Parent-Reported Behavioural Symptoms of Anxiety in Children with Autism Spectrum Disorders across Levels of Functioning

by

Laurel Dault

A thesis submitted to the Department of Psychology in conformity with the requirements for the degree of Master’s of Science

Queen’s University
Kingston, Ontario, Canada
(October, 2013)

Copyright ©Laurel Dault, 2013
Abstract

The current study examined anxiety and its observable correlates in children with Autism Spectrum Disorders (ASD) across a broad range of levels of cognitive functioning that in the past have not been accurately explored. I sought to challenge the assumption that there is a positive linear relationship between anxiety and level of cognitive functioning by including individuals across a broad range of cognitive functioning in my analyses, and by developing a measure (The Somatic Anxiety Scale) appropriate for assessing anxiety symptoms in children with little to no communicative functioning. Sixty-seven parents of children with ASD aged 5 to 12 completed a battery of measures in an online study assessing their child’s anxiety, repetitive behaviours, sensory processing issues, and adaptive functioning. The Somatic Anxiety Scale was significantly correlated with an existing measure of anxiety designed for verbal children (when only highly verbal children were assessed), suggesting that it may provide a foundation to develop a measure of anxiety symptoms in non-verbal individuals. No clear predictive relationship was observed between level of cognitive functioning and anxiety. Both lower and higher-order repetitive behaviours predicted anxiety, although higher-order behaviours were more predictive. Finally, a cluster analysis indicated three patterns of anxious behaviour divided across three categorizations of level of functioning. I suggest that previous assumptions about the relationship between level of cognitive functioning and anxiety may be underestimating the complexity of the relationship and suggest future research to study this relationship further.
Co-Authorship

My supervisor, Dr. Elizabeth Kelley and I assume shared responsibility for the conceptualization and for concocting the idea for the research reported in this thesis. I assume primary responsibility for the design, execution, and write-up of this thesis. Dr. Kelley assisted in all aspects of this thesis.
Acknowledgements

First and foremost, I would like to thank Dr. Elizabeth Kelley for her incredible enthusiasm, patience, humour, support, and guidance throughout both my undergraduate and graduate degree. I am extremely grateful to have her as a supervisor and mentor.

I would also like to thank my committee members, Dr. Tom Hollenstein and Dr. Kate Harkness for their expertise, thoughtful feedback, and helpful suggestions.

I am very grateful to my parents, Wendy and Jim, for their continuing love and encouragement. Special thanks to Sara Furlano, Layla Hall, and Alex Irwin for their helpful insight, but above all, their support and friendship.

I would like to thank the undergraduate students who devoted many hours to working in ASD Studies lab. In particular, I would like to thank Jenny Rigby, Jennifer Gillies, Caeleb Goff, Emily Thain, and Jenny Sooyoun Lee for their help in recruitment and scoring. Finally, I would like to give special thanks to the families who generously volunteered their time to participate in this study.
Table of Contents

Abstract .............................................................................................................................................. ii

Co-Authorship .................................................................................................................................. iii

Acknowledgements ......................................................................................................................... iv

List of Figures .................................................................................................................................... vii

List of Tables ...................................................................................................................................... viii

Chapter 1 : Introduction .................................................................................................................... 1

  What is Autism Spectrum Disorder? ................................................................................................. 1
  What is anxiety? .................................................................................................................................. 6
  How does anxiety relate to level of cognitive functioning? .............................................................. 9
  How do we measure anxiety in nonverbal individuals? .................................................................. 12
  How are repetitive behaviours related to anxiety? ......................................................................... 14
  How are sensory processing issues related to anxiety? ................................................................. 17
  How do somatic symptoms, repetitive behaviours, and sensory processing issues relate to one another across levels of functioning? ........................................................................ 19

The Current Study ............................................................................................................................ 20

Chapter 2 : Methods ........................................................................................................................ 26

  Participants ..................................................................................................................................... 26
  Materials ....................................................................................................................................... 27
  Procedure ....................................................................................................................................... 30
  Data Analyses .................................................................................................................................. 30

Chapter 3 : Results ............................................................................................................................. 36

  Preliminary Analyses .................................................................................................................... 36
  Method of Communication in Children ....................................................................................... 40
  Assessing the Somatic Anxiety Scale ............................................................................................. 44
  Anxiety across Levels of Cognitive Functioning .......................................................................... 44
  Repetitive Behaviours and Anxiety ............................................................................................... 45
  Patterns of Observable Behavioural Correlates of Anxiety .......................................................... 48
List of Figures

Figure 1. Relationship between indirect indicators of anxiety ............................................. 3
Figure 2. Overall Sample Mean of Each Scale: Spence, Somatic Anxiety, Lower-Order Repetitive Behaviour (LO RB), Higher-Order Repetitive Behaviour (HO RB), SSP, SCQ, and the Vineland for the three cluster groups. ................................................................. 50
Figure 3. Somatic anxiety scores for cluster groups ............................................................... 51
Figure 4. Lower-Order Repetitive Behaviour scores for cluster groups ............................. 52
Figure 5. Higher-Order Repetitive Behaviour scores for cluster groups ......................... 53
Figure 6. Short Sensory Profile Scores for cluster groups .................................................. 54
Figure 7. Vineland Communication Standard Scores for cluster groups ......................... 55
Figure 8. Social Communication Questionnaire scores for cluster groups ..................... 56
List of Tables

Table 1. Reliability Analyses Results for All Scales .................................................. 38
Table 2. Pearson Correlations of all Scales and Age .............................................. 39
Table 3. Frequencies and Percentages of Communication Styles .......................... 41
Table 4. Descriptive Statistics for Children who Communicate with Highly Fluent Language ............................................................................................................ 42
Table 5. Descriptive Statistics for Children who Communicate with the use of Short Sentences, Few words, are Non-verbal, use Sign Language, Other communicative device, or Other ............................................................................................................ 43
Table 6. Hierarchical Multiple Regression for the Prediction of Somatic Anxiety with Parent Anxiety Entered First, Followed by Higher-Order Repetitive Behaviours and Lower-Order Repetitive Behaviours ............................................................................................................ 47
Table 7. Hierarchical Multiple Regression for the Prediction of Somatic Anxiety with Age Entered First, Followed by Higher-Order Repetitive Behaviours and Lower-Order Repetitive Behaviours ............................................................................................................ 60
Table 8. Shapiro Wilk’s W Results ............................................................................. 95
Table 9. Skewness and Kurtosis ................................................................................ 96
Chapter 1: Introduction

Research in Autism Spectrum Disorder (ASD) has tended to focus on the core deficits of social, communicative, cognitive, and behavioural functioning, and neglected emotional well-being among these individuals. Recently, there has been an increasing focus on understanding the many co-morbid disorders that tend to co-occur in individuals with ASD. For example, individuals with ASD are at a greater risk of experiencing anxiety than their typically-developing counterparts (Ghaziuddin, 2002). Researchers have suggested that within the ASD population, there is a positive linear relationship between anxiety and cognitive functioning (Bellini, 2004; Weisbrot et al., 2005; White et al., 2009); however, there are two major problems with this assumption. First, nonverbal and cognitively low-functioning individuals are rarely included in the research, and second, in the few cases when low-functioning individuals have been included, the anxiety measures have not been appropriate for their communicative ability.

Some researchers may assume that because individuals are low-functioning or non-verbal, that they lack the cognitive skills necessary to experience anxiety because cognitive processes are theorized to be central to the verbally-based worry and rumination that is characteristic of anxiety (Borkovec & Inz, 1990). This assumption is unfounded, as an individual’s inability to communicate their thoughts does not mean that those thoughts do not exist (Grandin & Panek, 2013). The primary reason that cognitively low-functioning individuals have been excluded from anxiety research is likely due to complications that stem from attempting to measure the latent variable of anxiety in individuals who are not easily able to communicate their symptoms. Because anxiety cannot be directly measured in non-verbal individuals, we must instead rely on a number of variables that have been found to be highly correlated with anxiety in order to examine this construct. Somatic symptoms are observable
behavioural manifestations of anxiety, and thus were measured as the main construct in this study. Repetitive behaviours are seen as a possible means to cope with anxiety, by allowing the child to withdraw from the world (lower-order behaviours) or providing a more predictable environment (higher-order behaviours). Sensory processing issues are theorized to contribute to anxiety, as over-arousal stemming from these processing issues makes the world a more stressful place. As these three constructs have all been found to play a role in the experience of anxiety, they were measured in the current study as a means to examine the latent variable of anxiety. See Figure 1 for a pictorial representation of these relationships.

The current study aimed to explore anxiety in individuals with ASD across a wide spectrum of communicative functioning. I compared caregiver reports of symptoms of anxiety across a broader level of functioning of individuals with ASD than has been generally studied in the past. To improve upon anxiety assessment, parents completed more objective behavioural measures thought to reflect the underlying construct of anxiety, yet not requiring the child to have a high verbal ability to be assessed. By addressing the limitations of previous research, the current study adds to our understanding of anxiety in all children with ASD, not just those who are highly verbal.
Figure 1. Relationship between indirect indicators of anxiety
What is Autism Spectrum Disorder?

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social communication, and restricted and repetitive behaviours (American Psychiatric Association (APA), 2013). Symptoms typically become apparent before the age of three. ASD prevalence rates are estimated to be 1 in 88 children and are almost five times more common in boys than girls (Baio, 2012). The drastic increase in the reported prevalence of ASD over recent decades has underscored the importance of understanding more about this disorder and how it impacts multiple areas of the lives of those affected by it. There is great diversity among individuals with ASD, particularly across varying levels of cognitive and adaptive functioning.

Until recently, the Diagnostic and Statistical Manual-Fourth Edition-Text Revision (DSM-IV-TR; APA, 2000) divided what we now call ASD into five separate diagnostic labels including Autistic Disorder, Asperger’s Disorder, Pervasive Developmental Disorder-Not Otherwise Specified, Rett’s Disorder, and Childhood Disintegrative Disorder. Each disorder varies in age of onset, level of functioning, and degree of symptomatology. The fifth edition of the DSM has replaced these five labels with one umbrella term “Autism Spectrum Disorder”. Within the umbrella term of ASD, there are designated severity levels based on the amount of support needed due to challenges with social communication and restricted interests and repetitive behaviors. The three levels are categorized from 1 to 3 according to support needed and are called Requiring Support, Requiring Substantial Support, and Requiring Very Substantial Support. These changes have been made to the DSM in order to offer a simpler, clearer, more reliable diagnostic scheme and recognize the essential shared features of the autism spectrum (Lohr & Tanguay, 2013).
Even before the updates in the fifth edition of the DSM, ASD was often divided into categories of functioning based on IQ or adaptive functioning (e.g. Perry, Flanagan, Geier, & Freeman, 2009; Weisbrot et al., 2005). While there is no official standard for cut-off scores, high-functioning ASD typically refers to individuals with autism whose IQ score is in or above the normal range, whereas individuals considered low-functioning are generally classified as having an intellectual disability, with an IQ below 70 (Baron-Cohen, 2000; Baron-Cohen, 2006; Perry et al.). When administering an IQ test is not feasible or practical, levels of cognitive functioning can also be determined using adaptive functioning, as assessed by the Vineland Adaptive Behaviour Scale (Sparrow, Balla, & Cicchetti, 2005), among others. Adaptive functioning refers to an individual’s independence and effectiveness at coping with daily life based on what is typical for the individual’s age group (APA, 2013). Although not all areas of adaptive functioning are identical to cognitive level, Communication and Daily Living Skills have been found to be strongly related to IQ (Freeman, DelHomme, Guthrie, & Zhang, 1999; Perry et al.).

Low-functioning individuals comprise a large proportion of the ASD population; epidemiological studies report that roughly 50 to 60% of children diagnosed with autism have an IQ below 70 (Bertrand et al., 2001; Chakrabarti & Fombonne, 2005; Charman et al., 2011) and 38.5% are estimated to have a severe to profound level of intellectual disability (Fombonne, 2005). Additionally, the percentage of individuals with ASD who are considered to be nonverbal has been estimated to be as high as 50% (Prizant, 1996). There is no precise data on the number of low-functioning individuals who are nonverbal, but it is estimated that a high proportion of individuals considered low-functioning never acquire language, or at the most acquire a few words or signs (Boucher, Mayes, & Bigham, 2008).
Regardless of verbal or cognitive functioning level, individuals with ASD often suffer from comorbid disorders such as depression and bipolar disorder (Matson & Nebel-Schwalm, 2007). Individuals with ASD are more likely to suffer from other psychiatric disorders than typically-developing individuals (Skokauskas & Gallagher, 2012). Anxiety in particular is among the most common presenting problems in children and adolescents with ASD (Ghaziuddin, 2002); however, research studies addressing co-morbid psychiatric disorders are generally conducted with children considered to be high-functioning. It is important that anxiety be studied in individuals with ASD across a broad range of cognitive functioning using measures appropriate for their cognitive abilities.

**What is anxiety?**

Anxiety occurs when individuals experience “apprehensive anticipation of future danger or misfortune accompanied by a feeling of worry, distress, and somatic symptoms of tension” (APA, 2013, p. 818). Anxiety disorders are marked by excessive fear or worry in inappropriate contexts (Goldsmith & Lemery, 2000), and are the most commonly diagnosed psychiatric disorder in children and adolescents, with reported prevalence rates ranging from 2.6% to 41.2% in children below age 12 (Cartwright-Hatton, & Doubleday, 2006). As typically-developing children age, separation anxiety and specific phobia tend to decrease, while social anxiety and generalized anxiety tends to increase (Costello, Mustillo, Erkanli, Angold, & Costello, 2003; Lecavalier, 2006). Frick and colleagues (1994) found that mothers who are anxious have a tendency to over-report anxiety symptoms in their children and thus it is important to control for age and maternal anxiety when assessing anxiety in children, particularly when relying on parent report.
Anxiety has many interacting components including hypervigilance, cognitive biases, and negative affect (Barlow, 2000). According to Barlow, uncontrollability is at the heart of this interaction, and consequently he characterizes anxiety as “a state of helplessness, because of a perceived inability to predict, control, or obtain desired results or outcomes in certain upcoming personally salient situations or contexts” (p.1249). The impact of uncontrollability on anxiety has been observed in multiple studies with adults (Grillon, 2002; Grillon et al., 2008; Lake & LaBar, 2011; Walters & Charles, 1997). The impact of unpredictability is even apparent in animal models; animals exhibit cognitive, behavioural, and somatic symptoms similar to those found in clinical anxiety when they are exposed to unpredictable aversive stimuli, but these symptoms do not appear when the aversive stimuli is predictable (Maier, 1991; Mineka & Kihlstrom, 1978).

Many anxious children have cognitive processing difficulties that are related to emotion regulation (McKay & Storch, 2011). Children who are anxious have a tendency to shift their attention towards threatening stimuli (Vasey, El-Hag, & Daleiden, 1996). Additionally, children high in anxiety tend to have lower self-efficacy, which results in a perceived inability to control their emotions and responses in arousing situations (Suveg & Zeman, 2004; Weems, Silverman, Rapee, & Pina, 2003).

At the heart of anxiety disorders are maladaptive attempts to regulate anxious emotions (Campbell-Sills & Barlow, 2007). Avoidance is one maladaptive method individuals may use to regulate emotion by keeping away from arousing situations altogether. The problem with this technique is that although it is useful in the short term to avoid anxiety, it actually exacerbates symptoms over time by never affording the individual the opportunity to learn to regulate their anxiety in anxiety-inducing situations (McKay & Storch, 2011). Distraction is another technique that children may employ to avoid engaging in an emotional experience, again preventing them
from using a more adaptive coping style such as cognitive restructuring to modify an intrusive worry (McKay & Storch).

Anxiety can be regarded as two distinguishable constructs: state anxiety and trait anxiety. State anxiety is a transitory emotional state characterized by subjective feelings of tension activated by perceived dangerous stimuli, whereas trait anxiety is a relatively stable behavioral disposition to respond anxiously to a wide range of threatening stimuli (Spielberger, Gorsuch, & Lushene, 1970). Measures of state anxiety tend to assess cognitive-worry and autonomic-emotional responses while measures of trait anxiety assess the predisposition to experience anxiety in specific situations (Endler & Kocovski, 2001). The current study will focus on the experience of state anxiety, as this may be more objectively measured in one time-point study with non-verbal individuals. It should be noted, however, that with repeated episodes of state anxiety, individuals frequently become more prone to trait anxiety over time. That is, the repetition of anxious episodes decreases the baseline stimulation necessary to produce anxiety and leads to the individual becoming more anxious overall (trait anxiety).

The study of anxiety in children and adolescents is important because of the many negative implications of prolonged anxiety. Anxiety can have serious harmful effects on social and academic functioning (Pine, 1997), and individuals suffering from anxiety are at a higher risk for other serious conditions, such as depression and substance abuse (Kovacs, Gatsonis, Paulauskas, & Richards, 1989; Kushner, Sher, & Beitman, 1990).

Anxiety can be especially problematic in the ASD population because it may further compound social difficulties already ubiquitous in individuals with ASD. Feeling anxious often leads to avoidance of social situations, and by withdrawing from such situations, children limit their opportunities to interact with other children and thus hinder the development of their social
skills, further impairing social functioning. Such impairments increase the likelihood of negative social interactions, conditioning the child to feel even more anxious about social situations (Bellini, 2006; Myles, Barnhill, Hagiwara, Griswold, & Simpson, 2001).

Although anxiety is not considered a phenomenological characteristic of ASD, comorbidity rates of generalized anxiety in individuals with ASD are relatively high compared to typically developing individuals; in their review, White, Oswald, Ollendick, and Scahill (2009) found that up to 84% of children with ASD experience some degree of impairing anxiety. Another study found that 55% of individuals with ASD met diagnostic criteria for at least one anxiety disorder (de Bruin, Ferdinand, Meester, Nijs, & Verheij, 2006). Reported prevalence rates for anxiety in the ASD population vary due to differing measures, informants, samples and methodologies across studies. Anxiety rates also tend to differ according to certain characteristics such as age. Cognitive ability has also been found to affect anxiety prevalence rates in ASD populations. Anxiety is widely reported to be positively correlated with cognitive functioning in ASD (Weisbrot et al., 2005); however, there are methodological limitations to this finding, which the current study will address.

**How does anxiety relate to level of cognitive functioning?**

Several studies have reported that children with ASD who are higher functioning (i.e., have a higher IQ, higher adaptive functioning, and greater verbal ability) experience greater anxiety than children who are lower functioning (Bellini, 2004; Weisbrot et al., 2005; White et al., 2009). Based on these studies, researchers have made the assumption that there is a positive correlation between anxiety and level of cognitive functioning across the entire autism spectrum. There are two major problems with the conclusion that this trend can be applied to all individuals with ASD: first, nonverbal and low-functioning individuals are rarely included in the research,
and second, in the few cases when low-functioning individuals have been included, the anxiety measures have not been appropriate for their communicative ability.

The first problem, which is that nonverbal and low-functioning children are rarely studied, is common in many areas of ASD research. It is very difficult to bring low-functioning individuals into the lab and to conduct assessments with individuals who have limited verbal communication. As a result, research is often focused on the high-functioning and verbal subset of the ASD population that is able to report their symptoms and understand the research tasks (Bradley, Summers, Wood, & Bryson, 2004). The majority of studies examining anxiety across levels of functioning have compared children with Asperger’s disorder to children with High-Functioning Autism (e.g., Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Weisbrot et al., 2005; White et al., 2009). While it is true that these studies have indeed compared some children with ASD to peers who are ‘lower’ functioning, these individuals do not meet criteria to be considered ‘low-functioning’; therefore, it is not appropriate to generalize this finding to all individuals across the spectrum, especially those with limited cognitive and verbal ability. It is possible that anxiety’s relationship to level of cognitive functioning is not linear, and that a different pattern may emerge if researchers studied anxiety in nonverbal and low-functioning individuals.

The second problem with the assumption that lower-functioning individuals across the spectrum experience less anxiety is that in the few instances in which nonverbal and low-functioning individuals have been studied, researchers have not employed appropriate measures for their unique set of abilities (e.g. Evans, Canavera, Kleinpeter, Maccubbin, & Taga, 2005; Sukhodolsky et al., 2008;). While it is possible that severe communication deficits in lower-functioning individuals result in lower anxiety because the impairment reduces their ability to
feel anxious or reflect on their anxiety, a differing explanation suggests that level of functioning affects merely the amount of anxiety that is verbally expressed rather than the amount of anxiety experienced (Tsai, 1996). Many individuals with intellectual disabilities cannot adequately convey the information required to identify their anxiety symptoms due to communication and comprehension deficits (Gillott & Standen, 2007; Kim et al., 2000; MacNeil, Lopes, & Minnes, 2009). Davis et al. (2011) found that anxiety is negatively correlated with communication deficits in individuals with ASD. At lower levels of communication, there is less reported anxiety, whereas individuals with better communication skills report greater anxiety. The authors of this study suggest that perhaps individuals who are low-functioning or nonverbal simply lack the communication skills necessary to convey their anxiety. This finding implies that perhaps the previous research indicating higher anxiety in higher-functioning individuals is an artifact of the extrapolation across a limited range of cognitive functioning.

Many items on anxiety scales endorsed by higher-functioning individuals are not applicable to low-functioning individuals. For instance, the Spence Children’s Anxiety Scale (Spence, 1997), which has been widely used to examine anxiety within both typically-developing and ASD populations, includes items such as “My child feels afraid when (s)he has to talk in front of the class” and “My child can't seem to get bad or silly thoughts out of his / her head”. The first item, which asks about talking in front of the class, is obviously not applicable to nonverbal children because of the condition that the child must speak; the opportunity to experience this situation does not arise and consequently this item would not be endorsed by parents of nonverbal individuals. The second question, which asks about the child’s thoughts, is not applicable because the child cannot convey such thoughts to parents or interviewers without fluent language. There are many questions relating to “bad thoughts” in various child anxiety
scales (e.g., March, 1998; Reynolds & Richmond, 1985; Silverman & Albano, 1996). The result is that high-functioning individuals who are capable of communicating their thoughts and feelings score higher on anxiety scales than their peers who lack the ability to convey such thoughts even though they may be experiencing the same levels of underlying anxiety.

Due to the difficulty in assessing the internal symptoms that are characteristic of anxiety without verbal language, individuals who are nonverbal and those with lower cognitive ability are often ignored in anxiety research. There are very few published studies that have employed appropriate measures of anxiety for low-functioning participants and of these, none have specifically examined how anxiety levels are affected by level of cognitive functioning (Bradley et al., 2004). Therefore, the current study developed a measure of anxiety that is more sensitive to assessing anxiety in nonverbal children than those used in the past.

**How do we measure anxiety in nonverbal individuals?**

Because nonverbal individuals cannot communicate the cognitive aspects of anxiety that are typically used for measurement, the current study must rely on caregiver reports of the observable behavioural characteristics of anxiety to compare low-functioning individuals to high-functioning individuals. Somatic complaints are a characteristic of anxiety disorders that may serve as manifestations of anxiety in individuals across all levels of cognitive functioning. Barlow (2000) suggests that there is a strong somatic component accompanying the negative affect typical of anxiety that may reflect brain circuit activation. Numerous studies have found a positive correlation between measures of anxiety and parent and self-reports of children’s somatic complaints (e.g., Garber, Walker, & Zeman, 1991; Masi, Favilla, Millepiedi, & Mucci, 2000; Walker & Green, 1989). Researchers have also found that children diagnosed with an
anxiety disorder report more somatic complaints than children without an anxiety disorder (Dorn et al., 2003; Hofflich, Hughes, & Kendall, 2006; Hughes, Lourea-Waddell, & Kendall, 2008).

Somatic complaints related to anxiety include chest pain, headache, nausea, heartburn, constipation, diarrhea, palpitation, breathlessness, impaired hearing, blurred vision, and pain in the neck, shoulders, hands, breast-abdomen, upper-back, low back, hips, or knees. Nausea, stomach aches, and headaches are among the most frequently reported somatic complaints in children with anxiety disorders (Beidel, Christ, & Long, 1991; Hughes et al., 2008; Last, 1991). Caregivers should be able to rely on their observations of the child’s behaviour for these items. For instance, a child may clutch or rub a body part to indicate pain, and parents are likely to be aware of any constipation or diarrhea. Caregivers may not be able to report on certain somatic complaints without communicating with their child (e.g. blurred vision, impaired hearing) and so it is important when investigating anxiety in nonverbal children to assess complaints that are relatively easy to observe.

It is important to note that somatic symptoms do not necessitate the presence of anxiety and that somatic complaints are not solely associated with anxiety. Somatic symptoms have been reported by individuals who suffer from other psychiatric disorders such as depression (Haug, Mykletun, & Dahl, 2004). Somatic symptoms may also be related to organic diseases such as hypertension, gastrointestinal difficulties, diabetes, thyroid disease, or myocardial infarction (Haug et al.). Such difficulties are also associated with anxiety; children with autism with gastrointestinal problems have significantly higher rates of anxiety than those without such problems (Mazurek et al., 2013). The current study thus asked for children’s medical history and controlled for the presence of known diseases that may cause somatic symptoms. Although somatic complaints may not be the ideal indication of anxiety, they are a more appropriate
measure of anxiety than asking parents of nonverbal children to report on their child’s negative thoughts and verbally-based experiences.

There are, however, certain somatic symptoms typically associated with anxiety that may require some communication to express, such as feeling dizzy or nauseous. Because parents of individuals who are nonverbal may not be able to observe or infer such behaviours, the number of somatic symptoms which are clearly observable to parents are somewhat limited; therefore, the current study also inquired about non-somatic observable behavioural characteristics linked to anxiety. Rather than asking about how the child feels, the scale asks about observable behaviours that are measurable in nonverbal individuals. For instance, instead of including the item “My child feels shaky”, the scale includes “My child trembles or shakes when confronted with certain objects or situations”. Many of these items were taken from the Diagnostic Assessment for the Severely Handicapped scale (DASH; Matson et al., 1991), which has been used with nonverbal individuals in previous research (Bradley et al., 2004), and was designed specifically to address psychiatric symptoms in individuals with severe intellectual disability who do not have the verbal capacity to discuss their feelings (Matson et al.).

By collecting information about observable aspects of anxiety that are easy for parents to report on, I hoped to gain a better understanding of how anxiety differs across levels of cognitive functioning in children with ASD. The current study also explored repetitive behaviour as another indicator of anxiety seen in children with ASD.

**How are repetitive behaviours related to anxiety?**

Repetitive and stereotyped behaviour is one of two core defining features of ASD and is required for a diagnosis of ASD (APA, 2013). These behaviours are linked by repetition, rigidity, and inappropriateness, and often include preoccupations and restricted patterns of interest,
inflexible adherence to specific routines or rituals and stereotyped and repetitive motor movements such as hand or finger flapping (APA, 2013). Although repetitive and stereotyped behaviours are also seen in other disorders such as obsessive-compulsive disorder and Tourette’s syndrome, there are differences in the prevalence and type of behaviours expressed compared to ASD. Parent reports of children with ASD and obsessive-compulsive disorder indicate that both groups engage in similar levels of repetitive movements and insistence on sameness behaviours in which the individuals resist changes to their environments or routines (Zandt, Prior, & Kyrios, 2007), but children with obsessive-compulsive disorder tend to exhibit more compulsions and obsessions than children with ASD, and the compulsions in ASD tended to be less sophisticated (Zandt, Prior, & Kyrios, 2009). Repetitive sensorimotor behaviours have been found to be more common in ASD than other developmental disorders such as Tourette’s syndrome (Richler, Bishop, Kleinke, & Lord, 2006).

Typically-developing individuals also have a tendency to engage in repetitive behaviours when feeling anxious (Zohar & Felz, 2006). Consider how an adult may engage in finger-drumming, heel-tapping, or pacing during anxious states. Scholey et al. (2009) found that bursts of repetitive movement during states of nervous anticipation can reduce stress. For instance, children swing their legs rhythmically when they are confronted with difficult problems in the classroom (Soussignan & Koch, 1985). These behaviours can be observed as early as infancy; infants reared in institutions who were not hugged or cuddled engage in more rocking behaviour than controls (Provence & Lipton, 1962). In children with ASD, repetitive monotonous stimulation such as body rocking has been found to have a calming effect (Willemsen-Swinkels, Buitelaar, Dekker, & van Engeland, 1998; Zentall & Zentall, 1983). Similar types of behaviours are also seen in Obsessive-Compulsive Disorder and Tourette’s syndrome. While repetitive
behaviours in these disorders may be understood as diagnostic criteria for Obsessive-Compulsive Disorder and Tourette’s syndrome, it is also worth noting that individuals with greater levels of anxiety manifest these behaviours to a greater degree (Cath et al., 2001).

Repetitive behaviours have been subdivided into lower- and higher-order categories for individuals with ASD (Turner, 1999). Lower-order behaviours involve the repetition of specific movements (such as hand-flapping, rocking, or twirling), whereas higher-order behaviours involve more complex behaviours such as adherence to rules, compulsions, rituals, circumscribed interests (e.g. a fascination with animals, lighting, movies, etc.), and insistence on sameness (e.g. use same bowl every time to eat cereal, following a specific schedule, etc.). Both IQ and age are correlated with each type of repetitive behaviour; younger children and individuals characterized as low-functioning tend to engage in more lower-order actions while older children and those with a higher IQ are more likely to engage in higher-order behaviours, although most individuals with ASD engage in both types of behaviours (Turner).

While repetitive behaviours occur for multiple reasons, I theorize that repetitive behaviours often serve as a coping mechanism for anxiety, as individuals high in anxiety often exhibit these behaviours. Kinsbourne (1987) suggests that each subtype of repetitive behaviour moderates anxiety in its own way. Lower-order repetitive movements serve to compensate for anxiety occurring at the time, while higher-order behaviours such as insistence on sameness serve to defend against the possibility of encountering an anxiety-inducing situation in the future. Lower-order repetitive movements may serve as a distraction technique which temporarily allows the individual to avoid engaging in an experience of anxiety in the present. That is, by engaging in a behaviour such as rocking or flapping, the individual with ASD is able to withdraw into themselves and screen out whatever stimuli is making him/her anxious. Meanwhile, higher-
order behaviours may be an avoidance technique, which could serve as a method to regulate anxiety by simply attempting to evade it altogether. By engaging in rituals and insisting on sameness in their environment, the individual with ASD attempts to avoid anxiety-provoking stimuli altogether. The current study attempted to clarify the relationship between repetitive behaviours and anxiety by examining how somatic symptoms of anxiety relate to lower-order and higher-order repetitive behaviours individually.

**How are sensory processing issues related to anxiety?**

Another observable correlate of anxiety is sensory processing issues, which are an under-exaggerated or over-exaggerated response to typical sensory stimulation (Reynolds & Lane, 2008). Sensory processing issues can be measured in individuals across levels of functioning, as they result in observable behaviours including sensory-seeking, (attempts to increase sensory stimulation), or avoiding sensory stimulation, (active attempts to control exposure to aversive stimuli), and sensory sensitivity (distress in response to sensations which would not cause such distress in most individuals) (Ben-Sasson, Carter, & Briggs-Gowan, 2009).

Sensory processing issues are common in individuals with ASD (Liss, Saulnier, Fein, & Kinsbourne, 2006) and recently, hyper- and hypo-reactivity to sensory input were added to the diagnostic criteria for ASD (APA, 2013), indicating the prevalence of such difficulties in individuals with ASD. Sensory processing difficulties have also been linked to repetitive behaviours in children with ASD (Tordjman et al. 1999).

Sensory processing issues are associated with higher levels of fear and anxiety in young typically-developing children (Goldsmith et al., 2006) and a significant positive relationship has been found between anxiety and sensory processing issues in typically-developing adults (Kinnealy & Fuiek, 1999; Neal et al., 2002). The overlap of symptoms is such that medical
professionals have difficulty distinguishing between the constructs of anxiety and sensory processing issues when diagnosing toddlers (Ben-Sasson, Cermak, Orsmond, Carter, & Fogg, 2007).

Unlike somatic symptoms which can be thought of as observable behavioural manifestations of anxiety, and repetitive behaviours which can be thought of as means to cope with anxiety, sensory processing issues may instead serve as one possible cause of the underlying construct of anxiety. Research suggests that individuals with anxiety are hypersensitive and have a tendency to over-respond to environmental stimuli (Clark & Watson, 1991; Neal et al., 2002). Individuals with sensory processing issues are theorized to have a “low neurological threshold resulting in strong reactions to sensory stimuli with minimal input” (Pfeiffer, 2005, p.336). Lai, Parham, and Johnson-Ecker (1999) theorized that typically-developing children who are hypersensitive will attempt to block sensory input in order to protect themselves from sensory overload.

Individuals with ASD have often been found to have difficulty with sensory processing (e.g., Dunn, Myles, & Orr, 2002; Pfeiffer et al., 2005). The prevalence of sensory processing issues is estimated to be as high as 70% of children with ASD (Baranek et al., 2006), while prevalence rates range from 10-17% of the typically-developing population (Ben-Sasson et al., 2009). It has been hypothesized that in order to limit exposure to external stimulation, individuals with ASD turn their attention inward and instead engage in repetitive behaviours (Kinsbourne, 2011). Significant correlations have been found between the degree of sensory abnormalities and the amount of restricted and repetitive behaviours reported in children with Asperger syndrome and High Functioning Autism (Chen, Rodgers, & McConachie, 2009).
Green, Ben-Sasson, Soto, and Carter (2012) found evidence to suggest that sensory processing issues may increase the risk of developing anxiety or exacerbate a predisposition for anxiety in individuals with ASD. They argue that overreacting to a sensory stimulus may generalize to a whole environment or situation through context conditioning in which contextual information becomes associated with another stimulus, thus contributing to hypervigilance and anxiety (Green & Ben-Sasson 2010). This has been supported by preliminary findings with physiological measures which suggest that sensory processing issues are causally related to anxiety in children in ASD (Lane, Reynolds, & Dumenci, 2012). Although the nature of the current study cannot assess causal relationships, more research is needed to examine the relationship between sensory processing issues, repetitive behaviours, and anxiety across levels of functioning.

How do somatic symptoms, repetitive behaviours, and sensory processing issues relate to one another across levels of functioning?

Because we cannot assess the worry and rumination aspects of anxiety in nonverbal individuals, we must rely on observable behaviours that have been found to be related to anxiety. Somatic symptoms, repetitive behaviours, and sensory processing issues have each been linked in different roles to anxiety in both typically-developing individuals and individuals with ASD (Joosten, Bundy, & Einfeld, 2009; Neal et al., 2002; Rodgers, Riby, Janes, Connolly, & McConachie, 2012). In a preliminary study examining these features, Joosten et al. (2009) found anxiety to be a stronger motivator for repetitive behavior than sensory seeking in children with ASD. They theorized two possibilities for this finding; it may be that children with ASD who are anxious use sensation to calm themselves, or it may be the case that although sensory processing issues result in sensory seeking behaviours such as repetitive behaviours, sensory processing
issues might also result in anxiety as children try to cope with unpredictable sensory input. I theorize that sensory processing issues contribute to anxiety, while somatic symptoms are indicators of anxiety, and repetitive behaviours are an attempt to regulate anxiety. Although the current study could not examine causality, I sought to explore if the relationship between anxiety, repetitive behaviours, and sensory processing differs across levels of cognitive functioning.

The Current Study

My research questions were:

1. Does somatic anxiety correlate with anxiety as assessed by traditional measures (i.e., the Spence Children’s Anxiety Scale; Spence, 1998) in children with ASD who are considered high-functioning?

2. How do somatic symptoms of anxiety differ across levels of communicative functioning in ASD?

3. How do lower- and higher-order repetitive behaviours differ in their relationship to somatic symptoms of anxiety?

4. What is the relation among somatic symptoms, repetitive behaviours, and sensory processing issues, how do those relations change across levels of communicative functioning in ASD, and how does level of anxiety relate to level of autistic symptomatology?

To extend research on anxiety profiles across levels of communicative functioning in ASD, the current study examined three observable indirect indicators anxiety in children with ASD aged 5-12 years. Parents completed a battery of measures assessing their child’s somatic symptoms, repetitive behaviours, and sensory processing. The use of observable behavioural
measures allowed for the inclusion of nonverbal and lower-functioning participants. Because mothers who are anxious have a tendency to over-report anxiety symptoms in their children (Frick et al., 1994), I controlled for parental anxiety in all analyses where the caregivers had to report on these observable correlates of anxiety.

I developed a measure of somatic symptoms for the current study designed to assess somatic and other observable, non-repetitive behavioural symptoms that tend to co-occur with state anxiety. Some items were taken from the Anxiety Disorders Interview Schedule for Children (ADIS-C; Silverman & Nelles, 1988), the State-Trait Inventory for Cognitive and Somatic Anxiety (STICSA; Ree, MacLeod, French, & Locke, 2000), the Diagnostic Assessment for the Severely Handicapped scale (DASH; Matson et al., 1991), and the Multidimensional Anxiety Scale for Children (MASC; March, 1998). These measures were designed for either low functioning individuals or young children, and were thus deemed to be appropriate measures from which to draw items. I adjusted the wording of items to be appropriate for parents to complete about their child, regardless of whether the child had little or no verbal ability. I designed the measure to be appropriate for use with individuals across all levels of cognitive functioning. Once a number of items were selected, I piloted them on a mother of a nonverbal teenage boy with autism, who provided feedback as to which items she thought that she was able to assess in her son; items were only included with her approval. As this measure was conceived of as an exploratory measure to take the first step in investigating anxiety in low-functioning children with ASD, the only further validation that was explored was the measure’s correlation with a more traditional measure of anxiety.
Does somatic anxiety correlate with anxiety as assessed by a traditional measure (i.e., the Spence Children’s Anxiety Scale; Spence, 1998) in children with ASD who are considered high-functioning?

In order to confirm that somatic and behavioural symptoms were related to anxiety within the ASD population, I collected information about the cognitive aspects of anxiety in high-functioning individuals using the Spence Children’s Anxiety Scale (Spence, 1998). For the sake of brevity, I included items from only three of the six subscales deemed to be the best measures of pure anxiety in children of this age: Generalized Anxiety/Overanxious Disorder, Separation Anxiety, and Panic/Agoraphobia. Items from the Spence, a more traditional anxiety measure, were correlated with scores from the Somatic Anxiety Scale to determine the strength of the relationship. I hypothesized that if there was a strong correlation, I could assume that, like in typically-developing individuals, somatic symptoms are at least somewhat indicative of anxiety in the ASD population.

As discussed above, measures assessing the cognitive traits of anxiety are not appropriate for nonverbal individuals; therefore I did not examine the relation between somatic anxiety symptoms and cognitive aspects of anxiety in nonverbal children and instead relied solely on the data of higher-functioning children. A correlation between somatic symptoms and cognitive anxiety in higher-functioning children would be indirect evidence that a similar relationship exists in nonverbal individuals. Perhaps if nonverbal individuals had the ability to express the cognitive aspects of anxiety, they would show the same trend as their higher-functioning counterparts. Based on previous research, I expected that somatic symptoms as measured by the Somatic Anxiety Scale would be significantly related to cognitive anxiety as measured by the Spence (Garber et al., 1991; Masi et al., 2000; Walker & Green, 1989).
How do somatic symptoms of anxiety differ across levels of communicative functioning in ASD?

The proposed study examined the relationship between somatic symptoms of anxiety and children’s level of cognitive functioning using a test of communicative adaptive functioning. I included communicative functioning instead of cognitive level because it was not possible to administer a valid IQ test online. Adaptive Communication has been found to be strongly related to IQ in children with ASD (Freeman et al., 1999; Perry et al., 2009). By using level of cognitive functioning as the predictor variable and level of anxiety as the criterion variable, I explored linear, quadratic, and cubic trends.

I hypothesized that I would find a quadratic trend in which I would observe high anxiety in individuals considered to be low-functioning, lower levels of anxiety in the mid-range of functioning, and then high anxiety again in very high-functioning individuals. The expectation that individuals in the mid-range may experience less anxiety than individuals who are higher-functioning is based on previous research which found that individuals with Asperger’s (considered the highest level of cognitive functioning in ASD) experience more anxiety than individuals with High-Functioning Autism and those with an IQ above 70 (Bellini, 2004; Weisbrot et al., 2005); these findings suggest that the highest level of cognitive functioning will experience greater anxiety than those individuals in the middle range of cognitive functioning.

The hypothesis that individuals at the lowest end of the spectrum would experience greater anxiety than the mid-range of functioning was based in theory. The core definition of anxiety lies in the perceived lack of control over upcoming events. It is possible that individuals considered very low-functioning lack the cognitive skills necessary to make accurate predictions. Their cognitive impairment prevents them from gaining a sense of what to expect, and therefore
their world is constantly filled with the unknown. This inability to make accurate predictions or feel in control leaves them facing a constant onslaught of uncertainty about the world around them, which translates into anxiety. Experiencing greater uncontrollability leads them to feel more anxious than individuals who are in the middle range of cognitive development. However, individuals at the highest level of functioning as in Asperger’s or High Functioning Autism are more cognitively able to ruminate and thus feel more anxious than their peers who are slightly lower functioning, but still in a normal IQ range. I hypothesize that in individuals with ASD, there is a threshold in which individuals are cognitively developed enough to have some sense of what to expect about the world, but not so much that they ruminate. Although no research to date has found evidence that individuals at the low end of the spectrum experience more anxiety than individuals in the mid-range, this may be due to inadequate assessment (as discussed previously). It is possible that previous findings about low-functioning individuals are limited due to the inappropriate measurement of anxiety in nonverbal individuals. By measuring behavioural symptoms which can be observed by caregivers without relying on verbal communication in their children, I provided the parents of low-functioning individuals with an equal opportunity to endorse items as the parents of their higher-functioning counterparts.

**How do lower- and higher-order repetitive behaviours differ in their relationship to somatic symptoms of anxiety?**

I also explored how types of repetitive behaviours relate to somatic symptoms of anxiety. Previous research has found that higher-order behaviours are more strongly correlated with anxiety than lower-order behaviours (Kinsbourne, 1987); therefore, I expected that higher-order repetitive behaviours would be more strongly correlated with somatic symptoms of anxiety than lower-order repetitive behaviours across all levels of cognitive functioning.
What is the relation among somatic symptoms, repetitive behaviours, and sensory processing issues, how do those relations change across levels of communicative functioning in ASD, and how does level of anxiety relate to level of autistic symptomatology?

The current study aimed to explore how observable indirect indicators of anxiety (somatic symptoms, repetitive behaviours, and sensory processing) differ across levels of functioning. Because I was unable to assess the worry and rumination aspects of anxiety in nonverbal individuals, I instead relied on observable behaviours that have been found to be related to anxiety. Somatic symptoms, repetitive behaviours, and sensory processing issues are each correlated with anxiety in ASD (Clark & Watson, 1991; Neal et al., 2002; Scholey et al., 2009). Thus, I also explored how patterns of somatic symptoms, repetitive behaviours, and sensory processing issues differ across levels of functioning. I expected to find high levels of somatic symptoms, repetitive behaviours, and sensory processing issues in both the lowest and highest functioning individuals, and medium levels in the middle functioning individuals. I also planned to explore how the level of autistic symptoms fit into these patterns of behaviour.
Chapter 2: Methods

Participants

I collected my data from the primary caregivers of 92 children with ASD aged 5-12. The current study received ethics clearance from GREB. The sample was reduced to 67 because 21 children did not meet the cut-off for an ASD diagnosis according to the Social Communication Questionnaire, and 4 parents did not complete all of the measures. Approximately 48% of participants were parents of boys, 12% were parents of girls, and 39% did not disclose their child’s sex. Only one participant indicated a comorbid disorder that may cause somatic symptoms; therefore I did not control for such disorders in my analyses. Although ASD commonly occurs with other disorders, I did not eliminate participants with other disorders because I had no way of confirming or disproving these diagnoses. Additionally, I wanted to study a fully representative sample of the complete range of individuals with ASD, and eliminating participants with other disorders would prevent this.

The primary caregivers who completed the study were predominantly mothers (n = 62), and there were also five fathers who completed the study. The majority of participants resided in Canada and four caregivers who completed the study resided in the United States. On average, it took caregivers 50 minutes to complete the study.

The primary caregivers of children with ASD were recruited through numerous autism websites and from the ASD Database maintained by the ASD Studies lab at Queen’s University. The ASD Database is populated by families with children with ASD that initiated contact in response to recruitment flyers sent through Hotel Dieu, Ongwanada, Pathways, and Autism Ontario Kingston, ads posted on Kijiji, as well as ads broadcasted through a Kingston radio station. Participants did not receive compensation for participating in the study.
Materials

**History and Demographics Questionnaire.** This questionnaire gathered a brief history of the child’s family history, diagnosis and treatment, as well as general demographic information. The questionnaire provided information about when the child was diagnosed with ASD, who provided the diagnosis, and if the child was diagnosed with any other disorders that may be high in somatic symptoms.

The questionnaire also included a set of questions probing about the child’s verbal ability. Parents selected their child’s *typical* communication style from a list (Highly fluent language; Use of short sentences; Few words; Nonverbal; Communicates using sign language; Communicates using other communicative device; Other). If parents indicated that their child speaks in full sentences, they were asked to complete the Spence Children’s Anxiety Scale.

**Zung Self-Rating Anxiety Scale.** The Zung (Zung, 1971) is a 20-item self-report questionnaire designed to assess anxiety in adults. It is based on a Likert scale and scores range from 20 to 80, with higher scores indicating greater anxiety. The Zung was used in the current study to assess primary caregivers’ level of anxiety and allowed me to control for any biased reporting that may have occurred in anxious caregivers. Once the scoring was corrected (see below), the Zung was found to have good reliability, with an alpha of .78.

**Social Communication Questionnaire (SCQ).** The SCQ (Rutter, Bailey, & Lord, 2003) is a 40-item parental questionnaire based on the DSM-IV criteria for autism with items derived from the Autism Diagnostic Interview-Revised (Lord, Rutter, & Le Couteur, 1994). The SCQ was used in the current study to confirm a diagnosis on the autism spectrum. The SCQ evaluated individuals on three domains: Reciprocal Social Interaction, Communication, and Stereotyped Behavior. A cut-off score of ≥22 has been found to indicate autism and ≥11 has been found to
indicate ASD (Wiggins, Bakeman, Adamson, & Robins, 2007). The SCQ demonstrated good reliability, with alpha of .72. If the SCQ indicated that the children did not meet the criteria for a diagnosis on the autism spectrum, those participants were excluded from the study. Twenty-one children were excluded from the current study for this reason.

**Vineland Adaptive Behaviour Scale- Parent/Caregiver Rating Form.** The Vineland (Sparrow et al., 2005) is a measure of children’s adaptive functioning completed by the caregiver. The Vineland assesses a range of adaptive behaviors and yields standard scores for the domains of Communication, Daily Living Skills, and Socialization, as well as a composite standard score. Due to the focus of my research questions, I only collected information on the Communication domain for the current study. The Vineland had high reliability, with an alpha of .88. Parents completed the rating form which uses a scale rating format. The rating form is less time-consuming than the interview version and does not require an administrator to complete the measure. Because I could not administer a reliable IQ test online, the Vineland Communication Scale provided information about level of cognitive functioning.

**Somatic Anxiety Scale.** A somatic symptom scale appropriate for nonverbal individuals was designed for the current study to assess state anxiety (Appendix A). The scale was developed by combining items assessing somatic symptoms of anxiety from various existing scales and re-wording those items to be appropriate for non-verbal individuals. The scale contained 18 items designed to assess somatic and other observable, non-repetitive behavioural symptoms that tend to co-occur with anxiety. The item “My child has difficulty getting to sleep” negatively impacted reliability, so that item was removed, creating good reliability for the Somatic Anxiety Scale, with an alpha of .70
**Spence Children’s Anxiety Scale** (Spence, 1998). The Spence Children’s Anxiety Scale is a parent report measure which is comprised of 44 Likert-type items which assess the frequency with which children experience anxious symptoms on six factors: generalized anxiety/overanxious disorder, fears of physical injury, obsessive-compulsive disorder, separation anxiety, social phobia, and panic/agoraphobia. The internal consistency for the Spence was high with an alpha of .87. In the current study, I only included 19 items assessing scores on three of the subscales: Generalized Anxiety/Overanxious Disorder, Separation Anxiety, and Panic/Agoraphobia. Only parents who indicated that their child speaks in full sentences completed the Spence.

**Short Sensory Profile (SSP).** The SSP (Dunn, 1999) measured children’s responses to sensory events. Primary caregivers reported children’s difficulties in sensory processing, sensory modulation, and associated behavior and emotional responses. The SSP contained 38 items and was based on a five-point Likert scale ranging from 1 (always) to 5 (never). The SSP measured sensory processing issues for the current study. The SSP had good reliability with an alpha of .86.

**Repetitive Behaviour Scale Revised (RBS-R).** The RBS (Bodfish et al. 2000) is a 43-item questionnaire which measured the presence and severity of a variety of forms of restricted, repetitive behaviour that are characteristic of ASD distributed across six conceptually-derived subscales: Stereotyped Behavior (apparently purposeless movements or actions that are repeated in a similar manner), Ritualistic Behavior (performing activities of daily living in a similar manner), Sameness Behavior (resistance to change, insisting that things stay the same), Compulsive Behavior (behavior that is repeated and is performed according to a rule, or involves things being done “just so”), Restricted Behavior (limited range of focus, interest or activity),
and Self-Injurious Behaviour (movement or actions that have the potential to cause redness, bruising, or other injury to the body, and that are repeated in a similar manner). Items were scored on a 0 to 3 scale where a score of 0 indicated that the behavior does not occur and a score of 3 indicated that the behavior occurs and is severe. The Stereotyped and Self-Injurious subscales are considered lower-order behaviours, whereas the Compulsive, Restricted, and Ritualistic and Sameness subscales are considered to be higher-order behaviours. The overall reliability of the RBS-R was high, with an alpha of .94.

**Procedure**

Primary caregivers (all parents in this study) logged on to the study webpage (www.qualtrics.com). Parents read the letter of information and indicated their consent at the bottom of the page by moving on to the survey itself. They were then asked to complete the Vineland, the Somatic Anxiety Scale, the SCQ, the Zung, the Repetitive Behaviour Scale-Revised, the Short Sensory Profile, and the History and Demographics Questionnaire in that order. Caregivers who indicated that their child speaks with highly fluent language were also asked to complete the Spence Children’s Anxiety Scale. Questionnaires were presented in the same order for all participants and participants had the option to exit the survey at any time and return to the questionnaires at a later date. On average, it took participants 50 minutes to complete. All but one participant completed the survey in a single sitting. After completing all the questionnaires, caregivers were debriefed and thanked for their time.

**Data Analyses**

I conducted reliability analyses with each of the Repetitive Behaviour Scale-Revised, the Short Sensory Profile, the Zung, the Spence, the Vineland, and the Somatic Anxiety Scale. In order to assess the internal consistency for the scales, I computed the Cronbach’s coefficient
alpha, with a cut-off of .70 indicating good reliability. If alpha was below .70, I removed items that negatively impacted reliability. This only affected the Somatic Anxiety Scale, in which the item “My child has difficulty getting to sleep” was removed.

Previous research has found that anxious caregivers tend to over-report anxiety symptoms in their children; therefore I controlled for the caregiver’s level of anxiety as assessed by the Zung in all analyses involving the Somatic Anxiety Scale, the Spence, the Repetitive Behaviour Scale, and the Short Sensory Profile because these measures are all related to anxiety. Age has also been found to affect anxiety; therefore, I conducted correlation analyses with all the scales and age with the intention that I would control for this factor in any analyses including anxiety measures if they were significantly correlated.

Prior to conducting analyses for group comparisons, I conducted a missing data pattern analysis to evaluate what percentage of data was missing and if there was any specific pattern to the missing data. In order to complete the online study, participants were forced to select a response for each question and so there was no missing user data; however, I chose to add a “Don’t Know/Not Applicable” option to all scales so that participants would not become frustrated and quit the study if they were unsure of how to respond to a given question. I then chose to interpret “Don’t Know/Not Applicable” responses as missing data because this response was not part of the original questionnaires and could therefore not be scored. Because “Don’t Know/Not Applicable” was scored as missing data on all measures excluding the Zung (explained below), there were multiple points of missing data throughout the sample. I conducted a Missing Value Analysis, and found that excluding data from the Zung, 2% of the entire data set was missing and there was no evidence for any pattern in the missing data, with the most common pattern being that one data point for each variable was missing. I conducted multiple
imputation using the Markov Chain Monte Carlo algorithm on the Somatic Anxiety Scale, the Spence, the RBS-R, and the SSP to provide estimates for missing data points rather than excluding cases from the analyses. I chose not to conduct listwise deletion because 66% of participants were missing at least one item and to remove them would greatly diminish the sample size to 29 participants.

However, specifically for the Zung, 29% of the data was considered missing because parents selected the “Not Applicable/Don’t Know” option, often multiple times within the survey. Upon analyzing the patterns of how parents skipped questions, I determined that a great amount of data was missing because parents interpreted the “Not Applicable/Don’t Know” option to indicate the absence of symptoms, rather than as a means to skip over the question. There are a number of factors that support this hypothesis.

First, the lowest possible response on the Zung was "A little of the time"; there was no "Never" option. I believe that parents used the "Not Applicable/Don’t Know" option to indicate "Never". The items on which it was very common to score "Not Applicable/Don't Know" were anxiety symptoms that we would only expect to see in extreme cases. For instance, 60% of participants responded "Not Applicable/Don't Know" to the item "I have fainting spells or feel like it". Similarly, 56% of participants responded "Not Applicable/Don’t Know" to "My legs shake and tremble". This occurred in cases even when parents responded to most other items on the scale. Conversely, reverse-coded items such as "I feel calm and can sit easily", only received "Not Applicable/Don’t Know" in 3% of cases, because presumably all participants felt that way at least some of the time. Approximately 26% of participants responded “Not Applicable/Don’t Know” to five or more items. This was striking because these same parents were quite thorough
with the other scales and rarely selected the “Not Applicable/Don’t Know” anywhere but the Zung.

Third, to explore differences between participants who were thorough with the Zung compared to those who selected “Not Applicable/Don’t Know” in many cases, I went through and dichotomized cases based on whether participants were missing data for 1 or more items. I then conducted t-tests on the other scales to compare characteristics across the included and excluded participants. While age, adaptive functioning, and sensory processing did not differ across groups, the “thorough” versus “incomplete” participants differed significantly on somatic anxiety and repetitive behaviours. The “thorough” group scored significantly higher on those scales, consistent with previous research indicating that anxious children have parents with higher reported anxiety. I assumed that it was not the case that the “thorough” group was more careful or forthcoming at completing the Zung; I believed that they were indeed more anxious, and therefore rarely selected the ”Not Applicable/Don’t Know” option as they would experience even the most extreme anxious symptoms at least “a little of the time”.

While there may be exceptions, I believe that for the most part, the "Not Applicable/Don't Know" response was interpreted by participants to mean an absence of symptoms. Based on this, I chose to score “Not Applicable/Don’t Know” responses as zero instead of missing, and thus did not impute data for the Zung. In order to be cautious with this assumption, I conducted a second set of analyses in which I excluded the Zung from any analyses where it was originally included as a covariate.

Once imputation was completed, to confirm that somatic symptoms were related to anxiety and to address my first research question, I conducted a correlation between anxiety scores as assessed by the Spence and the score on my Somatic Anxiety Scale for parents of
verbal individuals who were able to speak in full sentences (and thus express their levels of anxiety to their parents).

In order to address my second research question, to assess how level of communicative functioning related to somatic symptoms expressed in individuals with ASD, I conducted a linear regression using level of cognitive functioning (as assessed by the Vineland) as the predictor, and somatic symptom score as the criterion, controlling for parental anxiety. I explored linear, quadratic, and cubic trends.

To address my third research question, I conducted hierarchical regression analyses controlling first for parental anxiety to determine how somatic anxiety related to lower-order compared to higher-order behaviours. I conducted a regression to determine if somatic anxiety predicted higher-order behaviours and lower-order behaviours. I hypothesized that higher-order behaviours would better predict somatic symptoms than lower-order behaviours.

My fourth research question was to examine how somatic symptoms, repetitive behaviours, and sensory processing issues are related to one another in children with ASD and how this relationship differ across levels of functioning, and how anxiety relates to autism symptomology. In order to examine how patterns of behaviour differ across individuals, I compiled all scores together and conducted a cluster analysis. I chose to conduct a Two-Step Cluster Analysis because it does not require knowing the number of clusters prior to the analysis and it also guides the decision of how many clusters to retain from the data by calculating measures-of-fit (Bacher, Wenzig, & Vogler, 2004). The Two-Step Clustering method is also more resistant to outliers than alternative methods (Bacher et al.) and it allows for the inclusion of evaluation fields. The items in the evaluation fields do not contribute to the formation of the clusters, but allow for easy comparison of the items across clusters. There is no generally
accepted rule regarding minimum sample sizes or the relationship between sample size and number of clustering variables used, although Formann (1984; as cited in Mooi & Sarstedt, 2011) recommends a sample size of at least $2^x$, where $x$ equals the number of clustering variables. Based on this guideline, it is acceptable to conduct a cluster analysis with four variables with my sample size. To examine how anxiety relates to autism symptomatology and level of functioning, I conducted an ANOVA to investigate how autism symptoms and level of functioning differed across different cluster groups.
Chapter 3: Results

Preliminary Analyses

I conducted reliability analyses to estimate the internal consistency of the Spence, Somatic Anxiety Scale, Zung, Lower-Order RBS-R, Higher-Order RBS-R, the SSP, Vineland, and SCQ. Participants missing data on any items within a scale were excluded from reliability analyses for that particular scale. The Somatic Anxiety Scale initially had an alpha of .65, which increased to .70 by removing the item “My child has difficulty getting to sleep”. Reliability results for the scales are presented in Table 1.

To test for normal distribution, I conducted a series of Shapiro-Wilk’s W tests and also tested for skewness and kurtosis with the Spence, Somatic Anxiety Scale, Zung, Lower-Order RBS-R, Higher-Order RBS-R, the SSP, Vineland, and SCQ. The results of Shapiro-Wilk’s W tests are presented in Appendix B and the results of the skewness and kurtosis tests are presented in Appendix C. All scales had a normal distribution, except for the SCQ, the Higher-Order RBS-R and the Lower-Order RBS-R. The SCQ was not normal because I excluded cases scoring below 11, and therefore this was expected. The ratio of skewness to the standard error of skewness of Higher-Order Repetitive Behaviours was less than 3 and the ratio of skewness to the standard error of skewness of Lower-Order Repetitive Behaviours was greater than 3; therefore, I ran all analyses involving Higher-Order and Lower-Order Repetitive behaviours with bootstrapping (Preacher & Hayes, 2004).

I conducted correlation analyses for all scales and age to gain a preliminary understanding of how they were related to one another (n = 67). Note that the sample size differed for correlations involving the Spence because not all participants completed this measure (n = 31). Results are presented in Table 2. The Somatic Anxiety Scale was significantly
correlated with the Spence, the Zung, both Lower and Higher-Order Repetitive Behaviours, and the SSP. Age was significantly correlated with Lower-Order Repetitive Behaviours, and so I controlled for age in all analyses involving that scale. The Zung was significantly correlated with Somatic Anxiety and the Spence, and so I controlled for parent anxiety in all analyses involving those scales.
Table 1

Reliability Analyses Results for All Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>N</th>
<th>alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Communication Standard Score</td>
<td>49</td>
<td>.88</td>
</tr>
<tr>
<td>Social Communication Questionnaire</td>
<td>43</td>
<td>.72</td>
</tr>
<tr>
<td>Short Sensory Profile</td>
<td>41</td>
<td>.86</td>
</tr>
<tr>
<td>Spence Children’s Anxiety Scale</td>
<td>31</td>
<td>.85</td>
</tr>
<tr>
<td>Somatic Anxiety Scale</td>
<td>46</td>
<td>.70</td>
</tr>
<tr>
<td>Zung Self-Rating Anxiety Scale</td>
<td>65</td>
<td>.78</td>
</tr>
<tr>
<td>RBS-R Total Score</td>
<td>53</td>
<td>.94</td>
</tr>
<tr>
<td>Higher-Order Repetitive Behaviours</td>
<td>53</td>
<td>.94</td>
</tr>
<tr>
<td>Lower-Order Repetitive Behaviours</td>
<td>64</td>
<td>.84</td>
</tr>
</tbody>
</table>
Table 2
*Pearson Correlations of all Scales and Age*

<table>
<thead>
<tr>
<th></th>
<th>Vineland Communication Raw Score</th>
<th>Somatic Anxiety Scale (n = 31)</th>
<th>RBS-R Total Score</th>
<th>Higher-Order RBs</th>
<th>Lower-Order RBs</th>
<th>Short Sensory Profile</th>
<th>SCQ</th>
<th>Zung Self-Rating Anxiety Scale</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Communication Raw Score</td>
<td>1.00</td>
<td>-.06</td>
<td>.13</td>
<td>-.13</td>
<td>-.07</td>
<td>-.36*</td>
<td>-.03</td>
<td>-.50**</td>
<td>.11</td>
</tr>
<tr>
<td>Somatic Anxiety Scale</td>
<td>-.06</td>
<td>1.00</td>
<td>.65**</td>
<td>.49**</td>
<td>.52**</td>
<td>.36</td>
<td>-.28*</td>
<td>.12</td>
<td>.34**</td>
</tr>
<tr>
<td>Spence Children’s Anxiety</td>
<td>.13</td>
<td>.65**</td>
<td>1.00</td>
<td>.29</td>
<td>.27</td>
<td>.12</td>
<td>-.19</td>
<td>.06</td>
<td>.45*</td>
</tr>
<tr>
<td>Scale (n = 31)</td>
<td>RBS-R Total Score</td>
<td>-.13</td>
<td>.49**</td>
<td>.29</td>
<td>1.00</td>
<td>.97**</td>
<td>.76**</td>
<td>-.44**</td>
<td>.24</td>
</tr>
<tr>
<td>Higher-Order Repetitive Behaviours</td>
<td>-.07</td>
<td>.52**</td>
<td>.27</td>
<td>.97**</td>
<td>1.00</td>
<td>.57**</td>
<td>-.37**</td>
<td>.15</td>
<td>.16</td>
</tr>
<tr>
<td>Lower-Order Repetitive Behaviours</td>
<td>-.36*</td>
<td>.36*</td>
<td>.12</td>
<td>.76**</td>
<td>.57**</td>
<td>1.00</td>
<td>-.25*</td>
<td>.38**</td>
<td>.21</td>
</tr>
<tr>
<td>Social Communication Questionnaire</td>
<td>-.50**</td>
<td>.12</td>
<td>.06</td>
<td>.24</td>
<td>.15</td>
<td>.38**</td>
<td>-.20</td>
<td>1.00</td>
<td>.07</td>
</tr>
<tr>
<td>Zung Self-Rating Anxiety Scale</td>
<td>.11</td>
<td>.34**</td>
<td>.45*</td>
<td>.15</td>
<td>.16</td>
<td>.21</td>
<td>-.19</td>
<td>.07</td>
<td>1.00</td>
</tr>
<tr>
<td>Age</td>
<td>.03</td>
<td>-.03</td>
<td>.18</td>
<td>-.17</td>
<td>-.06</td>
<td>-.32*</td>
<td>-.06</td>
<td>-.20</td>
<td>-.18</td>
</tr>
</tbody>
</table>

**p < .01, * p < .05**

RBs = Repetitive Behaviours
SCQ = Social Communication Questionnaire
Method of Communication in Children

Parents indicated their child’s method of communication; the frequencies of each communication type are reported in Table 3. Children were then dichotomized based on whether parents reported that their child communicated with highly fluent language versus whether they communicated with the use of short sentences, with few words, were non-verbal, used sign language, used some other communicative device or other. Four parents indicated “Other” as the method of communication and their responses were: “1-2 word requests but utilizes echolalia learned in movies etc at appropriate time”, “a mix of PECS [Picture Exchange Communication System] and short words”, “often struggles to communicate needs, becomes frustrated, makes an attempt to use signs/gestures, etc.”, and “gestures”. Based on these responses, it is appropriate to include these individuals as those who did not communicate with highly fluent language. The descriptive statistics for scale scores associated with children who communicated with highly fluent language are reported in Table 4 while the descriptive statistics for scale scores associated with children who did not communicate with highly fluent language are reported in Table 5.
Table 3

*Frequencies and Percentages of Communication Styles*

<table>
<thead>
<tr>
<th>Communication Style</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly fluent language</td>
<td>31</td>
<td>46.3</td>
</tr>
<tr>
<td>Use of short sentences</td>
<td>17</td>
<td>25.4</td>
</tr>
<tr>
<td>Few words</td>
<td>11</td>
<td>16.4</td>
</tr>
<tr>
<td>Non-verbal</td>
<td>4</td>
<td>6.0</td>
</tr>
<tr>
<td>Sign Language</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other communicative device</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Table 4

*Descriptive Statistics for Children who Communicate with Highly Fluent Language*

<table>
<thead>
<tr>
<th>Scale</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Communication Standard Score</td>
<td>31</td>
<td>89.20</td>
<td>17.90</td>
<td>70 - 127</td>
</tr>
<tr>
<td>Somatic Anxiety Scale</td>
<td>31</td>
<td>29.53</td>
<td>5.47</td>
<td>19 - 41</td>
</tr>
<tr>
<td>Spence Children’s Anxiety Scale</td>
<td>31</td>
<td>30.31</td>
<td>7.51</td>
<td>18 – 45</td>
</tr>
<tr>
<td>RBS-R Total Score</td>
<td>31</td>
<td>73.18</td>
<td>14.91</td>
<td>52 – 111</td>
</tr>
<tr>
<td>Higher-Order Repetitive Behaviours</td>
<td>31</td>
<td>52.33</td>
<td>13.68</td>
<td>34 – 85</td>
</tr>
<tr>
<td>Lower-Order Repetitive Behaviours</td>
<td>31</td>
<td>21.00</td>
<td>4.18</td>
<td>14 – 34</td>
</tr>
<tr>
<td>Short Sensory Profile</td>
<td>31</td>
<td>113.49</td>
<td>17.26</td>
<td>80 – 147</td>
</tr>
<tr>
<td>Social Communication Questionnaire</td>
<td>31</td>
<td>17.13</td>
<td>4.41</td>
<td>11 – 30</td>
</tr>
<tr>
<td>Zung Self-Rating Anxiety Scale</td>
<td>31</td>
<td>29.87</td>
<td>10.90</td>
<td>4 – 46</td>
</tr>
</tbody>
</table>
Table 5

*Descriptive Statistics for Children who Communicate with the use of Short Sentences, Few words, are Non-verbal, use Sign Language, Other communicative device, or Other*

<table>
<thead>
<tr>
<th>Scale</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Communication Standard Score</td>
<td>36</td>
<td>62.65</td>
<td>14.91</td>
<td>31 – 95</td>
</tr>
<tr>
<td>Somatic Anxiety Scale</td>
<td>36</td>
<td>30.49</td>
<td>6.54</td>
<td>16 – 45</td>
</tr>
<tr>
<td>RBS-R Total Score</td>
<td>36</td>
<td>85.79</td>
<td>23.12</td>
<td>47 – 136</td>
</tr>
<tr>
<td>Higher-Order Repetitive Behaviours</td>
<td>36</td>
<td>59.34</td>
<td>17.35</td>
<td>30 – 99</td>
</tr>
<tr>
<td>Lower-Order Repetitive Behaviours</td>
<td>36</td>
<td>25.54</td>
<td>7.42</td>
<td>17 – 42</td>
</tr>
<tr>
<td>Short Sensory Profile</td>
<td>36</td>
<td>114.46</td>
<td>20.95</td>
<td>64 – 145</td>
</tr>
<tr>
<td>Social Communication Questionnaire</td>
<td>36</td>
<td>20.49</td>
<td>5.32</td>
<td>12 – 31</td>
</tr>
<tr>
<td>Zung Self-Rating Anxiety Scale</td>
<td>36</td>
<td>30.47</td>
<td>9.67</td>
<td>13 – 57</td>
</tr>
</tbody>
</table>
Assessing the Somatic Anxiety Scale

To address my first research question, I conducted a correlation to examine the association between the Somatic Anxiety Scale and the Spence Children’s Anxiety scale in children who were highly verbal. Only those parents who indicated that their child communicates in full sentences completed the Spence, and therefore only those children were considered in this analysis ($n = 31$). Scores on the Somatic Anxiety and Spence Children’s Anxiety Scale were positively associated ($r(29) = .65, p < .001$). This association remained significant when controlling for parent anxiety as assessed by the Zung ($r(28) = .53, p = .003$). This finding suggests that the Somatic Anxiety Scale developed for the current study may indeed tap into somatic symptoms of anxiety in ASD populations.

Anxiety across Levels of Cognitive Functioning

Despite the fact that somatic anxiety and level of cognitive functioning were not correlated, this was a key part of my research questions and I wanted to be sure that these variables were still were not correlated even after controlling for parental anxiety. In order to address my second research question, to assess how level of cognitive functioning relates to somatic symptoms expressed in individuals with ASD, I conducted regression analyses using level of cognitive functioning (as assessed by the Vineland Communication Standard Score) as the predictor, and Somatic Anxiety score as the criterion. A linear regression controlling for parental anxiety indicated that cognitive functioning did not predict somatic anxiety ($\beta = -.08$, $t(64) = -.80, p = .43$). Further regression analyses revealed no quadratic trend ($\beta = -.69$, $t(63) = -1.01, p = .31$), nor was there a cubic trend ($\beta = 3.34$, $t(62) = .95, p = .34$). From this, I failed to reject the null hypothesis that there is no relationship between somatic anxiety and cognitive functioning as assessed by the Vineland Communication subscale.
Previous research indicating a relationship between anxiety and cognitive functioning rarely included lower functioning individuals; therefore, it is possible that by including a broad sample of individuals across a wide range of cognitive functioning in the current study, any relationship that may have occurred at the top of the spectrum was no longer evident. To check for this possibility, I performed a post-hoc regression analysis eliminating the data of individuals who scored below a standard score of 55 on the Vineland. The results again indicated no relationship between somatic anxiety and level of functioning, (β = -.17, t(54) = -1.36, p = .17).

**Repetitive Behaviours and Anxiety**

My third research question aimed to examine how lower and higher-order repetitive behaviours differ in their relationship to somatic symptoms of anxiety. To address this, I first calculated a total score for lower-order behaviours by summing scores from the Stereotyped and Self-Injurious subscales, and calculated a total score for higher-order behaviours by summing scores from the Compulsive, Restricted, Ritualistic, and Sameness subscales. Next, I standardized these values by converting them to z-scores because each subscale had a different number of items. I conducted a hierarchical regression in which parent anxiety and age followed by both subtypes of repetitive behaviour were entered in two steps to compare their prediction of somatic anxiety. In step 1, somatic anxiety was the criterion variable and age and parent anxiety, as assessed by the Zung, were the predictor variables. In step 2, Higher-Order and Lower-Order Repetitive Behaviour were added to the step 1 equation. Before the hierarchical regression analysis was performed, the predictor variables were examined for collinearity. Tests for multicollinearity indicated a very low level of multicollinearity.

The results of step 1 indicated that parent anxiety combined with age explained 11% of the variance in somatic anxiety, which was a significant amount of explained variance.
Higher-Order Repetitive Behaviour and Lower-Order Repetitive Behaviour were entered into the regression equation. The addition of Higher-Order Repetitive Behaviour and Lower-Order Repetitive Behaviour to the model explained an additional 26% of the variance in somatic anxiety, which was a significant increase in explained variance. Lower-order repetitive behaviours did not predict somatic anxiety over and above higher-order repetitive behaviours, parent anxiety and age. Higher-order repetitive behaviours predicted somatic anxiety over and above lower-order repetitive behaviours, parent anxiety and age. Overall, the final model explained 37% of the variance in somatic anxiety. Values for the models are reported in Table 6.
Table 6

*Hierarchical Multiple Regression for the Prediction of Somatic Anxiety with Parent Anxiety and Age Entered First, Followed by Higher-Order Repetitive Behaviours and Lower-Order Repetitive Behaviours*

<table>
<thead>
<tr>
<th>Model 1 Variable</th>
<th>β</th>
<th>AdjR²</th>
<th>F</th>
<th>ΔR²</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zung</td>
<td>.36**</td>
<td>.11</td>
<td>6.20*</td>
<td>.13</td>
<td>6.20*</td>
</tr>
<tr>
<td>Age</td>
<td>-.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2 Variable</th>
<th>β</th>
<th>AdjR²</th>
<th>F</th>
<th>ΔR²</th>
<th>ΔF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zung</td>
<td>.26*</td>
<td>.37</td>
<td>12.78**</td>
<td>.26</td>
<td>16.87**</td>
</tr>
<tr>
<td>Age</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher-Order RB</td>
<td>.47**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower-Order RB</td>
<td>.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05, **p < .001
RB = Repetitive Behaviour
Patterns of Observable Behavioural Correlates of Anxiety

In order to explore the relationship among somatic anxiety, repetitive behaviours, and sensory processing issues, I conducted a cluster analysis on 67 cases, each including total scores from the Somatic Anxiety Scale, Lower-Order Repetitive Behaviours, Higher-Order Repetitive Behaviours, and the Short Sensory Profile. A Two-Step cluster analysis using Ward’s method produced three clusters, which I named the Low-Functioning Cluster, the Medium-Functioning Cluster, and the High-Functioning Cluster based on their respective mean Vineland scores. The Low-Functioning Cluster was smallest \((n = 7)\), and high in somatic anxiety, sensory processing issues and both types of repetitive behaviours. The Medium-Functioning Cluster \((n = 25)\) was low in all four categories. The High-Functioning Cluster was predominant \((n = 35)\) and was characterized by medium somatic anxiety, low lower-order repetitive behaviours, medium higher-order repetitive behaviours, and high scores in sensory processing issues. Boxplots of cluster groups’ survey scores are presented in Figures 2 through 5. In the boxplots, the line through the middle of the box indicates the median, with the box areas above and below this line representing the inter-quartile range. The top whisker indicates the upper quartile, and the bottom whisker indicates the lower quartile. Any points beyond the whiskers indicate outliers who scored beyond the upper or lower quartile. I re-ran the cluster analysis excluding outliers to ensure they were not driving the cluster; analyses without the outliers revealed the same results.

Although Vineland Communication Standard Scores and SCQ scores were not used to determine cluster membership, they were examined in the evaluation fields. The Low-Functioning Cluster scored high on the SCQ (indicating higher levels of autistic symptomatology) and low on the Vineland, while both the Medium-Functioning and High-
Functioning Clusters scored lower on the SCQ and higher on the Vineland. Boxplots for Vineland and SCQ scores according to cluster group are presented in Figures 6 and 7.
Figure 2. Overall Sample Mean of Each Scale: Spence, Somatic Anxiety, Lower-Order Repetitive Behaviour (LO RB), Higher-Order Repetitive Behaviour (HO RB), SSP, SCQ, and the Vineland for the three cluster groups.
Figure 3. Somatic anxiety scores for cluster groups
Figure 4. Lower-Order Repetitive Behaviour scores for cluster groups
Figure 5. Higher-Order Repetitive Behaviour scores for cluster groups
Figure 6. Short Sensory Profile Scores for cluster groups

*note that lower scores indicate more sensory processing issues
Figure 7. Vineland Communication Standard Scores for cluster groups
Figure 8. Social Communication Questionnaire scores for cluster groups
I created a grouping variable based on cluster membership and used this as the independent variable in a one-way analysis variance to examine cluster group differences in SCQ scores. The dependent variable was severity of ASD as assessed by the SCQ. The ANOVA was significant, $F(2, 65) = 3.55, p = .04$. I conducted follow-up tests to evaluate pairwise differences among the means. Tukey’s HSD revealed significant differences between the Low-Functioning Cluster and both the High ($p = .04$) and Medium-Functioning Clusters ($p = .04$), but no significant differences between the High and Medium-Functioning Clusters ($p = .99$). The Low-Functioning Cluster scored significantly higher on the SCQ than the other groups.

Next, I conducted an ANOVA to examine cluster group differences in Vineland Communication scores. The dependent variable was level of cognitive functioning as assessed by the Vineland. The ANOVA was significant, $F(2, 65) = 3.66, p = .03$. I conducted follow-up tests to evaluate pairwise differences among the means. Tukey’s HSD revealed significant differences between the Low-Functioning Cluster and the High-Functioning Cluster ($p = .03$), but not between the Low and Medium-Functioning Cluster ($p = .21$), or between the High and Medium-Functioning Cluster ($p = .38$). The Low-Functioning Cluster scored significantly lower on the Vineland than the High-Functioning group.

In order to further explore group differences in anxiety scores, I compared the group means of clusters using Spence scores. I only compared scores between the High-Functioning Cluster and Medium-Functioning Cluster because as individuals in the Low-Functioning Cluster were all non-verbal, none of their parents completed the Spence. I conducted an independent samples $t$-test to evaluate the difference in Spence scores between the High and Medium-Functioning Clusters. The test was significant, $t(29) = 2.94, p = .003$. Individuals in the High-Functioning Cluster ($M = 31.80, SD = 7.63$) on average exhibited greater anxiety than those in
the Medium-Functioning Cluster ($M = 24.20, SD = 3.99$). The 95\% confidence interval for the difference in means was wide, ranging from 2.30 to 12.67. This suggests that there is a difference a difference in anxiety between levels when assessed with the Spence.

**Analyses without Controlling for Parent Anxiety**

Because of issues due to missing data with the Zung, I conducted all analyses in which I had originally controlled for parent anxiety again, this time without using the Zung as a covariate. This was to ensure that if the “Don’t Know/Not Applicable” scores did indeed bias the Zung, that controlling for those biased scores did not impact my findings in a profound way.

In my second research question, to assess how level of cognitive functioning relates to somatic symptoms expressed in individuals with ASD, I conducted regression analyses using level of cognitive functioning (as assessed by the Vineland Communication Standard Score) as the predictor, and Somatic Anxiety score as the criterion. I re-ran this analysis without controlling for parent anxiety. A linear regression indicated that cognitive functioning did not predict somatic anxiety ($\beta = -.04, t(65) = -.46, p = .64$). Further regression analyses revealed no quadratic trend ($\beta = -.69, t(64) = -.98, p = .33$), nor was there a cubic trend ($\beta = 4.35, t(63) = 1.06, p = .29$). From this, I failed to reject the null hypothesis that there is no relationship between somatic anxiety and cognitive functioning as assessed by the Vineland Communication subscale, even without controlling for parent anxiety.

To assess my third research question aimed to examine how lower and higher-order repetitive behaviours differ in their relationship to somatic symptoms of anxiety, I conducted a hierarchical linear regression, this time without controlling for parent anxiety. Results were the same as when I controlled for parent anxiety, with higher-order repetitive behaviours predicting somatic anxiety over and above lower-order repetitive behaviours.
The results of step 1 indicated that age explained only 1% of the variability in somatic anxiety, which is not a significant amount of explained variance. In step 2, Higher-Order Repetitive Behaviour and Lower-Order Repetitive Behaviour were entered into the regression equation. The addition of Higher-Order Repetitive Behaviour and Lower-Order Repetitive Behaviour to the model explained an additional 34% of the variance in somatic anxiety, which was a significant increase in explained variance. Lower-order repetitive behaviours did not significantly predict somatic anxiety over and above age and higher-order repetitive behaviours. Higher-order repetitive behaviours significantly predicted somatic anxiety over and above age and lower-order repetitive behaviours. Overall, the final model explained 32% of the variance in somatic anxiety. Values for the models are reported in Table 7.
Hierarchical Multiple Regression for the Prediction of Somatic Anxiety with Age Entered First, Followed by Higher-Order Repetitive Behaviours and Lower-Order Repetitive Behaviours

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>$\text{Adj}R^2$</th>
<th>$F$</th>
<th>$\Delta R^2$</th>
<th>$\Delta F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 Age</td>
<td>-.10</td>
<td>-.01</td>
<td>.38</td>
<td>.01</td>
<td>.38</td>
</tr>
<tr>
<td>Model 2 Age</td>
<td>.02</td>
<td>.32</td>
<td>13.80*</td>
<td>.34</td>
<td>20.42**</td>
</tr>
<tr>
<td>Higher-Order RB</td>
<td>.47**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower-Order RB</td>
<td>.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4: Discussion

The current study examined observable features of anxiety in children with ASD across differing levels of cognitive functioning. In order to study anxiety across levels of cognitive functioning, I developed the Somatic Anxiety Scale, which was highly correlated with the Spence, a traditional anxiety measure. This correlation suggests that somatic symptoms as assessed by the Somatic Anxiety Scale are at least somewhat indicative of anxiety in the ASD population. Using this scale, I then explored the relationship between somatic anxiety and level of cognitive functioning and found no relationship between anxiety and cognitive functioning. I did find that somatic anxiety was significantly correlated with both lower and higher-order repetitive behaviours, but higher-order repetitive behaviours were predictive of somatic anxiety while lower-order repetitive behaviours were not.

In order to explore how different patterns of behaviours linked to anxiety relate to one another across levels of functioning, I conducted a cluster analysis with somatic anxiety, lower-order repetitive behaviours, higher-order repetitive behaviours, and sensory processing issues as the observable correlates of anxiety and thus the variables of interest. The analysis revealed three clusters. The Low-Functioning Cluster, which was characterized by the lowest level of cognitive functioning (measured using Vineland Communication scores) and highest level of autistic symptoms on the SCQ, scored high in all four categories of observable correlates of anxiety. The Medium-Functioning Cluster, which had medium scores on the Vineland and fewer autistic symptoms, scored low on all four categories of observable correlates of anxiety. Finally, the High-Functioning Cluster, characterized by the highest cognitive functioning and fewer autistic symptoms, was medium in somatic anxiety and higher-order repetitive behaviours, low in lower-order behaviours, and high (expressed as a low score on the Sensory Profile) in sensory...
processing issues. These findings suggest that manifestations of anxiety are heterogeneous across certain levels of functioning thresholds; however, results must be interpreted with caution given that only seven individuals were clustered into the Low-Functioning Cluster. Moreover, there was a great deal of overlap between clusters on cognitive functioning.

**Measuring Anxiety in Non-Verbal Individuals**

The use of inappropriate measures with individuals who are considered non-verbal or low-functioning is a major downfall of previous research on anxiety in the ASD population. In the past, researchers have consistently assessed anxiety using surveys that are not designed to accurately assess non-verbal individuals’ true levels of anxiety due to the verbal content of the questionnaires. One goal of the current study was to address this problem by developing a measure of anxiety appropriate for non-verbal and low-functioning individuals with ASD.

Previous research suggests that children diagnosed with an anxiety disorder report more somatic complaints than children without an anxiety disorder (Dorn et al., 2003; Hofflich et al., 2006; Hughes et al., 2008). Based on these findings, I drew from a series of somatic complaints measured in other anxiety assessments in order to develop a measure of parent-reported somatic symptoms of anxiety. Although one or two items may be more easily identifiable in children with communicative abilities, none of the items exclusively relied on verbal communication in order for parents to recognize their children’s symptoms. I theorized that if my survey was correlated with an existing reliable anxiety measure, it could provide a foundation to further develop a measure that could be used in a research setting to assess anxiety in non-verbal children. Results indicated that the Somatic Anxiety Scale was highly correlated with the Spence Children’s Anxiety Scale, a test that has been used extensively in anxiety research. Moreover, the Somatic Anxiety Scale was also correlated with the Repetitive Behavior Scale-Revised, a
measure that is hypothesized to reflect coping mechanisms for anxiety, and the Short Sensory Profile, a measure that is hypothesized to reflect an underlying cause of anxiety. This suggests that the Somatic Anxiety Scale could provide a starting point for the development of an effective measure of somatic symptoms of anxiety that could be administered in further research to examine anxiety across levels of cognitive functioning. Further research should attempt to provide convergent validity for this scale by examining the associations between scores on this scale and more ‘objective’ measures of anxiety, such as baseline heart rate and Galvanic skin response. Furthermore, divergent validity should be examined to investigate the unique predictive ability of the Somatic Anxiety Scale to assess anxiety rather than depression or psychosomatic or physical disorders.

**Anxiety across Levels of Cognitive Functioning in ASD**

My next goal was to examine the relationship between cognitive functioning and anxiety. To date, researchers have made the assumption that there is a positive correlation between anxiety and level of cognitive functioning across the entire autism spectrum based on previous findings indicating that children who have higher cognitive functioning and greater verbal ability experience greater anxiety than children who are lower functioning, yet still have IQs in the average range (Bellini, 2004; Weisbrot et al., 2005; White et al., 2009). As discussed in my introduction, there are two problems with this assumption. First, due to testing and recruiting issues, researchers rarely include non-verbal and low-functioning individuals in studies, instead making comparisons between children with Asperger’s and children with High-Functioning Autism and then extrapolating those results across the entire spectrum. Second, in the rare cases when non-verbal individuals are examined, researchers have not employed appropriate measures for their unique set of abilities (Evans et al., 2005).
The current study aimed to resolve the problems that have affected past anxiety research with ASD populations by including non-verbal individuals in the study sample and by assessing their anxiety with a measure designed to be appropriate for their specific difficulties. I assessed anxiety by examining somatic symptoms, and assessed level of functioning with the communication subscale of the Vineland Adaptive Behaviour Scale, a measure that has been found to be highly correlated with IQ in individuals with ASD (Freeman et al., 1999; Klin et al., 2007; Perry et al., 2009).

In examining the relationship between anxiety and cognitive functioning, I hypothesized that I would find a quadratic trend in anxiety across levels of cognitive functioning in which I would observe high anxiety in individuals considered to be low-functioning, lower levels of anxiety in the mid-range of functioning, and then high anxiety again in very high-functioning individuals. Results indicated no relationship between anxiety and level of functioning at the linear, quadratic, or cubic level. Below, I explore possible explanations for why I observed no relationship between the variables.

The first explanation for my failure to reject the null hypothesis may be that there is indeed no relationship between anxiety and level of functioning when including individuals of varying cognitive levels. Previous research indicating a linear relationship between anxiety and cognitive functioning included measures of anxiety that were highly cognitive in nature. Instead of administering a cognitively-based anxiety measure, the current study used the Somatic Anxiety Scale, a measure designed to be appropriate for all communicative abilities. It is possible that parents of low functioning children report the same level of anxiety as their higher functioning counterparts when assessed with an appropriate measure. This supports Tsai’s (1996) theory that level of functioning affects merely the amount of anxiety that is verbally expressed.
rather than the amount of anxiety experienced. Items on typical measures of anxiety often require verbal and higher cognitive abilities to communicate those symptoms to caregivers, resulting in what appears to be higher anxiety rates in more cognitively capable individuals. By administering a measure that taps into anxiety symptoms of individuals of all cognitive levels, it may be that anxiety is indeed stable across levels of functioning in ASD.

Alternatively, it is possible that the somatic measure of anxiety was not sensitive to differences between levels of functioning due to poor construct validity. It may be that somatic complaints are indeed indicative of anxiety in children with ASD, but that the health complications typical of individuals with ASD may better account for somatic symptoms. Some researchers hypothesize that there are so many health complications that ASD may be thought of as a full-body disorder, comprised of numerous immune and gastrointestinal abnormalities (Herbert, 2000). However, when parents were asked to indicate if their child suffered from any health complications, only one parent indicated that their child was diagnosed with gastrointestinal problems; therefore it is unlikely that health complications interfered with results. Additionally, the fact that the Spence, a measured deemed reliable and valid by the research community (Nauta et al. 2004), was highly correlated with the Somatic Anxiety Scale, suggests that the lack of a relation between cognitive functioning and the Somatic Anxiety Scale is not simply a result of poor construct validity within the newly developed measure.

Another possible explanation for finding no relationship between anxiety and level of functioning in the current study may lie in the characteristics of my sample. Previous research indicating a linear relationship between anxiety and cognitive functioning rarely included lower functioning individuals; it is possible that by including a broad sample of individuals across a wide range of cognitive functioning in the current study, any relationship that may have occurred
at the top of the spectrum was no longer evident. To check for this possibility, I performed a post-hoc regression analysis eliminating the data of individuals who have typically been excluded from past research due to their moderate to profound cognitive impairments (i.e., those who scored below 55 on the Vineland). The results again indicated no relationship between somatic anxiety and level of functioning. However, it may be possible that this linear relationship would be seen were I to conduct a regression only on those individuals who scored within the average range of functioning.

Lastly, it is possible that the failure to reject the null hypothesis stemmed from problems with the measurement of level of functioning. Previous studies have outlined issues with the Vineland as a substitute measure of IQ, particularly about how subgroups of more cognitively able children tend to have different scoring profiles than lower functioning subgroups (Perry et al., 2009). When comparing IQ scores to Vineland scores, researchers have found that cognitive functioning (as assessed by IQ tests) is higher than adaptive functioning (as assessed by the Vineland) in subgroups of cognitively more able children with ASD. Conversely, for children with ASD considered lower functioning, adaptive skills are somewhat higher than cognitive skills (Bolte & Poustka, 2002; Klin et al., 2007; Perry et al., 2009). It is theorized that the difference could be related to the score distributions, as the Vineland standard scores have a relatively high basal requirement at young ages. Perhaps the overestimation of abilities in low functioning individuals and underestimation in high functioning individuals has resulted in a more restricted range of scores in the current study, masking a real effect. However, my sample did show a very wide range of Vineland standard scores, thus making this interpretation an unlikely cause.
In ASD research, the Semi-Structured Interview format of the Vineland is more commonly administered than the Rating Form of the Vineland, suggesting that the Rating Form may be less accurate than the Interview version. The Rating Form is considered an alternative approach, used instead of the interview only when access to caregivers or time is limited. The authors of the Vineland indicate that the rating scale format may result in biased ratings by the respondent, who may embellish or minimize the child’s performance (Sparrow et al., 2005). The authors also acknowledge that respondents may overestimate their child’s behavior because they may confuse ability to perform the behavior with their usual performance (Sparrow et al., 2005). Rating scales have been found to not always accurately reflect the child’s actual behaviours because caregivers are subject to situational and contextual biases (Wells, 1981). In order to combat these biases, the authors of the Vineland suggest that the examiner must play an active role in reviewing the form and instructions with the respondent. Unfortunately, due to the online nature of the current study, it was not possible for an examiner to carefully take parents through the survey, and this may have negatively affected the accuracy of results.

Whether the current study’s failure to replicate previous results finding a relationship between anxiety and cognitive functioning is due to differences in measurement, a broader sample, or some other unknown cause, more research is needed to explore anxiety in individuals across a broad range of cognitive abilities, using more appropriate measures than have been used in the past. The cluster analysis did suggest differences in anxiety across levels of functioning and is discussed below.

**The Relationship between Anxiety and Repetitive Behaviours**

The current study replicated findings that higher levels of anxiety are associated with a greater presence of repetitive behaviours in children with ASD (Tantam 2003; Rodgers, Glod,
The current study sought to extend recent findings suggesting that anxiety may be differentially related to lower-order versus higher-order behaviours. I found that higher-order repetitive behaviours were indeed better at predicting somatic anxiety than lower-order behaviours. This is similar to a recent finding by Rodgers and colleagues indicating that in anxious individuals, insistence on sameness and circumscribed interests are significantly correlated with anxiety while sensory-motor repetitive behaviours are not.

Lower-order behaviours involve the repetition of specific movements (such as hand-flapping, rocking, or twirling), whereas higher-order behaviours involve more complex behaviours such as adherence to rules, compulsions, rituals, circumscribed interests, and insistence on sameness. Kinsbourne (1987) suggests that each subtype of repetitive behaviour moderates anxiety in its own way, with lower-order repetitive movements serving to compensate for anxiety occurring at the time, while higher-order behaviours serve to defend against the possibility of encountering an anxiety-inducing situation. Other researchers support Kinsbourne’s theory about each type of behaviours’ differential effects; anxious children with ASD have been found to use lower-order behaviours to calm themselves (Bauer et al. 2002; Joosten et al., 2009), while higher-order behaviours, such as restricted interests and routines may provide a sense of organization and controllability, possibly providing a buffer against anxiety (Baron-Cohen, 1989; Mercier et al., 2000; Zandt et al., 2007). In terms of coping behaviours, lower-order repetitive behaviours are a distraction technique, temporarily allowing the child to escape the negative experience, and higher-order behaviours are an avoidance technique, regulating emotional arousal by evading unpredictability altogether.

I theorize that avoidance of anxiety is the reason that higher-order repetitive behaviours are a better predictor of somatic anxiety than lower-order behaviours. As discussed above,
higher-order repetitive behaviours promote controllability and by extension predictability, which serves to reduce anxiety at the time by limiting demands placed by the surrounding environment on a child with ASD. Rodgers et al. (2012) suggest that the positive feeling brought on by this manufactured predictability leads to positive beliefs about the role and function of higher-order repetitive behaviours, further encouraging their use. Over time, the use of such behaviours leads to poor engagement with the wider environment and consequently, individuals rely more on repetitive behaviours, thus perpetuating the anxiety cycle. While children may try to limit their anxiety by controlling the predictability of their environment with higher-order repetitive behaviours, it is impossible for their lives to be completely predictable; therefore, when they are forced out of their routine, the change is even more traumatic, resulting in greater anxiety. Simply put, although avoidance is effective at reducing anxiety in the short-term, it prevents the individual from learning to regulate his or her emotional arousal. Because the individual never achieves a sense of mastery over the anxiety-provoking event, their fears are maintained. I propose that individuals high in higher-order repetitive behaviours engage in this perpetual cycle resulting in a continuous stream of anxiety, whereas lower-order behaviours result in less anxiety as they serve simply to distract from anxiety as it happens in the moment. Higher-order repetitive behaviours are more associated with anxiety because they never allow the child to develop truly effective coping styles over time.

It is important to note that individuals with ASD do not engage in repetitive behaviours exclusively to cope with anxiety. One explanation similar to that of coping with anxiety is that individuals with ASD engage in repetitive behaviours in order to modulate levels of arousal and thus maintain homeostasis (Turner, 1999). They may also be learned operant behaviours that allow the individual to gain attention from caregivers or some other reinforcement (Turner).
Finally, some repetitive behaviours may be a manifestation of executive functioning impairments that prevent individuals from planning and controlling their behaviours (Turner). While there are multiple reasons for engaging in repetitive behaviours, anxiety reduction may be a primary motivator for engaging in these behaviours, at least in some children.

**Cluster Patterns of Observable Behaviours**

In order to explore patterns of how observable correlates of anxiety are related to one another across levels of cognitive functioning, I conducted a cluster analysis and found three cluster groups. The Low-Functioning Cluster, which was characterized by the lowest level of cognitive functioning and highest level of autistic symptoms, scored high in all four categories of observable correlates of anxiety. The Medium-Functioning Cluster, which had medium cognitive functioning and fewer autistic symptoms, scored low all four categories of observable correlates of anxiety. Finally, the High-Functioning Cluster, characterized by the highest cognitive functioning and fewer autistic symptoms, was medium in somatic anxiety and higher-order repetitive behaviours, low in lower-order behaviours, and high in sensory processing issues.

The Low-Functioning Cluster scored the highest on autistic symptoms as assessed by the SCQ and lowest on cognitive functioning as assessed by the Vineland, a relationship that is expected based on previous research (Bölte, Holtmann, & Poustka, 2008). These individuals scored the highest on all four observable correlates of anxiety: somatic anxiety, higher-order repetitive behaviours, lower-order repetitive behaviours, and sensory processing issues. While low-functioning individuals have typically not scored high on anxiety in the past, it is likely that the Somatic Anxiety Scale was able to pick up on symptoms not assessed in scales requiring verbal communication. The higher level of sensory processing issues replicates previous findings indicating a correlation between anxiety and sensory processing issues (Clark & Watson, 1991;
Neal et al., 2002). The increased number of both lower and higher-order repetitive behaviours in this group is also supported by previous theories suggesting that individuals high in sensory processing issues engage in repetitive behaviours in order to calm themselves (Kinsbourne, 2011); however, the observation of high levels of higher-order repetitive behaviours in low-functioning individuals was less reflective of previous research, as these are more commonly observed in high-functioning individuals (Turner, 1999). That said, both types of behaviours are often present in individuals across the spectrum so it is not surprising that I would observe these behaviours in low-functioning individuals. One does not have to be verbal in order to exhibit many of the higher-order repetitive behaviours. Many higher-order items are simply resistance to change (e.g. “Insists on sitting in the same place”, “Dislikes changes in appearance/behaviour of the people around him/her”) and are therefore quite easily expressed by low-functioning individuals, particularly as they have a tendency to focus on the minute details of their environment. As mentioned above, these results do need to be interpreted with caution given that there were only seven individuals in this cluster.

It is possible that the limited cognitive functioning of individuals belonging to the Low-Functioning Cluster led them to experience heightened anxiety. The inability to verbally communicate with the caregivers prevents them from gaining a sense of what to expect in their day to day lives, and therefore their world is constantly filled with the unknown. The discomfort that comes with high levels of sensory processing issues may further compromise the predictability of their surroundings, exacerbating their anxiety. In order to deal with the unpredictability of their lives, these individuals engage in lower-order repetitive behaviours to calm themselves while engaging in higher-order repetitive behaviours to add some level of
control to their otherwise chaotic lives. This group comprises those individuals typically excluded from research due to difficulties with assessment and recruitment.

The Medium-Functioning Cluster was characterized by low scores on all scales, except cognitive functioning where they scored in the middle. While these individuals do experience problems, they exhibit fewer autistic symptoms which may make their experiences more controllable and less stressful, yet they are not at an advanced cognitive level resulting in a greater ability to reflect and ruminate on their difficulties.

Finally, the High-Functioning Cluster had the highest Vineland scores and the fewest autistic symptoms. These individuals expressed the most complicated pattern of behaviours as they scored medium in somatic anxiety and higher-order repetitive behaviours, low in lower-order repetitive behaviours, and high in sensory processing issues. I expect that these individuals engaged in less lower-order repetitive behaviours as those behaviours are more commonly observed in individuals considered low-functioning (Turner, 1999). Both higher-order repetitive behaviours and the tendency to over-respond to environmental stimuli are associated with anxiety (Clark & Watson, 1991; Neal et al., 2002; Rodgers et al., 2012). I theorize that the increased levels of higher-order repetitive behaviours and sensory processing issues contributed to anxiety in the High-Functioning group.

Individuals in the High-Functioning Cluster scored higher than the Medium-Functioning Cluster on both the Somatic Anxiety Scale and the Spence. This follows with previous research with individuals whose IQs are in the normal range indicating that higher-functioning individuals experience greater anxiety than those who are lower-functioning (Bellini, 2004; Weisbrot et al., 2005; White et al., 2009). I propose that the highest functioning individuals experience more
anxiety than their peers who are slightly lower-functioning because they have greater cognitive ability to reflect and ruminate on their deficits, and a better understanding of their difficulties.

Interestingly, children in the High-Functioning Cluster scored lower on somatic anxiety than those in the Low-Functioning Cluster. This finding suggests that previous assumptions about a positive linear relationship between anxiety and level of cognitive functioning may be incorrect. It is possible that individuals in the High-Functioning Cluster may have scored medium in somatic anxiety because they are able to express their anxiety in more cognitively advanced ways and so they do not hold in that tension to the same degree, resulting in less somatic symptoms than individuals in the Low-Functioning Cluster. It may also be the case that when anxiety is accurately assessed in low-functioning and non-verbal individuals, that they exhibit the greatest levels of anxiety. Although I did not observe a relationship between somatic anxiety and level of functioning in regression analyses, the findings of the cluster analysis suggest that it is possible that the sample simply lacked the necessary power, and that there is indeed a quadratic trend, in which the highest and lowest functioning individuals exhibit higher levels of anxiety, while those at a medium functioning level exhibit less anxiety. However, given the small low-functioning cluster, and the wide variability of functioning seen within the other two clusters, further research is needed to explore the association between cognitive functioning and anxiety to clarify the nature of this association.

Limitations and Future Directions

The results of the current study must be interpreted with a degree of caution due to a number of limitations. The nature of an online study comes with many complications. Because the researchers never came in direct contact with the participants, it is impossible to know whether respondents were paying attention or providing accurate information as they completed
the study. The study was lengthy in duration and therefore it is possible that parents may have clicked through without closely attending to questions. This is unlikely, however, given that the reliability of all scales was in the acceptable range.

Another problem that came with conducting a study online was incomplete data. In order to encourage participants to complete as many of the surveys as possible without becoming frustrated by being unsure of a response, participants were permitted to answer “Not Applicable/Don’t Know” to most of the questions. This resulted in missing data for many of the surveys, particularly for the Zung, a measure designed for parents to complete about their own anxiety. This resulted in limited data for analyses and notably affected the reliability of the scale. As discussed in my data analysis reasoning, I chose to interpret “Not Applicable/Don’t Know” responses in the Zung as absence of the symptom; however, the scale was never validated with this adjustment. I made this assumption based on analyses of the data and of patterns within the data but I cannot know with absolute certainty that participants interpreted “Not Applicable/Don’t Know” as an absence of symptoms. I should have included “None of the time” as an option and first piloted the adjusted version of the scale. This is a major limitation of my study, as parent anxiety has been found to bias parent reports of child anxiety (as it indeed appeared to in this study), and therefore it is important to control for its impact. In future research, it would be more effective to require that participants provide a response from the original validated scale for all items.

Because of the online nature of the study, the Vineland Rating Scale was used to measure cognitive functioning; however, as discussed above, it is not the ideal measure due to misinterpretation of instructions and biases that may occur with the use of rating scales (Wells, 1981). The current study may have observed different findings had it been possible to administer
a more accurate tool. In order to improve the current findings, future researchers should assess cognitive functioning with either the Vineland Semistructured Interview, or a well-established IQ test.

Finally, the current study could have been improved with the inclusion of more participants. Unfortunately, due to time constraints, I could not recruit as many participants as I originally intended. Further, I had to exclude twenty-one participants because they did not meet the cut-off for an ASD diagnosis according to the SCQ, although parents indicated that these children had been diagnosed with an ASD by a clinician. The cluster analysis in particular would benefit from a larger sample as cluster estimates become more reliable as sample size increases, and every additional variable requires an over-proportional increase in observations to ensure valid results (Mooi & Sarstedt, 2011). Future studies could improve upon my findings, and extend upon our understanding of cluster groups in particular, by including more participants.

Additionally, while the Somatic Anxiety Scale was found to be internally consistent and correlated with a traditional measure of anxiety, it is not conclusive at this time that it is an acceptable measure of anxiety. The first problem with the Somatic Anxiety Scale is that it relies on parent report. Parents can only report on the symptoms they observe in their children; however, this limitation is difficult to overcome as self-report is not feasible in the population of interest. Findings from the current study could be extended by including more objective measures of anxiety and measuring the children directly. Physiological measures in particular may provide further insight into the objective experience of anxiety (Bauer, Quas, & Boyce, 2002). Additionally, future researchers interested in developing a measure of anxiety appropriate for non-verbal individuals should examine the discriminant validity of the Somatic Anxiety Scale to ensure that it is genuinely a measure of somatic symptoms of anxiety and not associated with
multiple disorders or simply a measure of general impairment or discomfort. Another limitation of the Somatic Anxiety Scale may be that certain items may be more easily endorsed by parents of verbal individuals. Although I strived to only include scale items that did not require a verbal component for parents to recognize, items such as “My child's heart beats faster than normal” may be more easily identified in children who can communicate that feeling to their caregivers; however, I did not find that verbal items were correlated with the Vineland Talking subdomain and so I feel confident that they did not require verbal ability to recognize. While many methods may be improved upon, the current study has provided a starting point from which to begin further investigating anxiety as it occurs in low-functioning individuals with ASD.

**Implications**

The findings from the current study have many implications. The primary goal of the current study was to further our understanding of low-functioning individuals with ASD who are often excluded from anxiety research due to difficulties in measuring their symptoms. ASD is a heterogeneous condition and it is therefore inappropriate to assume that results from studies with high-functioning individuals apply to their lower-functioning counterparts. The Somatic Anxiety Scale, a measure designed for the current study to assess somatic symptoms associated with anxiety in individuals without verbal communication, may provide a foundation to develop a measure of anxiety symptoms in non-verbal individuals. It is important that non-verbal and low-functioning individuals are included in research as they comprise up to 40% of the ASD population (Fombonne, 2005). I am hopeful that the development of a measure that does not require verbal communication will encourage researchers to include low-functioning and non-verbal participants in their future research projects. With an improved understanding of these
complicated individuals, intervention programs can be better developed and consequently low-functioning children with ASD can have a better outcome.

Anxiety is overrepresented in the ASD population, with approximately 40% of youth with ASD meeting criteria for an anxiety disorder (Van Steensel, Bogels & Perrin, 2011). With such a high prevalence, it is important to identify symptoms as soon as possible in order to provide early intervention in order to reduce the mental, social, and emotional burden on individuals and their families. It is possible that through early intervention state anxiety could be prevented from becoming trait anxiety. Although the current study could not determine causality, by conducting cluster analyses and establishing patterns of co-occurring behaviours, this study provided a starting point to elucidate the mechanisms contributing to anxiety and of identifying which children are most vulnerable. Understanding behavioural patterns that occur with anxiety allows for the development of risk profiles which can then be used to inform the development of screening tools to identify those individuals most at risk.

There are many negative implications of prolonged anxiety; individuals suffering from anxiety are at a higher risk for depression and substance abuse (Kovacs et al., 1989; Kushner et al., 1990). Anxiety also further exacerbates the social difficulties already characteristic of ASD (Bellini, 2006; Myles et al., 2001). For individuals with ASD and their families, anxiety aggravates what is already a stressful and complicated disorder; therefore it is important to gain a better understanding of symptoms in order to improve the lives of those affected.
References


Appendix A
Somatic Anxiety Scale

Below is a list of items that describe children. For each item please circle the response that best describes your child’s typical behaviour in the past three months. Please answer all the items to the best of your knowledge.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>My child has difficulty catching his/her breath</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>My child has heart palpitations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>My child has stomach aches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>My child has hot or cold flushes or chills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>My child’s heart beats faster than normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>My child trembles or shakes when confronted with certain objects or situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>My child runs away or hides from certain objects or situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>My child clings to family when confronted with certain objects or situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>My child cries when confronted with certain objects or situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>My child visibly sweats when confronted with certain objects or situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>My child’s breathing becomes heavier or faster when confronted with certain objects or situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>My child becomes agitated or cries with separated from familiar people</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>My child becomes agitated or cries with changes in routine or surroundings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>My child has difficulty getting to sleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>My child wakes up frequently during the night</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>My child is cranky or irritable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>My child cries easily or cries for no obvious reason</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>My child is restless or agitated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B
Normality Tests

Table 8

*Shapiro Wilk’s W Results*

<table>
<thead>
<tr>
<th>Test</th>
<th>df</th>
<th>Statistic</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Communication Standard Score</td>
<td>67</td>
<td>.09</td>
<td>.20</td>
</tr>
<tr>
<td>Somatic Total Score</td>
<td>67</td>
<td>.98</td>
<td>.45</td>
</tr>
<tr>
<td>Spence Total Score</td>
<td>31</td>
<td>.96</td>
<td>.37</td>
</tr>
<tr>
<td>RBS-R Total Score</td>
<td>67</td>
<td>.93*</td>
<td>.002</td>
</tr>
<tr>
<td>Higher Order Total Score</td>
<td>67</td>
<td>.96*</td>
<td>.02</td>
</tr>
<tr>
<td>Lower Order Total Score</td>
<td>67</td>
<td>.87*</td>
<td>.000</td>
</tr>
<tr>
<td>Short Sensory Profile Total Score</td>
<td>67</td>
<td>.99</td>
<td>.65</td>
</tr>
<tr>
<td>Social Communication Questionnaire</td>
<td>67</td>
<td>.96*</td>
<td>.04</td>
</tr>
<tr>
<td>Zung Total Score</td>
<td>67</td>
<td>.99</td>
<td>.72</td>
</tr>
</tbody>
</table>

* indicates significance
## Appendix C

Skewness and Kurtosis Tests

Table 9

*Skewness and Kurtosis*

<table>
<thead>
<tr>
<th>Measure</th>
<th>n</th>
<th>Skewness</th>
<th>Std. Error of Skewness</th>
<th>Kurtosis</th>
<th>Std. Error of Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Communication Standard Score</td>
<td>67</td>
<td>.29</td>
<td>.28</td>
<td>-.33</td>
<td>.56</td>
</tr>
<tr>
<td>Somatic Anxiety Scale</td>
<td>67</td>
<td>.24</td>
<td>.30</td>
<td>-.05</td>
<td>.59</td>
</tr>
<tr>
<td>Spence Children’s Anxiety Scale</td>
<td>31</td>
<td>.36</td>
<td>.43</td>
<td>-.68</td>
<td>.83</td>
</tr>
<tr>
<td>RBS-R Total Score</td>
<td>67</td>
<td>.92*</td>
<td>.30</td>
<td>.54</td>
<td>.59</td>
</tr>
<tr>
<td>Higher-Order Repetitive Behaviours</td>
<td>67</td>
<td>.72*</td>
<td>.30</td>
<td>.20</td>
<td>.59</td>
</tr>
<tr>
<td>Lower-Order Repetitive Behaviours</td>
<td>67</td>
<td>1.32*</td>
<td>.30</td>
<td>1.37*</td>
<td>.59</td>
</tr>
<tr>
<td>Short Sensory Profile</td>
<td>67</td>
<td>-.16</td>
<td>.30</td>
<td>-.46</td>
<td>.59</td>
</tr>
<tr>
<td>Social Communication Questionnaire</td>
<td>67</td>
<td>.44</td>
<td>.30</td>
<td>-.69</td>
<td>.59</td>
</tr>
<tr>
<td>Zung Self-Rating Anxiety Scale</td>
<td>67</td>
<td>-.05</td>
<td>.30</td>
<td>-.12</td>
<td>.59</td>
</tr>
</tbody>
</table>

* indicates significance