AN EXPLORATION OF THE RELATIONSHIP BETWEEN WORRY
AND OTHER VERBAL PHENOMENA

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Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

May 2008

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This study hypothesized a direct relationship among three verbal phenomena: derived relational responding, verbal intelligence, and worry. It also hypothesized that experiential avoidance would mediate the relationship between derived relational responding and worry. Overall, results from this study failed to support a relationship between worry and the other two verbal phenomena, however, results did support a relationship between derived relational responding and verbal intelligence. Additionally, results indicated a significant relationship between experiential avoidance and worry. Future research should clarify the relationship among the three primary variables of interest, improve measurement of these variables, be more sensitive to external validity, and promote the study of acceptance-based treatments that target experiential avoidance.
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ACKNOWLEDGEMENTS

First, I would to thank my major professor, Dr. Amy R. Murrell, who has provided acceptance, support, and guidance throughout this endeavor, and who has been willing to go above and beyond what is required. I would also like to thank my committee members, Dr. Sharon Rae Jenkins and Dr. Randall J. Cox, for adding their own perspectives and suggestions, which have changed this project for the better. Additionally, each member of my research team has provided me with invaluable input and assistance. I would like to give special mention to Amanda Adcock, Tiffani Allison, Jeffrey Geddes, Nikki Hernandez, Cicely LaBorde, Christina Larson, Jonathan Schmalz, and Andrew Scherbarth, whose unique perspectives and knowledge are reflected in this project.

Finally, I would like to thank my fiancé, friends, and family, for their continued encouragement and patience. As always, their confidence in me has been my strength and motivation.
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INTRODUCTION

Relational frame theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001) is a behavioral account of human language and cognition, both known in this tradition as verbal behavior. Proponents of this theory conceptualize psychopathology as more normal than abnormal and as more common than not. In fact, they note that psychopathology and human suffering are pervasive, universal phenomena, and they point to an equally pervasive, universal (and human) cause: human language and cognition. According to Hayes and colleagues (2001), human language and cognition are responsible for much of our suffering and psychopathology.

Without the processes of verbal behavior, we would not be able to say to ourselves, “I am anxious all the time,” or “my parents were horrible,” or “I will never be happy.” Neither would we be able to remember our past nor worry about the future. Extensive research on the construct of worry has confirmed that worry is a verbal linguistic-phenomenon. The current project therefore seeks to explore the relationship between worry and other types of verbal phenomena, including (1) derived relational responding ability, which has been conceptualized in the behavior analytic tradition as the basis for verbal behavior, and (2) the more traditional concept of verbal intelligence.

Worry: An Overview

Worry is a common, universal human experience (Tallis, Davey, & Capuzzo, 1994), but what exactly is worry? Is it good or is it bad? Is it adaptive or maladaptive? The answer to these questions, not surprisingly, is both. Worry is all of these things, and, like so many psychological constructs, cannot be reduced to an either-or explanation. Worry can be both past and future
oriented. It is both a dispositional and a situational variable. Individuals suffering from depression may worry, individuals suffering from anxiety may worry, and individuals suffering from nothing more than the stresses of everyday living may worry.

**Evaluating Worry**

MacLeod, Williams, and Berkerian (1991) provide a summary definition of worry based on characteristics that are commonly cited in the literature: “Worry is a cognitive phenomenon, it is concerned with future events where there is uncertainty about the outcome, the future being thought about is a negative one, and this is accompanied by feelings of anxiety” (p.478). Borkovec (1994) offers a similar definition: “Worry is a predominantly verbal-linguistic attempt to avoid future aversive events” (p.7) and further notes that worrying is often perceived as unwanted and uncontrollable. Davey’s (1994) concern is that these definitions pathologize worry and assume that all worry is associated with high levels of anxiety. He therefore draws a distinction between non-pathological and pathological worry, suggesting that non-pathological worry solves problems and reduces anxiety, whereas pathological worry exacerbates problems and enhances anxiety; for Davey, pathological worry is problem solving gone awry (Davey 1994). Chronic worriers do not necessarily lack problem-solving abilities – in fact, Davey revealed a relationship between better problem solving and increased worrying – rather, chronic worriers lack confidence in their problem-solving abilities (Davey, 1994).

Interestingly, Davey (1994) found that the controllability of the stressor predicted the degree of benefit obtained from worrying, such that the more controllable the stressor the greater the benefit. However, controllability was not related to the frequency of worry or the
perception that worrying increased anxiety. This would seem to be in direct contrast to current thought on the nature of pathological worry, which is differentiated from non-pathological worry based on frequency, intensity, and controllability (Borkovec, 1994). However, Davey (1994) refers to the controllability of the stressor, while Borkovec (1994) refers to the controllability of the worry itself. In fact, Wells (2004) has found that an important differentiating factor between patients who suffer from pathological worry and non-patients is the level of negative belief about the uncontrollability of worry. That is, individuals with pathological worry engage in what Wells has termed Type 2 worry or meta-worry: they worry about worrying (Wells, 2004). They believe that their worry is out of control.

So worry, though adaptive for most people most of the time, can quickly become maladaptive when individuals lack confidence in their problem solving abilities and when they perceive their worrying as out of their control. Given that chronic, pathological worry is a pervasive symptom of much suffering and psychopathology (Tallis et al., 1994; American Psychiatric Association, 2000), a thorough understanding of the nature, origins, and functions of worry is necessary for the refinement of current treatment approaches.

The Verbal-Linguistic Nature of Worry

The Penn State group. The modern worry literature has been influenced considerably by the work of Thomas Borkovec and colleagues, whose research program at Pennsylvania State University was the first to study worry outside of the context of test anxiety. Their preliminary exploration of worry (Borkovec, Robinson, Pruzinski & DePree, 1983) consisted of three studies designed to generate a characterization of the “worrier” and a description of the actual worry
process. Results from this early research led the Penn State group to define worry as “a chain of thoughts and images, negatively affect-laden and relatively uncontrollable” (Borkovec et al., 1983, p.10). Subsequent investigations of worry in clinically anxious samples (Borkovec & Inz 1990; Borkovec & Lyonfields, 1993) led to the conclusion that worry consisted primarily of thoughts rather than images, and the original definition was therefore revised to indicate that worry is a verbal-linguistic phenomenon. Simply put, worry is “talking to oneself in an anxious way” (Borkovec et al., 2004, p. 82). Indeed, evidence that worry is not verbal-linguistic in nature has not been presented to date.

Empirical support for worry as thought initially came from a study by Borkovec and Inz (1990) that contrasted the frequencies of reported thoughts and images among participants who had been diagnosed with generalized anxiety disorder (GAD) and a non-clinical control group. Both groups were asked to report the prevalence of thoughts and images during 10-minute periods of experimenter-induced relaxation and worry. During the relaxation period, non-clinical controls reported predominantly imagery whereas clients with GAD reported equal amounts of imagery and thought. During the worry period, both clients with GAD and non-clinical controls reported primarily thought, indicating that worry consists predominantly of thought activity. The findings from this empirical study were later supported in a questionnaire study (Borkovec & Lyonfields, 1993) in which participants indicated that, during past periods of worry, they had experienced significantly more thought activity (70%) than imagery (30%).

**Independent support.** Similar results have been found by researchers independent of the Penn State group and will be presented chronologically. In 1992, Butler, Wells & Dewick hypothesized, on the basis of findings from the Penn State group, that the effects of worrying
after witnessing a distressing experience would differ from the effects of engaging in imagery after witnessing the same experience. In their study, 33 participants were shown a distressing video about an industrial accident and then asked to either worry, engage in imagery, or “settle down.” A follow-up interview with participants revealed that those who worried after watching the video experienced significantly less anxiety than those who engaged in imagery, supporting the hypothesis that worry is distinct from imagery.

In 1993, Rapee conducted a study to investigate the relationship between working memory and worry. Sixty-eight participants were randomly assigned to one of four conditions and instructed to worry about a topic important to them while simultaneously engaging in an assigned task. The nature of the assigned task varied by condition. Results indicated that the task involving generation of random letters was the only task to significantly interfere with the worry process, which in turn suggested that worry involved phonological aspects of working memory.

In a preliminary study of the phenomenology of non-pathological worry, Tallis, Davey and Capuzzo (1994) also concluded that worry is fundamentally verbal in nature. In their study, each participant completed the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990), the Worry Domains Questionnaire (WDQ; Tallis, Eyseenck, & Mathews, 1992), and a 56-item questionnaire designed to elicit information about the phenomenology of worry, including but not limited to content, frequency, duration, precipitants, and formal qualities. Regarding the formal qualities of worry, responses to the questionnaire indicated that 71.3% of the sample reported a predominance of thought over imagery, and 14.8% reported thoughts only. Additionally, responses indicated that all
participants ascribed some narrative quality to their worry, ranging from a single repeated phrase (19.3%) to several phrases resembling a short story (47.1%).

In 1996, Freeston, Dugas, and Ladouceur sought to replicate the initial work of Borkovec & Inz (1990). Participants in their study were categorized into two groups based on their scores on the Generalized Anxiety Disorder Questionnaire (GADQ; Roemer, Posa, & Borkovec, 1991): those who met cognitive criteria for GAD (labeled excessive worriers) and those who did not. All participants were asked to report the percentage of thoughts and the percentage of images during typical periods of worry; both groups reported that their worry consisted primarily of thoughts (70.4%) rather than images (24.8%). Additionally, the group of excessive worriers reported a significantly greater percentage of thoughts (75.6%) than the other group (69.6%).

*Electroencephalograph (EEG) studies.* Support for worry as a verbal-linguistic activity comes from not only from research involving self-report measures but also studies involving electrocortical analyses which have shown heightened left frontal cortical activity both in individuals with GAD and in individuals with trait-like worry (Carter, Johnson, & Borkovec, 1986; Borkovec, Ray, & Stober, 1998); this same area of the brain is activated during non-anxious verbal cognitive activity.

In 1986, Carter and colleagues assigned participants to either a worry group or a non-worry group based on self-reports of worry. Electrocortical activity was recorded by EEG during four different periods: (1) a 3-minute baseline period, during which participants were asked to relax, (2) a 10-minute worry period, during which participants were asked to worry about a topic of personal concern, (3) a 10-minute cognitive task period, during which participants were asked to perform cognitive tasks designed to differentially activate cortical hemispheres (to
provide a baseline measure of EEG activity during a non-worry period), and (4) a 25-minute relaxation period, during which participants received progressive muscle relaxation training via audiotape. Results indicated that the worry group showed greater overall cortical activation as well as relatively greater left hemisphere activation than did the non-worry group. Additionally, progressive muscle relaxation training was associated with decreased activity in the left hemisphere for the worry group.

In a review of the literature on worry, Borkovec and colleagues (1998) reported a recent study of theirs in which the EEG patterns of clients who had received a diagnosis of GAD were compared pre- and post-treatment (14 therapy sessions) as well as to a non-GAD control group. Differences in EEG patterns were found among the three conditions (baseline, relaxation, and worry) and between the two groups, as well as within in the treatment group pre and post-treatment. Specifically, all participants showed greater left frontal activity during the worry condition; participants with a diagnosis of GAD showed greater left frontal activity during the worry condition than did controls; and the left frontal activity decreased from pre- to post-treatment for the participants with a diagnosis of GAD.

Related Constructs

Anxiety. Worry was first differentiated from anxiety as a result of findings generated by studies of test anxiety (e.g., Davidson & Schwartz, 1976), in which separate cognitive and somatic components to the anxious process were identified. Indeed, worry is essentially thought (Borkovec, 1994), and it is only when this thought becomes maladaptive that it
becomes highly correlated with measures of anxiety and fear (Davey, Hampton, Farrell, & Davidson, 1991).

The Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990), a measure of pathological worry, has been found to correlate significantly yet moderately with trait measures of anxiety (Molina & Borkovec, 1994). However, even the highest correlations of the PSWQ with trait measures of anxiety indicate only 50% shared variance, supporting the notion that worry and anxiety are separate constructs. Indeed, in one study of patients diagnosed with GAD, the PSWQ did not correlate significantly with any of the five commonly used trait measures of anxiety (Molina & Borkovec, 1994).

**Obsessive thoughts.** Langlois and colleagues (2000a) have identified several similarities between worry and obsessive thoughts: each can be found in both clinical and non-clinical populations, and the frequency of both worry and obsessive thoughts distinguishes clinical from non-clinical populations. Also, both constructs are accompanied by negative emotions. However, the first in a pair of studies by Langlois and colleagues (2000a) also demonstrated clear differences between worry and obsessive thoughts on a number of dimensions. First, worry causes more severe and pervasive interference than do obsessive thoughts because it appears to be more vague and diffuse. Second, worry is more closely related to specific events or triggers than are obsessive thoughts. Third, and most important to this study, worry is more often experienced in verbal form, whereas obsessive thoughts are more often associated with images.

Other differences between worry and obsessive thoughts have been noted as well. Thought-action fusion can differentiate obsessions from worry (Coles, Mennin, & Heimberg,
Thought-action fusion, a cognitive process in which thought and action are fused, or confused (Rassin, Merckelback, Muris, & Spaan, 1999), was found (Coles et al., 2001) to be more closely related to obsessive thoughts than to worry.

Still, findings from the second study by Langlois and colleagues (2000b) suggest that worry and obsessive thoughts share common processes and may in fact lie along a continuum. The two constructs are clearly related but conceptually distinct. A future study that explores the relationship between obsessive thoughts and verbal behavior might help to clarify the relationship between worry and obsessive thoughts. Like the relationship between worry and obsessive thoughts, the relationship between worry and rumination is in need of further investigation.

Rumination. Current literature reveals debate as to the exact relationship between worry and rumination (Mennin, Heimberg, & Turk, 2004). This is not surprising, given that even experts in the field use one construct to describe the other: “in the case of pathological worrying, these thoughts tend to be overwhelmingly negative, characterised by obsessive rumination and catastrophizing” (Davey & Tallis, 1994, p.2-3). Additionally, though worry is considered the hallmark symptom of GAD, and rumination is considered a characteristic of major depression (Nolen-Hoecksema, 2000), the high co-morbidity between anxiety symptoms and disorders and depressive symptoms and disorders (Clark & Watson, 1991) clearly suggests the presence of a relationship between the two constructs.

Many researchers, in fact, believe that the two constructs are essentially the same process (Segerstrom et al., 2003; Watkins, 2004; Watkins, Moulds, & Mackintosh, 2005), differing only in content and/or purpose. Other researchers maintain that worry and
rumination represent different processes altogether (Fresco, Frankel, Mennin, Turk & Heimberg, 2002). In one study, exploratory factor analysis revealed separate factors for each of the constructs (Fresco et al., 2002). Additionally, worry and rumination as constructs originated from distinct research traditions and theories which describe their role in the maintenance of mood disorders differently (Fresco et al., 2002). Clearly, further research is necessary to determine a more precise relationship between these two constructs. The present study will focus its inquiry on worry with the understanding that rumination, because of its verbal-linguistic nature, may have a similar relationship with verbal behavior.

Worry: Origins and Functions

In simplest terms, worry originates in response to a future threat of some kind (Borkovec 1994). In that sense, worry might be conceived of as a result of situational factors. However, that presents too incomplete a picture, primarily because not all individuals react to future threat with worry all of the time.

So what differentiates who does and who does not react to future threat with worry? And what differentiates individuals whose worry is non-pathological from those whose worry is pathological? We have already answered this question to some extent, through a brief explanation of the metacognitive theory of worry: the negative appraisal of worry results in meta-worry (Wells, 2004), a construct that has been found to differentiate pathological from non-pathological worry. Two other important theories that attempt to illuminate both the origins and function of worry will now also be considered. The first theory posits that the intolerance of uncertainty plays an important role in the etiology and maintenance of worry
(Dugas, Buhr, & Landouceur, 2004), and the second theory, the cognitive avoidance theory of worry, conceptualizes worry as serving an avoidant function on a number of different levels (Borkovec, Alcaine, & Behar, 2004). The following exploration and discussion of these two theories serves to illuminate the nature of worry.

**Worry and intolerance of uncertainty.** Individuals who are intolerant of uncertainty become upset and distressed when faced with ambiguity; they evaluate uncertain situations negatively and believe that uncertainty should be avoided (Dugas et al., 2004). In fact, Dugas and colleagues (2004) observed that many of their patients with GAD (who suffered from chronic worry) preferred a negative outcome to an uncertain one. Not surprisingly, intolerance of uncertainty was found to correlate strongly with worry (Dugas et al., 2004), which replaces uncertainty with hypothesized future negative events.

In fact, Dugas, Gosselin, and Landouceur (2001) were initially concerned that worry and intolerance of uncertainty were not separate constructs. They examined the relationships between the Intolerance of Uncertainty Scale (IUS; Freeston et al., 1994) and the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) in order to address this concern. Scores on the IUS and the PSWQ were differentially related to a series of behavioral tasks, which allowed the researchers to conclude that worry and intolerance of uncertainty were in fact distinct constructs. An examination of gender differences on the IUS and the PSWQ further supported their claim: women reported a greater tendency to worry than men, but there were no gender differences in levels of intolerance of uncertainty (Dugas et al., 2001).

Intolerance of uncertainty may be a distinguishing factor between individuals with GAD
and non-clinical individuals (Buhr & Dugas, 2002). Additionally, it may be a better predictor of worry than are anxious and depressive symptoms in both adolescents and adults (Laugesen et al., 2003; Dugas et al., 1997). So what exactly is this striking relationship between worry and intolerance of uncertainty?

The most direct relationship between the two constructs consists of being intolerant that there is no guarantee that a future negative event will not occur (Dugas, 2004). This can lead to worry in many ways. A study by MacLeod and colleagues (1991) showed that not only were high worry individuals more likely to predict negative outcomes in the face of uncertainty, they also demonstrated a greater ability to provide an explanation for why these negative outcomes might occur.

Dugas and colleagues (2004) delineate three indirect links between worry and intolerance of uncertainty. The first link involves positive beliefs about worry. Chronic worriers hold a number of positive beliefs about worry (Borkovec, Hazlett-Stevens, & Diaz, 1999; Wells, 2004). They believe that worry is useful in motivation and problem-solving, in preparing for negative outcomes, in preventing negative outcomes, and in distracting themselves from more emotional topics (Borkovec et al., 1999). Intolerance of uncertainty is thought to contribute to the formation and maintenance of the positive beliefs as well as to the maintenance of worry itself; if individuals can avoid uncertainty through worry, then worry, positive beliefs about worry, and the avoidance of uncertainty are reinforced.

The second link involves a negative problem orientation (Dugas et al., 2004). Because all problems entail some uncertainty as to their resolution, individuals who are intolerant of uncertainty are likely to appraise problems in a negative way and to focus on those aspects of
the problem that are uncertain and therefore threatening (Dugas et al., 1997). Furthermore, intolerance of uncertainty may influence an individual’s confidence in her problem-solving ability through a reduction in the cognitive and emotional resources needed for problem solving. This is certainly consistent with Davey’s (1994) assertion that chronic worriers lack confidence in their problem solving abilities.

*The cognitive avoidance theory of worry (Dugas et al., 2004).* Borkovec and colleagues have conceptualized worry as avoidance on a number of levels (Borkovec, 1994; Borkovec, Alcaine, & Behar, 2004). First, they have found that worry is a cognitive attempt to avoid the occurrence of future negative events. Empirical evidence supports that people do believe that worry is an effective method of avoiding disaster (Borkovec et al., 1999; Wells, 2004), and their worry (like other avoidance behaviors) is negatively reinforced upon the non-occurrence of the disaster. Avoidance therefore precludes the worrier from learning that the disaster most likely would not have occurred in the absence of worry. Intolerance of uncertainty further contributes to the maintenance of worry in the sense that these uncertain future disasters are difficult to tolerate and therefore must be avoided (Dugas et al., 2004).

Not only does worry function to avoid the occurrence of future events, it also serves to avoid the unpleasant images and somatic anxiety that are experienced upon the perception of threat (Borkovec et al., 2004). A number of studies have shown that somatic reactions to threatening images are attenuated through the cognitive activity of worry (Borkovec & Hu, 1990; Borkovec, Lyonfields, Wiser, & Diehl, 1993); that is, worry inhibits sympathetic activation. Because worry is essentially thought, the shift from threatening imagery to cognitive activity
results in the ability to escape a physiological and emotional fear response (Borkovec et al., 2004). Again, worry is negatively reinforced.

Avoidance of emotional expression. On another level, worry results in the avoidance of emotional expression. Whether worriers are actively avoiding emotion or simply not in possession of enough resources to experience emotion is unclear. It may be that worriers, being constantly engaged in the cognitive activity of worry, simply do not have the concurrent capacity for emotional expression. (Borkovec et al., 2004). On the other hand, individuals may indeed worry to avoid the processing of emotional topics, be they past traumas or present life concerns (Borkovec et al., 2004).

In one study, the self-report of the use of worry to avoid internal distress was the only reason for worry that consistently differentiated individuals suffering from GAD from individuals with sub-clinical anxiety (Borkovec & Roemer 1995). Another study by Roemer and colleagues (1997) revealed that the actual content of worry is not as important as the avoidant function that worry serves. In addition, the diffuse nature of worry among individuals with GAD may relate to possible avoidant functions (Roemer et al., 1997). Individuals with GAD fail to experience positive emotions in the present because they are constantly worrying about negative events that may happen in the future; because they spend most of their time in the future, then, they do not have the resources to experience any intense positive and negative emotions in the present (Borkovec & Sharpless, 2004). Worry therefore interferes with successful emotional processing in the present (Borkovec 1994).

A study by Roemer and colleagues (2005) found that self-reported worry was significantly correlated with both experiential avoidance (the avoidance of internal events such
as thoughts and feelings) and fear of emotional responding. Individuals with GAD, then, may not successfully process emotions because they avoid them; this supports the finding that worry serves an avoidant function in terms of the reduction of internal distress (Borkovec 1994). In fact, Williams and colleagues (1997) have hypothesized that fear of anxiety and other emotions may predict the initial development of anxiety disorders. Individuals with GAD may find emotional responses in general to be overwhelming and aversive (Mennin, 2002). Ironically, part of the unpleasantness of avoided emotions comes not from the emotions themselves but rather from the avoidance of them (Hayes et al., 1996): “Trying not to feel anxious is itself an anxiety-provoking thing to do” (Hayes et al., 2002, p.327). Chronic worriers are thus caught in a cycle of avoidance and suffering. Their attempts to avoid emotional responses result in anxiety and worry, and their attempts to avoid anxiety and worry paradoxically increase them.

**Worry and experiential avoidance.** Experiential avoidance has been defined as “the phenomenon that occurs when a person is unwilling to remain in contact with particular private experiences (e.g., emotions or thoughts) and takes steps to alter the form and/or frequency of these events and the contexts that bring them about” (Hayes et al., 1996, p. 1154). The construct of experiential avoidance has been explained from an RFT perspective; from this perspective, experiential avoidance is a natural by-product of human language and cognition (Hayes et al., 2001). Both the experiential avoidance literature and the cognitive avoidance theory of worry as developed by Borkovec and colleagues share the assumption that the avoidance of private experiences such as thoughts and feelings ultimately results in psychopathology.
A recent preliminary study by Roemer & colleagues (2005) directly tested the relationship between experiential avoidance, chronic worry, and GAD, and found that experiential avoidance was significantly correlated with levels of trait worry and level of distress associated with GAD symptoms. These findings are supported by Roemer and colleagues’ subsequent investigations (2005) that have shown worry to be associated with higher levels of self-reported experiential avoidance itself. Finally, a case study of 4 participants with GAD found that rigid, repeated attempts to avoid worry and anxiety actually served to maintain their disorder (Orsillo et al., 2003).

Meta-cognitive theory revisited. Not surprisingly, worry itself becomes an avoided experience (Wells 2002). Studies have revealed that individuals with GAD often worry about worrying, engaging in what has been termed meta-worry (Wells & Carter, 2001). Additionally, individuals with GAD evaluate their worry as dangerous and uncontrollable (Wells 2002; Wells & Carter, 2001) and report more difficulty in attempts to control their worry than do non-anxious control subjects (Abel & Borkovec, 1999). In their efforts to avoid worry, then, individuals with GAD are ironically trying to avoid something that they perceive as uncontrollable. Unfortunately, this attempt to avoid worry may actually increase it. The literature on thought suppression (see Purdon 1999 for a review) indicates that the suppression of particular thoughts (e.g., worrisome thoughts) actually increases the likelihood that these thoughts will occur. The problem with deliberate avoidance of worrisome thoughts, then, is that it in devising and executing a verbal plan to avoid the worrisome thoughts, the individual actually comes into contact with the verbal item (Hayes et al., 1996). For example, saying to
oneself, “Don’t worry,” actually calls “worry” to mind. Individuals with GAD are thus caught in a vicious, verbal cycle of avoidance and suffering.

Derived Relational Responding: Another Verbal Phenomenon

Multiple definitions of the term verbal exist. The claim that worry is verbal in nature assumes a more traditional definition of verbal such as the following dictionary definition: “of, relating to, or consisting of words” (Meriam-Webster, 2007). Clinical behavior analysts have taken a different perspective and define any phenomenon or process as verbal behavior if the stimulus functions controlling it are derived (Wilson & Blackledge, 2000). To understand what this means, it is necessary to understand some of the basics of RFT (Hayes, Barnes-Holmes, & Roche, 2001), a behavior analytic account of human language and cognition that has redefined verbal behavior based on a functional contextualist (rather than a mechanistic) philosophy of science. According to RFT, a highly sophisticated vocabulary would be related to a highly sophisticated system of relational networks (Hayes et al., 2001). These relational networks, termed relational frames, consist of stimuli (defined as any internal or external event with which the individual comes into contact) whose relationships have been derived through an indirect learning process. Given words as stimuli, language development can be explained as the acquisition and development of relational networks of words. As Hayes and colleagues (2001) note, however, the relations among words, and not merely their verbal content, are key to the definition of verbal behavior. So it is the ability to derive relations, or derived relational responding ability, that has been given the title of verbal behavior.
Relational Frame Theory: An Overview

Relational frame theory (RFT; Hayes et al., 2001) posits that relations among stimulus events are derived as a result of indirect learning. RFT research has shown that verbally competent humans can derive relations among stimulus events without ever having been directly taught to do so (Hayes et al., 2001). The classic example given in the RFT literature (Hayes et al., 2001) involves an individual who is directly taught that (a) stimulus event A is related to stimulus event B in a particular manner; and that (b) stimulus event A is related to stimulus event C in a particular manner. After being directly taught these two relations, the individual then indirectly learns that B and C are related. That is, although the individual has never actually been taught that B and C are related, nor has ever been reinforced for relating them, the relationship between B and C is nevertheless derived.

Derived relational responding, in this example, results in a three-member class (A, B, and C) or relational frame. Relational frames can be defined in terms of three properties: mutual entailment, combinatorial mutual entailment, and the transfer of functions (Hayes et al., 2001). Mutual entailment involves responding to one stimuli in terms of the other: If A is related to B, then B must be related to A. Combinatorial mutual entailment involves the combination of two or more derived relations: If A is related to B, and A is related to C, then B is related to C. Transfer (or transformation) of functions refers to the transfer of the function of a given stimuli in a relational frame to other members of that frame. For example, if snakes, camping trips, and the lake are members of a relational frame, and snakes are known to be anxiety provoking (provoking anxiety is their function), then, through transfer of function, camping trips and the lake are (indirectly) learned to be anxiety provoking as well.
Five important types of relational frames, or five important relations that may occur among A, B, and C, are coordination, contingency or causality, evaluative comparison, hierarchical class membership, and frames of perspective taking (Hayes et al., 2001).

Coordination, the dominant relational frame, can be conceptualized as the IS relationship, or the equivalence relation: A is B. Contingency, or causality, can be conceptualized as the TIME or BECAUSE relation, or the if-then relation: A comes before B, or If B then A. Evaluative comparison can be conceptualized as the BETTER relation: A is better than B. Hierarchical class membership can be conceptualized as the ATTRIBUTE relation: A is part of B. Finally, perspective taking can be conceptualized as the PERSPECTIVE relationship: I am here, now.

These five types of relational frames, along with the property of mutual entailment, allow the verbally competent human to derive such relations as B is A, B comes after A, B results from A, B is worse than A, and B includes A. Hayes and colleagues (2001) theorize that these five types of relational frames (coordination, contingency or causality, evaluative comparison, hierarchical class membership, and frames of perspective taking) are sufficient for the production of suffering and psychopathology.

Relational Frame Theory and the Problem with Language – Psychopathology

Given the RFT definition of verbal behavior (the act of framing events relationally), and given that the five types of relational frames discussed above are sufficient for the production of suffering and psychopathology, it follows that language and cognition would be sufficient for the production of suffering and psychopathology. Indeed, RFT boldly asserts that language and cognition are the direct source of many human psychological problems (Hayes et al., 2001).
assertion, that normal behavior (language and cognition) underlies much of what has been considered abnormal behavior (psychopathology), is supported by the observation that human suffering and psychopathology are so pervasive (Hayes et al., 2001). Within this framework, human suffering and psychopathology are not abnormal at all; they are merely the direct result of the normal behavioral processes of language and cognition.

Many forms of psychopathology are based on problems in the areas of language and cognition; this perspective is not unique to an RFT account of behavior. Indeed, Hayes and colleagues (2001) note that the very name of the field is “mental” health, that certain pathologies are labeled “thought” disorders, and that one of clinical psychology’s most successful treatments is titled “cognitive” behavioral therapy. However, RFT uniquely defines language and cognition as the process of relational framing and posits that relational framing leads to suffering and psychopathology.

An understanding of how relational framing leads to suffering and psychopathology can be illustrated by returning to the previous example involving, snakes, camping trips, and lakes. Despite never having had any direct contact with a snake, verbally competent humans can derive that snakes are bad. If snakes are bad, and if snakes exist in a relational frame with camping trips and the lake, then the camping trip and the lake become bad as well. As noted, the camping trip and the lake, through transfer of function, acquire the anxiety-provoking function of the snake. Additionally, the word “snake” exists in a relational frame with an actual physical snake. Likewise, the words “camping trips” and “lake” exist in a relational frame with actual camping trips and lakes as well as with the word “snakes” and actual snakes. In this way, the words “snake” and “camping trip” and “lake” can each provoke anxiety through transfer of
function. As such, both past memories of camping trips and future plans to go to the lake are capable of producing anxiety in the absence of an actual snake. Language allows suffering by bringing both the past and the future into the present (Hayes et al., 2001).

Experiential avoidance, the avoidance of private experiences, is a natural by-product of human language. The individual for whom snakes, camping trips and lakes function as anxiety producing stimuli will attempt to avoid not only snakes, camping trips, and lakes, but also any other stimuli that exist in a relational frame with snakes, camping trips, and lakes (including “snakes,” “camping trips,” and “lakes”). As individuals experience unpleasant anxious responses as a result of derived stimulus relations, then, they not surprisingly attempt to avoid the anxious response experience itself, thereby engaging in experiential avoidance (Hayes et al., 2002). As noted, Hayes and colleagues (1996) have suggested that many forms of psychopathology, including pathological worry, can be usefully viewed as maladaptive expressions of experiential avoidance (Hayes et al., 1996).

The Derived Relational Responding-Verbal Competence Link

Hayes and colleagues (2001) have asserted that only verbally competent humans can engage in derived relational responding. In asserting this, they are in fact relating their own conceptualization of verbal behavior with the more traditional idea that verbal competence involves a certain mastery of vocabulary and language skill. In fact, nonhuman subjects require extensive training in order to demonstrate derived relational responding ability (Schusterman & Kastak, 1994), and even then the ability has been trained directly rather than derived indirectly.
Empirical evidence that performance on derived relational responding tasks varies with language performance comes from a number of studies. Devaney, Hayes, and Nelson (1986) found that, of a sample of mentally handicapped children, the verbally disabled children were unable to demonstrate relational framing ability (of the coordination frame type) regardless of chronological age. They also observed that the youngest child to demonstrate relational framing ability was 2-years and 1-month-old (Devaney et al., 1986).

Barnes, McCullagh and Keenan (1990) looked at a sample of normally developing children in order to determine whether the findings of Devaney and colleagues (1986) were confounded by the mentally handicapped factor. Barnes and colleagues’ (1990) sample consisted of three groups of cognitively normally developing preschoolers: those children without a hearing impairment, hearing impaired children with verbal ages above 2 years, and hearing impaired children with verbal ages below 2 years. Verbal age was established by a speech therapist (Barnes et al., 1990). The only child who failed to demonstrate relational framing ability was the hearing impaired child with the youngest verbal age; no differences were found between hearing impaired and non-hearing impaired children with verbal ages above 2 years (Barnes et al., 1990).

Pelaez, Gewirtz, Sanchez and Mahabir (2000) studied relational framing in pre-linguistic infants. In keeping with previous findings that verbal ability and relational framing ability are related, they found that pre-linguistic infants were unable to form relational frames (Pelaez et al., 2000). In a case study of a developing child, Lipkens and colleagues (1993) studied the progression of relational framing performance and found that it corresponded to typical language development.
Rate of accurate derived relational responding has only recently been compared to traditional, established measures of verbal intelligence. O’Hora, Pelaez, and Barnes-Holmes (2005) defined verbal competence as performance on two verbal subtests of the WAIS-III, Vocabulary and Arithmetic. Participants in their study completed these two subtests, as well as a complex relational task designed to elicit derived relational responding. Results indicated that participants who successfully completed the relational task scored higher on both the Vocabulary and Arithmetic sections of the WAIS-III than did those participants who were unable to complete the relational task.

Finally, support for derived relational responding ability as verbal behavior comes from both electrophysiological and neuroimaging studies of the brain. Barnes-Holmes and colleagues (2004) have studied physiological activity associated with human language and cognition. Measures of reaction time, along with neurophysiological measures (EEG), indicated that a pattern typically associated with semantic processing is sensitive to derived stimulus relations. Research by Dickins and colleagues (Dickins, 2004; Dickens, Singh, & Roberts, 2001) using neuroimaging (fMRI) further supported that brain activity during matching-to-sample tests was similar to brain activity during semantic processing. Specifically, both the successful formation of equivalence relations (a subtype of derived relational responding) during the matching-to-sample tests and semantic processing during a verbal fluency task correlated with left lateralization of dorsolateral prefrontal cortex activity.

Worry, Derived Relational Responding, and Verbal Intelligence

Hayes and colleagues note that humans would not be able to worry were it not for their
ability to derive relational frames (2001). If the presence of the ability to form relational frames is at the heart of human suffering and psychopathology, then do varying degrees of the ability correspond to varying degrees of suffering and psychopathology? That is, does the potential for suffering and psychopathology increase with an increased rate of accurate derived relational responding?

Worry can become pathological, and whether it rises to the level of pathology or not, worry can result in suffering. The substitution of “worry” for “suffering and psychopathology” then results in the following question: Does the potential for worry increase with increased rate of accurate derived relational responding? Given that worry itself is verbal in nature, it seems reasonable to assume that derived relational responding and worry are intricately linked. Furthermore, given preliminary data that associate derived relational responding ability with verbal intelligence, it seems reasonable to assume that verbal intelligence would also be in relationship with worry.

Interestingly, research on worry that originates from a completely different paradigm than the functional contextualist paradigm of RFT has conceptualized worry in ways that are consistent with RFT and with the hypothesis that worry results from derived relational responding. For example, Mathews (1990) concluded that worry involves the cognitive avoidance of the elaboration of the associative network surrounding anxious material. The “associative network” of which he speaks resembles a relational frame. Substituting RFT terminology for Mathews’, then, results in the statement that worry involves the avoidance of members of relational frames whose functions are anxiety provoking.
Borkovec (1994) stated that for chronic worriers, worry is triggered by subconscious internal cues. Might these internal cues be members of relational frames who bear relation to thoughts, emotions, or other environmental stimuli? He also noted that the quandary for the chronic worrier is that worrying itself is likely to facilitate the retrieval of aversive images that need to be immediately avoided (Borkovec, 1994). This is another way of saying that worrying itself becomes part of a relational frame whose members’ function is anxiety-provoking and that therefore results in efforts at experiential avoidance.

Finally, Eysenck’s storage characteristics theory (Eysenck, 1984) posits the existence of “organized clusters” of worry related information in long-term memory; the duration and frequency of worry are determined by the number and structure of these worry clusters. Were Eysenck to have studied RFT, he might have posited the existence of relational frames instead of “organized clusters” and then hypothesized that the duration and frequency of worry are determined by the transformation of stimulus functions (and the nature of these functions) within and across these relational frames.

Again, though Mathews, Borkovec, and Eysenck have conceptualized worry in ways that are consistent with RFT, their underlying assumptions are not consistent with RFT. For example, they have not provided the means to observe or measure “organized clusters” and “associative networks” of worry. However, relational framing or derived relational responding ability as a behavior can and has been observed in numerous studies of derived relational responding and stimulus equivalence. RFT provides a philosophical and theoretical background for understanding language and cognition (verbal behavior) and may therefore aid in our understanding of worry. Surprisingly, the relationship between worry and rate of accurate
derived relational responding has never been empirically investigated.

Study Rationale

Theoretical Model

Based on RFT and the previous literature on worry and experiential avoidance, then, the following theoretical model is proposed (see Figure 1): Worry, which is verbal in nature, will increase as rate of accurate derived relational responding, a verbal behavior, increases. Because rate of accurate derived relational responding is expected to correlate with a standardized measure of verbal intelligence, worry is also expected to increase as scores on this measure increase. The relationship between worry and both rate of accurate derived relational responding and standardized verbal intelligence will be mediated by experiential avoidance.

![Figure 1](image-url)  
*Figure 1. Initial path-analytic model. Relationship between derived relational responding ability and verbal intelligence as well as the influence of derived relational responding ability, verbal intelligence, and experiential avoidance on level of worry.*

Experiential avoidance is conceptualized as a mediator because neither rate of accurate derived relational responding (verbal behavior) nor verbal intelligence are expected to be sufficient
conditions for high levels of worry except in the presence of experiential avoidance. That is, individuals with greater verbal abilities (defined as both verbal behavior and verbal competence) are only expected to have high levels of worry if they are also engaging in experiential avoidance.

Consider the following scenario. Suppose that A is a worry-provoking stimulus, a future threat of some kind, and B is the worry response of verbal behavior or negative self-talk. According to RFT, not only do A and B become related, but so do any stimuli, including thoughts and emotions, that are related to either A or B or to any stimuli indirectly trained to them. If C represents any thought or emotion related to A, then the size of the network or relational frame including A and B is potentially limitless. The individual need not encounter the original future threat (A) in order to respond with worry; he or she need only encounter any stimuli related to A to have a worry response. A worry response (B) itself will result in another worry response (B). If this individual is highly fluent at deriving relations among stimuli and has a rich relational repertoire, then he or she will be prone to have more elaborated worry networks and more likely to worry more often. Furthermore, this individual will likely engage in experiential avoidance to avoid the suffering produced by worry. That is, he or she will likely avoid any stimuli that are members of this relational frame that produces worry. As we have seen, experiential avoidance begets more psychopathology, and the individual is thus caught in a cycle of language-based suffering.

Research Questions and Hypotheses

Based on the theoretical model presented above, the following research questions and
hypotheses have been developed:

Research Question 1. What is the relationship among the following three verbal phenomena: worry, derived relational responding ability, and a standardized measure of verbal intelligence?

- Hypothesis 1. Derived relational responding ability will positively correlate with a standardized measure of verbal intelligence.
- Hypothesis 2. Derived relational responding ability will predict level of worry such that a greater derived relational responding ability will predict higher levels of worry.
- Hypothesis 3. A standardized measure of verbal competence will predict level of worry such that higher scores on the measure of verbal competence will predict higher levels of worry.

Research Question 2. How does experiential avoidance relate to worry, and does the presence of experiential avoidance affect the relationship between worry and derived relational responding ability?

- Hypothesis 4. Experiential avoidance will predict level of worry such that higher levels of experiential avoidance will predict higher levels of worry. Because of the high correlation between experiential avoidance and depression, effects of depression will be controlled for in the statistical analysis. Scores on a measure of experiential avoidance are expected to predict higher levels of worry above and beyond scores from a measure of depression.
- Hypothesis 5. Experiential avoidance (again, controlling for the effects of depression) will mediate the relationship between derived relational responding and worry such that the higher levels of experiential avoidance will predict higher levels of worry than will lower levels of experiential avoidance with the relationship between derived relational responding and worry held constant.
METHOD

Participants

The sample recruited for this study consisted of 53 undergraduate students taking psychology courses at the University of North Texas who could opt to participate in research as partial fulfillment of course requirements ($n = 11$) or for extra credit ($n = 42$). Though a power analysis for multiple regression analyses (Tabachnick & Fidell, 2001) revealed that a sample size of 43 would ensure an 80% likelihood of detecting an effect size of 0.2 ($p \leq .05$), more participants were recruited than necessary to account for participants who signed up for the study but failed to appear at the scheduled time. Females dominated this particular sample; there were 38 female participants and 15 male participants. The average age for the sample was 22.3 years ($SD = 6.10$).

Measures

Demographics Questionnaire

Participants completed a brief demographics questionnaire (Appendix A) to determine: age, gender, level of education, GPA, current job status (full or part time), and reason for participation (course requirement or extra credit). Additionally, participants were asked to report the number of hours per week they spend in each of the following activities: working, studying, reading, being in class, watching television, playing video games, using the Internet, drinking, using other substances, and exercising. These variables were chosen on the basis of their relationship to both worry and derived relational responding as reported in past literature as well as per the expectation that they may vary with other measurement outcomes.
Penn State Worry Questionnaire

The Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) is a 16-item Likert-type trait measure administered to assess pathological worry. The PSWQ measures the excessiveness, pervasiveness, and uncontrollability of worry by asking respondents to indicate on a 5-point scale from Not at all typical (1) to Very typical (5) how typical certain statements are of them. Sample statements include, “I am always worrying about something,” and “Once I start worrying, I can’t stop.” Scores range from 16 to 80, with the mean score for individuals diagnosed with GAD at 67.66 (SD = 8.86) (Molina & Borkovec, 1994). The mean score for non-anxious selected groups is 43.81 (SD = 11.32) (Molina & Borkovec, 1994).

The PSWQ possesses high internal consistency reliability in both college samples (r = .88 - .95) and samples of individuals suffering from clinical levels of anxiety (r = .86 - .93) (Molina & Borkovec, 1994), as well as for the current sample (r=.94). The PSWQ also possesses adequate to high test-retest reliability (r = .74-.93) across intervals ranging from 2 – 10 weeks (Molina & Borkovec, 1994). Finally, the PSWQ has demonstrated clear criterion validity, yielding significantly higher scores for individuals who have been diagnosed with GAD as compared to individuals who have received other anxiety disorder diagnoses, such as OCD and PTSD (Molina & Borkovec, 1994; Fresco, Mennin, Heimberg & Turk, 2003).

Worry Domains Questionnaire

The Worry Domains Questionnaire (WDQ; Tallis, Eysenck, & Mathews, 1992) was administered to assess non-pathological worry. Respondents were asked to rate how much
they worried about a list of 25 different worries on a Likert-type scale ranging from Not at all (0) to Extremely (4). These 25 different worries cluster into five domains: (D1) Relationships, (D2) Lack of Confidence, (D3) Aimless Future, (D4) Work, and (D5) Financial (Tallis, Davey, & Bond, 1994). Total scores range from 0 to 100, with the mean score for non-clinical samples differing somewhat between students ($M = 26.6$, $SD = 13.0$) and working adults ($M = 23.1$, $SD = 13.4$) (Tallis et al., 1994). This difference can be attributed to elevations in (D1) Relationships and (D4) Work for students. The mean scores for clinical samples, including patients diagnosed with either GAD ($M = 40.03$, $SD = 19.8$) or obsessive-compulsive disorder (OCD; $M = 50.7$, $SD = 20.8$) were significantly higher than the scores for the non-clinical sample.

The WDQ demonstrates high internal consistency reliability ($r = .92$) and satisfactory test-retest reliability ($r = .79$) with a large student population (Tallis et al., 1994). For the current sample, internal consistency reliability is also high ($r = .94$). Convergent validity of the WDQ is evidenced by satisfactory correlations between the WDQ and the PSWQ ($r = .44$) as well as between the WDQ and the Student Worry Scale ($r = .65$) (SWS; Davey, Hampton, Ferrell, & Davidson, 1992).

**Acceptance and Action Questionnaire**

The Acceptance and Action Questionnaire (AAQ; Hayes, Strosahl, Wilson, Bissett, Pistorello, Toarmino, et al., 2004) is being developed for the purposes of measuring experiential avoidance as conceptualized by RFT. The current version of the AAQ consists of 9 statements which respondents are asked to rate on a Likert-type scale ranging from Never True (1) to Always True (7). Higher scores are associated with higher levels of experiential avoidance.
Sample statements include, “I rarely worry about getting my anxieties, worries, and feelings under control,” and “Anxiety is bad.” The current study employed the use of all 49-items in the original item pool generated for the development of the AAQ-II, which is currently under development by Frank Bond at Goldsmiths College at the University of London and which remains unpublished.

Internal consistency is adequate \((r = 0.70)\) for the 9-item version used with two clinical samples: a sample of university undergraduates seeking counseling at a university counseling center and a sample of clients receiving psychotherapy from a large HMO in the northwest (Hayes, et al., 2004). An earlier 16-item version of the AAQ, which correlates strongly with the current 9-item version, was found to have adequate internal consistency \((r = 0.70)\) with a female, college sample (Roemer, Salters, Raffa, & Orsillo, 2005). The 49-item version used with the current sample evidenced a high internal consistency reliability \((r = .90)\). The AAQ correlates significantly yet moderately with measures of general psychopathology such as the Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983) and the Symptom Checklist-90 Revised (SCL-90-R; Derogatis, 1994). The AAQ also correlates significantly yet moderately with more specific measures of depression, anxiety, and trauma, such as the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown & Steer, 1988), the Beck Depression Inventory (BDI; Beck, Rush, Shaw, & Emery, 1979), and the Post-traumatic stress Diagnostic Scale (PDS; Foa, 1995). Still, preliminary data indicate that the AAQ measures a separate, unique construct (Hayes, et al., 2004).

*Center for Epidemiological Studies Depression Scale*

Due to the high correlation between AAQ scores and scores on the BDI (Hayes, et al.,
2004), the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977), a 20-item self-report measure for depression, was administered so that depression scores could be partialled out, allowing for a more pure measure of experiential avoidance. Respondents were asked to indicate on a 4-point scale from Rarely or none of the time (1) to Most or all of the time (4) how often they felt or behaved in certain ways during the past week. Sample statements include, “I had crying spells,” and “I felt fearful.” Scores range from 0 to 60, with higher scores indicating the presence of more serious psychopathology.

The CES-D possesses high internal consistency reliability (.85 - .92) for populations of diverse gender, age, ethnicity, and geographic location (Kohut, Berkman, Evans, & Cornoni-Huntley, 1993; Radloff, 1977; Roberts, 1980; Santor & Coyne, 1997; Sheehan, Fifield, Reisine, & Tennen, 1995). Internal consistency reliability for the current sample was also high 

Validation studies indicate that the CES-D demonstrates good convergent validity, discriminative validity, as well as sensitivity and specificity (Himmelfarb & Murrell, 1983; Husaini, Neff, Harrington, Hughes, & Stone, 1980; Mulrow, Williams & Gerety, 1995).

**Wechsler Abbreviated Scale of Intelligence**

The Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corporation, 1999) is an abbreviated measure of intelligence for use with individuals ages 6 through 89. The WASI consists of four subtests: Vocabulary, Block Design, Similarities, and Matrix Reasoning. The two-subtest form of the WASI will be used for the purposes of this study; it includes the Vocabulary and Matrix Reasoning subtests. The Vocabulary subtest consists of 44 items, 4 of which are picture items and 38 of which are word items. Respondents are required to identify
pictures and define words, respectively. The Matrix Reasoning subtest consists of four types of non-verbal reasoning items: pattern completion, classification, analogy, and serial reasoning (Stano, 2004). Respondents are required to choose the correct pattern from an array of four or five choices to complete a matrix. Each of these subtests is similar in content to the corresponding subtests in both the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III) and the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV) (Stano, 2004). Limitations to the WASI relate to its abbreviated nature and include some sacrifice of clinical accuracy and the inability to conduct a comprehensive cognitive assessment.

The WASI was normed on 2,245 children and adults whose demographic characteristics mirrored 1997 census data. Average split-half reliability coefficients for WASI subscales in an adult sample range from .92 to .98. Average test-retest reliability coefficients for the adult sample range from .79 to .90 for individual subtests, and from .87 to .92 for the IQ scales. Demonstrating concurrent validity, WASI IQ scores correlate (range of .84 to .92) with corresponding IQ scores derived from the WAIS-III. Though the four-subtest form is a more valid screening tool than the two-subtest form, for the practical purposes, the two-subtest form will be used. Because the Vocabulary and Matrix Reasoning subtests of the WAIS-III correlate most highly with the Verbal and Performance IQ indices respectively (Kaufman & Lichteberger, 2002), these two subtests are the most reliable and valid available estimates of Verbal and Performance IQ.

**Matching-to-Sample (MTS) Procedure**

Derived relational responding ability was measured using a computerized MTS
procedure. This procedure measures the ability to derive the coordination frame, or the IS relationship, by first directly training two relationships (A-B and A-C) and then testing for the derivation of equivalence relationships (B-C and C-B). For a presentation of all stimuli (A1, A2, A3, B1, B2, B3, C1, C2, C3) to be used in the procedure, please see Table 1. All instructions, training, and testing will be presented on a PC computer using Microsoft VisualBasic.Net programming.

Table 1

Neutral Stimuli Used in the MTS Procedure

<table>
<thead>
<tr>
<th>Equivalence Class</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>B</td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>C</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>

The computer program for the familiarity task and experiment begins as follows: “Hello. Thank you for taking part in this experiment. In this experiment, you will be presented with several trials. Each of these trials will be similar. One box will appear at the top of the screen
and three boxes will appear at the bottom of the screen. Your job is to choose one of the boxes at the bottom of the screen. Use the mouse to choose your answer. At first, you won’t know what to do, but the computer will tell you if you are correct or not. During some parts of the experiment, the computer will not tell you whether you are correct or not. Just do the best you can. Work as quickly as possible.” Figure 2 provides a graphical depiction of what participants saw on the computer screen during the experiment.

**Figure 2.** View of computer screen during mts procedure. The nonsense words appearing in the white boxes will be replaced by neutral stimuli in the actual task.

Direct training consisted of three phases. During Phase 1, participants were directly trained to pick B stimuli that accurately correspond to A stimuli. When the sample stimulus (the symbol at the top of the screen) was A1, for example, the participants were trained to pick stimulus B1 from an array containing all B stimuli. Likewise, when given A2 and A3 as samples, choosing B2 and B3, respectively, was reinforced by computer feedback. There were 6 trials in
each block, presented in pseudo random order. Participants were required to reach a criterion responding level (80% correct) in matching all three ‘A’ sample stimuli to their assigned ‘B’ comparison stimuli (A1-B1, A2-B2, A3-B3) before moving on to Phase 2. Phase 2 was identical to Phase 1, except that ‘C’ stimuli (instead of ‘B’ stimuli) will be used as comparison stimuli. Phase 3 involved a mix of all trials from Phases 1 and 2 presented in random order. Each trial type was presented once for a total of 6 trials in each block.

For all three phases of direct training, participants’ initial responses were expected to be guesses, as the answers were not obvious. When the participant chose correctly, the words, “GOOD JOB – CORRECT!” appeared on the screen for 2 seconds. If the participant chose an incorrect response, the word “INCORRECT!” appeared on the screen. Participants continued training until reaching the criterion responding level on Phase 3 (80% correct), at which time the computer screen read, “WELL DONE!” and participants were exposed to testing for derivation of equivalence relationships.

Twelve test trials were conducted in random order to test for derived relations between the ‘B’ and ‘C’ stimuli. During testing, each ‘B’ stimulus was presented as the sample two times with the ‘C’ stimuli presented as comparisons. Likewise, each ‘C’ stimulus was presented as the sample two times with the ‘B’ stimuli as comparisons. Feedback regarding task performance was not provided to the participants during test trials.

The computer was programmed to collect data on two relevant variables throughout the MTS procedure: number of correct items in each training or testing phase and total number of seconds in each training or testing phase. These two variables were used to create a measure of rate of accurate derived relational responding after all data were collected. Rate of accurate
Derived relational responding was defined as the number of correct items in each training or testing phase divided by the total number of seconds spent in that phase.

Data Collection Procedures

All participants were assigned a unique identification number at the beginning of the study, and all questionnaires and computer files were coded with this number. A master list linking participant identification numbers with participant names was destroyed after all data had been collected and analyzed and all participants have received proper credit for their participation. All data with any identifying information, including copies of signed informed consent forms and debriefing forms, are currently stored in a locked cabinet in a locked room in Dr. Amy Murrell’s research lab (328) in Terrill Hall at the University of North Texas. Research assistants with access to this research lab have been thoroughly trained in procedures necessary to protect participant confidentiality.

Upon arrival, each participant was first asked to read and sign a copy of the Informed consent form (Appendix). Participants were then administered the Vocabulary and Matrix Reasoning section of the WASI. This measure was given first due to practical concerns; graduate student researchers trained in the administration of the WASI were able to administer that measure and then allow undergraduate research assistants to administer the remaining measures.

Participants completed the remaining measures in order depending on the reactivity of the measure. The self-report questionnaires were administered on the computer in the following order: Demographics questionnaire, WDQ, PSEQ, CES-D, and AAQ. The computer was
programmed such that participants could not submit their answers to the self-report questionnaires unless each item was answered, therefore precluding the possibility of missing data for these measures. Participants’ final task was to complete the MTS procedure. Upon completion of the study, research assistants debriefed all participants and assigned credit through the UNT Psychology Department’s SONA system.

Data Analysis

Descriptive Statistics

Means and standard deviations were calculated for age, years of college, and GPA. Means and standard deviations were also calculated for hours per week spent in each of the following activities, as reported on the Demographics questionnaire: working, studying, reading, being in class, watching television, playing video games, using the Internet, drinking, using other substances, and exercising.

Internal consistency reliability coefficients for the current sample were calculated for the following scales: PSWQ, WDQ, AAQ-II, and CES-D. Additionally, means and standard deviations were calculated for the entire sample for each scale. Means and standard deviations were also calculated for the entire sample for the two key variables from the MTS procedure, number of correct items in each training or testing phase and total number of seconds in each training or testing phase, as well as for the composite variable, rate of accurate derived relational responding.
Preliminary Analyses

Univariate and multivariate outliers were identified and removed according to procedures outlined by Tabachnik & Fidell (2001). Skewness and kurtosis data were then examined for variables measuring worry, experiential avoidance, depression, verbal intelligence, and derived relational responding during Phase 4 (testing phase) in order to determine whether the distributions for these variables deviated significantly from the normal distribution.

Because of the exploratory nature of this study, a correlation matrix was constructed to present an atheoretical formulation of the relationship among the following variables: worry, as measured by both the PSWQ scores and WDQ scores, experiential avoidance, as measured by AAQ scores, depression, as measured by CES-D scores, verbal intelligence, as measured by Verbal T scores on the WASI, and derived relational responding ability, as measured by rate of accurate responding on the MTS procedure. In anticipation of a strong correlation between AAQ-II and CES-D scores, residualized AAQ-II scores were calculated and used for hypothesis testing.

Hypotheses Testing

To test Hypothesis 1, the correlation between rate of accurate derived relational responding and verbal intelligence was assessed for statistical significance. Before testing the remainder of the Hypotheses, assumption of non-collinearity between predictors was examined, as were assumptions of linearity and homoscedasticity.

To test Hypotheses 2, 3, and 4, rate of accurate derived relational responding, verbal
intelligence (WASI Verbal T scores), and experiential avoidance (residualized AAQ-II scores) were entered as predictors in a hierarchical multiple regression analysis. A total worry score, calculated by summing total scores for the PSWQ and the WDQ, was entered as the criterion variable.

The mediator model presented in the path analytic model and proposed in Hypothesis 5 was tested using the method presented by Barron and Kinney (1986). This method involves a series of regression analyses that explored whether (a) derived relational responding ability contributed significantly to the variance in residualized AAQ-II scores, (b) derived relational responding contributed significantly to the variance in total worry scores, and (c) the contribution of derived relational responding to the variance in total worry scores was reduced when residualized AAQ-II scores were added as a predictor variable.
RESULTS

Descriptive Statistics

Table 2 presents means and standard deviations for sample age, years of college, GPA, and WASI Verbal T, Performance T, and Full Scale IQ scores, as well as for hours per week spent in each of the following activities, as reported on the Demographics questionnaire: working, studying, reading, being in class, watching television, playing video games, using the Internet, drinking, using other substances, and exercising.

Table 3 presents means, standard deviations, and internal consistency reliability coefficients for the current sample for the following scales: PSWQ, WDQ, AAQ-II, and CES-D. Table 4 presents means and standard deviations for the two key variables from the MTS procedure, number of correct items in each training or testing phase and total number of seconds in each training or testing phase, as well as for the composite variable, rate of accurate derived relational responding.

Preliminary Data Analysis

As recommended by Tabachnik & Fidell (2001), standardized scores and frequency histograms were examined for univariate outliers for variables relevant to hypothesis testing, including worry (Total Worry Score), experiential avoidance (AAQ-II scores), depression (CES-D scores), verbal intelligence (Verbal T scores), and derived relational responding (DRR Phase 1 through 4). Four cases were identified as univariate outliers, two of which were also identified as multivariate outliers by their Mahalanobis distance values. The two multivariate outliers were removed from the data set as suggested by Tabachnik & Fidell (2001). The two remaining
univariate outliers were also removed on the basis of their not being part of the population intended for sampling. These two outliers represent data for participants who were flagged as having limited English proficiency, as assessed by their communication skills during testing.

Table 2

*Descriptive Statistics for Sample (n=53)*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>22.30</td>
<td>6.10</td>
</tr>
<tr>
<td>Years of College</td>
<td>3.09</td>
<td>1.63</td>
</tr>
<tr>
<td>GPA</td>
<td>3.60</td>
<td>3.76</td>
</tr>
<tr>
<td>Verbal T</td>
<td>55.30</td>
<td>10.55</td>
</tr>
<tr>
<td>Performance T</td>
<td>53.79</td>
<td>6.43</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>108.09</td>
<td>12.09</td>
</tr>
<tr>
<td>Working (hours per week)</td>
<td>10.09</td>
<td>11.52</td>
</tr>
<tr>
<td>Studying (hours per week)</td>
<td>11.42</td>
<td>8.40</td>
</tr>
<tr>
<td>Reading (hours per week)</td>
<td>2.23</td>
<td>2.51</td>
</tr>
<tr>
<td>Being in class (hours per week)</td>
<td>13.82</td>
<td>3.32</td>
</tr>
<tr>
<td>Watching TV (hours per week)</td>
<td>9.85</td>
<td>10.26</td>
</tr>
<tr>
<td>Playing video games (hours per week)</td>
<td>1.83</td>
<td>5.76</td>
</tr>
<tr>
<td>Using Internet (hours per week)</td>
<td>11.15</td>
<td>11.72</td>
</tr>
<tr>
<td>Drinking (hours per week)</td>
<td>1.75</td>
<td>3.23</td>
</tr>
<tr>
<td>Using other substances (hours per week)</td>
<td>0.19</td>
<td>0.83</td>
</tr>
<tr>
<td>Exercising (hours per week)</td>
<td>3.72</td>
<td>3.80</td>
</tr>
</tbody>
</table>
Table 3

Descriptive Statistics for Scales (n = 53)

<table>
<thead>
<tr>
<th>Scale</th>
<th>$M$</th>
<th>$SD$</th>
<th>$M$ for clinical sample</th>
<th>$M$ for non-clinical sample</th>
</tr>
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<tr>
<td>PSWQ</td>
<td>49.15</td>
<td>14.85</td>
<td>67.66*</td>
<td>43.81*</td>
</tr>
<tr>
<td>WDQ</td>
<td>31.75</td>
<td>19.33</td>
<td>40.03-50.70*</td>
<td>26.60*</td>
</tr>
<tr>
<td>AAQ-II</td>
<td>220.80</td>
<td>33.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CES-D</td>
<td>16.96</td>
<td>10.63</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Means from clinical and non-clinical samples as reported in Measures section of this document.

Table 4

Descriptive Statistics for MTS Variables (n = 53)

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th></th>
<th>Phase 2</th>
<th></th>
<th>Phase 3</th>
<th></th>
<th>Phase 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Number Correct</td>
<td>8.75</td>
<td>5.13</td>
<td>12.49</td>
<td>9.09</td>
<td>7.19</td>
<td>3.63</td>
<td>9.55</td>
<td>2.43</td>
</tr>
<tr>
<td>Seconds per phase</td>
<td>124.79</td>
<td>85.30</td>
<td>178.17</td>
<td>175.11</td>
<td>73.62</td>
<td>47.60</td>
<td>108.85</td>
<td>0.02</td>
</tr>
<tr>
<td>DRR Ability</td>
<td>.07</td>
<td>.02</td>
<td>.08</td>
<td>.02</td>
<td>.11</td>
<td>.02</td>
<td>.09</td>
<td>.03</td>
</tr>
</tbody>
</table>

Skewness and Kurtosis data were then examined according to procedures outlined by Tabachnik & Fidell (2001) for the same variables listed above. Results indicated that AAQ-II total scores and CES-D total scores deviated significantly from the normal curve, and therefore transformations for these scores were necessary. Because AAQ-II total scores exhibited moderate negative skewness, they were reflected and then subject to a square root transformation. Because CES-D total scores exhibited moderate positive skewness, a square root transformation was applied to CES-D total scores.

Correlation coefficients were computed among PSWQ scores, WDQ scores, a total worry
score, AAQ-II scores, CES-D scores, Verbal T scores, and derived relational responding ability during testing (DRR Phase 4). The results of the correlational analyses presented in Table 5 show that 11 out of 21 correlations were statistically significant \((p < .05)\). PSWQ and WDQ scores were significantly correlated both with each other and with the Total Worry score, which was expected given that both measures assess worry and that the sum of both measures comprised the Total Worry score. Correlations among all worry measures, the AAQ-II and the CES-D were significant, consistent with previous empirical findings (Hayes et al., 2004). Given the theoretical assertion made in this paper that experiential avoidance underlies a wide range of pathologies (Hayes et al., 1996), these significant correlations are not surprising. Verbal T scores and DRR Phase 4 were significantly correlated with each other but not with any other variables.

Table 5

Correlations Among Key Variables (n=49)

<table>
<thead>
<tr>
<th>Variables</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSWQ</td>
<td>--</td>
<td>.64**</td>
<td>.86**</td>
<td>-.55**</td>
<td>.38**</td>
<td>.43**</td>
<td>.01</td>
<td>-.07</td>
</tr>
<tr>
<td>WDQ</td>
<td>--</td>
<td>--</td>
<td>.93**</td>
<td>-.79**</td>
<td>.45**</td>
<td>.66**</td>
<td>.19</td>
<td>-.07</td>
</tr>
<tr>
<td>Total Worry Score</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-.76**</td>
<td>.46**</td>
<td>.62**</td>
<td>.12</td>
<td>.01</td>
</tr>
<tr>
<td>AAQ-II</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-.73**</td>
<td>-.64**</td>
<td>.18</td>
<td>-.04</td>
</tr>
<tr>
<td>AAQ-II</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.00</td>
<td>.10</td>
<td>-.08</td>
</tr>
<tr>
<td>CES-D</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.20</td>
<td>.12</td>
</tr>
<tr>
<td>Verbal T</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.29*</td>
</tr>
<tr>
<td>DRR Phase 4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*Note. * \(p < .05\), ** \(p < .01\). ***Indicates raw AAQ-II scores. ****Indicates transformed, residualized AAQ-II scores.*
For the analyses of Hypotheses 2, 3, 4, and 5, assumptions for multiple regression were tested. The assumption of non-collinearity among predictors was met as correlations among AAQ-II scores, derived relational responding in Phase 4, and Verbal T scores did not exceed \( r = .90 \) (see Table 5). Plots of predicted values of total worry scores against residuals revealed that the assumptions of normality, linearity, and homoscedasticity were met.

**Hypothesis Testing**

**Hypothesis 1**

Hypothesis 1 stated that derived relational responding ability would positively correlate with a standardized measure of verbal intelligence. Bivariate correlation analyses indicated that derived relational responding ability, as measured by DRR Phase 4, was significantly positively correlated with Verbal T scores from the WASI \( (r = .29, \ p < .05) \). Thus, the data supported Hypothesis 1.

**Hypotheses 2, 3, and 4**

Hypotheses 2-4 were tested using a hierarchical multiple regression analysis. The criterion for this analysis was the total worry score, or the sum of scores on the PSWQ and WDQ. The predictors consisted of residualized AAQ-II scores, accurate rate of derived relational responding, and Verbal T scores from the WASI. Residualized AAQ-II scores were entered into the model first because there is more empirical support for the relationship between experiential avoidance and worry than for the relationship between either derived relational responding ability or verbal intelligence and worry. Accurate rate of derived relational
responding (DRR Phase 4) was entered second given the theoretical connection between derived relational responding behavior and the verbal behavior that characterizes the worry process. The final predictor entered into the model was the WASI Verbal T score, which has not been related to worry either empirically or theoretically (only indirectly through its relationship to derived relational responding). Data from 49 participants were utilized in the hierarchical multiple regression. The means, standard deviations, and ranges for the predictor and criterion variables for this sample are presented in Table 6. See Table 7 for \( B \), Standard Error of \( B \), \( \beta \) and the squared semi-partial correlations \( (sr^2) \) for each predictor.

Table 6

**Descriptive Statistics for Sample Used in Hypothesis Testing (n=49)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Worry Score</td>
<td>83.63</td>
<td>30.48</td>
<td>20-169</td>
</tr>
<tr>
<td>AAQ-II</td>
<td>218.55</td>
<td>30.97</td>
<td>139-269</td>
</tr>
<tr>
<td>Verbal T Score</td>
<td>56.47</td>
<td>8.27</td>
<td>41-75</td>
</tr>
<tr>
<td>DRR Phase 4</td>
<td>0.10</td>
<td>0.03</td>
<td>0.03-0.15</td>
</tr>
</tbody>
</table>

Table 7

**Relative Strength of Individual Predictors (n=49)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>( B )</th>
<th>Std. Error ( B )</th>
<th>( \beta )</th>
<th>( sr^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAQ-II (Residualized)</td>
<td>8.11</td>
<td>2.27</td>
<td>.46</td>
<td>.46</td>
</tr>
<tr>
<td>DRR Phase 4</td>
<td>43.71</td>
<td>124.52</td>
<td>.05</td>
<td>.05</td>
</tr>
<tr>
<td>Verbal T Score</td>
<td>.26</td>
<td>.51</td>
<td>.07</td>
<td>.07</td>
</tr>
</tbody>
</table>

*Note. \( *p < .01 \)
**Hypothesis 2**

Hypothesis 2 stated that derived relational responding ability would predict level of worry such that a greater derived relational responding ability would predict higher levels of worry. Model 2 statistics revealed that rate of accurate derived relational responding during Phase 4 (DRR Phase 4) did not account for a significant proportion of the variance in worry over and above AAQ-II scores (Adj. $R^2 = .18, \Delta R^2 = .12, \Delta F = .12, p = .73, sr^2 = .05$). The data did not support Hypothesis 2.

**Hypothesis 3**

Hypothesis 3 stated that a standardized measure of verbal intelligence would predict level of worry such that higher scores on the measure of verbal intelligence would predict higher levels of worry. A hierarchical multiple regression analysis was used to test this hypothesis. Model 3 statistics revealed that Verbal T scores did not account for a significant proportion of the variance in worry over and above AAQ-II scores and DRR Phase 4 (Adj. $R^2 = .17, \Delta R^2 = .01, \Delta F = .27, p = .61, sr^2 = .07$). The data did not support Hypothesis 3.

**Hypothesis 4**

Hypothesis 4 stated that experiential avoidance would predict level of worry such that higher levels of experiential avoidance would predict higher levels of worry. Because of the significant correlation between experiential avoidance and depression (see Table 5), the variance in experiential avoidance accounted for by depression was removed and residualized AAQ-II scores were used in place of transformed AAQ-II scores in all hypothesis testing. Model 1
statistics revealed that the established predictor of experiential avoidance (as measured by residualized AAQ-II scores) accounted for a significant proportion of the variance in total worry scores (Adj. $R^2 = .20$, $\Delta R^2 = .21$, $F(1,47) = 12.73$, $p < .01$, $sr^2 = .46$). A value of 0.25 for Cohen’s $F$ indicates a medium effect size for this relationship. Data for the current sample therefore provided support for Hypothesis 3. Experiential avoidance was a significant predictor of worry in this analysis.

*Hypothesis 5*

Hypothesis 5 stated that experiential avoidance would mediate the relationship between derived relational responding and worry such that the higher levels of experiential avoidance would predict higher levels of worry than would lower levels of experiential avoidance, with the relationship between derived relational responding ability and worry held constant. As per Barron and Kinney’s (1986) suggested approach to test for mediation effects, the first analysis conducted was a linear regression predicting residualized AAQ-II scores (the mediator) from DRR Phase 4. Results indicated that derived relational responding ability (DRR Phase 4) did not predict level of experiential avoidance (residualized AAQ-II scores) (Adj. $R^2 = -.02$, $F(1, 47) = .28$, $p = .60$), violating the first condition necessary to establish a mediation effect (Barron & Kinney, 1986). As such, the remainder of the mediator analyses were not conducted. Though experiential avoidance scores contributed significantly to variance in total worry scores, the lack of relationship between derived relational responding ability and worry precludes any mediation effect between the two.
Path Analytic Model

Though the linear combination of predictors from the hierarchical multiple regression (Model 3) accounted for a significant proportion of the variance in total worry scores ($R^2 = .22$, Adj. $R^2 = .17$, $F (1, 45) = 4.23, p = .01$), and though Verbal T scores and rate of accurate derived relational responding were significantly correlated ($r = .29, p < .05$), overall results failed to support the proposed model. Neither Verbal T scores nor rate of accurate derived relational responding evidenced a relationship with worry (see Figure 3).

**Figure 3.** Path-analytic model with correlations and beta weights. Depicts relationships between derived relational responding ability and verbal intelligence as well as the influence of derived relational responding ability, verbal intelligence, and experiential avoidance on level of worry for the sample ($n=49$).
DISCUSSION

The purpose of the current study was to explore the relationship among three verbal phenomena of interest: derived relational responding ability, verbal intelligence, and worry. The proposed model predicted that the relationship between the former two phenomena and worry would be mediated by experiential avoidance. Overall, results from this study failed to support a relationship among derived relational responding ability, verbal intelligence, and worry. However, the relationship between derived relational responding and verbal intelligence that has been reported in past literature was supported in the current study, as was the relationship between experiential avoidance and worry. The results of hypothesis testing, general implications and limitations, and future directions for research will be explored below.

Derived Relational Responding and Verbal Intelligence

In the current sample, derived relational responding was significantly correlated with verbal intelligence. This finding supports previous findings, both theoretical and empirical (including brain studies), that indicate a direct relationship between the two (Barnes-Holmes et al., 2004; Devaney et al., 1986; Dickins, 2004; Dickens et al., 2001; Hayes, Barnes-Holmes, & Roche, 2001; Lipkens et al., 1993; O’Hora, et al., 2004; Pelaez et al., 2000). RFT (Hayes et al., 2001) supports a relationship between derived relational responding ability and verbal intelligence in its claim that derived relational responding ability forms the basis for the ability to develop vocabulary and other language skills. Studies with verbally disabled or pre-linguistic participants have indicated that these individuals are unable to derive relations (Devaney et al., 1986; Pelaez et al., 2000), and a case study of a developing child linked the progression of
derived relational responding ability to typical language development (Lipkens et al., 1993).

Finally, O’Hora and colleagues (2004) reported that participants who scored higher on verbal subtests of the WAIS-III also performed better on a task requiring derived relational responding. Though the correlation between derived relational responding and verbal intelligence was statistically significant, the actual value ($r=.29$) was smaller than expected. Research to extend this finding should therefore consider measurement issues that may have underestimated the relationship between derived relational responding and verbal intelligence in the current study. A more complex matching-to-sample task that can differentiate among levels of derived relational responding ability should be employed. Additionally, the definition of derived relational responding ability should be more carefully considered. That is, perhaps rate of accurate derived relational responding is not the best measure of derived relational responding ability, particularly as it relates to verbal intelligence. Other definitions might consider accuracy and speed independently or take a different direction altogether and examine the complexity of derived relational networks.

Verbal intelligence was estimated from the short-form of an already abbreviated intelligence measure. Future studies should therefore consider utilizing a more comprehensive measure of verbal intelligence. In the study by O’Hora and colleagues (2004), verbal intelligence was represented by a combination of scores on the Vocabulary and Arithmetic sections of the WAIS-III based on Hayes and colleagues discussion (2001) of both vocabulary and arithmetic skills as manifestations of derived relational responding ability. Alternatively, intelligence measures other than the Wechsler scales may prove useful in understanding the relationship between the derived relational responding process and verbal intelligence. For example, the
Rebus Learning subtest from the Kaufman Adolescent and Adult Intelligence Test (KAIT; American Guidance Service, 1993) requires respondents to derive relations among words and symbols, a task that clearly parallels matching-to-sample tasks.

**Derived Relational Responding, Verbal Intelligence, and Worry as Verbal Phenomena**

Neither derived relational responding ability nor verbal intelligence accounted for a significant proportion of variability in worry. This finding does not support the proposed path analytic model (see Figures 1 and 3), which was based on both empirical and theoretical literature. To better understand this finding, relevant paths from the path analytic model will be examined in turn, with the exception of the relationship between derived relational responding ability and verbal intelligence, which has already been discussed.

**Derived Relational Responding and Worry**

Results failed to demonstrate a relationship between derived relational responding and worry. These findings are surprising when considered from a RFT perspective, given that derived relational responding is theorized to be a prerequisite process for the ability to worry. There are several potential explanations for the lack of significant relationship. First, the nature of the relationship may not be as hypothesized. Perhaps worry is related not to rate of accurate derived relational responding but rather to the complexity of one’s relational networks. That is, the more complex the relational networks, the greater the potential for problematic, uncontrollable levels of worry. For example, if a relational network consists of “hurricane” and “Florida,” then an individual traveling to Florida may worry about the possibility of a hurricane.
However, if the relational network consists of “hurricane,” “Florida,” “sharks,” and “death,” then the individual would worry not only about the possibility of a hurricane, but also about the possibility of shark attacks as well as the possibility of death by either hurricane or shark attack.

Another explanation might be that level of worry does not vary with derived relational responding ability, as was hypothesized here, but rather that worry is simply made possible by the presence of derived relational responding ability. For example, an individual would need the ability to relate two or three concepts in order to be able to worry, but the accuracy and/or speed with which that relationship was derived would not determine whether worry takes place. Neither would complexity of derived relational responding determine whether worry takes place. For example, if an individual learns that hurricanes often occur in Florida, and then learns that hurricanes often result in casualties, he or she can derive a relationship between Florida and casualties. The individual might then fear traveling to Florida based on that derived relationship. Accuracy does not contribute to worry, as the fear of death is present even though many travelers to Florida do not die. The speed with which the individual made that connection is also not prerequisite to a fear of death in Florida. Finally, the relational network here only consists of three stimuli (hurricanes, Florida, and casualties), which is relatively non-complex.

A third possible explanation for the failure to find a relationship between worry and derived relational responding is that inappropriate or inadequate measures were used to assess worry (PSWQ and WDQ). The current study hypothesized a positive correlation between worry and derived relational responding ability based on the theoretical assertion that derived relational responding ability is the basis for verbal processes in general and that worry is an example of a verbal process. If the PSWQ and/or WDQ measured negative affect or distress
rather than frequency and/or intensity of “talking to oneself in one’s head,” or the verbal
nature of worry, then a different relationship between derived relational responding and worry
would be expected.

Related to that, and possibly the most likely reason for lack of significant findings is that
there was no opportunity for a transfer of worry related functions among the all neutral stimuli.
As previously stated, for behavior to be considered “verbal” from an RFT perspective, three
properties must co-occur in a context. These properties are mutual entailment, combinatorial
mutual entailment, and transfer (or transformation) of function. In order to complete a MTS
task, evidence of the first two properties are required. Derived relational responding ability as
measured in this study, then, is proof that two of the three processes associated with verbal
behavior have occurred. The third piece was not assessed in this task.

Past research has demonstrated that symptom specific (in addition to general) distress
slows people down on matching-to-sample tasks (Leslie, Tierney, Robinson, Kennan, Watt, &
Barnes, 1993; Murrell, 2005; Wilson, 1998). For example, in a study of anxious and non-anxious
individuals, Leslie and colleagues (1993) found that non-anxious individuals could derive
relations between anxiety-provoking situations (e.g., job interview) and pleasant adjective
states (e.g., calm), whereas participants with anxiety disorders could not make such
associations. In a study designed to investigate the effects of parental stress on the ability to
learn positive parenting skills, mothers who reported higher levels of parental stress had more
difficulty deriving relations between stressful parenting situations (e.g., a child throwing a
tantrum) and positive parenting words (e.g., nurturing ) than did mothers who reported lower
levels of parenting stress (Murrell, 2005). Given these findings, a more appropriate hypothesis
concerning the relationship between derived relational responding and worry would have been that worry hinders derived relational responding ability, especially with respect to worry-related stimuli.

Future researchers that wish to study the relationship between worry and derived relational responding should consider the alternative relationships discussed. They might choose to include non-neutral stimuli in their matching-to-sample tasks. Because the purpose of the current study was to examine derived relational responding ability as a basis for verbal processes in general, the stimuli for the MTS procedure were intentionally neutral or arbitrary. One idea would be to create non-neutral stimuli intended to correspond to different worry networks, such as the different domains of worry measured by the WDQ (Relationships, Lack of Confidence, Aimless Future, Work, and Financial), and to determine whether derived relational responding ability in each of these different domains correlates to domain scores on the WDQ. The use of non-neutral stimuli would also allow for transformation of function, the missing piece in the current study, to occur.

**Verbal Intelligence and Worry**

Results failed to demonstrate a relationship between verbal intelligence and worry. The first consideration is that there is indeed no relationship between these two constructs. However, given that verbal intelligence is associated with derived relational responding ability, and given that RFT provides a rationale for assuming a relationship between derived relational responding ability and worry, failure to find a relationship between these two constructs is more likely due to other limitations. Limitations regarding the measurement of verbal
intelligence have already been discussed. Measurement of worry may have been limited as well. The essential feature of worry of interest to this study was its verbal nature. Neither the PSWQ nor the WDQ specifically measure the verbal nature of worry. Rather, the PSWQ measures the frequency and severity of worry, and the WDQ measures worry content. As such, it would be useful to develop a worry scale that (1) defines worry for participants as “talking to oneself in one’s head,” and/or (2) includes items that indicate the verbal nature of worry, e.g., “I can’t seem to turn off my thoughts.”

Other limitations that could have precluded the discovery of a relationship between worry and verbal intelligence are related to general sample limitations. Though verbal intelligence scores for the sample were normally distributed, the average GPA for the sample was higher than would be expected for a general student population. This would suggest that the average participant was overachieving – an assertion further supported by the fact that the majority of the sample participated not as part of course requirements but rather for extra credit. This sample of “overachievers” may have developed compensatory strategies for achieving academic success that concurrently preclude the need to worry, or they may be unlikely to report worry due to demand characteristics.

Experiential Avoidance and Worry

Experiential avoidance proved to be the only predictor that contributed significantly to the variance in worry scores. This finding supports literature from the Penn State Group asserting the cognitive avoidance function of worry (Borkovec, 1994; Borkovec, Alcaine, & Behar, 2004) as well as studies that have demonstrated relationships among experiential
avoidance, chronic worry, and GAD (Borkovec & Roemer, 1995; Orsillo et al., 2003; Roemer et al., 1997; Roemer et al., 2005). Given the considerable co-morbidity between anxiety and depression (and the corresponding difficulties in distinguishing worry from rumination) (Clark & Watson, 1991; Segerstrom, et al., 2003; Watkins, 2004; Watkins, Moulds, & Mackintosh, 2005), as well as the issue of the co-morbidity of DSM-IV diagnoses in general (Kessler, 1997; Kessler et al., 1994), this finding underscores the importance of finding a common underlying factor to these pathologies and again suggests that experiential avoidance might well be that factor.

Of note, experiential avoidance correlates with a range of adjustment problems (beyond pathological worry) in adults (Hayes et al., 1996). A host of studies have revealed relationships between experiential avoidance and other variables related to psychopathology, including but not limited to social anxiety (Kashdan, 2007), GAD (Roemer & Orsillo, 2007), post traumatic stress disorder (PTSD; Plumb, Orsillo, & Leterek, 2004; Tull, Gratz, Salters, & Roemer, 2004; Orcutt, Pickett, & Pope, Marx & Sloan, 2005; Tull & Roemer, 2003; Boeschen, Koss, Figueredo, & Coan, 2001), substance abuse (Chapman & Cellucci, 2007; Polusny, Rosenthal, Aban, & Follette, 2004; Forsyth, Parker, & Finlay, 2003), self-harm behaviors (Gratz & Gunderson, 2006, Howe-Martin, 2007), depression (Spira, Beaurdeau, & Jimenez, 2007) and rumination (Cribb, Moulds, & Carter, 2006), as well as lower quality of life (Hayes et al., 2004).

General Implications

Theoretical

The current study has several implications for RFT. First, though derived relational responding ability may be a learning mechanism that supports the development of language, it
is not equivalent to verbal intelligence as traditionally measured. As such, when describing derived relational responding as verbal behavior, care should be taken to define “verbal” in that particular context and to differentiate it from established ideas of what “verbal” means. Second, though derived relational responding ability may be a prerequisite process for worry, worry involves more than just derived relational responding ability. In fact, a majority of the variance in worry for the current sample was accounted for by experiential avoidance. Interestingly, though no evidence was found to support a relationship between derived relational responding ability and worry, experiential avoidance, which was significantly related to worry in the current study, is theoretically tied to derived relational responding. Therefore, a more precise theoretical formulation depicting the pathway including derived relational responding ability, experiential avoidance, and worry is needed.

*Research*

As mentioned, further basic research is needed to clarify the tenets of RFT. Specifically, researchers should engage in a more comprehensive investigation into the nature of derived relational responding and its precise relationship to other variables, including cognitive ability and variables related to language. This would best be accomplished be a systematic comparison between various derived relational responding variables as measured by matching-to-sample tasks (e.g., number correct by phase, time spent in each phase, patterns among phases) and various aspects of cognitive ability (e.g., verbal knowledge, verbal fluency, abstract verbal reasoning).
The applied implications of the current study pertain mostly to the finding that experiential avoidance accounts for a significant proportion of the variance in worry. Many studies (Bond & Bunce, 2000; Forman et al., in press; Gaudiano & Herbert, 2006; Gifford et al., 2006; Gregg et al, 2007; Hayes et al, 2004; Lappalainen et al., 2007; Lillis & Hayes, 2007; Lundgren et al, 2006; Zettle & Hayes, 1986) have highlighted the importance of experiential avoidance as a mediator of outcome in acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 1999), one of many third wave behavioral therapies designed to impact the willingness of people to accept (rather than to avoid) painful thoughts and feelings related to the above listed variables. ACT and other acceptance-based treatments such as mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982; 1990), mindfulness-based cognitive therapy (MBCT; Segal, Williams & Teasedale, 2002) and dialectical behavior therapy (DBT; Linehan, 1993) should therefore continue to be evaluated for treatment efficacy and utilized with populations that suffer from pathological worry and other disorders whose symptomatology may serve an experientially avoidant function. Interestingly, denial, as conceptualized in the psychoanalytic tradition appears to serve an avoidant function similar to experiential avoidance, and as such, research that seeks to bridge the gap between this tradition and the acceptance-based therapies mentioned above might result in a more complete understanding of the mechanisms of change that characterize effective psychotherapy.

General Limitations

In general, measurement of key variables can be considered a limitation to the current
As discussed, more complex and comprehensive measures of derived relational responding ability and verbal intelligence are needed, as is a measure of worry that more explicitly captures its verbal nature. More appropriate measures would improve the internal validity of the study. Regarding external validity, the current study was limited in that the sample consisted only of undergraduate psychology students whose GPAs were above average and who were inclined to seek extra credit opportunities. The sample was biased for gender, and, regrettably, ethnicity was not elicited on the demographics questionnaire. Also, participants were not assessed for English proficiency or for acculturation to the dominant U.S. educational culture. WASI scores (and scores from other measures) cannot be interpreted for individuals of limited English proficiency, and cognitive ability testing in general has been charged with being less a measure of intelligence than of acculturation to the dominant U.S. educational culture (Helm, 1992).

Future Directions

Several suggestions for future research have been mentioned throughout the course of this discussion, including a more in-depth study of the relationship between particular derived relational responding variables and other types of verbal behavior. This would include improved measurement of the three types of verbal behavior discussed in this paper. Most importantly, future researchers should create a matching-to-sample task that assesses for transformation of function in addition to mutual entailment and combinatorial mutual entailment. As noted, all three of these properties must co-occur in order for derived relational responding to be considered “verbal” behavior in terms of RFT. In order to assess for transformation of function,
participants would need to rate the emotional impact (function) of non-neutral stimuli both before and after a matching-to-sample task in which non-neutral stimuli are used to train a negative function. Another measurement issue involves the construction of a scale designed specifically to measure the process of “talking to oneself in one’s head,” or that targets the verbal nature of worry specifically, which would allow researchers to better investigate a possible relationship between worry and other verbal phenomena.

As with much psychological research, replications of or modifications to the current study should be conducted with more diverse populations so as to increase external validity of findings. Because language differences among cultures and nationalities are great, any universal statements about language development and verbal behavior should be based on research with a linguistically diverse and representative population. Likewise, language differences among individuals of the same culture and nationality depend on stage of language development as well as on the presence of disorders that impede language development, and therefore future researchers that wish to establish a universal theory of human language and cognition will need to consider these differences as well.

Related to the goal of establishing a universal theory of human language and cognition is the need for culturally equivalent cognitive ability tests. Racial and ethnic group differences in performance on standard cognitive ability tests have long challenged psychologists and psychometricians to create bias free measures (Helms, 1992). Use of standardized cognitive ability testing in U.S. public schools has historically resulted in inappropriate special education placement for many minority children (Coutinho & Oswald, 2000). Children of limited English proficiency are doubly impacted, given the consensus in the literature that administration of
tests in English is inappropriate for individuals whose first language is not English (Saenz & Huer, 2003). Data from the current study suggest alternative means of measuring intelligence for this population. Individually Verbal T scores for 5 participants identified by the researcher as possessing limited English proficiency were significantly lower than the mean Verbal T score for the remainder of participants. Interestingly, these two groups did not differ in their performance on a matching-to-sample task designed to measure verbal behavior as defined by RFT (Hayes, Barnes-Holmes, & Roche, 2001). Future research should attempt to determine whether derived relational responding as measured by performance on matching-to-sample tasks might be a culturally equivalent measure of general cognitive ability.

Lastly, the current study suggests future directions for clinical practice. The confirmation of a strong relationship between experiential avoidance and worry highlights the need for treatments that target experiential avoidance. Third-wave behavioral therapies, many of which are also classified as acceptance-based therapies due to their promotion of the acceptance of negative painful thoughts and feelings, fulfill that need. Research and practice should therefore continue to focus on refining and implementing these treatments.
Informed Consent Form

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study, risks, and how it will be conducted.

Title of Study: Learning to worry: The role of derived relational responding

Principal Investigator: Karen M. O’Brien, B.A., University of North Texas (UNT), Department of Psychology.

Purpose of the Study:

You are being asked to participate in a research study on worry and related distress. We hope to discover ways in which worry is related to language and cognition.

Study Procedures:

If you decide to volunteer, you will complete a series of questionnaires on the computer. First, you will answer a brief series of questions about yourself and your life. The remainder of the questionnaires contain questions about worry and related distress. After completing the questionnaires on the computer, you will be asked to perform a learning task on the computer that lasts about 1 hour. You do not need any background in computer use. Visual figures will appear on the screen. During this portion of the experiment, you will be asked to select figures by pointing to them with the mouse and clicking on them. This learning task involves both learning and remembering. Following the learning task, either Karen O’Brien or a trained research assistant will ask you to define some vocabulary words and to complete a series of visual patterns. The total time for all study activities is 2 hours.

Foreseeable Risks:

It is possible that answering questions about your distress may lead you to think about upsetting things. We do not expect the level of distress that you might feel from completion of this study to be any greater than you would feel in your daily life. Also, if you aren’t used to doing memory tasks or computer experiments, you might become frustrated. Again, we do not expect this feeling to be extreme. If you do become emotionally distressed, you may stop doing the study. There will be no negative consequences for withdrawal. The researchers will provide you with an appropriate referral should you need psychological assistance.

Benefits to the Subjects or Others:

There will not be any direct benefits of this research to you other than the experience of being involved in a study. There is a potential benefit to psychology, in that the research may advance our understanding of complex human behavior. In addition, information from this study may be used to develop new psychological treatment for worry and anxiety.

Compensation for Participants:

If you are a psychology student, you will receive 2 hours of experimental credit for your participation in this study.

Procedures for Maintaining Confidentiality of Research Records:
Your name will not be attached to any materials used except for this consent form. This form will be kept separately from all other information. You will be assigned a subject number at the beginning of the experiment. This number will be placed on a master list that connects your number to your name. After the study is complete we will destroy the master list. At that point, there will be no way to connect your name to questionnaires or to your computer file. All of your materials will be attached to this number and not your name. Your informed consent, and the data from this experiment, will be kept in a locked file cabinet in a locked room in Dr. Amy Murrell’s lab in Terrill Hall. Your name will not be used in any research reports or publications that result from this study, nor will your participation be disclosed to any unauthorized person.

Questions about the Study:

If you have any questions about the study, you may contact Karen O’Brien or Dr. Amy Murrell. Dr. Amy Murrell is a faculty member of the UNT Psychology Department and the sponsor for this project.

Review for the Protection of Participants:

This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

Research Participants’ Rights:

Your signature below indicates that you have read or have had read to you all of the above and that you confirm all of the following:

- Karen O’Brien, or a research assistant, has explained the study to you and answered all of your questions. You have been told the possible benefits and the potential risks and/or discomforts of the study.
- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights as a research participant and you voluntarily consent to participate in this study.
- You have been told you will receive a copy of this form.

Psychology Clinic

If you have any psychological or emotional concerns, there is help available. The Psychology Clinic is located in Terrill Hall on the UNT campus and is open to both UNT students and community members. If you feel that you would need or want
psychological services please call to schedule an appointment. The phone number is (940) 565-2631.

______________________________ ____________
Participant date of birth Age

______________________________ ____________
Signature of Participant Date

For the Principal Investigator or Designee:

I certify that I have reviewed the contents of this form with the subject signing above. I have explained the possible benefits and the potential risks and/or discomforts of the study. It is my opinion that the participant understood the explanation.

______________________________ ____________
Signature of Principal Investigator or Designee Date
REFERENCES


