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Intellectual ability in children with anxiety: a replication and exploration of the differences

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INTELLECTUAL ABILITY IN CHILDREN WITH ANXIETY: A REPLICATION AND EXPLORATION OF THE DIFFERENCES

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Abstract

The purpose of this study was to examine the effect of anxiety on the intellectual functioning of children. Specifically, the current researchers sought to replicate previous findings that children with higher levels of anxiety have significantly lower scores on tests of intelligence. A second goal was to examine possible reasons for these deficits, including possible deficits in working memory and/or attention. Participants were divided into two groups with high and low anxiety, based on a self-report measure, though none of the children reported clinically problematic anxiety. The participants were 19 children (10 males, 9 females) who were recruited from the community and from an anxiety clinic. Children were administered an intelligence test and a memory test by a trained clinician. Parents and children were also asked to complete self-report measures of anxiety symptoms and other problem behaviors. Contrary to the hypothesis, those with higher levels of anxiety scored significantly higher on the intelligence test then children reporting lower anxiety. No differences were found between the groups on the measures of working memory or attention, therefore meditational analyses were not undertaken. Possible explanations of these findings, as well as limitations and recommendations for future research are also explored.

Introduction

Anxiety disorders are a frequently occurring problem, having a lifetime prevalence of approximately 25% of the United States population (Kessler et al., 1994). While rates are lower for adolescents, approximately 15-20% of teens will experience a diagnosable case of anxiety or depression (Bird, 1996; Kashani & Orvaschel, 1990). Given the prevalence of anxiety and its debilitating nature, research has focused not only on the disorders themselves, but also on associated impairments and deficits associated with anxiety. One area that has become a major focus in the anxiety disorder literature, especially with children, has been the lower intellectual ability of these children (Hodges & Plow, 1990; Zimet, Zimet, Farley, & Adler, 1994). While there have been contradictory findings in the literature, recently Davis, Ollendick, and Nebel-Schwalm (2008) found that children that have been diagnosed with anxiety disorders score significantly lower on tests of intellectual ability than psychopathology-free children. Given these findings, the present study was designed to further build upon and clarify these data. As a result, the current study had two primary goals: (1) to replicate previous findings that children with anxiety problems score lower on measures of intellectual ability than children without anxiety, and (2) to examine possible mediators of this effect including poorer working memory and greater inattention.

Anxiety

Anxiety is a common experience for the average person. Most children, for example, experience at least some developmentally appropriate fears and worries (see Gullone, 2000 for a review). However, if these fears or worries exceed normative developmental limits, which occurs far less frequently, then they may be described as clinically significant. If symptoms persist for an extended duration of time or occur more frequently than would be appropriate, then

they are considered pathological and in need of clinical intervention (Gullone, 2000; *DSM-IV-TR*, 2000). The Diagnostic and Statistical Manual of Mental Disorders-4th Edition-Text Revision (*DSM-IV-TR*; American Psychiatric Association, 2000) classifies several disorders under the heading of anxiety, including agoraphobia, panic disorder with and without agoraphobia, specific phobia, social phobia, obsessive-compulsive disorder, posttraumatic stress disorder, acute stress disorder, generalized anxiety disorder, separation anxiety disorder, anxiety disorder due to a general medical condition, substance-induced anxiety disorder, and anxiety disorder not otherwise specified.

Anxiety disorders are the most prevalent form of psychopathology in children and adolescents (Albano, Chorpita, & Barlow, 1996). A recent review of the literature found that between 2.6% and 41.2% of children experienced some kind of anxiety disorder, depending on the methodology used and the type of disorder examined (Cartwright-Hatton, McNicol, & Doubleday, 2006). Costello and colleagues (2003) estimated that by the age of 16 years, 36.7% of children will have met criteria for at least one psychological disorder. Separation anxiety disorder is the most common anxiety disorder found in children, with as many as 41% of children experiencing some concern due to separation, and 5-10% meeting criteria for separation anxiety disorder (Costello & Angold, 1995). Separation anxiety disorder is characterized by excessive anxiety regarding separation from the home or from attachment figures (e.g. parents), characterized by three or more of the following: recurrent distress when separation occurs, excessive worry about harm coming to attachment figures, fear something will happen to the child themselves that will lead to separation (e.g. being kidnapped), and reluctance to go to school or to sleep for fear of being away from attachment figure. Anxiety about separation must

have occurred for at least 4 weeks and cause significant distress or impairment in functioning (American Psychiatric Association, 2000).

Etiology

Despite their high prevalence, the causes of anxiety disorders are not clearly understood. Genetic factors (Hirshfeld, Rosenbaum, Smoller, Fredman, & Bulzacchelli, 1998; Silove, Manicavasagar, O'Connell, & Morris-Yates, 1995; Stevenson, Batten, & Cherner, 1992; Fryer, Mannuzza, Chapman, Liebowitz, & Klein, 1993) and family interactions (see Wood, McLeod, Sigman, Hwang, & Chu, 2003 and Bogels & Phares, 2008 for reviews) both have been shown to play a part in the onset and maintenance of many of these anxiety disorders. Rachman (1977) proposed a three-pathway theory that states that fear is acquired through classical conditioning, modeling, and/or negative information. This model did not prove to be sufficient, however, as there were several fears (i.e. water) that could not be completely explained by these pathways (King, Gullone, & Ollendick, 1998). The non-associative account was developed to explain these fears with the premise that they have an evolutionary basis (Pouton & Menzies, 2002; Menzies & Clark; 1995; Ollendick & King, 1991; Rachman, 2002).

Consequences of Anxiety

Researchers have uncovered a number of problems associated with anxiety disorders in children. Several studies have demonstrated that children with anxiety disorders have social problems, including social incompetence, low self-worth, and higher levels of peer victimization (Grills & Ollendick, 2002; Bernstein & Garfinkel, 1986; La Greca & Fetter, 1995; Strauss, Last, Hersen, & Kazdin, 1988). Furthermore, children with anxiety disorders are more likely to exhibit school refusal behaviors (Bernstein & Garfinkel, 1986), show higher levels of loneliness (Crick & Ladd, 1993), and display higher rates of other psychopathology, including depression

(Kovacs, Gatsonis, Paulauskas, & Richards, 1989; Cantwell & Baker, 1989; Seligman & Ollendick, 1999; Strauss et al., 1988). More generally, anxiety has also been found to be associated with lower quality of life ratings (see Olatunji, Cisler, & Tolin, 2007 for a review).

Conflicting evidence has been reported about whether children with anxiety disorders experience negative consequences into adulthood. Some studies suggest that while they may be at a greater risk for developing other forms of psychopathology, their overall outcome in young adulthood is favorable (Last, Perrin, Hersen, & Kazdin, 1996; Last, Hansen, & Franco, 1997). Others suggest that these children are at an increased risk for continued anxiety, depression, and illicit drug dependence in adulthood (Ferdinand & Verhulst, 1995; Pine, Cohen, Gurley, Brook, & Ma, 1998; Woodward & Fergusson, 2001). Those with anxiety disorders are also at an increased risk of death by suicide (Noyes, 1991), with several studies showing that the risk of suicide completion in those with anxiety disorders is equal to the risk in those suffering from depression (Coryell, Noyes, & House, 1986; Allgulander & Lavori, 1991).

Several research groups have also shown that adults (Spielberger, 1962; Chapin, 1989; Xu, Zhang, & Xu, 2006) and children (Ialongo, Edelsohn, Werthamer-Larsson, Crockett, & Kellam, 1996; Rapport, Denney, Chung, & Hustace, 2001; Preckel, Holling, & Vock, 2006) reporting anxiety symptoms have lower academic achievement than those without these symptoms. As with the other findings in this area, however, results are not always consistent across studies. Some researchers have found that there were no significant differences between these groups (Davis et al., 2008) and some of these findings vary across groups within the same study. For example, Ialongo et al. (1996) found that depressive symptoms were associated with lower academic achievement for boys, but anxiety symptoms were not. For girls, comorbid

depressive and anxious symptoms were associated with lower academic achievement, but neither was related individually.

Theories

Several theories have been proposed to integrate the various etiological factors contributing to anxiety disorders (Mandler, 1975; Spielberger, 1985; Beck & Clark, 1997; Barlow, 2002; Mineka & Zinbarg (2006). Bioinformational theory (Lang, Cuthbert, & Bradley, 1998; Foa & Kozak, 1986, 1998) has emerged, however, as the most prominent and relevant theory for anxiety (Barlow, 2002). According to Lang and colleagues (1998) emotions occur "when specific memory episodes (about context and behavior) are retrieved" (p. 656). Several memory units (each representing a detail of an event) form a network, and the activation on one unit may trigger the emotion. Specifically, there are three types of units that can trigger an emotion: stimulus, response, and meaning. Stimulus units are activated from the senses. Response units are activated from the three basic components of emotional response: behavioral, physiological, and cognitive components (Lang et al., 1998). Finally, meaning units are activated by declarative knowledge about the event. The model assumes that any input that matches one of these units can trigger the emotion, and that the larger the number of units and the more similar they are to the original event, the more likely the emotion will be activated. The theory also assumes that emotion has several dimensions, including arousal, valence, and control. Emotions (i.e. anxiety) are created by the pairing of events with these various dimensions, which then come to potentiate certain responses.

Attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007), a modification of processing efficiency theory (Eysenck & Calvo, 1992), provides an alternative to this explanation. Processing efficiency theory (Eysenck & Calvo, 1992) is based on the assumption

that worry is the component of anxiety that is responsible for deficits in effective and efficient performance. The theory is based on Baddeley's original tripartite model of working memory (Baddeley, 1986), and assumes that the main effect of anxiety on performance is due to its impact on the central executive system. Attentional control theory (Eysenck, et al., 2007) expands on processing efficiency theory and states that anxiety increases attentional processes to threatening stimuli, thereby decreasing attention to task related stimuli. Threatening stimuli can include not only external things in the environment, but also internal things such as worrying. This lack of attentional control causes important cues about the task to be missed, and thus performance on a task to be diminished. Rather than worrying accounting for the diminished performance, as in processing efficiency theory, problems with worrying in the current theory are accounted for by general problems with inhibition function.

Anxiety and Intelligence

Another area where the presence of an anxiety disorder has been linked to deficits is in intelligence. Research in the area of intellectual ability in children with various forms of psychopathology has returned discrepant results. Initial studies found lower intellectual ability in children with delinquent behavior (Moffitt, Gabrielli, Mendick, & Schulsinger, 1981; Ollendick, 1979) and depressive symptoms (Blumberg & Izard, 1985; McGee, Anderson, Williams, & Siva, 1986), but not anxiety (Gittleman, 1986). Hodges and Plow (1990) were the first to show that children in a psychiatric hospital for anxiety disorders had significantly lower intelligence quotient (IQ) scores than children hospitalized for other psychological problems. This study divided children in an inpatient setting into groups based on diagnoses derived from the Child Assessment Schedule (CAS; Hodges, 1987), a semi-structured diagnostic interview for children. Diagnostic groups were conduct disorder, oppositional disorder, depressive disorder,

and anxiety disorder. While these results were significant, they were also confounded by the fact that children with comorbid disorders were assigned to multiple diagnostic categories in statistical comparisons.

In an attempt to remedy some of the problems present in Hodges and Plow (1990), Zimet, Zimet, Farley, and Adler (1994) again assessed differences in intellectual functioning between children with varying psychopathology. In this study children were assigned to diagnostic groups based only on their primary diagnoses (i.e., no other diagnoses were assigned), instead of assigning children to multiple groups. Using this methodology, Zimet, Zimet, Farley, and Adler (1994) did not find any significant differences between children with anxiety disorders and those without. While inconsistent with the findings of Hodges and Plow (1990), these results were consistent with other studies that found that differences in intellectual ability between groups of children with various forms of psychopathology were not clinically significant when the standard error of measurement of the test was taken into account (Zimet, Zimet, Farley, Adler, & Zimmerman, 1994). The problem with this study was, while the same child was not included in multiple groups, they did not specify whether or not comorbid diagnoses existed, and if so, how this was handled (Davis et al., 2008). If comorbid diagnoses were simply ignored, then this study would suffer from the same methodological flaws as Hodges and Plow (1990). Further, Zimet, Zimet, Farley, and Adler (1994) did not utilize any diagnostic measures when assigning a primary diagnosis, making the reliability of their diagnostic decisions questionable.

Davis et al. (2008) conducted the most recent study addressing the discrepant findings described above. In order to bring some resolution to the debate, this study compared the intellectual functioning of children with anxiety disorders to other children in several different ways. In order to test the findings of Hodges and Plow (1990), children were assigned to the

anxiety disorder group if this disorder was present anywhere in their diagnostic profile, and then compared to a non-anxiety disorder clinical control group. Dividing the groups in this way produced significant differences between the groups, in that children with an anxiety disorder scored significantly lower than children without an anxiety disorder. These findings were consistent with Hodges and Plow (1990). Children were then divided into groups based on the methodology of Zimet, Zimet, Farley, and Adler (1994), wherein children with an anxiety disorder as their primary diagnosis were compared to a control group who did not have a primary diagnosis of an anxiety disorder, but may have an anxiety disorder as a secondary or tertiary diagnosis. Consistent with previous findings grouped in this way (Zimet, Zimet, Farley, & Adler, 1994), no significant differences were found between the groups. In order to address the methodological limitations of the previous two studies, Davis and colleagues (2008) analyzed two additional groupings of the participants. The first compared children with comorbid anxiety (anxiety anywhere in the diagnostic profile) but no attention-deficit/hyperactivity disorder (ADHD) to children who did not have an anxiety disorder diagnosis, but may have other forms of psychopathology. This comparison produced no significant differences in ability level between the groups. Finally, children diagnosed with only an anxiety disorder were compared to children who did not have any psychological diagnoses. In this comparison, children with an anxiety disorder had a significantly lower full scale IQ than children with no diagnoses. Children in the anxiety disorder group also had a significantly lower performance IQ score than children in the no diagnosis group. Overall this study lends support to the idea that children with anxiety disorders perform lower on measures of intellectual ability than other children.

While the above articles are important contributions to the debate on whether children with anxiety disorders have a lower intellectual ability than other children, the effects of other

disorders on intellectual ability have also been debated. For example, several studies have found that people with Posttraumatic Stress Disorder (PTSD) score lower on tests of intellectual ability than those without this disorder (Vasterling, Brailey, Constans, Borges, & Sutker, 1997; McNally & Shin, 1995). Other studies have found no differences between these groups (Sutker, Bugg, and Allain, 1991; Zalewski, Thompson, and Gottesman, 1994). The most recent study in this area found that children diagnosed with PTSD scored significantly lower on a test of intelligence than a control group that had experienced no trauma, and a group that had experienced a trauma but did not meet criteria for the disorder (Saigh, Yasik, Oberfield, Halamandaris, & Bremner, 2006). While not specifically in the area of intellectual ability, deficits have also been found in various cognitive functions in people with schizophrenia, including executive functioning (Zanello, Perrig, & Huguelet, 2006), attention (Mirsky, 1988; Zanello et al., 2006), and memory (Saykin et al., 1991; Zanello et al., 2006). Even so, as of yet Davis et al. (2008) has been the only study to date to examine potential mediators of this impact on intellectual ability. They found that inattention as measured by the Conner's Continuous Performance Task (CPT; Conners, 1995) did not serve to mediate the association between anxiety and intellectual ability. As a result, they posited other potential mediators of attention as possible or even other aspects of executive functioning (e.g., working memory).

Working Memory

Working memory (WM) refers to the ability to store and manipulate information necessary for complex cognitive tasks (Baddeley & Hitch, 1974). Although alternative models of working memory exist (Shah & Miyake, 1996; Friedman & Miyake, 2000), Baddeley's (1996) tripartite model still forms the basis of most accepted models (Alloway, Gathercole, & Pickering, 2006). This model states that there is a central executive system that manipulates the

information in storage and controls attention. This system organizes information from the two subsystems, the phonological loop and the visuospatial sketchpad.

The phonological loop can also be broken down into two parts, the phonological store which holds acoustic information and the articulatory control process which produces our inner speech. Information can be kept in the phonological store for approximately two seconds. Because of this limited amount of time, research has demonstrated that memory performance is better for words that can be pronounced more quickly (Baddeley, Thomson, & Buhanan, 1975). Baddeley, Gathercole, and Papagno (1998) have since suggested that the main function for the phonological loop may be in learning new language. The visuospatial sketchpad allows us to mentally maintain and manipulate images. The purpose of this subsystem is to allow people to plan and execute spatial tasks (Baddeley & Hitch, 1994), as well as to resolve visual ambiguities in the environment (Logie, 2003).

Baddeley (2000) added a fourth component, the episodic buffer, to his model to better explain the complexities of working memory. This subsystem is still assumed to be controlled by the central executive system, and is thought to be primarily responsible for integrating information from multiple places. The episodic buffer is thought to be capable of pulling information together from the phonological loop, the visuospatial sketchpad, and long term memory into a single, unified representation.

The development of working memory has also been explored in children. Factors that effect memory span in children have been investigated and it was determined that older children have increases in memory span, not due to increases in the total processing space, but rather due to more efficient processing strategies (Case, Kurland, & Goldberg, 1982). Other researchers have explored whether verbal and visuospatial working memory were separable in children and

found that, across all ages, children process the tasks for both types of memory from the same resource pool, but that the storage of the different types of information is domain specific (Alloway, Gathercole, & Pickering, 2006). These findings suggest that the conceptualization of working memory in children fits with Baddeley's (2000) model.

Several studies have shown that working memory may form the basis for intelligence (Case, 1992; Schweizer & Koch, 2002). Working memory has been found to be related to fluid intelligence, with intelligence showing influence on even simple tasks of working memory (Salthouse & Pink, 2008). Similarly, Unsworth and Engle (2006) found a constant relationship between working memory and intelligence, no matter how large or small the set of information to be remembered was.

Memory Deficits and Psychopathology

Several groups of researchers have demonstrated the relationship between anxiety disorders and memory deficits in adult populations. Obsessive compulsive disorder in general, has been associated with visual memory deficits (Cohen et al., 1996; Dirson, Vouvard, Cottraux, & Martin, 1995; Purcell, Maruff, Kyrios, & Pantelis, 1998; Singh, Mukundan, & Khanna, 2003), particularly in those with checking compulsions (see Tallis, 1997 for a review). Tasks to measure working memory in these studies included tasks such as the Cambridge Neuropsychological Test Automated Battery (CANTAB; Morris et al., 1987), which involves looking under boxes on the screen to find blue tokens and remembering which boxes had the tokens. Other studies have suggested that these memory deficits are related to other things, such as comorbid depression (Mortiz et al., 2006) or organizational problems (Mataix-Cols et al., 2003; Penades et al., 2005). Verbal and visual memory deficits have also been shown in social phobia (Cohen et al., 1996; Asmundson, Stein, Larsen, & Walker, 1994), PTSD (see Isaac,

Cushway, & Jones, 2006 for review), and panic disorder (Asmundson et al., 1994; Lucas, Telch, & Bigler, 1991).

The relationship between anxiety disorders and memory deficits has also been shown in children—though not as thoroughly. Yasik and colleagues (2007) found that children diagnosed with posttraumatic stress disorder scored lower on measures of general memory and visual memory than non-traumatized control children on the Wide Range Assessment of Memory and Learning (WRAML; Sheslow & Adams, 1990). Other studies have shown that children with posttraumatic stress disorder have lower immediate and delayed story recall on the Rivermead Behavioural Memory Test (RBMT; Wilson et al., 1989; see Moradi et al., 1999), and on short and long delay free recall tasks of the California Verbal Learning Test (Beers & DeBellis, 2002). Similarly, visual and verbal deficits have been found in children with separation anxiety disorder and overanxious disorder (Toren et al., 2000), and reduced visual memory on the WRAML has been found in children with social phobia (Vasa et al., 2007). Further, Pine and colleagues (1999) demonstrated that memory deficits on the WRAML predicted future social phobia, separation anxiety disorder, and overanxious disorder.

Several explanations for the negative impact of anxiety on working memory have been offered in the literature. One possible explanation is that anxiety causes an increase in cognitive load, which decreases the amount of cognitive resources available for the task (Eysenck & Calvo, 1992). Put another way, reciting the worry silently to one's self could be taking up space on the phonological loop, therefore not allowing for the reciting of task relevant information (Eysenck & Calvo, 1992; Morris, Davis, & Hutchings, 1981). This theory was modified by Eysenck and colleagues (2007) to say that anxiety affects what information is attended to and, therefore, what gets processed in memory.

More recently however, the medial temporal lobe, an area of the brain involved in both anxiety and memory, has been suggested to explain these findings (Charney, 2003; Shu, Wu, Bao, & Leonard, 2003). Several studies have shown a specific relationship between the prefrontal cortex and both anxiety (Bechara, Damasio, & Damasio, 2000; Davidson, Pizzagalli, Nitschke, & Putnam, 2002) and working memory (Monoach et al., 2004). Shackman, Pizzagalli, Lavric, and Davidson (2006) defended the idea that anxiety uses the resources of the prefrontal cortex normally allocated to working memory, therefore causing deficits in memory performance.

Integration and Purpose for the Current Study

Overall, the literature on the impact of anxiety on intellectual functioning has had mixed results (Davis et al., 2008; Zimet, Zimet, Farley, and Adler, 1994; Hodges & Plow, 1990), although recent work suggests that children with anxiety disorders do have impairments in this area (Davis et al., 2008). Inattention (Mirsky, 1988; Zanello et al., 2006) and working memory (Yasik et al., 2007; Toren et al., 2005; Vasa et al., 2007; Pine et al., 1999) have also been found to be decreased in children with anxiety. The current study attempted to clarify the literature by replicating these findings of impairments using dimensional measures of anxiety. Specifically, this study attempted to determine whether children who reported higher levels of anxiety would have impaired intellectual ability as compared to children with lower levels of anxiety. Given that inattention and working memory have been found to be deficient in children with anxiety, these variables were explored as possible mediators of the deficits in intellectual functioning. Specific hypotheses about each of these variables are detailed below.

Hypotheses

Hypothesis 1: Though the effect has only been demonstrated on the WISC-III to date, it is hypothesized that children who score higher in anxiety will score significantly lower in IQ.

Hypothesis 2: Based on the findings discussed above (Yasik et al., 2007; Toren et al., 2005; Vasa et al., 2007; Pine et al., 1999) it is hypothesized that children scoring higher in anxiety will score significantly lower in working memory (i.e., subtest of the WRAML-2).

Hypothesis 3: Based on the research presented above (Mirsky, 1988; Zanello et al., 2006) it is hypothesized that children scoring higher in anxiety will score significantly lower in attention/concentration (i.e., a subscale of the WRAML-2).

Hypothesis 4: Lower working memory scores will mediate the relationship between anxiety and lowered IQ scores.

Hypothesis 5: Lower attention/concentration scores will mediate the relationship between anxiety and lowered IQ scores.

Method

Participants

Nineteen Caucasian children and adolescents (10 males, 9 females; 10 anxious, 9 non-anxious) ranging in age from 9 to 16 (M = 11.37, SD = 2.06) participated in this study. Fourteen of the children were recruited from the community and five were receiving psychoeducational evaluations at the Psychological Services Center and agreed to participate in the study. One child had a previous diagnosis of an anxiety disorder (specific phobia, thunder); however, no other previous diagnoses were reported for any of the children.

Based on effect sizes found by Davis et al. (2008) a medium effect size was estimated (f^2=.15), with power (1-β) set at .80, and alpha (α) < .05, at least 86 participants would be needed to detect any significant effects if present. G*Power 3.0 (Faul, Erdfelder, Lang, & Buchner, 2007) was used to calculate the power analysis. Recruitment for the current study proceeded as follows: 1100 flyers were distributed to local private schools at two different time points (2200 total; before and again after Hurricane Gustav), 300 flyers were distributed at local soccer games and in front of grocery stores, flyers were posted at businesses that would allow it, several professionals in the area were contacted and agreed to give flyers to patients/clients, and 50 letters were sent home with children at an after-school program. These community-based recruitment efforts yielded 15 individuals responding for evaluation, of which 14 met inclusion criteria. In addition, five participants participated in conjunction with their assessments at the Psychological Services Center on the Louisiana State University campus.

Measures

The Wechsler Intelligence Scale for Children – Fourth Edition. The Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2003) was used to assess

the intellectual abilities of participants. The WISC-IV was standardized on a sample of 2,200 children ranging in age from 6 to 16 with demographic characteristics that represented the United States population. The WISC-IV is made up of 10 core subtests, including similarities, comprehension, vocabulary, block design, picture concepts, matrix reasoning, digit span, letter-number sequencing, coding, and symbol search. Combinations of these subtests are used to form the Full Scale Intelligence Quotient (FSIQ), the Verbal Comprehension Index (VCI), the Perceptual Reasoning Index (PRI), the Working Memory Index (WMI), and the Processing Speed Index (PSI). The WISC-IV has been shown to have good internal consistency reliability (r = .91 - .92 for the four composites), and good test-retest reliability (r = .96 - .97; Wechsler, 2003).

The Wide Range Assessment of Memory and Learning – 2nd Edition. The Wide Range Assessment of Memory and Learning – 2nd Edition (WRAML2; Sheslow & Adams, 2003) is a standardized clinician administered instrument designed to evaluate an individual's memory functioning. The test is normed for children and adults, ages 5 to 90. The test contains a verbal memory index, a visual memory index, and an attention/concentration index which together yield a general memory index. The verbal memory index is made up of two subtests, story memory (child is read two stories and asked to remember the parts) and verbal learning (a list of 16 words is read to the child and the child repeats as many words as possible with the same list presented and recalled 4 times). The visual memory index is made up of the design memory subtest (child is shown 5 cards with geometric shapes and asked to recreate each arrangement after a short delay) and the picture memory subtest (child is shown 4 scenes and then, after each presentation, is shown a similar alternate scene and asked to mark the changes). The attention/concentration index is comprised of the finger windows subtest (the child demonstrates memory of visual

patterns by putting their finger through holes in the same sequences as the examiner) and the number letter subtest (child repeats sequences of numbers and letters in the same order as the examiner). A working memory index can also be calculated, which is made up of two symbolic working memory subtests (first has to point out a sequence of random numbers in numerical order and then a sequence of random numbers and letters in numerical and alphabetical orders, respectively) and two verbal working memory subtests (first the child is asked to recall a list of animals and other objects, recalling the animals first, then the task is repeated but the animals must be recalled in size order). The working memory subtests are normed for children ages 9 and older. Alpha reliabilities for the index scores of the WRAML2 have been found to be very high (general memory index r = 0.93; Sheslow & Adams, 2003). The working memory index also has high internal reliability and test-retest reliability, while the attention/concentration index has high internal reliability and adequate test-retest reliability (Strauss, Sherman, & Spreen, 2006).

The Child Behavior Checklist. The Child Behavior Checklist (CBCL; Achenbach, 1991) is a 118-item parent report measure of behavior problems for children ages 4 to 18 years. The CBCL provides a total problems score, as well as externalizing and internalizing subscales. Problems can further be broken down using the narrow-band subscales, which assess withdrawn, somatic complaints, anxious/depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior. Each item has parents rate children's behavior on a three-point scale ranging from 0 (not true) to 2 (often true). Studies have shown that the CBCL has high test-retest reliability (from 0.86 to 0.89; Achenbach, 1991) and high internal consistency (Achenbach, 1991; Aschenbrand, Angelosante, & Kendall, 2005).

Multidimensional Anxiety Scale for Children. The Multidimensional Anxiety Scale for Children (MASC; March, 1997) is a 39-item self-report measure of anxiety for children ages 8 to 19 years. The MASC provides four scales (physical symptoms, harm avoidance, social anxiety, and separation/panic) which combine for a total anxiety disorder index. Two additional scales measure total anxiety and inconsistency respectively. Each item is rated on a scale from "0" (never true about me) to "3" (often true about me). Scores are totaled on each of the respective scales and converted to *T*-scores. According to March (1997, pp. 17) "when no *T*-score is above 65, the MASC is not indicative of clinically elevated anxiety symptoms." This cutoff score has a sensitivity of 83% and a specificity of 92% when used to classify children with or without an anxiety disorder based on the *DSM-IV* (March, 1997). The MASC has been shown to have at least satisfactory internal consistency on all scales (March, 1997; March et al., 1997; Rynn et al., 2006), with intraclass correlation coefficients ranging from .627 to .644 for the anxiety disorders index, depending on the age range (March, 1997); as well as adequate test-retest reliability (March et al., 1997; March et al., 1999). The MASC has also demonstrated adequate construct, convergent, discriminant, and factorial validity (March et al., 1997; March et al., 1999; Rynn et al., 2006; March, Conners, & Arnold, 1999).

Demographic Questionnaire. The demographic questionnaire (see Appendix A) is a measure created to obtain background and history information on the child and family. Items included income level, race, age, gender, marital status, religious affiliation, family history of mental illness, child's mental health history, and number of people living in the home.

Procedure

Prior to recruitment, this study was reviewed and approved by this institution's internal review board. Participants were recruited through flyers (see Appendixes B and C) distributed at

local schools, soccer games, after school programs, grocery stores, and by several fellow professionals. The flyers instructed parents to call the Psychological Services Center if they were interested in participating. A phone screen (see Appendix D) was conducted to determine if the child met the initial inclusionary criteria and information was provided to the parents to answer any questions they might have had.

Children were eligible for inclusion if they were between the ages of 9 and 16 years (ages based on requirements of measures listed above) and did not meet exclusion criteria. Participants were excluded at this stage if they had a previous diagnosis of ADHD, had previously been found to display intellectual disability or a pervasive developmental delay, had a previous diagnosis of a learning disability, or did not speak English. Those with ADHD were excluded due to previous findings that this group also has deficits in intellectual ability (see Frazier, Demaree, & Youngstrom, 2004) in order to avoid a potential confound and potentially obfuscate results (cf. Davis et al., 2008). The other comorbid conditions were excluded, as they would severely inhibit the child's ability to complete the assessment. MASC total scores were used to divide the participants into an anxious group and a non-anxious group, using a median split.

Parents of children meeting these criteria were contacted to schedule the assessment. Assessments were conducted at the LSU Psychological Services Center by graduate students trained in the administration of standardized tests. Consent and assent were explained and signed, and parents were given the demographic questionnaire and the CBCL to complete about their child. Children completed the MASC and were administered the WISC-IV and the WRAML2. Order of tests administered was rotated to eliminate order effects; however, the subtests within each test were administered per specifications of the manual to maintain

standardization. Children were excluded at this stage if their scores on the CBCL revealed clinical elevations on any of the externalizing subscales (i.e. attention problems, aggressive behavior, rule-breaking behavior). Participants received written feedback about the results provided to their parents in a letter of thanks for their participation. Those with significant problems were to be referred for further testing and/or other treatment services; however, none necessitated such a referral.

Data Analysis

Analyses were conducted to determine whether statistically significant differences between the groups existed on the basis of age, gender, or recruitment source. These analyses were important to determine whether there was variance attributed to these variables that would need to be covaried out in future analyses.

Further analyses were conducted to determine if there were significant differences on the dependent variables between those who reported more anxious symptoms and those who reported fewer. An analysis of variance (ANOVA) was conducted to determine whether differences existed on the full scale intelligence quotient of the WISC-IV. A multivariate analysis of variance (MANOVA) was then conducted using Wilks' Lamda to determine whether statistically significant differences existed between children who scored high versus low on dimensional measures of anxiety on the verbal comprehension index, the perceptual reasoning index, the working memory index, and the processing speed index of the WISC-IV. Separate ANOVAs were also conducted to examine whether differences existed between the groups on the working memory index and the attention/concentration index of the WRAML-2 respectively. Finally, the general memory index and the attention concentration index of the WRAML2 were examined separately to determine if either served as a mediator of any significant findings

between the control group and the high anxiety group (cf. Baron & Kenny, 1986; Holmbeck, 2003).

Results

Analyses revealed no significant differences between the dependent variables and the demographic variables of age, gender, ethnicity, or recruitment source (see Table 1), therefore these variables were not considered in further analyses. Table 2 displays the relationships among all of the variables and the means for each. An ANOVA revealed that the anxious group (M = 114.60, SD = 8.55) performed significantly higher than the non-anxious group (M = 103.78, SD = 9.83) on the FSIQ of the WISC-IV, F (1, 18) = 6.59, p = .02. Table 3 displays the means and standard deviations for the anxious group and the non-anxious group respectively on all variables of interest.

The MANOVA conducted on the individual indexes of the WISC-IV revealed statistically significant differences between the anxious and non-anxious groups, Wilks' Λ , F (1, 18) = 3.25, p = .04. Further examination of the univariate analyses revealed that the anxious group (M = 113.30, SD = 11.50) scored significantly higher than the non-anxious group (M = 92.78, SD = 11.88) on the processing speed index, F (1, 19) = 14.62, p = .001; however, none of the other indices were significantly different (see Table 4).

Separate ANOVAs were conducted on the working memory and attention/concentration indexes of the WRAML2, respectively. No significant differences were found between the anxious group (M = 102.40, SD = 13.43) and the non-anxious group (M = 97.00, SD = 10.52) on the working memory index of the WRAML2, F (1, 18) = .94, p = .35. Similarly, no significant differences were found between the anxious group (M = 108.50, SD = 11.44) and the non-anxious group (M = 103.67, SD = 10.90) on the attention/concentration index of the WRAML2, F (1, 18) = .88, p = .36. As a result, further meditational analyses were not pursued.

Table 1. Means and standard deviations for demographic variables.

Demographic Variable (N)	FSIQ Mean (SD)	VCI Mean (SD)	PRI Mean (SD)	WM Mean (SD)	PSI Mean (SD)
Age					
9 (4)	109.25 (14.84)	102.50 (4.36)	111.25 (15.95)	102.25 (3.50)	111.75 (23.21)
10 (4)	115.75 (8.85)	120.00 (18.11)	109.50 (1.91)	105.75 (14.66)	110.25 (10.69)
11 (2)	106.50 (.71)	102.00 (2.83)	116.00 (1.41)	95.50 (2.12)	101.50 (6.36)
12 (5)	107.40 (8.96)	110.00 (19.63)	111.00 (5.66)	97.00 (5.34)	100.60 (6.50)
13 (1)	100.00	99.00	110.00	104.00	80.00
14 (1)	94.00	104.00	94.00	99.00	80.00
15 (1)	111.00	130.00	108.00	97.00	91.00
16 (1)	125.00	121.00	119.00	113.00	123.00
Gender					
Male (10)	106.40 (9.55)	107.10 (14.00)	110.90 (9.68)	97.30 (5.50)	100.40 (15.14)
Female (9)	112.89 (10.99)	114.11 (15.90)	110.22 (7.73)	105.33 (8.89)	107.11 (15.96)
Recruitment Source					
Community (14)	112.64 (8.77)	111.86 (15.00)	113.36 (6.72)	101.86 (9.04)	108.64 (12.63)
Clinic (5)	100.60 (10.64)	106.40 (15.69)	102.80 (9.01)	99.00 (5.43)	89.40 (14.79)

Note: Indexes are from the WISC-IV; FSIQ = full scale intelligence quotient, VCI = verbal comprehension index, PRI = perceptual reasoning index, WM = working memory index, PSI = processing speed index.

Table 2. Relationships among variables and overall means (n = 19).

Index	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) WISC VCI	1.00														
(2) WISC PRI	0.19	1.00													
(3) WISC WM	.27	.14	1.00												
(4) WISC PSI	.04	.63**	.41	1.00											
(5) WISC FSIQ	.68**	.70**	.58**	.71**	1.00										
(6) WRAML2 AC	.48*	.52*	.61**	.38	.72**	1.00									
(7) WRAML2 WM	.58**	.47*	.59**	.35	.73**	.63**	1.00								
(8) WRAML2 GM	.63**	.40	.61**	.37	.75**	.88**	.62**	1.00							
(9) MASC PS	.24	.25	.42	.60**	.56*	.29	.24	.29	1.00						
(10) MASC HA	.00	.08	.20	.19	.13	.02	.17	.13	-.11	1.00					
(11) MASC SA	.34	.13	.16	.31	.41	.13	.07	.28	.53*	.15	1.00				
(12) MASC Total	.32	.14	.28	.44	.47*	.13	.17	.30	.68**	.39	.90**	1.00			
(13) CBCL Internalizing	.05	-.45	.10	-.41	-.25	-.06	-.01	-.11	.17	-.05	.03	.10	1.00		
(14) CBCL Externalizing	.07	-.19	.03	-.33	-.15	.22	.12	.11	.00	-.30	-.29	-.28	.72**	1.00	
(15) CBCL Total	.02	-.42	-.03	-.47*	-.31	-.04	-.07	-.06	-.03	-.13	-.13	-.12	.88**	.86**	1.00
Mean	110.42	110.58	101.11	103.58	109.47	106.21	99.84	108.95	49.16	52.47	49.58	50.84	49.53	47.53	49.37
Standard Deviation	14.94	8.57	8.20	15.48	10.52	11.15	12.13	12.93	9.58	9.69	9.35	8.64	11.68	8.56	11.06

Note: VCI = verbal comprehension index, PRI = perceptual reasoning index, WM = working memory index, PSI = processing speed index, FSIQ = full scale intelligence quotient, AC = attention/concentration, WM = working memory, GM = general memory, PS = physical symptoms, HA = harm avoidance, SA = social anxiety.

* p <.05

** P <.001

Table 3. Means and standard deviations for variables of interest (n = 19).

Variable	Anxious Mean (SD)	Non-anxious Mean (SD)
FSIQ	114.60 (8.55)	103.78 (9.83)
WRAML2 WM	102.40 (13.43)	97.00 (10.52)
WRAML2 AC	108.50 (11.40)	103.67 (10.90)
WRAML2 GM	112.60 (12.78)	104.89 (12.54)
MASC PS	54.10 (8.89)	43.67 (7.28)
MASC HA	55.50 (5.52)	49.11 (12.36)
MASC SA	54.90 (9.60)	43.67 (4.27)
MASC Total	56.60 (7.73)	44.44 (3.64)
CBCL Internalizing	47.50 (12.00)	51.78 (11.58)
CBCL Externalizing	43.90 (6.52)	51.56 (9.07)
CBCL Total Problems	45.60 (11.13)	53.56 (9.93)

Note: VCI = FSIQ = full scale intelligence quotient, WM = working memory, AC = attention/concentration, GM = general memory, PS = physical symptoms, HA = harm avoidance, SA = social anxiety.

Table 4. Means and standard deviations for WISC-IV indexes (n = 19).

Index	Anxious Mean (SD)	Non-anxious Mean (SD)	F
VCI	112.10 (13.96)	108.56 (16.60)	0.26
PRI	113.50 (7.21)	107.33 (9.18)	2.68
WM	103.60 (10.39)	98.33 (3.64)	2.07
PSI	113.30 (11.50)	92.78 (11.88)	14.62**

Note: Indexes are from the WISC-IV; VCI = verbal comprehension index, PRI = perceptual reasoning index, WM = working memory index, PSI = processing speed index.
**p < .001

Discussion

The goal of the current study was to provide clarification as to whether children with anxiety had lower levels of intellectual ability than children who did not have anxiety. While previous researchers have found that anxiety-disordered children score significantly lower on measures of intellectual ability than children without anxiety (Davis et al., 2008; Hodges & Plow, 1990), others have found no differences (Zimet, Zimet, Farley, and Adler, 1994). Inconsistent with all of these studies, the current study found that children in the anxious group had significantly higher Full Scale IQ scores than those in the non-anxious group. When examining specific indices of the WISC-IV, no differences were found on Verbal Comprehension, Perceptual Reasoning, or Working Memory; however, the anxious group had significantly higher scores on Processing Speed than those in the non-anxious group. This is in contrast to findings by Davis and colleagues (2008), who found that not only was Full Scale IQ of the WISC-III negatively impacted by anxiety, but Performance IQ was also specifically impaired.

While intellectual ability was significantly higher in those with anxiety, no significant differences were found on the Working Memory or the Attention/Concentration index of the WRAML2. The lack of differences on working memory are somewhat surprising given that deficits in this area for children with anxiety have been a consistent finding in the literature (Yasik et al., 2007; Toren et al., 2005; Vasa et al., 2007). Given the links that have been found between working memory and intelligence previously (Case, 1992; Schweizer & Koch, 2002), it would have been expected that if those in the anxious group scored higher on the intelligence measure, they would have also scored higher on the working memory measures. While the trend was in this direction, the differences were not significant. Inattention, on the other hand, has

been found by some studies to be deficient in those with anxiety (Vasterling et al., 2002; Shucard, McCabe, & Szymanski, 2008) and not to be deficient in others (Davis et al., 2008). It is, therefore not as surprising that differences were not found on this measure.

There are several possible explanations to remedy the discrepancy between the findings of the current study and those of previous studies (Davis et al., 2008; Hodges & Plow, 1990; Zimet, Zimet, Farley, and Adler, 1994) with respect to intelligence. While previous studies examined clinical samples of anxious children with formal anxiety disorder diagnoses (Hodges & Plow, 1990; Zimet et al., 1994; Davis et al., 2008), the current study defined the anxious group by a child-report dimensional measure of anxiety. Further, only one of the children in the anxious group had a total score on the MASC that was above the cutoff specified by March (1997) to indicate clinically significant anxiety. This indicates that, while those in the anxious group reported more anxious symptoms than those in the non-anxious group, almost none of the children were reporting problematic anxiety. As a result, the anxiety symptoms in the anxious group may not have been severe enough to interfere with performance, though this does not address their higher scores.

To that end, one possible explanation for these paradoxical results comes from learning theory. Early learning theory researchers have suggested that increasing stimulus strength increases arousal, which increases performance up to a certain point. After which the stimulus strength becomes too much and starts to hinder performance (Yerkes & Dodson, 1908). The same relationship was later shown with emotional arousal (i.e. stress, anxiety) and performance (Broadhurst, 1957). The children in the anxious group of this sample may have been experiencing just enough anxiety to put them in that optimal level of performance, whereas those in the previous studies (Davis et al., 2008; Hodges & Plow, 1990) may have been experiencing

over arousal causing a detriment in performance. While no previous studies could be found that examined the impact of anxiety on intelligence in a non-clinical population, the results of the current study suggest that some anxiety is actually beneficial to performance.

This study has several significant limitations that require caution when drawing conclusions from the results. The most notable of these, as discussed above, is that the sample collected is not representative of children with anxiety problems. While this problem yields interesting results of its own, it may explain the paradoxical nature of these results when compared to previous studies. The small sample size is also a major limitation. There may not have been ample power to detect some differences between the groups if they did exist unless the effect sizes were very large. A post hoc power analysis was conducted using G*Power 3.0 (Faul, Erdfelder, Lang, & Buchner, 2007) and revealed that with the medium effect size ($f^2 = .15$) found by Davis and colleagues (2008), $\alpha < .05$, and 19 participants, the achieved power for the current study was $(1-\beta) = .18$. While significant differences were found on the full scale IQ and on the processing speed index, low participation in spite of heavy recruitment efforts may explain why other results were not significant (i.e. perceptual reasoning, working memory). Given the abundance of literature showing deficits in working memory for both children (Yasik et al., 2007; Toren et al., 2005; Vasa et al., 2007) and adults (Cohen et al., 1996; Isaac, Cushway, & Jones, 2006; Asmundson et al., 1994) with anxiety, as well as the number of theories that exist to explain these deficits (Eysenck & Calvo, 1992; Eysenck et al., 2007; Charney, 2003; Shu, Wu, Bao, & Leonard, 2003), it seems likely that the lack of deficits found in this study on measures of working memory for those with anxiety are due to a lack of representativeness in the sample (i.e., anxious group was not severely anxious) and a lack of power.

Another potential limitation of this study is a possible sampling bias of the participants. Participants were self-selected for participation and it may be that only parents of certain types of children were inclined to bring their children in for the testing. Further, while care was taken to attempt to recruit participants from a number of places in the community, only private schools were approached to send flyers home with the children, which may have yielded a more affluent sample then had public schools been approached as well. This sampling bias may explain why the full scale IQ for the overall sample was 5 points higher than the pure control group from Davis and colleagues (2008) and almost 15 points higher than the overall sample reported in Zimet, Zimet, Farley, and Adler (1994).

Future research should reexamine these findings with a larger sample size to determine whether the lack of differences found on the working memory and attention measures were due to true lack of effects or to a lack of power. Further, future studies should extend the current findings by examining the differences in a sample with clinical levels of anxiety to determine whether clinical levels of anxiety indeed lead to detriments in intellectual ability. While the current study did not have the sample to determine whether excessive anxiety had a detrimental effect on intellectual performance, the results did support the idea that some anxiety has a positive impact on intellectual functioning, at least to a point. The extent to which this is true and how much anxiety is needed to create optimal performance should also be explored in future studies.

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Appendix A.

Demographic Questionnaire.

Demographic Questionnaire

Child's Name_____ **Date of Birth**_____

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

Religious Affiliation (optional) _____

School_____ **Grade**_____

Address_____ **City**_____ **State**_____

Phone Number_____ **Alternate Phone Number**_____

Mother's Name_____ **Age**_____

Highest Education Completed_____

Occupation_____

Father's Name_____ **Age**_____

Highest Education Completed_____

Occupation_____

Living Arrangements

Who currently lives in the house with the child?

Relation	**Age**	**Sex**

Child Mental Health History

Has the child ever been diagnosed by a psychologist, psychiatrist, or medical doctor with…

Attention Deficit/Hyperactivity Disorder (ADHD)? YES NO

If yes, treatment?_____

Learning Disability? YES NO

If yes, type?_____ treatment_____

Intellectually or Developmentally Disabled (i.e. Autism)? YES NO

If yes, type?_____ treatment_____

Anxiety Disorder? YES NO

If yes, type?_____ treatment _____

Other Disorder (i.e. depression, schizophrenia)? YES NO

If yes, type? _____ treatment_____

Family Mental Health History

Has anyone in the immediate, biological family been diagnosed or treated for any type of psychological problem? YES NO

If yes, whom and for what?

Relation Diagnosis

_____

_____

_____

_____

_____

_____

Education History

Has the child skipped a grade? YES NO **Repeated a grade**? YES NO

Does the child have any specific learning difficulties? YES NO

If yes, please describe:_____

Highest grade on last report card? _____

Lowest grade on last report card? _____

Appendix B.

Recruitment Flyer.

Want to know your child's IQ for free?

Intellectual Ability in Children with and without Anxiety

- Is your child between the ages of 9-16?
- Would you like to know if your child has some possible trouble with anxiety?
- Would you like your child's intelligence tested with written feedback for no charge?

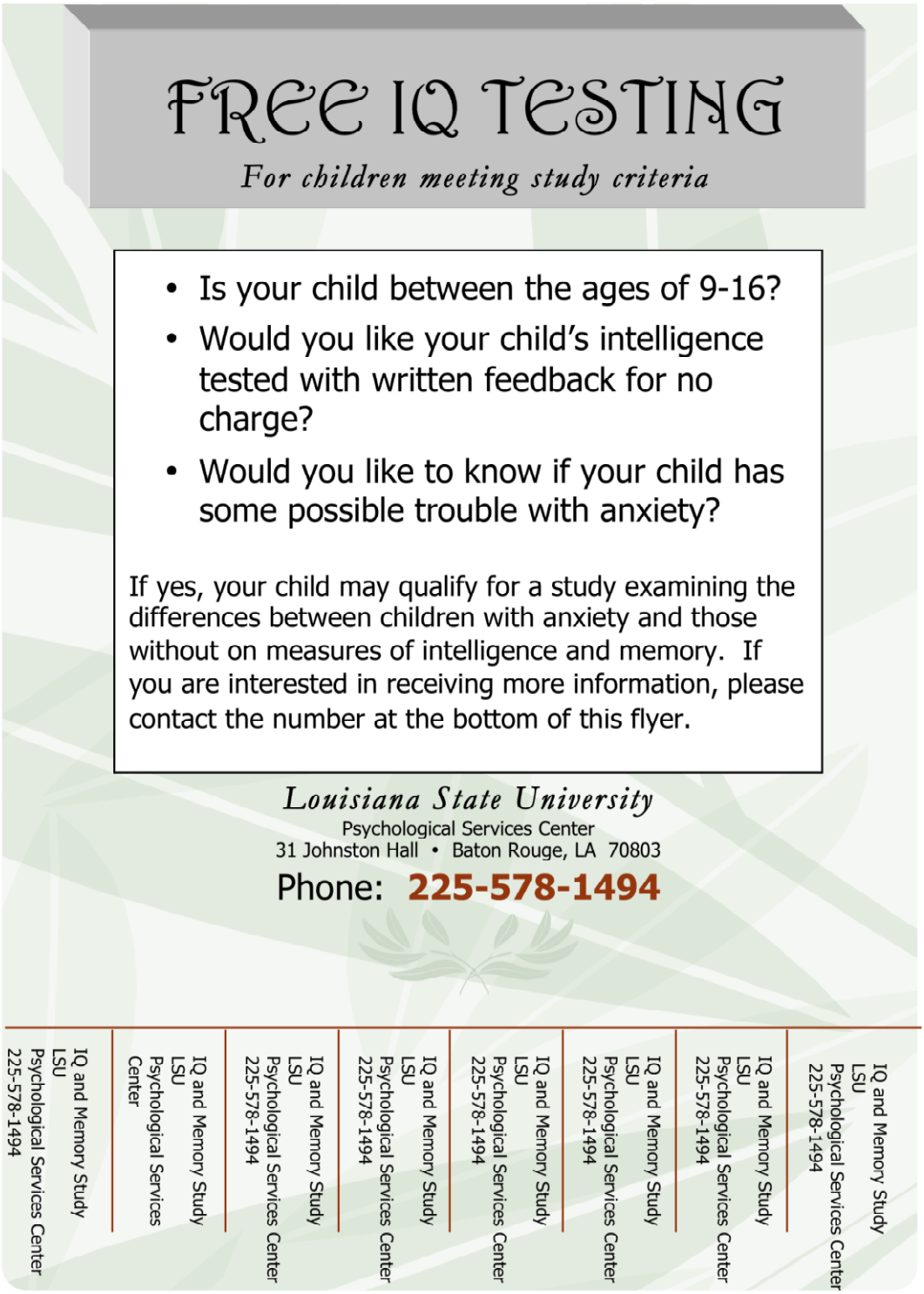
Please contact the number at the bottom of this flyer if you are interested in receiving more information.

LSU

Psychological Services Center
31 Johnston Hall
Baton Rouge, LA 70803
Ph: 225.578.1494

Appendix C.

Tear-off Recruitment Flyer.



Appendix D.

Phone Screen.

Intellectual Ability/Memory and Anxiety Study Phone Screen

Thank you for your interest in the study looking at the differences in intellectual functioning in children with and without anxiety. I just need to collect some initial information to determine if your child meets the inclusion criteria for the study.

Parent Name_____ Relationship to child_____

Child's Name_____

Age_____ (If not between the ages of 9-16, let them know they are not within the age range for the study and thank them for their time; if they desire testing anyway, refer to PSC-578-1494)

Phone Number_____

Address_____ City_____ Zip_____

Has your child ever been *diagnosed* by a doctor or psychologist with any of the following:

Attention Deficit/Hyperactivity Disorder	**Y**	**N**
Intellectual Disability (e.g., mental retardation)	**Y**	**N**
Pervasive Developmental Delay (e.g., autism, asperger's)	**Y**	**N**
A Learning Disability (e.g., reading disorder, dyslexia)	**Y**	**N**

(If Yes to any of the above, let the parent know that the child does not meet criteria for inclusion in the study and thank them for their time; if they desire testing anyway, refer to PSC-578-1494)

If no to all of the above and the child is within the age range, read the following:

Thank you for your time. That is all the information I need at this time. The study coordinator will be sending you the informed consent for the study, as well as some forms for you to fill out, and one to be completed by your child. You are encouraged to call if you have any questions once your packet arrives. You will then be contacted to let you know if your child meets criteria for one of the study groups, and if so a time will be scheduled for you to bring him/her in for the testing portion. Testing is expected to take approximately 3-4 hours.

Do you have any questions at this time that you would like the study coordinator to contact you to answer prior to sending out the packet? Y N

Vita

Melissa Munson was raised in Spring Hill, Florida, and obtained her undergraduate degree in psychology from the University of Florida in Gainesville, Florida. After completing her degree, Melissa worked for two years as a drug counselor aide and as an independent evaluator for a research project on the treatment of obsessive-compulsive disorder. Melissa began her studies in clinical psychology at Louisiana State University in August of 2006. She is specializing in working with children, with a specific interest the treatment of anxiety disorders and factors that cause children to be treatment non-responders.