theory also suggests that this phenomenon is largely a "placebo effect" in that what the person believes will produce a desired effect, does actually produce a desired effect, and suggests that without this belief, the treatment would fail (Giedt, 1997, p. 114). However, the effect on the body has been shown to be profound in many cases (Giedt, 1997). Also of interest was a meta-analysis of studies examining the effectiveness of treatments of panic disorder. This meta-analysis found that the studies that used relaxation as a control group tended to underestimate its effect and thus didn't show significant treatment effects (Clum, 1993).

Baddeley's theory (2000) also incorporates the idea of mental imagery with the use of the visual spacial sketchpad and the phonological loop. These two structures allow for internal subjective interpretation of sound (phonological loop) and visual data (visual special sketchpad). Baddeley accounted for what the strict behaviorists refused to account for, the subjective experience that is ultimately reflected by the participant as a mental image (Baddeley, 2000).

Examples in the literature. The area of medicine has completed extensive study of the effect of guided imagery on immune system function. Research in the area of cancer treatment suggests that patients utilizing relaxation procedures found "improved immune function and overall survival" rates (Giedt, 1997, p. 113). Research in the area of cardiac treatment also has seen the benefits of guided imagery. Reductions were found in "heart rate, blood pressure, pain and complications" with cardiac patients (Giedt, 1997, p. 113). Cortisol is a physical indicator of stress upon the body. At high levels it can contribute to health problems. Thus, Pawlow and Jones (2002) found a significant reduction in cortisol levels, state anxiety levels and heart rate following progressive muscle relaxation versus a control group that experienced a quiet period for the same duration as the relaxation condition.

Many studies have found that relaxation enhances performance on short-term memory tests. One study utilized adult participants with severe intellectual disability and generalized anxiety disorder and found that relaxation training improved short term memory test scores but did not improve long term memory test scores (Lindsay & Morrison, 1996).

Another study involving hyperactive children found that relaxation improved performance on the digit span with the hyperactive children but had no significant effect for the non-hyperactive children. Hyperactivity appears to elicit problems in activation that are similar to those found with high levels of anxiety. This was significant to this study as improvement was expected in participants with high anxiety in digit span performance but no change in digit span performance was expected with those with low to average anxiety (Braud, 1978).

Relaxation techniques were used with psychiatric inpatient clients and significant reduction in state anxiety was found. Techniques used in the study included progressive muscle relaxation, meditative breathing, guided imagery, and soft music (Weber, 1996). High school students trained in two types of relaxation training (behavioral and progressive muscle relaxation) showed significantly lower state anxiety than students not trained in the relaxation techniques. No significant difference was found between the two types of relaxation. No gender effects were found and no changes in trait anxiety scores were found. This study was unique in its findings as it used a non-clinical population and found reductions in state anxiety with no preexisting condition (Rasid & Parish, 1998).

Benson's (as cited in Cohen & Sedlacek, 1983) relaxation response procedure and a biofeedback procedure that also incorporated relaxation techniques were utilized in a study with people with high blood pressure. Pre and post test measures on blood pressure and the following testing instruments were utilized: digit span, block design, picture completion, and embedded figures. Post test changes showed no significant difference using Benson's relaxation response procedure. No significant difference was found on either condition pre and post test utilizing the digit span. This study also did monitor the patient's state anxiety level. The biofeedback procedure did have significant differences on blood pressure and block design, picture completion and the embedded figures test, all of which are performance based tests (Cohen & Sedlacek, 1983). This is interesting as other research has found no significant difference between types of relaxation (Rasid & Parish, 1998).

The duration of relaxation procedures ranges from 10 minutes to 45 minutes in the studies listed above. Robert Fried (1999) suggests that a period of 15 minutes is a

minimum for a guided imagery and music. Other studies have also used this 15 minute time period utilizing imagery (Smith, 1999). Thus, this minimum standard was utilized in the present study. Also, comparison conditions in the above studies were utilized in different fashion. Options include a waiting list control group, a reading period, no treatment, and a period of quiet silence. In the present study an informative reading recorded by the present researcher lasting the same amount of time (15 minutes) as the guided imagery technique was utilized. The imagery technique utilized in this study was entitled "Fall Leaves" and is not in a published document but was taught to the present researcher by P. E. Flanders (personal communication, February 13, 2002). The comparison document utilized in this study was an excerpt from a document entitled "How to Manage Your Time Efficiently, Study More Effectively, and Think Critically" (Straub & Brown, 1994).

In summary, the relaxation response coined by Benson, has developed into a field of study focused on improvement of mental and physical health. As in ancient times, there remain many methods of reaching this "higher consciousness" but all appear to gain similar responses. In the present study, the use of guided imagery to reduce state anxiety appears to be founded in research. Of interest in this study was the effect of anxiety on participant's recall of digits backward experiencing the relaxation procedure or the informative tape. In the following chapter, the manner in which this problem was investigated is defined. The method used to provide insight into individual differences in mean digits backward recalled in regard to state anxiety level is presented.

Hypotheses and Research Questions

This study had three research questions. Did state anxiety significantly affect the performance of male and female participants on average digits recalled on the digits backward section of the digit span subtest of the WAIS-III? Did relaxation significantly affect performance of male and female participants on average digits recalled on the digits backward portion of the digit span subtest of the WAIS-III? Did the relaxation or the informative reading comparison significantly affect state anxiety in college aged students?

Hypothesis 1. It was hypothesized that the relaxation condition would significantly affect performance of male and female participants of high anxiety on the digits backward portion of the digit span subtest of the WAIS-III. Further, the relaxation condition would not significantly affect performance of male or female participants of low anxiety on the digits backward portion of the digit span subtest of the WAIS-III.

Hypothesis 2. It was hypothesized that the relaxation condition would significantly affect state anxiety in both high and low anxious participants. Further, the comparison condition would not significantly affect state anxiety in either high or low anxious participants.

CHAPTER 2

METHOD

Participants

The sample included 80 students, 52 women and 28 men, enrolled in psychology and human sexuality classes at Bethany College, Kansas Wesleyan University, and Wichita State University. Volunteers from educational psychology, human sexuality, and general psychology at Bethany College and developmental psychology, human sexuality, and social psychology at Kansas Wesleyan, and general psychology at Wichita State University of both genders were utilized. There were four groups of 20 participants each utilized in this study. High trait anxiety was defined as equal to or greater than one standard deviation above the mean provided by the STAI for men and women or 47.48 and 50.55 respectively. Average trait anxiety was defined as equal to or less than the mean provided by the STAI for men and women, or 38.30 and 40.40 respectively. High state anxiety was defined as equal to or greater than one standard deviation above the mean or 46.49 for men and 50.71 in women for college aged students. Average state anxiety was defined as equal to or less than the mean for men and women, 36.47 and 38.76 respectively. The first group was of high trait anxiety and received the relaxation condition. The second group was of high trait anxiety and received the informative reading comparison condition. The third group was of average/low trait anxiety and received the relaxation condition. The fourth group was of average/low trait anxiety and received the informative reading comparison condition.

Instrumentation

The instrumentation utilized in this study included a demographic/medical questionnaire, the State-Trait Anxiety Inventory and the digits backward portion of the digit span subtest of the WAIS-III. The demographic/medical questionnaire was utilized to obtain information on gender, age, and history of problems with hearing, attention span, and head injury.

The Trait and State portions of the State-Trait Anxiety Inventory were utilized as a measure of trait and state anxiety. As there was no anxiety inducing condition placed upon the participants, trait anxiety was utilized as a screening for high or low anxiety. Thus, those with high trait anxiety would be most likely to also have high state anxiety. The digits backward portion of the digit span was utilized as a measure of working memory. The standard instructions were followed with both tests.

Procedures

The researcher completed the Application for Approval to Use Human Subjects form and gained approval from Emporia State University from the chair of the Division of Psychology and Special Education to use students enrolled in psychology classes who volunteered as participants. The researcher also gained approval from Roger Bishop, Chair of the Psychology Department at Bethany College, and from the Internal Review Board at Kansas Wesleyan University to utilize students enrolled in psychology classes who volunteered as participants.

Volunteers for psychological studies signed up for times to participate in the study presented to them by the researcher during their psychology classes. The participants signed up in groups of 1 to 6 participants per setting. The meetings were held in one hour

increments from 10 a.m. to 8 p.m. in rooms of similar size. The researcher dressed in casual attire in each group meeting. Each participant was addressed in the same manner and given the same information as described below.

The meetings were held on the Bethany College campus in Lindsborg, KS for the Bethany College students and at Central Kansas Foundation in Salina, KS for the Kansas Wesleyan students. The volunteers from Wichita State participated on the campus of Bethany College. Students were given an opportunity to sign up for and attend one of several possible meeting times, and were told the process would take no longer than one hour, and would be complete in one session. When the participants arrived for the study, they each received an informed consent form to sign which was explained by the researcher. The researcher also explained to the participants that the study consisted of two phases, and that all would participate in the first phase. The researcher then explained that there were pre-selected variables that may exclude some participants from the second phase, and stressed that it was not anything the participants did or said to be excluded. Next, a demographic/medical questionnaire was provided to each participant requesting the participant identify his/her gender, age, and answer questions about problems with hearing, concentration, and head injury.

The participants were then administered the State Trait Anxiety Inventory. The researcher prompted the participants to read the directions carefully, and further indicated that the first page was to be filled out according to how they felt "right now" and the second page was to be filled out on how they "generally feel." The documents were then collected. The trait portion of the STAI was then scored by the researcher.

Participants were excluded if they endorsed history of problems with hearing, concentration or head injury. They were also excluded if their trait anxiety fell between 38.31 and 47.47 for men and 40.41 and 50.54 for women. As the score on the STAI does not yield a decimal point, scores for men between 38 and 47 were excluded and scores between 40 and 50 were excluded for women. After the researcher met her need for low anxiety participants, she screened only for high anxiety participants, and thus at that point low anxiety participants were excluded from the study. Those that were excluded were thanked for their participation and given an opportunity to provide their name and address if they were interested in receiving a debriefing with the intent of the study as well as the results of the study in the mail and indicated they would receive this document in December 2003.

In this study, of the original 151 participants, 19 participants were excluded due to falling at the cut off between the range of high and low anxiety. Eleven participants were excluded due to the demographic questionnaire: 3 participants endorsed history of hearing problems; 2 participants endorsed problems with traumatic brain injury; and 5 participants endorsed problems with attention deficit disorder. One participant endorsed problems with both attention deficit and hearing problems. Forty-one participants were excluded due to the researcher having met her need for low anxiety participants.

A participant number was assigned following completion of the STAI and the demographic/medical questionnaire. Thus, excluded participants were not assigned a participant number. The informed consent document was removed from the STAI and demographic questionnaire after the participant number was assigned, thus removing any identifying information. The participants were given a paper with their participant

number on it to keep throughout the research session, so that the after treatment STAI data and digit span data could be adequately tracked. The participants remaining after the exclusion portion were randomly assigned to treatment and comparison condition based upon level of anxiety and gender. A random numbers table was utilized to randomly assign the participants to administration conditions.

A total of 40 participants of the high state anxiety condition and 40 participants of the average state anxiety condition were utilized. They appeared in groups of 6 participants or less. The relaxation experimental group experienced the guided imagery "Fall Leaves" that was pre-recorded by the researcher. The "Fall Leaves" guided imagery had a duration of 15 minutes. The participants in the informative reading comparison condition listened to an informative reading pre-recorded by the researcher that had a duration of 15 minutes.

After listening to the treatment or comparison tape, they were again asked to complete the both form YI and Y2 of the STAI to determine if there was a change in anxiety following the treatment and comparison conditions. They were then asked to go one by one to another room to complete the digits backward portion of the digit span. They entered in the order they completed their STAI. This portion lasted less than 1 minute per participant, so time between relaxation and administration of the digit span was minimal. The participants were tracked to determine if they were first, second, or third to participate in the digitspan backward. If the groups were greater than 3 participants in size, the researcher utilized an assistant to administer digits backward as well. Following the digits backward, the students were given an opportunity to ask questions, but few had any. The participants were then thanked for their participation and

given an opportunity to provide their name and address if they were interested in receiving a debriefing with the intent of the study as well as the results of the study in the mail. Then the participants were released.

The researcher then analyzed the digit span data in comparison to anxiety level and experimental or comparison conditions. Data was also analyzed to determine any gender differences.

CHAPTER 3

RESULTS

Statistical Design

The data were collected by the researcher at the time of digit span testing. The data was analyzed by the researcher and mean digits recalled were compared to anxiety level and experimental or comparison conditions for significance.

This study utilized a 2 x 2 x 2 analysis of variance (ANOVA). The dependent variable was mean digits backward recalled. The independent variables were as follows: anxiety level (high or low) and treatment condition (relaxation or informative tape) and Gender (male or female participants). A separate paired samples *t* test was conducted to determine if the relaxation or informative tape significantly changed state anxiety. A one way ANOVA was conducted to determine if the time delay in administering the digits backward to participants significantly affected average digits recalled.

The statistical program that was utilized to produce the ANOVA is the Statistical Package for the Social Sciences (SPSS) for Windows. This program is commonly used in psychology for this purpose. It provides accurate data in a timely manner, and provides for ease in calculation and analysis of data.

Analysis

The digit span data were analyzed with a 2 x 2 x 2 (Anxiety Level X Treatment Condition X Gender) ANOVA, with mean digits backward recalled serving as the dependent variable. Only one significant effect was found. Digits backward was significantly related to gender in that men recalled significantly more digits backward

than women at the .03 level of significance. No other significant main effects or interaction effects were found. Table 1 summarizes the results of the ANOVA.

Descriptive statistics were calculated for the digit span data based on anxiety level, treatment condition, and gender, and this can be found in Table 2. Descriptive statistics for the interaction effects can be found in Table 3 for high anxiety participants. Descriptive statistics for the interaction effects for low anxiety participants can be found in Table 4. The average digits recalled across conditions was 5.14. The average digits backward recalled for high anxiety participants was slightly less than low anxiety participants, 5.08 and 5.20 respectively. Men recalled on average 5.57 digits, and women recalled on average 4.90 digits.

A paired samples t-test was conducted to determine if State and Trait Anxiety were significantly different prior to and after treatment condition. State and Trait Anxiety were significantly different from before to after treatment at the 0.00 level. Table 5 summarizes the results of the *t* test.

A one-way ANOVA was completed to determine if the time delay in administering the digits backward to participants significantly affected average digits recalled. The results were not significant. Thus, average digits backward was not significantly affected by order the digit span was administered to participants. The largest group contained 6 participants and 2 people (the researcher and an assistant) were administering the digit spans. Most groups contained 1-2 participants.

Table 1

Summary of Factorial Analysis of Variance of Digits Backward as a Function of Anxiety Level (High, Low), Treatment Condition (Relaxation, Comparison), and Gender (Men, Women)

Source	*df*	SS	MS	F
(A)	1	0.46	0.46	0.27
(C)	1	1.15	1.15	0.66
(G)	1	8.01	8.01	4.60*
A X C	1	2.38	2.38	0.01
G X A	1	3.73	3.73	0 .02
G X C	1	0.53	0.53	0.31
G X A X C	1	1.05	1.05	0.60
Error	72	125.48	1.74	

Note. A=Anxiety Level; C=Treatment Condition; G=Gender

*$p < .05$

Table 2

Summary of Means and Standard Deviations of Digits Backwards by Anxiety Level, Treatment Condition, and Gender

Digits Backwards	*n*	*M*	*SD*
Anxiety Level			
High	40	5.08	1.19
Low	40	5.20	1.45
Total	80	5.14	1.32
Treatment Condition			
Relaxation	40	5.30	1.45
Comparison	40	4.98	1.16
Total	80	5.14	1.32
Gender			
Men	28	5.57	1.26
Women	52	4.90	1.30
Total	80	5.14	1.32

Table 3

Summary of Means and Standard Deviations of Digits Backwards for Interaction Effects for High Anxiety Participants by Treatment Condition (Relaxation, Comparison), and Gender (Men, Women)

Digits Backwards	*n*	*M*	*SD*
C (Relaxation)			
Men	8	5.38	1.06
Women	12	5.17	1.47
Total	20	5.25	1.29
C (Comparison)			
Men	7	5.58	1.13
Women	13	4.54	0.88
Total	20	4.90	1.07

Note. C=Treatment Condition

Table 4

Summary of Means and Standard Deviations of Digits Backwards for Interaction Effects for Low Anxiety Participants by Treatment Condition (Relaxation, Comparison), and Gender (Men, Women)

Digits Backwards	*n*	*M*	*SD*
C (Relaxation)			
Men	7	5.86	1.86
Women	13	5.08	1.50
Total	20	5.35	1.63
C (Comparison)			
Men	6	5.50	1.05
Women	14	4.86	1.35
Total	20	5.05	1.28

Note. C=Treatment Condition

Table 5

Summary of Paired Samples t Tests of State and Trait Anxiety Before and After Treatment Condition

Source	*df*	*M*	*SD*	*SEM*	*t*
Trait					
Before		42.74	12.18	1.36	
After		40.33	12.59	1.41	
Differences	79	2.41	3.38	0.38	6.38*
State					
Before		39.05	11.87	1.33	
After		32.89	10.16	1.14	
Differences	79	6.16	8.57	0.96	6.43*

*$p < .05$

CHAPTER 4

DISCUSSION

Hypotheses

Hypothesis 1. The initial hypothesis of the study expected that relaxation response would significantly affect average digits recalled in that those with high anxiety that experienced relaxation condition in that they would score better than those that experienced the comparison condition. The results of this study did not support hypothesis 1. Perhaps both groups were equally relaxed and thus, had no significant improvement based on treatment or comparison condition. However, in an examination of means, the relaxation condition had a greater mean difference from before treatment state anxiety to after treatment state anxiety, than did the comparison condition. Prior studies have indicated no change in digit span performance based upon Benson's (as cited in Cohen & Sedlacek, 1983) relaxation response procedures and biofeedback (Cohen & Sedlacek, 1983). The results of the present study appear to support the above studies in that no change in digits backward was found as a result of participation in guided imagery. The present study investigated the more complex task of digits backward and a utilized a different type of relaxation than the study listed above.

In the present study there was no statistically significant anxiety related decline found in average digits recalled on the digit span. Eysenck (as cited in Paulman & Kennelly, 1984) found at times, high anxiety ridden participants put forth more effort to complete a task to make up for their state of anxiety. The extra effort places an additional demand on activation upon working memory. Therefore, with participants such as these, their anxiety related decline would not appear until additional or more complex tasks

were added. It is possible that the digits backward portion of the digit span was not a complex enough task to lead to anxiety related decline. In future studies, it would be of interest to determine if adding a motor task while completing the digit span would lead to decline in those participants with high anxiety that experience the comparison condition as opposed to the relaxation condition.

The present data are congruent with the research indicating that the average person age 25 to 34 can recall 5 digits backward (Wechsler, 1997b). In the present study, the average digits recalled among participants was 5.14. However, the data are not congruent with research indicating no significant gender differences on average digits backward recalled. This study found a significant gender effect at a .03 level in average digits recalled. Though this effect was statistically significant, its clinical significance is minimal. Average digits recalled in the present study for men was 5.57 and for women was 4.90, both close to the average of 5 provided by the WAIS-III. A possible explanation for this anomaly is counterbalancing error. The participants were assigned to treatment or comparison based on their gender, as well as their anxiety level. There were only 28 men as opposed to 52 women. In future studies of interest would be to match groups with equal numbers of men and women. Also, perhaps intelligence was not controlled for efficiently by random assignment, as those of high intelligence tend to score higher on the digit span (Conners, Carr, & Willis, 1998). Of interest for further study may be the effect of IQ or grade point average on average digits backward recalled.

The participants self-report of no history of problems with hearing, concentration, or traumatic brain injury as well as age and gender was accepted without other sources

verifying such data. In further study, it may be helpful to gain collateral sources such as medical records to substantiate the information.

Hypothesis 2. The second hypothesis of the study indicated that the relaxation condition would significantly reduce state anxiety in both high and low anxiety participants. Further, the comparison condition will not significantly affect state anxiety in either high or low anxious participants. State anxiety was significantly reduced by the relaxation condition, which was one of the main primus' of the study. In examining the means, it does appear that the relaxation condition provided more of a change in state anxiety overall than did the comparison condition which was expected. Regression toward the mean is expected with anxiety, and this may explain the change in state anxiety provided by the comparison condition.

It appears the present study supported much of the research present about relaxation response. Particularly, it supports a study completed by Rasid & Parish (1998) that found that students utilizing relaxation training showed significantly lower state anxiety than students not trained in relaxation techniques. In the present study, only a minimal amount of training in relaxation was provided. Of interest for further study would be to provide several days of training in relaxation and determine if further training would provide more profound changes in state anxiety.

In the present study, trait anxiety also showed a significant decline upon treatment condition for both relaxation and comparison. This does not appear to support the research present about relaxation response. In the study completed by Rasid & Parish (1998) in which high school students trained in relaxation response and those not trained were compared on state and trait anxiety, no significant difference in trait anxiety was

found. Trait Anxiety appears to be more stable as a personality characteristic, and is less affected by short term changes in environment (Hodges & Durham, 1972). A decline in Trait Anxiety would thus not be expected in the present study. In examining the means, it appears the greatest decline appeared in the State portion. The researcher did prompt the participants to read the directions carefully on the STAI each time if was administered and indicated that the first page was how they are feeling "right now" and the second page was how they "generally feel." Despite these prompts, it appears that perhaps the participants misunderstood the trait directions, or failed to read them when completing the form the second time. It was obvious that the participants completed the form the second time in less time than the first, and that perhaps some practice effect was present. Boredom due to having so recently completed the form may have caused inattention to the direction details.

The average state anxiety before treatment or comparison condition for men was 38.39 and for women was 39.40. Average listed by the STAI is 36.47 for men and 38.76 for women (Spielberger, 1983). In the present study, the average trait anxiety before treatment or comparison condition for men was 41.39 and for women was 43.46. The average listed by the STAI is 38.30 for men and 40.40 for women (Spielberger, 1983). A reason for the slight elevation in the present studies averages could be due to the fact that equal groups of high and low anxiety participants were gathered. In this study, it appeared that about 1 in 4-5 people had high anxiety, and thus the study contained more highly anxious people in proportion to the general population, which could account for the difference in present study data to the STAI norms.

This study did not incorporate an adverse anxiety-provoking condition to substantially elevate state anxiety. Instead, the study held the assumption that those with high trait anxiety would also tend to have high state anxiety. This did not appear entirely consistent in this study. Of the 40 highly anxious participants, 11 of the women who had high trait anxiety also reported high state anxiety upon initial testing, 6 of the men who had high trait anxiety also reported high state anxiety upon initial testing, 15 of the women who reported high trait anxiety did not report high state anxiety, and 8 of the men who reported high trait anxiety did not report high state anxiety. Exploratory analysis was conducted utilizing data from men and women who had both high trait anxiety and high state anxiety compared to those who had high trait anxiety but not high state anxiety upon initial assessment in the study. A paired samples t-test was conducted, and it indicated a significant reduction in state anxiety at the .002 level after the treatment condition for the high state anxiety participants. The low state anxiety participants did not have a significant reduction after treatment condition. However, this may be due to the fact more of the high state anxiety participants were in the relaxation treatment condition (12 participants) than the low state anxiety participants (5 participants), and thus this may be related more to treatment condition than to level of anxiety. Further research should be completed incorporating an anxiety producing stimuli to insure that state anxiety will be elevated to at least one standard deviation above the mean provided by the STAI. Another possibility for further research would be for the researcher to score both trait and state anxiety and assign those people to the high anxiety group that have both high state and trait anxiety prior to treatment condition.

Conclusions and Future Directions

Anxiety and ways of treating and coping with it have been around for many years. Research has continued to assist the clinical world in the effort of treatment and successful management of problems created by anxiety. The present study attempted to gain a better understanding of the way anxiety affects short term memory. Further research will be necessary to explore the relationship between the ability of anxious participants to compensate for their ailment to a point. Further exploration into the point where the ability to compensate for anxiety is lost is of interest.

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Appendix A: Informed Consent Letter

EMPORIA STATE UNIVERSITY

Informed Consent Document

Read this consent form. If you have any questions ask the experimenter and she will answer the question. The Department/Division of Psychology supports the practice of protection for human subjects participating in research and related activities.

The following information is provided so that you can decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time, and that if you do withdraw from the study, there will be no consequences to you.

You will be taking the State Trait Anxiety Inventory, and if selected for the second phase, the digit span subtest of the WAIS-III, a portion of a commonly used intelligence test in psychology. This study will take approximately one hour of your time. The benefits are for my educational purposes. Information obtained in this study will be identified only by code number. Your name will be used only to indicate that you participated in the study and received extra credit for participating. Extra credit will be given to participants who complete 100% of the study.

If you have any questions or comments about this study, feel free to ask the experimenter. If you have any additional questions, please contact the chair of the Division of Psychology and Special Education at 620-341-5317.

"I have read the above statement and have been fully advised of the procedures to be used in this project. I have been given sufficient opportunity to ask any questions I had concerning the procedures and possible risks involved. I understand the potential risks

involved and I assume them voluntarily. I likewise understand that I can withdraw from the study at any time without being subjected to reproach."

_____ _____

Signature of Participant Date

THIS PROJECT HAS BEEN REVIEWED BY THE EMPORIA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD FOR TREATMENT OF HUMAN SUBJECTS FOR THE PROTECTION OF HUMAN SUBJECTS.

Appendix B: Demographic Questionnaire

Participant number _____ (to be provided by the researcher)

Gender: (check one) male_____ female_____

Age_____

Medical Questions:

I have a history of or am currently experiencing hearing problems or loss. Y / N

I have a history of or am currently experiencing attention deficit disorder or problems in attention span. Y / N

I have a history of or am currently experiencing problems associated with a head or traumatic brain injury? Y / N

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Date

An Examination of the Relationship Between State Anxiety, Relaxation Response, and Digit Span Performance

Title of Thesis

Signature of Graduate Office Staff Member

12-3-03

Date