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Dual-Task Attentional Limitations in Anxiety: Examined with the Attentional Blink Paradigm and the Beck Anxiety Inventory

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DUAL-TASK ATTENTIONAL LIMITATIONS IN ANXIETY: EXAMINED WITH THE ATTENTIONAL BLINK PARADIGM AND THE BECK ANXIETY INVENTORY

by

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Bachelor of Science, North Dakota State University, 2000

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This thesis, submitted by Heather B. Trangsrud in partial fulfillment of the requirements for the Degree of Master of Arts from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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This thesis meets the standards for appearance, conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

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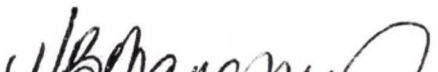
Signature 

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ABSTRACT

Many researchers have studied the areas of attention and anxiety. However, there is a lack of knowledge about anxiety when examined with the Attentional Blink (AB) paradigm. It was believed that an increase in anxiety would lead to an increase in the ABs. Due to high comorbidity of anxiety and depression, both constructs were measured and hypotheses were formulated to predict if the effects anxiety has on attentional dual-tasks are more highly related to anxiety alone, depression alone, or the combination of anxiety and depression. Participants were undergraduate and graduate students that were prescreened for anxiety with the Beck Anxiety Inventory (BAI; Beck & Steer, 1993). After completing the AB trials, participants filled out the BAI and the Beck Depression Inventory-II (BDI-II, Beck, Steer, & Brown, 1996). Then the accuracy rates from the AB trials and the scores from the BAI were compared. ANOVAs were conducted to determine if the level of anxiety was related to AB. Main effects were found for instruction condition (single- or dual-task) and for second target (T2) position. A two-way interaction was found for instruction and T2 position; however, no significant interactions were found when anxiety level was examined. A regression analysis was also conducted to determine whether anxiety score predicted the size of the participants' ABs. The regression was not significant. These findings suggest that even though anxiety is an important variable, it did not affect participants' performance on the AB task. An additional regression analysis was conducted using the scores obtained from the BDI-II to

determine whether or not depression predicted the size of AB. Possible reasons for the findings are discussed.

CHAPTER I

INTRODUCTION

Dual-Task Attentional Limitations in Anxiety: Examined with the Attentional Blink Paradigm and Beck Anxiety Inventory

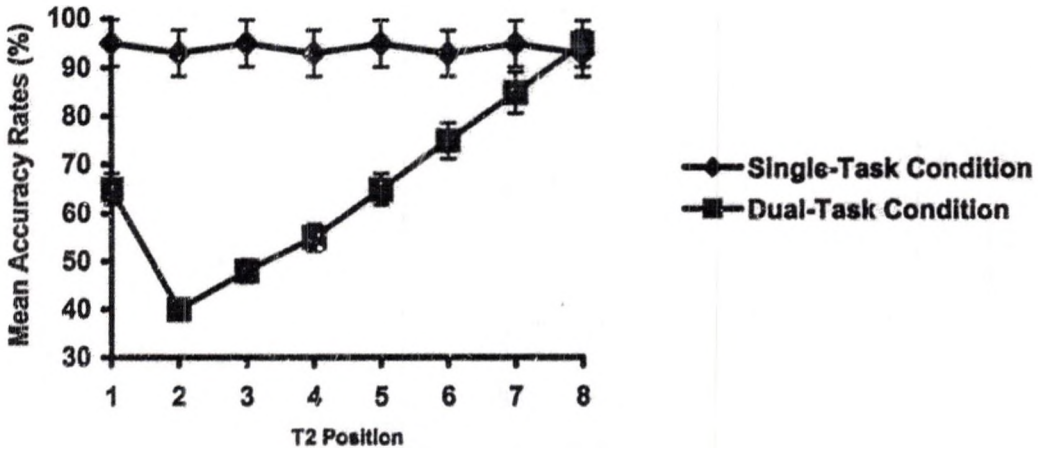
There has been much research in the recent past focused on different attentional and cognitive processes in order to discern how the mind works (e.g., Arnell & Jolicoeur, 1999; Arnell & Trangsrud, in review; Arnell, Trangsrud, Jones, & Larson, in review; Chun & Potter, 1995; Ellis, Thomas, & Rodriguez, 1984; Rogers & Monsell, 1995). This area of research is less developed than other areas of psychological research because it only came into focus in about the last 50 years (Styles, 1997). Conversely, there has been an immeasurable amount of research on anxiety, and much of that research has indicated that anxiety results in an impairment of functioning. According to the Diagnostic and Statistical Manual (4th Edition; DSM-IV), a primary characteristic of pathological anxiety is the impaired functioning of the anxiety "sufferer" (American Psychiatric Association, 1994). Even though attentional and cognitive research has become quite popular in contemporary times, not much of the research has focused on attention and anxiety collectively. More specifically, there is limited research on the cognitive phenomenon referred to as the "Attentional Blink" (AB) viewed in concert with anxiety.

The AB is a phenomenon that illustrates that attentional abilities are limited. The AB is the result of our attentional limitations, not a cause, and it occurs when a person is

required to attend to stimuli that are presented visually in a rapid fashion. More specifically, an AB occurs when individuals are instructed to watch for two targets amongst several other stimuli. While looking for the two targets, the ability to accurately identify the second target is reduced when there are fewer filler letters presented between them. The size of an AB can be determined in two ways. The first, and most common, way is to examine the mean accuracy rates (percentages) obtained from detection on a second target either across its positions after T1 or according to the number of milliseconds [ms] occurring between the two targets. To see what a typical AB looks like, see Figure 1. By the use of this illustration, it can be seen that the mean accuracy rates at the first few positions are lower than the mean accuracy rates at the later positions. The difference or variance of the mean accuracy rates at the different positions lends to the size of the AB. A larger AB or larger variance suggests that attentional performance occurs at a decreased level because individuals are still determining the identity of T1. A second way is to obtain an AB size score. This score is calculated by subtracting the dual-task mean accuracy rates (percentages) from each position from the corresponding single-task mean accuracy rates (dual- and single-task conditions are discussed later). Once this is done for each position, the sum of these numbers is the AB size score. An AB size score is usually only calculated to examine correlations. A robust AB is present if there are significant differences between the mean accuracy rates for each second target position or if a large AB size score is obtained.

There have been many studies that have focused on the Attentional Blink; however, not many studies have focused on the effects that psychological disorders have on this limitation. Since this is a gap in the current research, the present study focused on

Figure 1. General AB Example


Mean Accuracy Rates (%)
100
90
80
70
60
50
40
30
1
2
3
4
5
6
7
8
T2 Position
Single-Task Condition
Dual-Task Condition

the effects of anxiety on the AB. The present study attempted to clarify results of past studies, in particular a study by Rokke, Arnell, Koch, and Andrews (2002), and attempted to demonstrate whether limitations in attention are more highly correlated with level of depression, with level of anxiety, or equally with both anxiety and depression. Also, if meaningful categories of anxiety were established, then it could have been concluded that anxiety may lead to a decrease in attentional abilities, like Rokke et al. (2002) concluded when examining dysphoria.

Generally, the AB paradigm is examined in order to obtain more knowledge into how the human mind works so, for the most part, studies have not focused on clinical usage. However, there are always exceptions and, thus, there have been some studies that focused more on the applied use of tasks similar to the ones in AB studies in attempts to understand how information is processed. For instance, many studies have examined information processing by examining reaction or accuracy rates for emotionally-laden words, to examine how people process threatening stimuli, to examine sexual arousal, to examine how individuals process rape scenarios, or to examine the effects of lead exposure on attention (Fulcher, Mathews, Mackintosh, & Law, 2001; Buckley, Blanchard, & Hickling, 2002; Koukounas & McCabe, 2001; Sandberg, Lynn, & Matorin, 2001; and Morgan, Garavan, Smith, Driscoll, Levitsky, & Strupp, 2001, respectively). The basic premise of the aforementioned studies is that information processing is affected through many different methods. Specifically, it has been found that individuals with high levels of emotionality or increased abilities to dissociate tend to experience greater attentional interference from threatening stimuli than their lower level counterparts. This suggests that information processing is affected by a prescribed level of emotionality or

dissociation instead of being learned from past experiences (Fulcher et al., 2001; Sandberg et al., 2001). Contrary to this, Buckley et al. (2002) suggests that information processing is learned and that information is processed in a manner that is specific to an individual's disorder. Therefore, individuals with PTSD have delayed processing for stimuli that they believe is threatening or have characteristics similar to the trauma they experienced. Buckley et al. (2002) further suggests that only the information processing deficits that are learned can be treated successfully. Even though this information is quite interesting and valuable to the field of psychology, the present study was intended to obtain more general information about the attentional limitations that are present in individuals with anxiety. Using this general information, some brief speculations are made about potential research ideas that could be done in the future to gain insight into the ways the AB could be used clinically. Before getting into the present study further a review of what has been done is needed.

Literature Review

Unlike the areas of anxiety and cognition, there has been research conducted focusing on the role that depressed mood has on encoding, semantic processing, and cognitive effort (Ellis, Thomas, & Rodriguez, 1984; Seibert & Ellis, 1991). It was found that these three methods of information processing were contingent on the level of depression. These studies demonstrated that attention and cognition played a key role in information recall in depression (Ellis, Thomas, & Rodriguez, 1984; Seibert & Ellis, 1991). Due to these findings, other studies have been conducted on the role depression may have on types of attentional tasks, namely the Attentional Blink (AB). When attentional deficits were studied using depressed participants, level of depression was

found to play a significant role in the size and length of AB (Rokke, Arnell, Koch, & Andrews, 2002). Even though this study found significant results of an AB in dysphoric participants, the results cannot conclude that the AB is due only to dysphoria and not anxiety. Due to this shortcoming, the present study was employed. Also, the present study will help give a more complete look into how attentional processes are affected by anxiety. Further, it is hoped that this study will elicit some support for models of attention that have been proposed. Finally, the present study should demonstrate that there is further need to examine the role attention has in various clinical disorders.

Attention and the Attentional Blink

People have a limited amount of attention to apply to tasks. There have been many hypotheses about what causes this limitation. Some researchers believe that limited attentional capacity is due to a bottleneck approach, while others believe that limitations are due to interference from other stimuli or the level of importance assigned to certain stimuli (Styles, 1997), and still others believe it is due to the temporary suppression of the stimuli (Raymond, Shapiro, & Arnell, 1992). To understand the meaning of the bottleneck approach, picture a bottle lying on its side with the top pointing to the left. If information is presented and is being encoded, only a certain amount is able to get in at a time. Once all the information has gotten through the "bottleneck," the information goes together much like a puzzle. Once the information is "put together" it can be processed and therefore understood. Thus, since the information needs to go through this long process, some will be missed or lost in the process. This therefore leads to an attentional limitation (Broadbent, 1958; Navon & Miller, 2002). This is different than the belief that attentional limitations are due to importance of the stimuli. The degree of importance that

stimuli holds can lead to attentional limitations because if it is not seen as important to the person at that time, the stimuli are bypassed and ignored (Styles, 1997). Related to this idea, some researchers believe that attentional limitations are due to temporary suppression of presented information (Raymond et al., 1992). Temporary suppression can be compared to a storage unit. Information that is being presented is temporarily put into storage before it is encoded. In essence, it is put to the side and saved for later processing.

In a study by Raymond et al. (1992), it was discovered that attentional processes facilitated visual encoding. This was discovered with a phenomenon known as the "Attentional Blink" (AB). An AB occurs when participants are told to watch for two targets (letters) presented within a rapid serial visual presentation (RSVP) stream of other letters. When the first target (T1) is identified this "opens the attentional gates." As a result, the identity of T1 is temporarily set aside because they know they will have to watch for a second target (T2). T2 will interfere in the attentional process depending on when it is presented. If T2 is presented in the second or third position (or less than 400 milliseconds [ms]) after T1, then an "Attentional Blink" will occur. Basically, it can be interpreted that at these early positions or in the first 400 ms after T1, the individual is still trying to identify T1 so he or she can set it aside in order to watch for T2. However, if T2 is presented in one of the other eight possible positions (e.g., 4, 5, 6, 7, or 8) or more than 400 ms after T1, then no AB will be found or it will not result in decreased performance because the individual was able to identify it and temporarily set it aside. An AB begins to recover and returns to "normal attentional processing," beginning with the fourth position (or 400 ms) after T1. Like discussed, an AB occurs when T2 is presented

in one of the earlier positions or within 400 ms, though sometimes an AB will occur later and therefore take longer to recover.

To further support the introduction of the AB, the same researchers conducted another experiment to further understand what causes this deficit in attentional processes (Shapiro, Raymond, & Arnell, 1994). To address this, participants had to identify whether or not T1 and T2 were present or absent. This was addressed by having the participants respond to a sentence (e.g., "Was a white letter (T1) present or absent?" or "Was a black X (T2) present or absent?") presented on the computer screen after the stimuli were presented. Participants responded to the questions by pressing certain keys on the keyboard. A significant AB was found when T1 was present, but not when T1 was absent. This suggests that attentional limitations occur when T1 interferes with T2 (due to T1 still being encoded, T2 cannot be processed). This means that there must be two targets in order for an AB to occur (Shapiro et al., 1994).

T1 does not have to be a letter. A significant AB was found when a pattern of lines resembling a letter was used instead (Shapiro et al., 1994). It was also found that the number of filler letters in the stream changed the size of the AB. This was demonstrated by changing the amount of filler letters presented. When the number of filler letters is decreased, the size of the AB is also decreased (Shapiro et al., 1994). This suggests that the strength of the AB can be manipulated. Filler letters are often referred to as "masks." Masks "cover up" targets in order to make the task at hand more difficult. The more difficult the masks are, the larger the AB will be.

Since it was discovered that the number of masks changed the size of the AB, this piqued curiosity to see if the kind of mask used also played a role in the size of the AB.

Seiffert and Di Lollo (1997) suggest that the difficulty of T1 played a role in the size of the AB. More specifically, placement of targets and their masks affects the AB. If masks are placed to the side of T1 or T2 then they do not "mask" them (which demonstrates that these masks are irrelevant). Therefore, stimuli need to be in the same place to cause dual-task interference. Also, it has been found that the rate of target and mask presentation influenced the size of the AB (e.g., slow presentation produces a smaller AB, fast presentation produces a larger AB; Arnell & Jolicoeur, 1999; Jolicoeur, 1999).

It has been suggested that an AB could be found only when both targets are presented visually (e.g., not auditorily) and as either letters only or numbers only (Rogers & Monsell, 1995; Soto-Faraco &; Spence, 2002). If the targets are presented in different forms (e.g., T1 as a letter and T2 as a number) then this results in decreased performance due to task interference because of task-switching and not due to attentional limitations (Rogers & Monsell, 1995). Though task-switching has an attention component to it, deficits in performance in these instances are due more to a switch in task rather than due to limited amounts of attention. However, in a study by Potter, Chun, Banks, and Muckenhoupt (1998), it was suggested that an AB could only occur visually even when the targets and the masks are presented in different modalities (e.g., letters among number and vice-versa). This gave further support to the notion that an AB is only present when both targets are presented as visual stimuli, though a study by Arnell & Jolicoeur (1999, reviewed later) provides evidence to the contrary.

Since the AB was replicable, a model was devised to further understand the phenomenon. In a study by Chun and Potter (1995), a two-stage model was devised. The first stage consisted of the perceptual detection of the targets and the second stage

suggested there was a limited capacity of conscious retention. This model suggests that both T1 and T2 are detected; however, only T1 is consciously retained, while T2 is only attended to briefly. This therefore suggests that T2 cannot be processed because "attentional processes have run out" after consciously retaining T1 (Arnell & Jolicoeur, 1999; Chun & Potter, 1995; Navon & Miller, 2002). Basically, when we are presented information, we must decide if it is relevant or irrelevant, and eventually our resources get tapped out so we must stop taking in new information. This study also found that temporal and spatial limitations played an important role in the size of the AB (Chun & Potter, 1995).

Even though a vast amount of research supported the idea that an AB can only occur when both targets are presented visually, it has been found that the AB can occur when one target is presented visually and when the other target is presented auditorily (Arnell & Jolicoeur, 1999). This finding suggests that the AB is due to limits in central processing. Deficits that lie in central processing occur between stimuli encoding and response selection due to a limited amount of attentional resources available to complete a task (Arnell & Jolicoeur, 1999; Arnell & Trangsrud, in review; Arnell et al., in review). Differences in central processing in anxious individuals versus normal individuals may suggest that anxious individuals have slower central processing or a greater limitation in their amount of attentional resources. This issue will be examined in the present study.

Anxiety

There is a general consensus that anxiety plays an important role in the everyday functioning of individuals (Eysenck, 1967; Eysenck, 1992; Singh & Jain, 1987). Individuals with moderate levels of anxiety function better or perform at better levels,

which means they perform with more efficiency under pressure than individuals with high or low levels of anxiety because it is believe they are able to cope by either decreasing their worry or by increasing their motivation (Eysenck, 1967; Eysenck, 1992; Singh & Jain, 1987). Out of these three categories of anxiety, high anxiety individuals function with the lowest level of success (Eysenck, 1992; Singh & Jain, 1987). This suggests that in the present study, participants with no anxiety should perform better then the participants with low to high levels of anxiety. The participants with low or moderate levels of anxiety should perform similarly to each and at a lower level than participants with no anxiety on a measure of AB. Finally, participants with high or severe levels of anxiety should perform the worst. Therefore, an AB will be longer at the high anxiety level than at the other anxiety levels (e.g., no, low/moderate).

Models of Anxiety Functioning

There were three main models of attentional functioning in anxiety, and recently a fourth model has been proposed (Matthews & Mackintosh, 1998). The first three models of attention in anxiety are referred to as precursor models (Matthews & Mackintosh, 1998). The first model stated that when anxious individuals are presented stimuli perceived as highly threatening, they would have increased ability to identify the stimuli. Conversely, if the anxious individuals were presented stimuli that are perceived as low in threat, they would be able to ignore the stimuli therefore decreasing identification (Matthews & Mackintosh, 1998). The second model stated that anxious individuals use a monitoring plan when dealing with threatening stimuli. Individuals, according to this model, will only attend to stimuli that are threatening, therefore only highlighting the threatening information and not noticing the non-threatening information. This suggests

that individuals' attention is focused on threatening stimuli so they are more apt to process it. However, since the focus is on threatening stimuli, all threatening stimuli are identified even though some of the threatening stimuli may not get encoded (Matthews & Mackintosh, 1998). The third model of anxiety and attention has three steps. First, the information is analyzed to determine its features. Then the information is sent to an unconscious processing system. If the information meets the criteria for certain features (features are specific to the individual's anxiety-provoking stimuli) then it is passed onto the conscious processing system where the information is carefully analyzed for danger. If the information is dangerous then attention is placed on it and identified (Matthews & Mackintosh, 1998).

In the newly proposed model, Matthews and Mackintosh (1998) suggested that anxiety can explain biases in attention and that even low-anxious individuals will give more attention to threatening stimuli. However, they believed that the stimuli would have to be extremely threatening to receive more attention in low anxious individuals. They believe that attention deficits or interference can begin even before the stimulus is identified as threatening (Matthews & Mackintosh, 1998).

Further, Matthews and Mackintosh (1998) suggest seven assumptions related to this most recent model. The first assumption is that anxious individuals always attend to an anxiety-provoking stimulus if there is only one to attend to, but if there are two anxiety-provoking stimuli then anxious individuals must inhibit attention of one target to see the other. The second assumption is that there is slower processing when threat must be appraised with higher levels of control and conscious effort or when the individuals are aware they are assessing for a potential threat. However, if a threat has been seen

before, then the threat is processed faster. The third assumption is that certain features of a target are matched to current information held in storage and this information is then opened for further processing if it is similar. The fourth assumption is that stimuli that are more threatening will always be attended to, whereas less threatening stimuli will only be attended to in individuals with high levels of anxiety. The fifth assumption is that an effort to ignore a threatening stimulus can be effective. The sixth assumption is that neutral words are defined as more threatening in anxious individuals than in "normal" individuals. Finally, the seventh assumption is that threatening stimuli are associated with better recall than neutral stimuli. This, however, can be manipulated by when they are presented (Matthews & Mackintosh, 1998). After reviewing these models of anxiety and assumptions, it is important to point out that any stimuli that are threatening to one individual could be perceived as harmless to different individuals.

It has been found that anxiety affects individuals' attentional abilities by biasing it in a manner that is more under their control or strategic rather than automatic (Matthews & Wells, 2000). It has also been shown that anxiety makes individuals less adaptable to their situation (Matthews & Wells, 2000). Lower abilities to adapt to certain situations may play a role in anxious individuals' performance. This may demonstrate why it has been found that anxious individuals have a lower performance level with neutral stimuli, as suggested by Dibartolo, Brown, and Barlow (1997). However, lower abilities that are found in anxious individuals may also be due to their increased attention to negative stimuli, their lower threshold for negative or threatening stimuli, inability to inhibit threatening stimuli, or test anxiety due to their increased level of worry and avoidance

(Derryberry & Reed, 1998; Fox, 1994; Koegh & French, 1999; Mogg & Bradley, 1998; Eysenck & Calvo, 1992).

Depression

As mentioned earlier, attentional deficits were studied using depressed participants in a study by Rokke et al. (2002). Results suggested that level of depression played a significant role in the size and length of AB (Rokke, et al., 2002). This suggests that level of depression influences participants' attention, particularly at the severely depressed level. Related to this is a study, previously mentioned, that focused on the role of depressed mood on encoding, semantic processing, and cognitive effort (Ellis, Thomas, & Rodriguez, 1984). To recap, the study by Ellis et al. (1984) found the level of depression currently being experienced by the individual influenced these three elements of information recall.

There also have been a number of other studies and literature focusing on influences depression has on attention, memory, and information processing. One of the most commonly mentioned influences of depression is the tendency for depressed individuals to have a negatively biased focus with their attention processes (Gotlib & Krasnoperova, 1998). It is hypothesized that this occurs because the negative schemas they possess, due to past experiences, hamper their cognitive functioning by only allowing information that is congruent with their negative schemas to be processed (Gotlib & Krasnoperova, 1998). This hypothesis has been demonstrated through a variety of studies using paradigms such as the Stroop color-naming task, the dichotic listening task, and the deployment-of-attention task, as depressed participants in these studies would generally attend more automatically to negative stimuli versus neutral/positive

stimuli (Gotlib & McCann, 1984, McCabe & Gotlib, 1993, McCabe & Gotlib, 1995, McCabe & Toman, 2000). Related to the tendency that depressed individuals focus more attention toward negative stimuli, is the finding that depressed individuals also have an increased tendency to encode negative memories more readily than more neutral or positive memories. This has been demonstrated through reviewing depressed individuals' memory for their past experiences and in other laboratory-based experiments instilling the use of computers (Gotlib & Krasnoperova, 1998). In addition, depressed individuals tend to have better recall for negative information when they believe it pertains to them. This was demonstrated by having depressed participants read various adjectives and respond if they thought the adjective described them. At the end of the session, the participants were asked to list the adjectives they thought described them. They were able to list more of the negative adjectives that they thought described themselves rather than the positive ones (Dozois, & Dobson, 2001; Gencoz, Voelz, Gencoz, Pettit, & Joiner, 2001).

Besides this negative bias hypothesis, it has been suggested that depressed individuals demonstrate a greater amount of divided attention than nondepressed individuals (Thomas, Goudemand, & Rousseaux, 1998; 1999). This increased amount of divided attention occurs when depressed individuals are exposed to cross-modality stimuli (e.g., one auditory stimulus and one visual stimulus) or same-modality auditory stimuli and results in slower responses when they must attend to two tasks simultaneously and required to make a decision about the stimuli (Thomas, Goudemand, & Rousseaux, 1998; 1999). Interestingly, however, these findings are only found when depressed individuals are currently in a depressed state and not after they improve from

this state or return to a relatively more "normal" state of functioning (Thomas, Goudemand, & Rousseaux, 1998; 1999). The vast findings in the area of cognition and depression have even led some psychologists to believe that with more research, this experimental knowledge of cognition (namely attention and memory) could be applied directly in the therapy environment (Bootzin & McKnight, 1998; Gotlib, & Krasnoperova, 1998). It has been suggested by Gotlib and Krasnoperova (1998), that attentional tasks that examine priming or memory biases, could be used in conjunction with other assessments in determining depression since depressed individuals tend to recall more negative primes or memories than nondepressed individuals due to their negative schemas.

Purpose of Present Study

Using the aforementioned studies of attentional and cognitive processes and also anxiety and depression as a background, the purpose of the present study was to bring this information together to determine if a relationship was present between attention and anxiety, as well as between attention and depression. It was hypothesized that mean accuracy rates obtained from trials presented according to the Attentional Blink (AB) paradigm will decrease due to anxiety level (decrease in "anxious" participants, not "non-anxious"). The rationale for this study was to extend the knowledge of the AB to other clinical disorders and to present a clearer picture of attentional functioning in anxiety. Since anxiety and depression have a high rate of comorbidity, the present study attempted to demonstrate whether anxiety, depression, or both combined is more highly correlated to the AB task. However it was hypothesized that an equal correlation for anxiety and depression could be possible, suggesting that one is not more dominant than the other.

This study also attempted to determine whether information processing in anxiety was done centrally. Finally, it is hypothesized that the present study will have results similar to those of Rokke et al. (2002).

CHAPTER II

METHODS

Participants

Thirty students (12 undergraduate and 18 graduate, mean age = 26.6 years) from the University of North Dakota (UND) participated in the study. The majority of the participants were women (22 women; 8 men) and Caucasian (26 Caucasian; 1 African American; 1 Indian American; 2 unknown). See Table 1. Participants were informed about the study through their enrollment in an undergraduate-level career decision-making class, a graduate-level multicultural class, an invitation located at the University Counseling Center, and an advertisement on UND's Channel 3. All participants volunteered to participate and were prescreened using the Beck Anxiety Inventory (BAI; Beck & Steer, 1993) in order to ensure equally-sized comparison groups of "anxious" and "non-anxious" (how participants were broke down into groups will be discussed below). Participants were offered incentives for their time. They were entered into a monetary drawing for the amount of fifty dollars or, for the graduate-level multicultural course only, they could choose to either be entered into the monetary drawing or to receive 10 points of course credit. For the analyses, participants were broke into groups of "anxious" or "non-anxious" according to a post-screening that was done at a later date.

Table 1

Demographic Characteristics of All Participants

		n
Level of education		
	Undergraduate	12
	Graduate	18
	Total	30
Gender		
	Men	8
	Women	22
	Total	30
Race		
	Caucasian	26
	African American	1
	Indian American	1
	Unknown	2
	Total	30

Note. Demographics are of all participants and are not divided into groups according to their anxiety level.

Stimuli and Apparatus

Stimuli and tasks were similar to those presented in basic Attentional Blink (AB) studies (Raymond et al., 1992; Rokke et al., 2002). Therefore, all stimuli and tasks were completed using a computer monitor and keyboard. For the trials, the first target (T1), a white letter, was presented randomly within a stream of rapidly sequenced black letters and was never presented as the first letter. All letters of the alphabet had an equal chance at being T1 or a filler letter in the stream except for the letter X, which was used to represent the second target (T2). The letter X was only used for T2 and was not used as T1 or as a filler letter. T1 was always white and T2 was always black. As previously mentioned, T1 was never the first letter presented in the stream. It was always presented

as the 12th letter. T2 followed T1 in one of eight positions following T1 (e.g., 1,2,3…8). There were always eight letters presented after T2 to account for possible recency effects.

The letters were presented one at a time in a rapid serial visual presentation (RSVP) stream in the center of a gray-colored computer screen following a fixation point (plus sign). The fixation point was followed by 500 ms of blank space. The letters were then presented in the same location for 48 milliseconds (ms) each with no break between letters. The letters were presented in 18-point Geneva font. See Figure 2.

The program was written in PsyScope 1.1, which is a computer software program that is generally used for studies that rapidly present stimuli either visually, like the present study, or auditorily to participants (Cohen, MacWhinney, Flatt, & Provost 1993). After the trials were completed, the raw data was saved to a disk in order to be entered into UNIX scripts to get mean data for each individual. The data was numbered so each participant could be insured proper confidentiality. The data for each individual was then used in group analyses using SPSS.

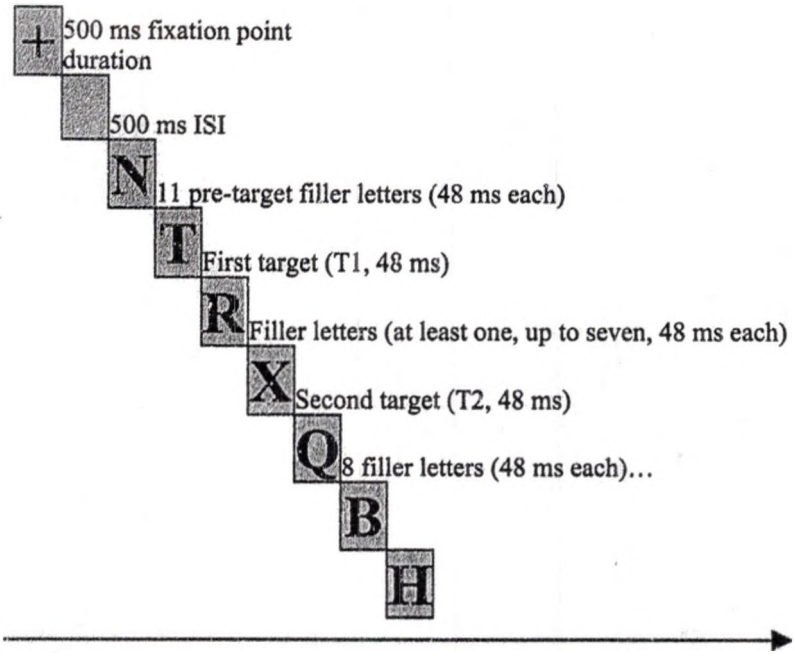
Measures

Beck Anxiety Inventory (BAI; Beck & Steer, 1993)

The BAI is a self-report measure made up of 21 items. The participant instructed to answer each item on a 4-point likert scale extending from 0 ("Not at all") to 3 ("Severely-I could barely stand it"). Scores can range from 0 to 63 with a high score indicating high levels of anxiety. The BAI has demonstrated exceptional internal consistency (alpha = .92) and test-retest reliability of .75 after a one-week period. In an effort to approximate this level of test-retest reliability in the present study, the number of

Figure 2. Illustration of a trial. Illustrates trials that were presented to participants. A fixation point was presented for 500 ms and was then followed by a 500 ms ISI interstimulus interval (ISI; or pause). Then the participants were presented 11 pre-target filler letters, which was followed by T1 (white letter). After T1, participants were presented 1 to 7 post-T1 filler letters that was followed by T2 (black X) in half of the trials. Eight additional filler letters ended the trial. All trials were presented in this manner, only difference between dual- and single-task trials were the instructions given to participants.

Figure 2. Illustration of a trial.



Note. Length of trial depends on amount of filler letters presented between T1 and T2. 1000 ms = 1 second.

days from pre-test BAI and post-test BAI was monitored ($M = 7.27$). Also, high factorial, convergent, and discriminant validity were found (Beck et al., 1988). The BAI scores were used to categorize the participants into comparison groups in order to compare differences with analyses of variance (ANOVAs). The BAI scores were split into the following categories: "non-anxious" (0-7; referred to as "minimal" in the test manual) and "anxious" (8-15; referred to as "mild" in the test manual; and 16-25; referred to as "moderate" in the test manual). The scores were split into these categories because this is how scores are suggested to be split, according to the BAI test manual, and to follow the methods of previous studies (Beck & Steer, 1993; Rokke et al., 2002, respectively). However, unlike the study conducted by Rokke et al. (2002), the present study was unable to recruit participants that fell into the "severe" category. Besides the use of the BAI scores in the ANOVAs, the scores were used, as were the scores from the BDI-II, in regression analyses to determine whether variance in AB is better predicted by anxiety or depression.

The Beck Anxiety Inventory (BAI; Beck & Steer, 1993) was compiled using the Anxiety Checklist, the PDR Checklist and the Situational Anxiety Checklist. In regard to validity, it was found that the BAI correlated more highly with tests measuring anxiety than with those that measure depression (Beck et al., 1988). This demonstrates evidence that the BAI has high levels of convergent and discriminant validity. It was also suggested that the BAI measures only anxiety, whereas the State-Trait Anxiety Inventory (STAI) yields both anxiety and depression. This was suggested because the STAI also yields high scores in individuals with depression. This therefore suggests that the BAI primarily measures levels of anxiety and not depression (Beck et al., 1988).

The BAI has been subject to several examinations of its factor structure (Beck et al., 1988; Osman, Kopper, Barrios, Osman, & Wade, 1997; Steer, Kumar, Ranieri, & Beck, 1995). Some studies have found 2, 4, and 5 factors (Beck et al., 1988; Osman, Kopper, Barrios, Osman, & Wade, 1997; Steer, Kumar, Ranieri, & Beck, 1995). However, most studies have confirmed a two-factor model. The two factors are subjective (cognitive) and somatic anxiety (Beck et al., 1988; Osman et al., 1997; Steer et al., 1995). One cautionary note to using the two-factor model is that some of the items overlap onto both factors in the measurement (Steer et al., 1995).

Beck Depression Inventory-II (BDI-II, Beck, Steer, & Brown, 1996)

The BDI-II is a self-report measure that is made up of 21 items. The participant is asked to choose a sentence for each item in the questionnaire that describes how they felt in the last two weeks, including the present day. There are four sentences to choose from on each item that correspond to different levels of depression. Scores can range from 0 to 63 with a high score indicating high levels of depression. The BDI-II has demonstrated exceptional internal consistency (alpha = .93, .90, and .91; Beck et al., 1996; Osman, Downs, Barrios, Kopper, Gutierrez, & Chiros, 1997; Dozois, Dobson, & Ahnberg, 1998, respectively) and test-retest reliability of .93 for a one-week period (Beck et al., 1996). Significant convergent, construct, factorial, and discriminant validity were also found (Dozois et al., 1998; Osman et al., 1997). The BDI-II manual reported a convergent validity coefficient of .93 when examining the BDI-IA and the BDI-II. The manual also reports discriminant validity coefficient of .60 between the BAI and the BDI-II (Beck et al., 1996). The BDI-II scores will be used along with the scores from the BAI in regression analyses to determine whether variance is mainly due to anxiety or depression.

Therefore, none of the depression scores will determine how the participants are categorized. However, in other situations, the score breakdowns suggested by the BDI-II manual to determine levels of depression are: 0-13, nondepressed; 14-19, mildly depressed; 20-28, moderately depressed; and 29-63, severely depressed (Beck et al., 1996).

Procedure

Students from the undergraduate-level career decision-making class, graduate-level multicultural class, UND Counseling Center, or who saw the ad on UND's Channel 3 and were interested in participating in the present study, were contacted by telephone by the investigator. At this time, participants were pre-screened using the Beck Anxiety Inventory (BAI; Beck & Steer, 1993). Prescreening was done either in person using a hard copy of the BAI or by verbally responding to the items on the phone (both written and verbal administration of the BAI are supported by the test manual). How this initial screening was done depended on the convenience for each participant and how confidential the administration environment was for the student. If they filled out a hard copy of the BAI, the participants were in a private and secluded office. However, over the phone, students determined their own level of confidentiality. All the participants were asked individually whether they were in an environment where they felt safe and comfortable to answer some questions about anxiety honestly and freely, if so, they were instructed on how to respond. Then the investigator read the questions according to the directions in the test manual. If they did not feel they were in a secure environment, arrangements were made to meet and fill out the BAI. Each participant was reminded that all information would be treated confidentially. Then using their score, they were either

placed into either the "anxious" or "non-anxious" group in order to ensure there would be equal amounts of participants in each group (how participants were divided into groups is discussed thoroughly in the measures section).

At the end of the prescreening, appointments were made for participation in the rest of the study. At this appointment, participants read and signed the consent forms. Then, in accordance with Rokke et al. (2002), participants were instructed how do the RSVP (rapid serial visual presentation) task (also called AB task). The participants were run through two sets (single- and dual-task trials) of trials using a computer and keyboard. Instructions for each set of trials were given individually, and were conducted according to counterbalancing to prevent confounding due to order of the trial sets.

On single-task trials, the participants were told to watch for a black X (T2) among the letters in the RSVP stream. They were told to ignore the white letter, T1. They were told that after each trial, a sentence would be displayed on the screen asking whether the X was present or absent. If they believed they saw the black X they were instructed to press the "1" key and if they believed the black X was absent they were instructed to press the "0" key. Participants were instructed to guess if they were unsure in the black X was present or absent. Participants were shown that both the "1" and "0" keys were marked either "present" or "absent" stickers on them to make responding to each trial easier.

On dual-task trials, the participants were instructed to watch for and identify a white letter. They were also told to watch for a black X. The participants were told that the white letter would always occur before the black X and that the white letter would never be an X. They were told that both tasks were important, however, so they should

work at identifying the white letter first and then work at detecting the presence or absence of the black X. They were told that after each trial, a sentence appeared asking for the identity of the white letter. The participants were instructed to report the identity of the white letter by pressing the corresponding key on the keyboard. They were shown, at this time, that a sticker covered up the X key to remind them that the white letter would never be an X. The participants were told that after entering in their answer for the white letter, another sentence would appear asking whether the black X was present or absent. If the X was present they were told to press the "1" key and if the black X was absent they were told to press the "0" key. If they were unsure, the participants were instructed to make their best guess. The participants were shown that both keys were had stickers with either "present" or "absent" on them to make responding to each trial easier.

The participants were then given as many practice trials as they needed in order to understand the task at hand. The participants took between 4 to 10 practice trials with a mean of 5 trials for both conditions. The experimenter watched the practice trials and had the participants continue practicing until they showed they were able to identify both T1 and T2 some of the time. The participants controlled the pace of the trials since each trial did not begin until the participants pressed the space bar on the keyboard to continue onto the next trial. After they pressed the space bar, a fixation sign (a black plus-sign) was presented in the middle of the gray computer screen for 500 ms to illustrate where on the computer screen the stream of letters would be presented. There was an interval of 500 ms of blank space (or interstimulus interval, ISI) before the RSVP stream began.

Following their responses in both conditions, a sentence appeared on the screen telling the participants to press the space bar to go on to the next trial. In both the single-

and dual-task conditions, the participants were told to do the best they can. In accordance with other AB studies, they were told that accuracy was the only thing being measured and were therefore told to take their time since response times were not being measured (Shapiro et al., 1992).

Following the completion of the computer trials, the participants took the Beck Anxiety Inventory (BAI), and Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), and filled out a demographics form. The participants were then divided into groups of either "anxious" or "non-anxious" according to their score on the post-test BAI as suggested by the testing manual. The scores and groupings from the post-test BAI were the only ones used in the analyses. See Table 2 for complete illustration of the procedure.

Table 2.

Description of the Procedure

Steps of procedure
1. Invited to participate via undergraduate-level career decision-making class, graduate-level multicultural class, invitation at the Counseling Center, and invitation from UND's Channel 3.
2. Prescreened with the BAI either in person or verbally over the phone.
3. Participant and experimenter met and went over informed consent, did both sets of trials, filled out the BAI, BDI-II, and a demographics forms.

Design

The design was a 2 (post-test anxiety level: anxious/non-anxious) X 2 (T2 presence/absence) X 2 (instruction: single-task/dual task-condition) X 8 (T2 position) mixed factorial design. In the present design, the score obtained on the post-test BAI determines the anxiety level or grouping for each participant. The instruction variable represents the two sets of trials that the participants completed on the computer. In the single-task condition participants were instructed to only determine the presence or absence of the black X in the stream of letters, whereas in the dual-task condition, participants were instructed to both identify the white letter and determine the presence or absence of the black X in the stream of letter. Participants performed one block of single-task and one block of dual-task trials according to counterbalancing set up across participants. T2 (second target) was presented in one of eight positions following the first target (T1) and was present in approximately half of the trials. T2 presence/absence and T2 position were both presented within participants across both instruction conditions. Only T2 present trials were used in the analysis since there must be two targets present in order to test for the AB. The reason for having the participants complete the T2 absent trials is to make sure they are really doing the task at hand. If these trials were not used all they would be required to do is to press the "present" button for that sentence when it appeared on the screen. The participants' accuracy rates were measured at each position. Then the mean accuracy rates for each position or their AB size were used as the dependent variables in the analyses. The two variables of T2 presence/absence and T2 position were presented an equal amount of times in a set number of trials (e.g., 32 trials). All participants performed 320 trials, and took approximately one hour to complete.

CHAPTER III

RESULTS

Using the scores obtained from the post-test BAI and the defined division of "anxious" or "non-anxious," 13 of the 30 participants were found to be "anxious" and 17 were found to be "non-anxious". For all the analyses that were conducted, the post-anxiety scores (e.g., specific number) or groupings (e.g., non-anxious or anxious) along with the mean accuracy rates from the attentional tasks were used unless otherwise specified.

Group Comparisons

In order to determine whether the "anxious" "non-anxious" groups could be compared with confidence, the two groups were examined for any differences. An independent-samples *t* test was conducted to evaluated whether the "anxious" and "non-anxious" groups differed according to the ages of the participants. The test was not significant ($t(28) = .12, p > .05$), thus suggesting that the ages of the participants did not differ significantly across anxiety group.

Two-way contingency table analyses were conducted to evaluate whether gender, level of education, and race influenced the participants' level of anxiety. In the first two-way contingency table analysis the two variables were gender (male or female) and anxiety group ("anxious" or "non-anxious"). Gender and anxiety group were not found to be statistically related, Pearson $\chi^2(1, N = 30) = 1.49, p = .22$, Cramer's $V = .22$. The next

two-way contingency table analysis the two variables were level of education and anxiety group. Level of education and anxiety group were not found to be statistically related, Pearson $\chi^2(1, N = 30) = .36, p = .55$, Cramer's $V = .11$. In the final two-way contingency table analysis, the two variables were race and anxiety group. Race and anxiety group were not found to be statistically related, Pearson $\chi^2(3, N = 30) = 3.69, p = .297$, Cramer's $V = .35$.

To summarize, all the analyses that were conducted in order to examine differences between the "anxious" and "non-anxious" groups did not result in any significant findings. This suggests that both anxiety groups are similar or homogeneous which decreases the likelihood that threats to statistical conclusion validity will be present; this will be an assumption in the rest of the analyses.

Measures and Stimuli

Correlation coefficients were computed among the measures (pre-test BAI, post-test BAI, and BDI-II), as well as among the trials since the participants were assigned different instruction conditions (single- or dual-task) for their first and second set of trials according to counterbalancing in attempts to account for order effects. Using the Bonferroni approach to control for Type I error across the correlations, a p-value of less than .017 (.05 / 3 = .017) was required for significance for the measures and a p-value of less than .025 (.05 / 2 = .025) was required for the significance for the trials. The results of the correlational analysis of measures in Table 3 show that all three of the correlations for the measures were statistically significant and were greater than or equal to .703. In general, the results suggest that that the scores for each participant were similar across measures. The results of the correlation analysis of trials were statistically significant (r^2

= .45, $p < .01$). In general, this suggests that the trials the participants were assigned were similar no matter which instruction condition (single- or dual-task) was first.

Table 3

Intercorrelations Between Measures for All Participants

Scores	1	2	3
Pre-test BAI	-----		
Post-test BAI	.811**	-----	
BDI-II	.703**	.703**	-----

Note. Intercorrelations are of all participants and are not divided into groups according to their anxiety level. Intercorrelations were adjusted according to Bonferroni approach to control for Type I error.
** $p < .003$
*$p < .017$

In order to prevent confounding due to order effects, the trials were counterbalanced across participants. To ensure that no order effects remained an independent samples *t*-test was conducted. No significant differences were found for the participants AB size when examining instruction condition (single- and dual-task) trials, $t(28) = -.94, p > .05$. This suggests that no order effects were present when either single-task or dual-task trials were completed first.

Target 1 Performance

Additional analyses were conducted examining both T1 and T2 performance. Performance checks are done before conducting the main analyses in order to ensure the mean accuracy rates that were obtained were not confounded by the way the participants responded (e.g., check to make sure the participants did not sacrifice performance for one

target in order to do better on the identifying the other target). An independent-samples *t* test was conducted to examine the T1 accuracy rates for T2 present trials for each of the "anxious" participants when compared to each of the "non-anxious" participants. The test did not find significant differences among anxiety groups ($t(28) = .450, p > .05$) thus suggesting the two anxiety groups understood the instructions, treated T1 as the principal task, and did not bypass their performance on T1 to improve their performance on T2.

Target 2 Performance

The next analysis examined false alarm rates. False alarm rates are examined in order to determine if performance on T2 is compromised in an attempt to improve performance on T1. Specifically, false alarm rates were examined using the mean percentage rates of T2 absent trials in which participants reported T2 as present. The analysis conducted was an independent-samples *t* test, which examined the false alarm rates for each of the participants in both the "anxious" and "non-anxious" groups. No significant differences were found between the two anxiety groups across instruction conditions. Therefore no significant findings were found in the dual-task condition, $t(28) = -1.800, p > .05$, or in the single-task condition, $t(28) = -1.901, p > .05$. This suggests both anxiety groups in both instruction conditions (dual- and single-task conditions) did not sacrifice T2 performance (determining the presence/absence of the black X) for T1 performance (identifying the white letter) and were able to do the task(s) required for either type of instruction.

Main Analyses

To test the hypothesis that accuracy rates would decrease due to anxiety level (decrease in "anxious" participants, but not "non-anxious") an ANOVA was conducted.

Specifically, a 2 (anxiety level: anxious or non-anxious) X 2 (instruction: single-or dual-task) X 8 (T2 position: 1 through 8) ANOVA was conducted using the mean accuracy rates from only the T2 present trials from each participant (mean accuracy rates were normally distributed across participants and did not obtain significant differences when compared to a normal distribution, $p = .726$). The instruction condition (dual- or single-task) and T2 position (positions 1-8) were entered as within-subject factors, whereas the anxiety level (non-anxious or anxious) was treated as a between-subject factor. The results indicated a main effect for instruction, $F(1, 28) = 72.27, p < .01$, a main effect for position, $F(7, 196) = 22.27, p < .01$, and a two-way interaction for instruction X T2 position, $F(7, 196) = 37.24, p < .01$. See Table 4 for means and standard deviations and Table 5 for the ANOVA results.

These results demonstrate that an AB was present. This implies that the participants' performance at each position was significantly better in the single-task condition than for each position in the dual-task condition. Like other AB studies, the participants' performance was notably better at the first few positions in the single-task condition than in the dual-task condition. For an illustration of this, see Figure 1 and Figure 3.

However, when anxiety was entered as a between-subject factor into an ANOVA, no significant results were found. There was no significant main effect for anxiety, $F(1, 28) = .29, p > .05$, no significant interaction with instruction, $F(1,28) = 1.68, p > .05$, no significant interaction with position, $F(7,196) = 1.78, p > .05$, and no significant three-way interaction with instruction and T2 position, $F(7,196) < 1, p > .05$. See Table 4 for means and standard deviations and Table 5 for the ANOVA results. This suggests that

Table 4

Mean Accuracy Percentages and Standard Deviations for the Analysis of Variance for the Main Effects and Interaction Effects of Instruction and Position on Anxiety Level

Position	Non-anxious (n = 17)		Anxious (n = 13)	
	M	*SD*	*M*	*SD*
	Single-Task Instruction			
1	85.29	19.40	85.38	22.59
2	92.35	9.03	92.31	9.27
3	96.47	6.06	90.77	15.53
4	95.88	7.12	94.62	13.91
5	95.88	7.12	89.23	25.32
6	94.12	7.12	88.46	22.30
7	97.06	5.88	85.38	24.02
8	98.82	3.32	91.54	24.78
	Dual-Task Instruction			
1	49.12	30.66	61.98	27.56
2	34.31	21.35	47.59	24.37
3	56.80	28.40	58.36	24.93
4	74.72	17.93	75.11	23.31
5	86.52	14.15	83.74	14.26
6	91.98	9.76	88.84	11.31
7	93.47	8.51	86.42	23.90
8	99.02	4.04	90.68	24.66

though there was an AB found with both groups of this sample, the AB was not affected by anxiety level. For an illustration of these results, see Figures 4 and 5 (means for the Figures are presented in Table 6).

The main ANOVA did not result in significant differences across position, however it still appeared that the variance of scores between anxiety groups was significant when examining positions 1-4 as one group and 5-8 as a second group. To check for potential differences, an additional ANOVA was conducted. In this follow-up 2 (anxiety level: anxious or non-anxious) X 2 (instruction: single-or dual-task) X 2 (T2 positions: 1-4 and 5-8) ANOVA findings were similar to those in the initial ANOVA.

Figure 3. Present Study AB (without Anxiety Level). Presents mean accuracy rates (in percentages) of T2 (black X) across all possible T2 positions. Significant AB was found.

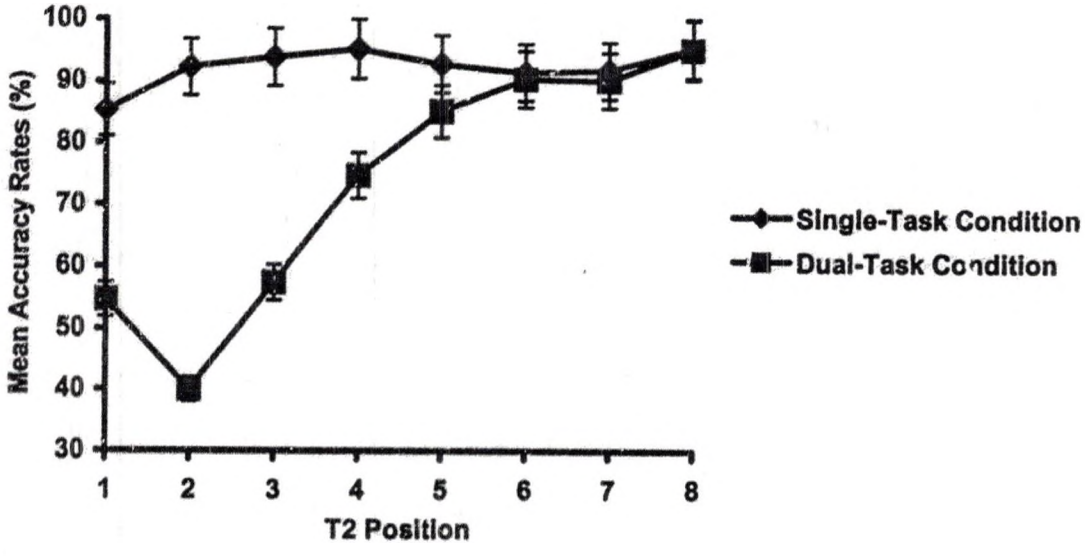

Mean Accuracy Rates (%)
100
90
80
70
60
50
40
30
1
2
3
4
5
6
7
8
T2 Position
Single-Task Condition
Dual-Task Condition

Table 5

Analysis of Variance for the Main Effects and Interaction Effects of Instruction and Position on Anxiety Level

Variable	*df*	*F*	η^2	*p*
	Between subjects			
BAI	1	.29	.987	.596
Within-cells error	28			
	Within subjects			
Instruction (I)	1	72.27	.721	.000**
Position (P)	7	22.27	.443	.000**
I x P	7	37.24	.571	.000**
I x BAI	1	1.68	.057	.205
P x BAI	7	1.78	.060	.094
I x P x BAI	7	.68	.024	.693
Within-cells error	196			

Note. BAI = BAI Scores.

** $p < .01$,

* $p < .05$

Table 6

Mean Accuracy Rates of Dual-Task & Single-Task Conditions for Each T2 Position

	T2 Position							
Group	1	2	3	4	5	6	7	8
Dual-Task								
Non-Anxious	49.11	34.31	56.80	74.72	86.52	91.98	93.47	99.02
Anxious	61.98	47.59	58.36	75.11	83.74	88.84	86.42	90.68
Single-Task								
Non-Anxious	85.29	92.35	96.47	95.88	95.88	94.12	97.06	98.82
Anxious	85.38	92.30	90.77	94.62	89.23	88.46	85.38	91.54

Note. All mean accuracy rates are presented in percentages. Table 6 represents the mean accuracy rates (%) in Figures 4 and 5.

Figure 4. Dual-task AB when Examining Anxiety Level. Presents mean accuracy rates (in percentages) of T2 (black X) across both levels of anxiety when it was required to report identity of T1 (random white letter). Significant attentional blinks (ABs) were not found when taking level of anxiety into account.

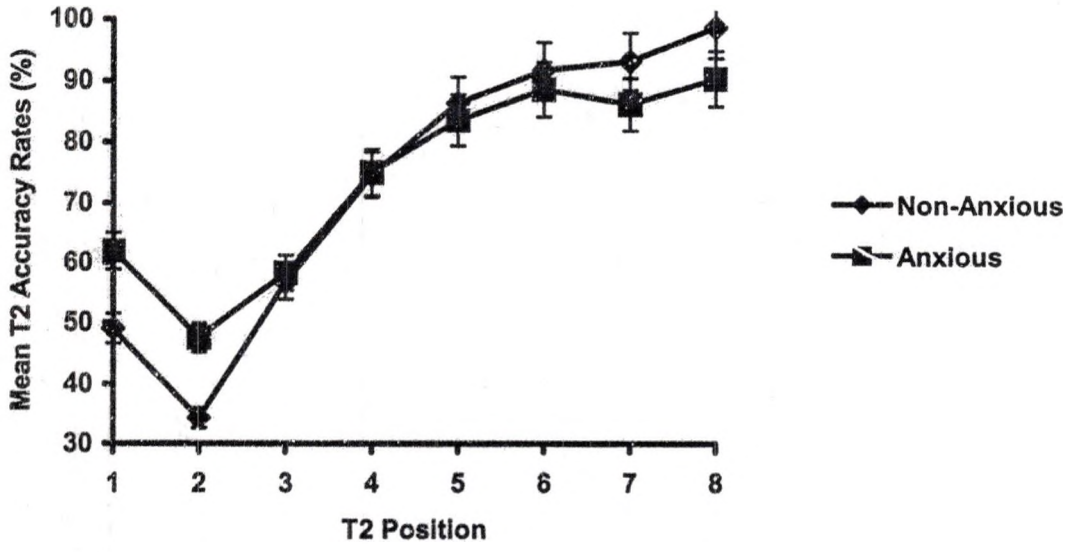
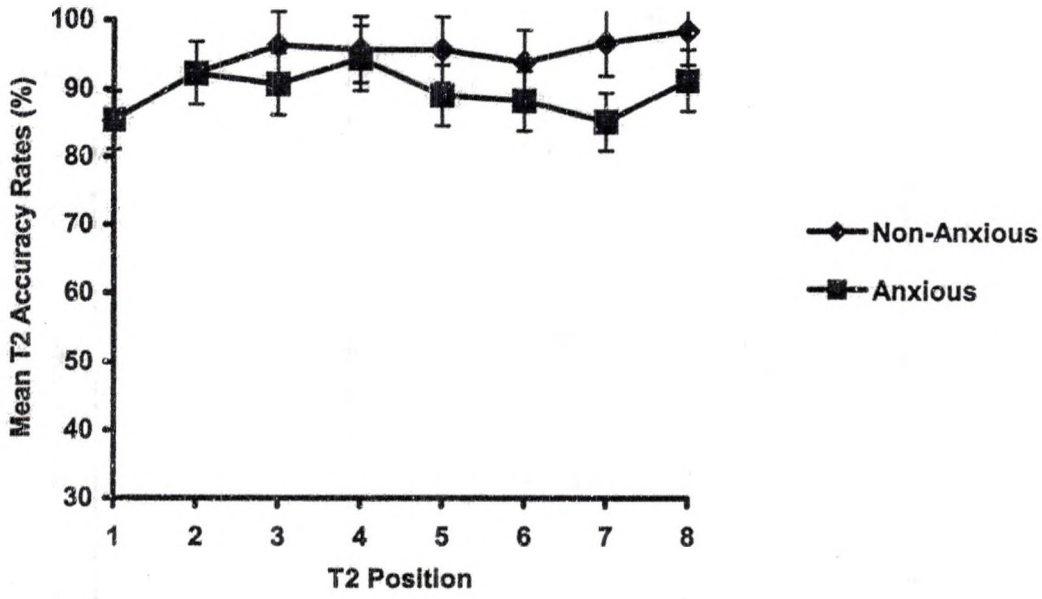

Mean T2 Accuracy Rates (%)
100
90
80
70
60
50
40
30
1
2
3
4
5
6
7
8
T2 Position
Non-Anxious
Anxious

Figure 5. Single-task Results when Examining Anxiety Level. Presents mean accuracy rates (in percentages) of T2 (black X) across both levels of anxiety when participants only watched for T2 and ignored T1 (random white letter). This demonstrates that participants across anxiety levels were able to detect T2 suggesting they are able to do task.


100
90
80
70
60
50
40
30
Mean T2 Accuracy Rates (%)
1
2
3
4
5
6
7
8
T2 Position
Non-Anxious
Anxious

However, in the follow-up ANOVA, the main effect of instruction, main effect of position, two-way interaction of instruction and position, and the three-way interaction of anxiety, position, and instruction increased, whereas the significance the two-way interactions for instruction by anxiety and position by anxiety decreased. The results indicated a main effect for instruction, $F(1, 28) = 70.49, p < .01$, a main effect for position, $F(1,28) = 38.19, p < .01$, and a two-way interaction for instruction X T2 position, $F(1,28) = 101.50, p < .01$. See Table 7 for means and standard deviations and Table 8 for the ANOVA results. These results demonstrate that an AB was present. This implies that the participants' performance for positions 1-4 and positions 5-8 were significantly better in the single-task condition than for positions 1-4 and positions 5-8 in the dual-task condition.

Table 7

Means and Standard Deviations for the Analysis of Variance Results for Main Effects and Interaction Effects of Instruction and Combined Positions on Anxiety Level

	Non-anxious (n = 17)		Anxious (n = 13)	
Positions	*M*	*SD*	*M*	*SD*
	Single-Task Instruction			
1-4	91.18	8.760	91.75	8.39
5-8	91.03	20.60	95.77	5.04
	Dual-Task Instruction			
1-4	55.29	22.31	58.73	14.97
5-8	87.71	15.41	94.00	3.16

Table 8

Analysis of Variance Results for Main Effects and Interaction Effects of Instruction and Combined Positions on Anxiety Level

Variable	*df*	*F*	η^2	*p*
	Between subjects			
Main Effect of BAI	1	1.20	.041	.282
Within-cells error	28			
	Within subjects			
Main Effect of Instruction (I)	1	70.49	.716	.000**
Main Effect of Position (P)	1	38.19	.577	.000**
I x P	1	101.50	.784	.000**
I x BAI	1	.17	.006	.683
P x BAI	1	.30	.011	.590
I x P x BAI	1	.01	.000	.929
Within-cells error	28			

Note. BAI = BAI Scores.
** $p < .01$
* $p < .05$

When anxiety was examined, there was no main effect for anxiety, $F(1, 28) = 1.20$, $p > .05$, no significant interaction with instruction, $F(1,28) = .17$, $p > .05$, no significant interaction with position, $F(1,28) = .30$, $p > .05$, and no significant three-way interaction with instruction and T2 position, $F(1,28) = .01$, $p > .05$. Refer back to Table 7 for means and standard deviations and Table 8 for the ANOVA results. These findings also suggest that anxiety level did not affect the participants' ABs, which lends further support to the initial ANOVA that may be more powerful since there are fewer levels examined for the anxiety variable.

In attempts to investigate whether anxiety, depression, or both were correlated with AB size a regression analysis was conducted. The first regression analysis was

conducted to determine if the score obtained from the BAI predicted the size of the participants' AB. The AB size was determined by subtracting each of their mean accuracy rates for the dual-task condition from their mean accuracy rates for the single-task condition. This was done for each of the eight positions and then a final AB size value was found by adding all of the eight positions together. This resulted in a number called the AB size for each individual participant. The regression analysis returned a non-significant result (-.16, $t(28) = -.83$, $p > .05$) suggesting that the post-BAI score did not predict AB size since only about 2.4% of the AB size was accounted for by the BAI scores. In order to compare results from the current study with the study by Rokke et al. (2002), an additional regression analysis was done to determine if BDI-II scores predicted AB size. As with the results from the BAI, there was no significant finding (-.19, $t(28) = -1.02$, $p > .05$), suggesting that depression score did not predict AB size since only about 3.6% of the AB size was accounted for by BDI-II scores. See Table 9 for an illustration of the means on each of the measures across anxiety groups and Table 10 for an illustration of the regression analyses.

Table 9

Beck Anxiety Inventory & Beck Depression Inventory-II Scores Across Anxiety Groups

Group	*n*	Minimum	Maximum	*M*	*SD*
BAI					
Non-Anxious	17	0	7	3.94	1.89
Anxious	13	8	22	12.77	4.87
BDI-II					
Non-Anxious	17	1	8	4.41	2.43
Anxious	13	3	21	10.77	5.57

Note. Scores are presented according to anxiety group for both the BAI and BDI-II.

Table 10

Summary of Regression Analyses Relating BAI and BDI-II Scores to AB Size (n = 30)

Measure	*B*	*SEB*	β	R^2
BAI	-2.61	3.16	-.16	.024
BDI-II	-3.51	3.43	-.19	.036

CHAPTER IV

DISCUSSION

The present study attempted to clarify the results of past studies, in particular the study by Rokke et al. (2002). It attempted to determine whether anxiety level leads to a decrease in attentional abilities or to the size of an AB, as well as attempting to determine whether limitations in attention are more highly correlated with depression, with anxiety, or equally with both anxiety and depression. The limitations, ideas for further research, and speculations about future studies are also reviewed, in addition to the results of the present study.

Before attempting to determine whether or not attentional limitations were affected by anxiety level or more correlated with anxiety (or depression), the anxiety groups were compared according to their demographic information. After completing the analyses, it appeared that both groups were similar in the variables of age, gender, level of education, and race. Therefore, this suggests that the groups could confidently be compared in further analyses without reducing validity.

In addition to examining demographic information, mean T1 accuracy rates and false alarm rates were examined to determine whether or not participants had sacrificed performance on one task in an attempt to do better at the other task. Neither of the analyses were significant suggesting that participants were able follow instructions and were, therefore, able to work at identifying T1 (white letter) and then determine the

presence or absence of T2 (black X) in the dual-task condition and able to ignore T1 and determine the presence or absence of T2 in the single-task condition.

Perhaps more importantly, when examining AB data along with anxiety level data, no significant differences were found due to anxiety level. This suggests that when individuals were either "non-anxious" or "anxious" (specifically "mild" or "moderate" according to BAI scores and suggested categorization from the test manual) there were no differences in the ability to detect the presence of a single target, or in detecting and identifying two targets, in a rapidly presented stream of letters. This implies that since there is not an effect on individuals' ABs when they have no or lower levels of anxiety, that anxiety does not affect the individuals' ability to complete difficult tasks when they were allowed to take their time and fully focus on the tasks. Since there were no participants with severe anxiety, this implication cannot be applied to that population or individuals who may have suffered from brain damage. However, if one takes this implication and compares it to the basic theory that there can be efficient levels performance associated with only moderate anxiety, a contradiction is found. In fact, according to some sources, it is suggested that individuals with moderate anxiety perform with better success than individuals with low anxiety (Eysenck, 1967; Eysenck, 1992). However, the present study was not able to find differences between these two levels of anxiety, suggesting that in certain situations where individuals try hard to focus, the performance deficits typically attributed to a low anxiety level are eliminated. Therefore, under certain focused situations anxiety effects can be decreased. However, the processing efficiency theory (Eysenck & Calvo, 1992) suggests that there are exceptions and anxiety does not affect performance in every situation because individuals may be

able to cope with their anxiety by either decreasing the worry or increasing the motivation they have for a task; this may be one of those situations. Though potentially the AB stimuli in the present study were not sensitive enough to detect differences in the anxiety groups (e.g., the masks were not hard enough) or the type of anxiety experienced by the participants was not related to the tasks at hand.

Further analyses suggest that neither anxiety nor depression predicted the size of AB. This suggests that attentional limitations are not more highly correlated with either anxiety level (at the low or moderate level) or depression level implying that anxiety and depression do not result in yielding larger ABs. However, caution is needed here since the sample of the present study did not have severe levels of either anxiety or depression represented (discussed in more detail below). Hence, with a more complete sample different findings could result.

In addition, since the present study did not find significant differences on the AB task according to different levels of anxiety, it cannot be concluded whether or not visual tasks are centrally processed in this case. Also, it is unsure if task-switching was present or absent. In order for task-switching to be disconfirmed, robust ABs must be found and closely examined for certain features. In other words, the present study cannot conclude that attention in anxiety is processed between stimulus encoding and response selection (e.g., centrally rather than earlier or later) or that the attentional limitations in anxiety are more due to switching between tasks (reviewed earlier with Arnell & Jolicoeur, 1999; Rogers & Monsell, 1995).

The previously mentioned implications do need to be taken with some caution, since there are some limitations in the present study leading to low statistical power even

though there were some precautions taken to avoid this from occurring (e.g., a repeated measures design was used and there was an increased number of trials per participant). One precaution that was overlooked, was examining the power level for the present study. If a power level had been obtained, then the limitations could have been reduced or closely monitored in another version of the present study. Some of the limitations that may have reduced the power of the present study include the small sample size, lack of representation for all levels of anxiety, insufficiently defined construct of anxiety, and not examining specific types of anxiety or anxiety-provoking situations.

The first limitation to the present study was the small sample size. Not only was the sample size small, but also there were no participants to represent the severe category level of anxiety, which may have lead to different findings. For example, if a larger sample size were used, there may have been more individuals with higher scores, leading to potential representation of "severe" anxiety and more statistical power. Had this occurred, analyses could have resulted like Rokke et al.'s study (2002), in which each level of depression was looked at individually. This larger variance in scores may have led to significant differences in AB across anxiety level similar to their findings. This is speculated because if a close look is taken at results of Rokke et al. (2002), there are no significant differences when only "nondepressed," "mildly depressed," and "moderately depressed" mean accuracy rates (percentages) are examined. However, significant findings were found when the "severely depressed" level was also examined. The reason for suggesting that the present study may have produced different results had there been "severe" anxiety group is supported by the high intercorrelation of the BAI and the BDI-II, since Rokke et al. (2002) also used the BDI-II to measure for depression level. Also,

due to the small sample size, anxiety level was only divided into either "anxious" or "non-anxious." If there were more participants all the suggested levels of anxiety (according to the BAI testing manual) could have been represented and therefore increasing the likelihood of finding results even more similar to the study by Rokke et al. (2002).

An additional limitation of the present study pertains to the measures used. The Beck Anxiety Inventory and the Beck Depression Inventory-II may measure similar characteristics, which would then lead to inaccurate conclusions. This is supported by the intercorrelations that were conducted between measures. In the present study, the BAI and the BDI-II have a correlation coefficient of .703, which has a p-value less than .001 (See Table 3 for illustration of correlations using the Bonferroni approach to control for Type I error). In addition, other limitations of the measures used to measure anxiety and depression are a huge downfall in the present study. Since only the BAI and BDI-II are being used to measure the participants' levels of anxiety and depression, these constructs could be insufficiently defined. Adding more measures could fix this, but it would have added to the time needed for participants to finish the study. However, these instruments were chosen due to some suggestions of higher discriminant validity than others measuring anxiety and depression (Beck et al., 1988). In addition, the results might be due to mainly to one specific class or type of anxiety disorder. This could lead to inaccurate significance or inaccurate insignificance (e.g., significant because of highly significant p value of test anxiety or not significant because of a non-existent p value of test anxiety). Therefore, the present study could also have look at the classifications of

anxiety disorders or tried inducing different levels of anxiety, but this is quite complex and instead is suggested for future studies.

Generally, the use of the AB paradigm is not intended to yield clinical applications and is instead usually focus on gathering more general information about the attentional limitations that are present in individuals. The present study was conducted to gather this type of knowledge specific to anxiety level. Nevertheless, there have been studies conducted on the AB paradigm and other related paradigms that do examine possible clinical use. By strengthening past results and findings surrounding the AB paradigm with the results of the present study, some potential uses in the realm of clinical use can be speculated. However, it must be noted that these are only speculations and further investigation will need to be done to accurately determine if the discussed clinical uses are appropriate. Since the findings of the present study suggest the possibility that lower levels of anxiety can be controlled in certain circumstances, it would be interesting to examine if the effects of anxiety could be controlled in other situations, such as in a college course or when driving an automobile. In these situations there is a large need for focus or ability to control the amount of attention given to a task, so the degree of control the student or driver has over one's anxiety would be a practical research question. If the speculations that the present study could have found that higher levels of anxiety led to decreased attentional abilities in a "severe" anxiety group, similar to Rokke et al. (2002), another research question transpires for further investigation. It would be interesting to see when the ability to suppress effects of anxiety ends and when effects of anxiety start to become more dominant in situations that require individuals to complete tasks with a high level of attention or focus. This could result in further knowledge about the limits

individuals may have in certain attention-demanding situations and possibly lead to further investigations examining potential ways to control for limitations.

In conclusion, the present study did not find significant differences in AB across anxiety level suggesting that anxiety (specifically anxiety that is categorized as "minimal," "mild," and "moderate" according to scores obtained from the BAI) did not affect performance on an AB task. However, after comparing the results to the study conducted by Rokke et al. (2002), there is some speculation that in future studies different results may be found if the sample population better represents all levels of anxiety. Finally, other results may also be found if different subtypes of anxiety or specific anxiety-provoking situations are examined.

APPENDICES

APPENDIX 1
INVITE

You are invited... to participate in a research study in order to further understand the attention abilities of individuals with anxiety. Heather B. Trangsrud, a graduate student from the UND Department of Counseling, is conducting the study. Please read the following information carefully to determine if you would like to participate in the study. If you are interested please call and leave a message at the number or e-mail address below.

In this study, attentional processes will be measured by using a computer program. You will sit at the computer and watch the computer screen for items that you are instructed to look for by the experimenter. You will enter in your responses by answering on the keyboard. The computer part of the study should take approximately 45 minutes to an hour. After the computer portion is finished, you will fill out three forms (demographic form, an anxiety measure, and a depression measure). These forms should take about 15 to 20 minutes to finish. The total approximated time to complete the study is one hour.

Your confidentiality will be maintained by assigning a number to your tests and results. The number will not be associated with your name in anyway. No individual results will be looked at on their own and you will not be identifiable in the results. Due to the confidentiality no specific feedback will be given on your results of the computer trials, the anxiety from, and the depression form. However, we will discuss the study in more detail after you are finished, but this may be disappointing not to get specific feedback. As required by university regulations, the information you provide this study will not be accessible to anyone except for the principal investigator. To ensure your confidentiality of counseling services, I will not ask how you heard about this study. Your participation will benefit psychology and counseling by supplying us with further information about attentional abilities. **You do <u>not</u> need to have a diagnosis of anxiety or depression to participate.**

You will be compensated for your participation by being entered into a drawing that will be held at the end of the study (amount of drawing or 2 drawings is $50 each). If you do choose to participate and would like to be informed of the results of the study, please contact the investigator at the phone number or e-mail address below.

Your participation in this study is strictly voluntary and you may drop out at anytime. If you would like to participate or have any further questions/comments about the study, please feel free to contact Heather B. Trangsrud.

Thank you,

Heather B. Trangsrud, Principal Investigator
UND Dept. of Counseling; Montgomery Hall, Box 8255; GF, ND 58202
Phone: (701) 746-8650 E-Mail: heather_trangsrud@und.nodak.edu

APPENDIX 2
POSTER INVITE

ANXIETY & ATTENTION

UND students are invited to participate in a study about attention and anxiety!

Both individuals with and without anxiety are wanted.

For more information please call or e-mail Heather at (701) 746-8650 or heather_trangsrud@und.nodak.edu.

APPENDIX 3
INFORMED CONSENT FORM

You have been invited to participate in a research study in order to further understand attentional processes of individuals with anxiety. Heather B. Trangsrud, a graduate student from the UND Department of Counseling, is conducting the study. Please read the following information carefully to determine if you would like to participate in the study. Also, you have the right to drop out of the study at any time without any penalty.

In this study, attentional processes will be measured by using a computer program to test your accuracy rates. You will sit at the computer and watch the computer screen for items that you are instructed to look for by the experimenter. You will enter in your responses by answering on the keyboard. The computer part of the study should take approximately 45 minutes to an hour. After the computer portion is finished, you will fill out three forms (one about anxiety, one about depression, and a demographics form). The forms should take about 15 to 20 minutes to finish.

Your confidentiality will be maintained by assigning a number to your computer data, the anxiety form, the depression form, and the demographic form. The number will not be associated with your name in anyway. No individual results will be looked at individually and you will not be identifiable in the results. Due to this, specific feedback regarding your performance on the computer task, anxiety form, and depression form will not be possible. This may be disappointing, but we will discuss the study in more detail after you are finished to answer any questions you may have. As required by university regulations, the information you provide this study will not be accessible to anyone except for the principal investigator and faculty advisors. Your participation will benefit the field by supplying us with further information about attentional processes. The risks of participating of this study may include issues related to anxiety or depression. If by participating in this study you are more aware of anxious, depressive, or suicidal issues please contact a local source for help as the investigators of this study will not know who may be in need of assistance since all the forms only have numbers and no names. (Please see attached list of services).

Your participation in this study is strictly voluntary. If you do choose to participate you will be compensated for your time by having your name placed in a drawing. At the end of the study, the winner (or 2 winners) of the drawing will receive $50. If you have any questions or comments about the study, please feel free to contact Heather B. Trangsrud or David Whitcomb, Ph.D.

Thank you,

Heather B. Trangsrud, Principal Investigator
UND Department of Counseling
Montgomery Hall, Box 8255
Grand Forks, ND 58202
Phone: (701) 746-8650

David Whitcomb, Ph.D., Advisor
UND Department of Counseling
Montgomery Hall, Box 8255
Grand Forks, ND 58202
Phone: (701) 777-3738

I have read the above information and would like to participate. I have asked any questions or about any concerns that I may have. I feel that these questions have been answered to my satisfaction. I understand that even after I agree to participate, I may drop out of this study at any time without any penalties. I have also received a copy of this consent form and local services for my own personal records.

Date	Participant Name (please print)	Participant Signature
Date	Primary Investigator (please print)	Primary Investigator Signature

APPENDIX 4

DEMOGRAPHIC FORM

Demographics Form:

Age: _____ **Gender** *(circle):* Male Female

Major: _____ **Year in college:** _____

Ethnicity/Race *(optional):* _____ *[Participant number: 1.]*

Demographics Form:

Age: _____ **Gender** *(circle):* Male Female

Major: _____ **Year in college:** _____

Ethnicity/Race *(optional):* _____ *[Participant number: 2.]*

Demographics Form:

Age: _____ **Gender** *(circle):* Male Female

Major: _____ **Year in college:** _____

Ethnicity/Race *(optional):* _____ *[Participant number: 3.]*

Demographics Form:

Age: _____ **Gender** *(circle):* Male Female

Major: _____ **Year in college:** _____

Ethnicity/Race *(optional):* _____ *[Participant number: 4.]*

Demographics Form:

Age: _____ **Gender** *(circle):* Male Female

Major: _____ **Year in college:** _____

Ethnicity/Race *(optional):* _____ *[Participant number: 5.]*

APPENDIX 5

REFERRAL SHEET

Campus & Campus-related Services:

University Counseling Center (free for currently enrolled UND students)
McCannel Hall; UND Campus
(701) 777-2127

Psychological Services (free for Grand Forks and surrounding communities)
210 Montgomery Hall; UND Campus
(701) 777-3691

UND Counseling Clinic (sliding scale fee with counseling practicum students)
151 4th Street South; Suite 401
(701) 777-3745

Community Services:

Altru Health System
860 South Columbia Road
Grand Forks, ND
(701) 780-5900

Northeast Human Service Center
151 4th Street South
Grand Forks, ND
(701) 795-3000 (Office)
(701) 775-0525 (24-hour crisis line)

Northwestern Mental Health Center
1620 Central Avenue NE
East Grand Forks, MN
(218) 773-6102
(800) 282-5005 (24-hour Emergency Line)

The Village Family Service Center
215 North 3rd Street
Grand Forks, ND
(701) 746-4584

**For other services see the yellow pages (e.g., counselors, psychologists, psychiatrists)

APPENDIX 6

BECK ANXIETY INVENTORY-II (BAI)

ME _____ DATE _____

w is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by each ptom during the PAST WEEK, INCLUDING TODAY, by placing an X in the corresponding space in the column next to each symptom.

	NOT AT ALL	MILDLY It did not bother me much.	MODERATELY It was very unpleasant, but I could stand it.	SEVERELY I could barely stand it.
1. Numbness or tingling.				
2. Feeling hot.				
3. Wobbliness in legs.				
4. Unable to relax.				
5. Fear of the worst happening.				
6. Dizzy or lightheaded.				
7. Heart pounding or racing.				
8. Unsteady.				
9. Terrified.				
10. Nervous.				
11. Feelings of choking.				
12. Hands trembling.				
13. Shaky.				
14. Fear of losing control.				
15. Difficulty breathing.				
16. Fear of dying.				
17. Scared.				
18. Indigestion or discomfort in abdomen.				
19. Faint.				
20. Face flushed.				
21. Sweating (not due to heat).				

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APPENDIX 7

BECK DEPRESSION INVENTORY-II (BDI-II)

BDI-II

Date:

Name: _____ Marital Status: _____ Age: _____ Sex: _____

Occupation: _____ Education: _____

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the **one statement** in each group that best describes the way you have been feeling during the **past two weeks, including today**. Circle the number beside the statement you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

1. Sadness

0 I do not feel sad.
1 I feel sad much of the time.
2 I am sad all the time.
3 I am so sad or unhappy that I can't stand it.

2. Pessimism

0 I am not discouraged about my future.
1 I feel more discouraged about my future than I used to be.
2 I do not expect things to work out for me.
3 I feel my future is hopeless and will only get worse.

3. Past Failure

0 I do not feel like a failure.
1 I have failed more than I should have.
2 As I look back, I see a lot of failures.
3 I feel I am a total failure as a person.

4. Loss of Pleasure

0 I get as much pleasure as I ever did from the things I enjoy.
1 I don't enjoy things as much as I used to.
2 I get very little pleasure from the things I used to enjoy.
3 I can't get any pleasure from the things I used to enjoy.

5. Guilty Feelings

0 I don't feel particularly guilty.
1 I feel guilty over many things I have done or should have done.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6. Punishment Feelings

0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7. Self-Dislike

0 I feel the same about myself as ever.
1 I have lost confidence in myself.
2 I am disappointed in myself.
3 I dislike myself.

8. Self-Criticalness

0 I don't criticize or blame myself more than usual.
1 I am more critical of myself than I used to be.
2 I criticize myself for all of my faults.
3 I blame myself for everything bad that happens.

9. Suicidal Thoughts or Wishes

0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10. Crying

0 I don't cry anymore than I used to.
1 I cry more than I used to.
2 I cry over every little thing.
3 I feel like crying, but I can't.

_____ Subtotal Page 1

Continued on Back

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11. Agitation

0 I am no more restless or wound up than usual.

1 I feel more restless or wound up than usual.

2 I am so restless or agitated that it's hard to stay still.

3 I am so restless or agitated that I have to keep moving or doing something.

12. Loss of Interest

0 I have not lost interest in other people or activities.

1 I am less interested in other people or things than before.

2 I have lost most of my interest in other people or things.

3 It's hard to get interested in anything.

13. Indecisiveness

0 I make decisions about as well as ever.

1 I find it more difficult to make decisions than usual.

2 I have much greater difficulty in making decisions than I used to.

3 I have trouble making any decisions.

14. Worthlessness

0 I do not feel I am worthless.

1 I don't consider myself as worthwhile and useful as I used to.

2 I feel more worthless as compared to other people.

3 I feel utterly worthless.

15. Loss of Energy

0 I have as much energy as ever.

1 I have less energy than I used to have.

2 I don't have enough energy to do very much.

3 I don't have enough energy to do anything.

16. Changes in Sleeping Pattern

0 I have not experienced any change in my sleeping pattern.

1a I sleep somewhat more than usual.

1b I sleep somewhat less than usual.

2a I sleep a lot more than usual.

2b I sleep a lot less than usual.

3a I sleep most of the day.

3b I wake up 1–2 hours early and can't get back to sleep.

17. Irritability

0 I am no more irritable than usual.

1 I am more irritable than usual.

2 I am much more irritable than usual.

3 I am irritable all the time.

18. Changes in Appetite

0 I have not experienced any change in my appetite.

1a My appetite is somewhat less than usual.

1b My appetite is somewhat greater than usual.

2a My appetite is much less than before.

2b My appetite is much greater than usual.

3a I have no appetite at all.

3b I crave food all the time.

19. Concentration Difficulty

0 I can concentrate as well as ever.

1 I can't concentrate as well as usual.

2 It's hard to keep my mind on anything for very long.

3 I find I can't concentrate on anything.

20. Tiredness or Fatigue

0 I am no more tired or fatigued than usual.

1 I get more tired or fatigued more easily than usual.

2 I am too tired or fatigued to do a lot of the things I used to do.

3 I am too tired or fatigued to do most of the things I used to do.

21. Loss of Interest in Sex

0 I have not noticed any recent change in my interest in sex.

1 I am less interested in sex than I used to be.

2 I am much less interested in sex now.

3 I have lost interest in sex completely.

9 10 11 12 A B C D E

_____ Subtotal Page 2

_____ Subtotal Page 1

_____ Total Score

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