A COMPARATIVE STUDY OF REPETITIVE BEHAVIOURS IN PEDIATRIC OBSESSIVE-COMPULSIVE DISORDER AND AUTISM SPECTRUM DISORDER

by

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A thesis submitted in conformity with the requirements for the degree of Master of Science
The Institute of Medical Science
University of Toronto

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Master of Science
Institute of Medical Science
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Abstract

Repetitive behaviours are a core feature and source of impairment in two neurodevelopmental disorders: obsessive-compulsive disorder (OCD) and autism spectrum disorder (ASD). However, few studies have systematically examined repetitive behaviours across these two disorders. As part of the Province of Ontario Neurodevelopmental Disorders network we compared repetitive behaviour subtypes in children and adolescents with OCD and ASD using several instruments. Findings revealed marked heterogeneity of repetitive behaviour subtypes in children and adolescents with OCD and ASD. Results suggest repetitive behaviour subtypes that are more common in OCD, ASD, and equally prevalent across disorders. Findings will help guide future pathophysiological studies by localizing dimensional traits of repetitive behaviours across disorders.
I would like to acknowledge the many people who have contributed to this thesis, and who have provided support, guidance, and encouragement over the past few years.

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<tr>
<td>AD</td>
<td>Autism Disorder</td>
</tr>
<tr>
<td>ASD</td>
<td>Autism Spectrum Disorder</td>
</tr>
<tr>
<td>ADI - R</td>
<td>Autism Diagnostic Interview – Revised</td>
</tr>
<tr>
<td>ADOS</td>
<td>Autism Diagnostic Observation Schedule</td>
</tr>
<tr>
<td>CBCL-OCS</td>
<td>Obsessive-Compulsive Scale of the Child Behaviour Checklist</td>
</tr>
<tr>
<td>CYBOCS-ASD</td>
<td>Children’s Yale-Brown Obsessive-Compulsive Scale for children with ASD</td>
</tr>
<tr>
<td>CY-BOCS</td>
<td>Children’s Yale-Brown Obsessive-Compulsive Scale</td>
</tr>
<tr>
<td>DSM-5</td>
<td>Diagnostic and Statistical Manual of Mental Disorders, 5th edition</td>
</tr>
<tr>
<td>ID</td>
<td>Intellectual Disability</td>
</tr>
<tr>
<td>K-SADS-PL</td>
<td>Kiddie-SADS-Present and Lifetime Version</td>
</tr>
<tr>
<td>OCD</td>
<td>Obsessive-Compulsive Disorder</td>
</tr>
<tr>
<td>OCI – R</td>
<td>Obsessive Compulsive Inventory – Revised</td>
</tr>
<tr>
<td>POND</td>
<td>Province of Ontario Neurodevelopmental Disorders network</td>
</tr>
<tr>
<td>RDoC</td>
<td>Research Domain Criteria</td>
</tr>
<tr>
<td>RBS-R</td>
<td>Repetitive Behaviour Scale Revised</td>
</tr>
<tr>
<td>RBQ</td>
<td>Repetitive Behaviour Questionnaire</td>
</tr>
<tr>
<td>SCQ</td>
<td>Social Communication Questionnaire</td>
</tr>
<tr>
<td>TOCS</td>
<td>Toronto Obsessive Compulsive Scale</td>
</tr>
<tr>
<td>WASI/WASI-IV</td>
<td>Wechsler Abbreviated Scale of Intelligence, 1st/2nd Edition</td>
</tr>
<tr>
<td>WISC-IV</td>
<td>Wechsler Intelligence Scale for Children, 4th Edition</td>
</tr>
<tr>
<td>WPPSI</td>
<td>Wechsler Preschool and Primary Scale of Intelligence</td>
</tr>
<tr>
<td>Y-BOCS</td>
<td>Yale-Brown Obsessive-Compulsive Scale</td>
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1 Introduction and Literature Review

1.1 Introduction

Obsessive-compulsive disorder (OCD) and Autism Spectrum Disorder (ASD) are two debilitating neurodevelopmental disorders that arise from disturbances in the development of the brain. The majority of individuals with OCD or ASD are diagnosed during childhood or adolescence. Although both disorders have different diagnostic criteria, one core feature of both disorders is the presence of repetitive behaviours.

Individuals with OCD or ASD engage in a wide range of repetitive behaviours but allegedly for different reasons. Those with OCD mostly engage in compulsions, or repetitive behaviours that are carried out with the goal to reduce or prevent anxiety or distress, while individuals with ASD engage in restricted, repetitive patterns of behaviour, interests, or activities that seem to be pleasurable to the individual. Examples of repetitive behaviours include stereotypic behaviours such as hand flapping, self-injurious behaviour such as skin picking, and ritualistic behaviours such as insisting on certain pre-bedtime routines. Although there are phenomenological differences between disorders, with regard to the repetitive behaviour most commonly seen in each condition, they may nonetheless have shared pathophysiology and etiology (Muehlmann & Lewis, 2012). This concept remains largely hypothetical, as few groups have systematically studied repetitive behaviours in a cross-disorder sample of individuals. One of the main methodological limitations of previously published literature has been the lack of common instruments to measure repetitive behaviours across these two disorders.

Currently, researchers tend to use different instruments to measure and assess repetitive behaviours in these two disorders.

Additionally, from a clinical perspective, repetitive behaviours are treated differently across both disorders as patients respond differently to different pharmacological and
psychosocial treatment regimens (Hollander et al., 2012; McDougle et al., 1996; McPheeters et al., 2011; King et al., 2009). Therefore, systematically studying repetitive behaviours across OCD and ASD is clinically relevant, as results from these studies could lead to 1) a better understanding of the neurobiological underpinnings of repetitive behaviours and 2) more effective and tailored treatment interventions. Studying repetitive behaviours across disorders is consistent with the current thinking about the dimensional nature of psychopathology as exemplified by the Research Domain Criteria (RDoC) initiative (Insel, 2014).

In this chapter, the RDoC project will first be reviewed. Next, clinical features of OCD and ASD will be defined, as well as the epidemiology of these disorders. A review of the literature concerning different types of repetitive behaviours and how repetitive behaviours are assessed and measured in each of these two disorders individually and across disorders will then follow. Subsequently, a brief review of the literature concerning the pathophysiology of repetitive behaviours will be presented.

1.2 Research Domain Criteria (RDoC)

The RDoC, by the National Institute of Mental Health (Insel, 2014) is a new initiative that is guiding the future of mental health research by establishing a new way of classifying mental disorders for research purposes. Rather than letting clinical disorders drive research questions, RDoC takes behavioural dimensions and neurobiological measures as a means to classify mental disorders. Specifically, the RDoC initiative challenges scientists to consider not only symptoms but also genetic and brain-circuit differences when studying and treating psychopathology (Insel & Cuthbert, 2015). As symptoms still remain relevant to understanding psychopathology, investigating symptoms that cut-across mental health disorders is an important starting point.
1.3 Clinical Features of Obsessive-Compulsive Disorder and Autism Spectrum Disorder

1.3.1 Diagnostic Criteria of Obsessive-Compulsive Disorder

The diagnostic criteria of obsessive-compulsive disorder (OCD) outlined by the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) include the following (as listed in Table 1.1): (a) Presence of obsessions, compulsions, or both; (b) the obsessions or compulsions are time consuming; (c) obsessions and compulsions are not attributable to the physiological effects of a substance; (d) disturbance is not better explained by symptoms of another mental disorder (American Psychiatric Association, 2013).

Furthermore, individuals with OCD vary in the degree of insight they have about the accuracy of the beliefs and thoughts that underlie their obsessive-compulsive symptoms. Insight can range from good or fair insight (the individual recognizes that OCD beliefs are definitely or probably not true or that they may or may not be true) to absent insight or delusional beliefs (the individual is completely convinced that OCD beliefs are true). Additionally, because up to 30% of individuals with OCD have a lifetime tic disorder, as seen most commonly in males with childhood onset OCD, it is important to also specify whether the individual has a current or past history of a tic disorder (American Psychiatric Association, 2013).
Table 1.1: DSM-5 Diagnostic Criteria for Obsessive-Compulsive Disorder

**DSM-5 Diagnostic Criteria for Obsessive-Compulsive Disorder**

A. Presence of obsessions, compulsions, or both:
   Obsessions are defined by (1) and (2):
   1. Recurrent and persistent thoughts, urges, or images that are experienced, at some time during the disturbance, as intrusive and unwanted, and that in most individuals cause marked anxiety or distress.
   2. The individual attempts to ignore or suppress such thoughts, urges, or images, or to neutralize them with some other thought or action (i.e., by performing a compulsion).
   Compulsions are defined by (1) and (2):
   1. Repetitive behaviors (e.g., hand washing, ordering, checking) or mental acts (e.g., praying, counting, repeating words silently) that the individual feels driven to perform in response to an obsession or according to rules that must be applied rigidly.
   2. The behaviors or mental acts are aimed at preventing or reducing anxiety or distress, or preventing some dreaded event or situation; however, these behaviors or mental acts are not connected in a realistic way with what they are designed to neutralize or prevent, or are clearly excessive.
   **Note:** Young children may not be able to articulate the aims of these behaviors or mental acts.

B. The obsessions or compulsions are time-consuming (e.g., take more than 1 hour per day) or cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

C. The obsessive-compulsive symptoms are not attributable to the physiological effects of a substance (e.g., a drug of abuse, a medication) or another medical condition.

D. The disturbance is not better explained by the symptoms of another mental disorder

1.3.2 Diagnostic Criteria of Autism Spectrum Disorder

ASD is categorized as a neurodevelopmental disorder in the DSM-5 (American Psychiatric Association, 2013) meaning that ASD has an onset during the developmental stage of life, and typically manifests early on in development (American Psychiatric Association, 2013).

ASD is characterized by persistent deficits in social communication and social interactions across multiple contexts, including deficits in social reciprocity, nonverbal communication behaviours, and skills in developing, maintaining, and understanding relationships. More important to this study, the diagnosis of ASD also requires the presence of restricted, repetitive patterns of behaviour, interests, or activities (American Psychiatric Association, 2013). The diagnostic criteria for ASD as outlined by the DSM-5 are described in Table 1.2.
Table 1.2: DSM-5 Diagnostic Criteria for Autism Spectrum Disorder

DSM-5 Diagnostic Criteria for Autism Spectrum Disorder

A. Persistent deficits in social communication and social interaction across multiple texts, as manifested by the following, currently or by history (for example):
1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
2. Deficits in nonverbal communicative behaviors used for social interaction, ranging for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history:
1. Stereotyped or repetitive motor movements, use of objects, or speech.
2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior.
3. Highly restricted, fixated interests that are abnormal in intensity or focus.
4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment.

C. Symptoms must be present in the early developmental period.

D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

1.4 Epidemiology

The lifetime prevalence of paediatric OCD is 2-3% by late adolescence (Rapoport et al., 2000). The prevalence in males is greater during childhood due to the earlier age of onset typically seen in young males; however, by adolescence OCD is equally common in males and females (Flament et al., 1988; Zohar, 1999). In recent years, frequencies of ASD worldwide have increased to approximately 1% (American Psychiatric Association, 2013). An increase in diagnosis over the years may reflect 1) the expansion of the diagnostic criteria to now include a wider range of behaviours, 2) increased awareness of the disorder in school and communities, 3) different inclusion criteria in research studies and 4) an actual increase in the frequency of ASD in the population.

1.5 Repetitive Behaviours in Typical Development

Repetitive behaviours are a feature of typical development among children, which may function to reduce anxiety and characterize a mechanism for organizing, accommodating, and mastering current and new environments (Evans et al., 1997). Particularly, throughout early childhood, children often engage in a number of repetitive behaviours (Evans et al., 1997; Thelen, 1980). For example, Leekam et al., (2007) investigated repetitive behaviours known to occur in children with ASD, but which also occur in typically developing children. They found that repetitive motor movements, adherence to routine, and preoccupations with restricted patterns of interest were found among 679 typically developing 2-year olds from a large community sample. Based on these results, it was suggested that repetitive behaviours represent a continuum of functioning that extends to the typically developing child population.

Thelen, (1979) conducted a naturalistic, longitudinal study on 20 typically developing infants to examine the frequency and age-related changes of rhythmical stereotypies. Infants were assessed biweekly during their first year of life. They found that stereotypy
rates peaked at 24-weeks old with some infants spending as much as 25 minutes per hour engaging in repetitive, rhythmical behaviour.

During the preschool years, typically developing children begin to engage in more ritualistic and compulsive-like behaviours that are characterized by their complexity and rigidity. For example, engaging in a particular bedtime routine, insisting on watching the same movie multiple times a day, insisting the door be left open a specific amount, or arranging toys in a way that feels “just right” (Evans et al., 1997).

Several studies have reported on the prevalence of obsessive-compulsive symptoms in non-clinical populations. In non-OCD adolescents, estimates of the prevalence of obsessive-compulsive symptoms vary between 2% (Flament et al., 1988) to 19% (Vallen-Basile et al., 1994; Vivan et al., 2014). Alvarenga et al., (2015) evaluated obsessive-compulsive symptoms in 9937 children between the ages of 6-12 years. The results indicate that 14.7% of children exhibit obsessive-compulsive symptoms as measured by the parent-report Dimensional Yale-Brown Obsessive-Compulsive Scale (DY-BOCS; Rosario-Campos et al., 2006). Children engaged the most in collecting/hoarding repetitive behaviours (9.27%) followed by symmetry/ordering/arranging repetitive behaviours (2.18%).

1.6 Repetitive Behaviours in Neurodevelopmental Disorders

Repetitive behaviours refer to a broad class of symptoms that are repetitive, rigid or inflexible, and lack apparent or appropriate reason. Although they are a core feature of OCD and ASD, the type of repetitive behaviour exhibited by individuals can be very heterogeneous. As such, it is important to define the various forms of repetitive behaviours commonly seen in these two neurodevelopmental disorders.
Compulsive behaviours: behaviours that are repeated and performed according to a rule, or involve things being done until it feels “right” to the individual (American Psychiatric Association, 2013).

Stereotyped behaviour: purposeless movements or actions that are repeated in a similar manner. For example, whole body rocking, hand flapping, head nodding etc.

Self-injurious behaviour: movement or actions that have the potential to cause redness, bruising, or other injury to the body, and are repeated in a similar manner. For example, hitting oneself with hand, hand biting, skin picking etc.

Ritualistic behaviour: performing daily activities in a similar manner. Individuals usually become upset or distressed when their routine is disrupted. For example, only drinks out of a certain cup, insists on specific order of activities when using the bathroom, insists on taking a specific route to a certain destination etc.

Sameness behaviour: resists change, insists that things stay the same. For example, insists that toys remain in the same place, insists on using a particular door, and insists that specific things take place at specific times.

Restricted behaviour: having a limited range of focus, interest, or activity. For example, fascination or preoccupation with trains, strongly attached to one specific object, preoccupation with part of an object rather than the whole object etc.

Turner, (1999) conceptualized repetitive behaviours by classifying them into two overarching categories: “lower-order” repetitive behaviours and “higher-order” repetitive behaviours (Figure 1.1). Lower-order repetitive behaviours include stereotyped movements, repetitive manipulation of objects, and repetitive forms of self-injurious behaviour whereas higher-order repetitive behaviours involve more complex actions such
as compulsions, rituals, insistence on sameness, and circumscribed interests, that also have a cognitive adherence to a specific rule or needing to have things “just so”.

Figure 1.1. “Lower-order” to “higher-order” restricted and repetitive behaviours in neurodevelopmental disorders (Turner, 1999)

Restricted Repetitive Behaviours in Neurodevelopmental Disorders

Body Stereotypy
Self-Injury
Object Stereotypy
Repetitive Verbal Behaviour
Compulsions
Rituals
Sameness
Restricted Behaviour

“Lower-order” repetitive sensory-motor behaviours

“Higher-order” insistence on sameness/resistance to change and circumscribed interests

1.7 Repetitive Behaviours and OCD

Repetitive behaviours are a multidimensional feature of OCD. The majority of children and adolescents with OCD will endorse both obsessions and compulsions, however the type of compulsion can take on many different forms. A few examples of common compulsions seen in paediatric OCD include: hand washing, sorting items in a particular order, checking and rechecking the door is locked etc. Individuals often perform compulsions as a way to temporarily prevent or reduce the anxiety brought on by an obsession (American Psychiatric Association, 2013).

1.7.1 Symptom Dimension of Repetitive Behaviours in OCD

The phenotypic nature of repetitive behaviours in OCD is one that is complex and heterogeneous. The research below highlights studies that have investigated the multidimensional nature of OCD (refer to Table 1.3 for a list of these studies)
In a principal components analysis by Stewart et al., (2007) symptom dimensions in children and adolescents with OCD were identified. Lifetime occurrence of obsessive-compulsive symptoms was assessed using the 13 symptom categories from the Children’s Yale-Brown Obsessive-Compulsive Scale (CY-BOCS). Their results revealed a four-factor solution that explained 59.8% of symptom variance. Of the four factors three pertain to this study: 1) symmetry/ordering/repeating/checking; 2) contamination/cleaning/aggressive/somatic; and 3) hoarding.

Similarly, in a meta-analysis Bloch, Landeros-Weisenberger, Rosario, Pittenger, & Leckman (2008) analyzed the symptom structure of OCD using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS). A total of twenty-one studies that included 5124 participants with a diagnosis of OCD were included in their analyses. The findings revealed a four-factor structure to explain symptom dimensions. Those that relate specifically to compulsions are: 1) symmetry/ordering/counting; 2) checking; 3) cleaning, and 4) hoarding.

A recent study conducted by Park et al. (2015, manuscript ready for submission), also examined the symptom structure of OCD. This study was unique in that it measured obsessive-compulsive features in a general community sample of children and adolescents. Obsessive-compulsive features were measured using the Toronto Obsessive Compulsive Scale (TOCS; Park et al. 2015, manuscript ready for submission), a 21-item scale that measures obsessions and compulsions on a 7-point scale (from “-3 = Far Less Often” to “+3 = Far More Often”), for frequency of symptoms. 17,263 children and adolescents between the ages of 6 and 17 years recruited from the Ontario Science Centre in Toronto, Canada were included in the study. The results of this study revealed six obsessive-compulsive dimensions. Of the six, four are pertinent to this study: 1) Cleaning/Contamination; 2) Hoarding; 3) Counting/Checking, and 4) Symmetry/Ordering.
### Table 1.3 Studies of Symptom Structure of Obsessive Compulsive Disorder

<table>
<thead>
<tr>
<th>Study</th>
<th>Measure</th>
<th>Number of Factors</th>
<th>Repetitive Behaviour Factor Names</th>
<th>Participants</th>
<th>Mean Age</th>
<th>n</th>
</tr>
</thead>
</table>
| Stewart et al. (2007)  | Y-BOCS  | 4-factor model    | 1. Symmetry/ordering/repeating/checking  
2. Contamination/cleaning/aggressive/somatic  
3. Hoarding  
4. Sexual/religious | OCD patients       | 12       | 231   |
| Bloch et al. (2008)*   | Y-BOCS  | 4-factor model    | 1. Symmetry obsession, repeating, counting  
2. Cleaning and contamination  
3. Hoarding  
4. Aggression, sexual, religious, and somatic obsessions and checking compulsions | OCD patients       | Paediatric and adult population | 5124  |
| Park et al. (2015)     | TOCS    | 6-factor model    | 1. Symmetry/ordering  
2. Cleaning/contamination  
3. Counting/checking  
4. Hoarding  
5. Rumination  
6. Superstition | Non-clinical population | 6-17     | 17263 |

*Meta-analysis of symptom structure of OCD
1.7.1.1 Age-Related Differences and Clinical Features of OCD

There is a well-established body of literature examining the influence of age of onset of OCD on the characteristics and phenomenology of the manifestation of the disorder (Geller et al., 1998). However, only few studies have directly compared OCD symptoms across the lifespan.

When comparing the phenomenology of OCD between children, adolescents, and adults previous literature suggests no age-related differences (Geller et al., 2001; Swedo, Rapoport, Leonard, Lenane, & Cheslow, 1989). One of the first studies to review the phenomenology of OCD in children and adolescents was conducted by Swedo et al. (1989) who compared the clinical presentations of OCD in their sample to adults with OCD. The most common symptoms reported were washing, grooming, and checking rituals, and preoccupation with disease, danger, and doubt and no significant difference between children, adolescents, and adults with OCD was found. Similar to this finding, Geller et al. (2001) also found that the type of compulsion endorsed was similar when they systematically compared children (< 12 years), adolescents (≥ 12 years), and adults with OCD. However, they did find that hoarding was reported more often in children and adolescents compared to adults (30% and 36% vs. 18%, respectively).

Other studies that systematically investigated OCD symptoms have focused on similarities and differences between child-onset OCD and late-onset OCD. Converging with previous studies, Mancebo et al., (2008) found no significant difference between type of compulsion endorsed and age group. This group collected data during a structured diagnostic interview and self-report questionnaire from 257 patients with child-onset OCD. The sample included 20 children, 44 adolescents and 193 adults. The most common type of compulsions endorsed was miscellaneous compulsions (for example, rituals involving other people, need to tell/ask, tic-like compulsions etc.) for children and adolescents (90%), and checking compulsions for adults (75%).
Contrary to previous findings, significant symptom differences between age groups has been reported (Butwicka & Gmitrowicz, 2010). Specifically, adults reported significantly more cleaning/washing, and checking compulsions, whereas adolescents reported significantly more miscellaneous related compulsions compared to adults. The authors of this study suggest that the different symptom presentation between age groups may be due to the postulation that adults with early-onset OCD differ clinically from adults with late-onset OCD.

In summary, few studies exist that have directly compared OCD symptomatology between children and adolescent patients with OCD. Furthermore, the literature mainly focuses on overall obsessive-compulsive symptoms, as opposed to focusing on compulsions or repetitive behaviours across the lifespan. Although most of the research has focused on differences between paediatric and adult patients, with a focus on age of OCD onset in adults, there nevertheless may be a difference of symptomatology across a patient’s lifespan.

1.7.2 Assessing Repetitive Behaviours in OCD

Repetitive behaviours in OCD are generally measured within the compulsions subscale of a parent/self-report scale or during a semi-structured interview between the clinician and child with OCD. Currently, there are many instruments that measure the presence of obsessive-compulsive symptoms and/or severity. However, there are no self/parent-report instruments that are designed to only measure repetitive behaviours in individuals with OCD. Below is a description of two parent/self-report scales used to measure obsessive-compulsive symptoms in OCD.

An example of a short self-report scale is the Obsessive-Compulsive Scale of the Child Behaviour Checklist (CBCL-OCS). The CBCL-OCS is an 8-item scale that measures symptoms on a 3 point scale from 0 to 2 with 0 if the item is not true of the child, 1 if the item is sometimes/somewhat true of the child and 2 if the item is often true for the child.
(Hudziak et al., 2006). Of the 8 items in the CBCL-OCS, only two reflect compulsions or repetitive behaviours. “Repeats certain acts over and over; compulsions” and “Strange behaviour”.

Another measure that is used to assess obsessive-compulsive symptoms in children and adolescents with OCD is the Obsessive Compulsive Inventory – Revised (OCI-R; Foa et al., 2002) – a shorter adaptation of the Obsessive Compulsive Inventory (Foa, Kozak, & Salkovskis, 1998). The OCI-R is comprised of six subscales: washing, checking, ordering, obsessing, hoarding, and neutralizing. When the OCI-R was used on individuals with OCD, and compared to individuals with other anxiety disorders, it was found to have good convergent validity, and performed well in discriminating OCD from other anxiety disorders. Furthermore, a confirmatory factor analysis confirmed the 6-factor symptom dimension model (Abramowitz & Deacon, 2006).

As mentioned previously, clinicians usually measure repetitive behaviours during a semi-structured interview. One measure that is commonly used during an OCD assessment interview is the CY-BOCS. The Compulsions Checklist of the CY-BOCS is grouped according to content such as washing, checking, and rituals. The presence of a particular compulsion, either within the past week (current) or in the individual’s past is noted. The severity of the compulsions is then rated on five Severity Items for Compulsions: time occupied by compulsions, interference due to compulsions, distress associated with compulsions, resistance against compulsions, and degree of control over compulsions. Each of these items are rated on a 5-point scale ranging from 0 to 4: 0 none; 1 mild; 2 moderate; 3 severe, and 4 extreme. The Compulsions Severity Score is then obtained by adding the five severity items, giving a compulsion sub score ranging from 0 to 20.

1.8 Repetitive Behaviours in ASD

Restricted, repetitive patterns of behaviour, interests, or activities represent a core diagnostic feature of ASD (American Psychiatric Association, 2013). Although these behaviours are grouped into one of three diagnostic domains, it should not be assumed
that restricted and repetitive behaviours are similar in their clinical presentation. Similar to OCD, repetitive behaviours in ASD are multidimensional. Children with ASD between the age of 18 months and 24 months display more frequent repetitive sensory motor behaviours compared to intellectually disabled individuals and typically developing controls (Watt, Wetherby, Barber, & Morgan, 2008).

1.8.1 Symptom Dimensions of Repetitive Behaviours in ASD

Research over the last two decades suggests that restricted and repetitive behaviours in children and adolescents with ASD can be divided into two main subcategories: 1) Repetitive Sensory Motor behaviours which include motor mannerisms, sensory seeking behaviours, and repetitive use of objects, and 2) Insistence on Sameness behaviours which are characterized by compulsions, rituals, and difficulties with transitions or changes in daily routines (Cuccaro et al., 2003). This result converges on previous concepts describing repetitive behaviours as “lower-order” and “higher-order” (Turner, 1999). However, studies conducted in a clinical population reveal that ASD restricted and repetitive behaviours can be categorized into 2 to 5 symptom dimensions. Several of these studies are described below (also refer to Table 1.4 for a list of studies examining different symptom subcategories and a description of factor dimensions in ASD).

Szatmari et al., (2006) was one of the first groups to investigate the structure of restricted and repetitive behaviours in ASD. Eleven items from the restricted, repetitive behaviours and interests domain from Autism Diagnostic Interview-Revised (ADI-R; Rutter, Bailey, & Lord, 2003) were used in a principal components analysis of 339 individuals with a diagnosis of Pervasive Developmental Disorders (in the DSM-IV, this includes Autistic Disorder, Asperger syndrome, Atypical Autism, Rett’s disorder, and Childhood Disintegrative Disorder) with a mean age of 100.8 months old. The findings indicate a 2-factor model: 1) insistence on sameness and 2) repetitive sensory and motor behaviours. Similarly, Georgiades, Papageorgiou, & Anagnostou (2010) also found a two-factor solution when they assessed 205 Greek individuals with ASD using the Repetitive Behaviour Scale - Revised (RBS-R; Bodfish et al. 2000). However, their two-factor
solution was described as “lower-order” and “higher-order” restricted and repetitive behaviours. Results from this study provide support that restricted and repetitive behaviours in ASD remain stable across cultures.

Bishop et al., (2013) conducted an exploratory factor analysis of the ADI-R and RBS-R to identify subcategories of repetitive behaviours in children with ASD. Data was used from the Simons Simplex Collection, a genetic study that is limited to one child with ASD who had no first, second, or third degree relative with ASD Fischbach & Lord, (2010), and included 1825 probands with ASD. For the ADI-R, a 2-factor solution provided a satisfactory fit to the data. The exploratory factor analysis of the RBS-R items reveals a 5-factor solution that provided a satisfactory fit to the data. The factor structure was similar to that originally reported by Lam & Aman, (2007) and Mirenda et al., (2010).

Lam, Bodfish, & Piven, (2008) conducted another factor analysis, using the ADI-R, on individuals with ASD aged 20 months to 29 years. A 3-factor solution accounted for 52% of the variance in the sample. Specifically, the three factors were 1) repetitive use of objects, hand and finger mannerisms, 2) compulsions, rituals, and insistence on sameness, and 3) circumscribed interests.

Anagnostou et al., (2011) examined repetitive behaviours in 181 children age 2 to 18 years with ASD. The authors carried out an exploratory and confirmatory factor analyses of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) checklist to identify a clinically meaningful factor structure. The analysis supported a 4-factor solution: obsessions, higher-order repetitive behaviours, lower-order repetitive behaviours, and hoarding.

A more recent study conducted by Scahill et al., (2014) analyzed the component structure of repetitive behaviours in children with ASD using the modified Children’s Yale-Brown Obsessive-Compulsive Scale for children with ASD (CYBOCS-ASD). Subjects included 272 medication-free patients from the Pediatric Psychopharmacology Autism Network.
trials. The factor analysis resulted in a 5-factor model to classify repetitive behaviours (that explained 34.4% of the variance).

In interpreting the variability in results it is important to be mindful of the differences in measures used in the above studies. Previous studies that used the Y-BOCS (Anagnostou et al., 2011) and CYBOCS-ASD (Scahill et al., 2014) were using measures that are generally used to assess symptoms of OCD. As such, that variability in the resulting number of factors could be because the instruments themselves included domains not previously assessed - specifically, hoarding (Anagnostou et al., 2011; Scahill et al., 2014) and obsessions (Anagnostou et al., 2011). For example, one could argue that when using the YBOCS to measure repetitive behaviours in ASD (for example, as Anagnostou et al., 2011 did), the findings converge with previous studies, demonstrating a 2-factor solution (“lower-order” and “higher-order”) plus two other domains (hoarding and obsession), not previously assessed.

In summary, the literature to-date suggests that restricted and repetitive behaviours associated with ASD comprise a heterogeneous group of behaviours. Specifically, subcategories of restricted and repetitive behaviours can be categorized from 2-factor dimensions up to 5-factor dimensions. The discrepancies outlined in the aforementioned studies may partly be due to methodological inconsistencies regarding basic differences of measures used to assess repetitive behaviours or population age. Taken together, repetitive behaviours exhibited by individuals with ASD seem to group into clusters that are more broadly defined in some analyses and more rigidly defined in others.
<table>
<thead>
<tr>
<th>Study</th>
<th>Measure</th>
<th>Number of Factors</th>
<th>Repetitive Behaviour Factor Names</th>
<th>Mean Age (years)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Szatmari et al. (2006)</td>
<td>ADI-R</td>
<td>2-factor model</td>
<td>1. Insistence on sameness 2. Repetitive sensory and motor behaviours</td>
<td>8.4</td>
<td>339</td>
</tr>
<tr>
<td>Bishop et al. (2013)</td>
<td>ADI-R</td>
<td>2-factor model</td>
<td>1. Insistence on sameness 2. Repetitive sensory motor,</td>
<td>8.9 (4-18)</td>
<td>1825</td>
</tr>
<tr>
<td>Lam, Bodfish &amp; Piven (2008)</td>
<td>ADI-R</td>
<td>3-factor model</td>
<td>1. Insistence on sameness 2. Repetitive motor behaviours 3. Circumscribed interests</td>
<td>9 (1.7 – 29 years)</td>
<td>316</td>
</tr>
</tbody>
</table>
1.8.1.1 Age Related Differences and Repetitive Behaviours in ASD

Age related differences in repetitive behaviours in individuals with ASD have received significant attention in the literature as the manifestation of these behaviours varies with age. Cross-sectional and longitudinal studies have shown that the severity of restricted and repetitive behaviours in ASD tends to decrease with age (Fecteau, Mottron, Berthiaume, & Burack, 2003; Mawhood, Howlin, & Rutter, 2000; Seltzer, Orsmond, Shattuck, & Krauss, 2003; Shattuck et al., 2007), however, existing research suggests that the manifestation of repetitive behaviours alters with age. For example, younger children exhibit more sensory repetitive behaviours while older children exhibit more complex, ‘higher-order’, repetitive behaviours (Milterni, Bravaccio, Falco, & Fico, 2002). Converging with previous literature, Lam and Aman (2007) revealed different age related patterns for different subtypes of repetitive behaviours when comparing children and adults with ASD. Specifically, they found that stereotyped and restricted repetitive behaviours were more common in children with ASD, self-injurious and compulsive repetitive behaviours were comparable across groups, and ritualistic and sameness repetitive behaviours were more frequent among adults with ASD.

In previous studies that compared younger and older children with ASD, self-injury, insistence on sameness, restricted interest, and compulsive repetitive behaviours were more frequent among older children with ASD (Bishop et al., 2006; Richler et al., 2010). However, the pattern of repetitive behaviours exhibited changed when nonverbal IQ was taken into account. Specifically, restricted interest repetitive behaviours did not show age-related differences, whereas self-injurious, insistence on sameness, and compulsive repetitive behaviours were more common in younger children with ASD compared to older children with ASD (Bishop et al., 2006).

In comparing 700 individuals with ASD, ranging in age from 2 to 62, Esbensen, Seltzer, Lam, & Bodfish, (2008) analyzed age-related difference of restricted repetitive behaviours using the RBS-R. According to their findings, overall, older individuals with ASD tended to exhibit less repetitive behaviour compared to younger individuals with ASD. This finding held true even when controlling for gender, comorbid diagnosis of Intellectual Disability, age, and prescription for psychotropic medication. When analyzing the different subscales of the RBS-R (stereotyped,
self-injurious, compulsive, ritualistic/sameness, and restricted interest), and controlling for gender, comorbid Intellectual Disability (ID), and psychotropic medication use, older individuals with ASD consistently exhibited fewer repetitive behaviours. Additionally, when taking into consideration a diagnosis of ID, stereotyped repetitive behaviours were the only subtype that appeared to be more persistent in individuals with comorbid ASD and ID. When considering age-related differences, children and adolescents with comorbid ID continue to exhibit more stereotyped repetitive behaviours compared to adults with comorbid ID.

In summary, extant research regarding age-related patterns of repetitive behaviours in individuals with ASD suggests that age is associated with variations in the manifestation of repetitive behaviours. Although there are discrepancies among the literature, as different studies include different age groups, there is some converging literature identifying a trend of repetitive behaviour subtypes remaining stable with age or becoming less frequent with age. Further research is needed to clarify the association between age and patterns of repetitive behaviours in individuals with ASD.

1.8.2 Assessing Repetitive Behaviours in ASD

Currently, researchers in the ASD field use various assessment tools to measure repetitive behaviours in ASD. The ADI-R (Lord, Rutter, & Le Couteur, 1994) is a semi-structured parent interview and is the most widely used research measure for the diagnosis of ASD. The ADI-R is categorized into three diagnostic domains: 1) social interaction, 2) nonverbal and verbal communication, and 3) restricted, repetitive behaviours and interests and is scored using ‘current’ (within 3 months of interview) and ‘ever’ (throughout the individual’s life) ratings.

Another measure that is commonly used to assess repetitive behaviours in ASD is the RBS-R, refined by Bodfish et al. (2000) from the original Repetitive Behaviour Scale (Bodfish, Symoms, & Lewis, 1999). The RBS-R has 6 subscales: 1) stereotyped, 2) self-injurious, 3) compulsive, 4) ritualistic, 5) sameness, and 6) restricted repetitive behaviours. The revised version of the RBS was expanded to explore more complex repetitive behaviours that are observed in individuals with ASD, and all items have been conceptually grouped based on clinical experience. Bodfish
and Lewis (2002) conducted a principal components analysis on the RBS-R and found that interrater reliability ranged from 0.55 (sameness) to 0.78 (self-injurious), and test-retest reliability ranged from 0.52 (ritualistic) to 0.96 (restricted).

1.9 Repetitive Behaviours Across Obsessive-Compulsive Disorder and Autism Spectrum Disorder

Recent efforts have been directed towards understanding the similarities and differences of repetitive behaviours in OCD and ASD. Because repetitive behaviours are a core feature and source of impairment in OCD and ASD, recent research has shifted to simultaneously studying this behavioural phenotype across both disorders (refer to Table 1.5 for a list of studies that examine repetitive behaviours across OCD and ASD).

Recognizing the need to systematically investigate the nature of repetitive behaviours in individuals with OCD compared to individuals with ASD, McDougle et al., (1995) was the first to do so using a case-controlled method. Their study included 50 adults with a primary diagnosis of autistic disorder (AD; in accordance with the DSM-III-R and DSM-IV), and 50 adults with a primary diagnosis of OCD (in accordance with the DSM-III-R and DSM-IV). Participants were administered the Y-BOCS symptom checklist and types of compulsions were evaluated across groups. Discriminant function analysis revealed that individuals with AD could be distinguished from those with OCD on the basis of type of repetitive behaviour they exhibited. Specifically, repetitive ordering, hoarding, telling/asking, touching, tapping, rubbing and self-injurious repetitive behaviours occurred significantly more in individuals with AD compared to OCD. Conversely, cleaning, checking, and counting behaviour was more common in individuals with OCD. From this study, the authors concluded that the repetitive behaviours identified in the AD group were, in general, less organized, whereas the repetitive behaviours identified in the OCD group were more complex. One limitation of this study is that participants that were included were adults. Further research is warranted to analyze the type of repetitive in children and adolescents with OCD or ASD, and to see if the pattern of repetitive behaviours observed differs from the adult population.
In the only study to include children and adolescents, Zandt, Prior, & Kyrios, (2007) compared repetitive behaviours in children with high functioning autism and children with OCD. Participants were 54 children and adolescents aged 7-16 years; 19 of which had a primary diagnosis of ASD, 17 had a primary diagnosis of OCD, and 18 were typically developing children. Parents or guardians were administered the Repetitive Behaviour Questionnaire (RBQ; Turner, 1995), a measure that assesses repetitive language, sameness, and repetitive movements in ASD. In addition, the CY-BOCS symptom checklist was also administered. Unlike McDougle et al. (1995), this study revealed no significant difference between the ASD group and OCD group for total repetitive behaviour, sameness behaviour, or repetitive movements scores from the RBQ. Furthermore, those in the OCD group reported significantly more compulsions compared to those in the ASD group. When refining the type of compulsions endorsed, children in the OCD group endorsed more compulsions across all domains. One exception was that children in the ASD group were comparable to the OCD group for compulsions involving another person and ordering compulsions. Based on these results, the authors concluded that compulsions in children with ASD tended to be less sophisticated; however, the authors acknowledged the study’s small sample size as well as the lack of structured diagnostic interviews. Nonetheless, the results from this study highlight the challenges associated with assessing repetitive behaviours across these two neurodevelopmental disorders.

As an extension of the above study, Zandt, Prior, & Kyrios, (2009) investigated the relationship between executive functioning and repetitive behaviours across OCD and ASD. In addition to the RBQ and CY-BOCS symptom checklist, the same individuals mentioned in the preceding study were compared across a battery of executive function measures. They found limited support for a relationship between executive function and repetitive behaviours; however, the effects were small and variable across the diagnostic groups and measures.

In summary, research concerning similarities and differences of repetitive behaviours in children and adolescents with OCD and ASD is lacking. Zandt, Prior, and Kyrios (2007) were the only
researchers to examine repetitive behaviours across these two disorders in children and adolescents. Further research is needed to delineate similarities and differences of repetitive behaviours across OCD and ASD. The overlapping feature of restricted and repetitive behaviours across OCD and ASD (for example, hand flapping as a stereotypy versus a compulsion performed according to a rule) makes differentiating between the two disorders a challenge for clinicians and can have significant implications for treatment.
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Measure</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zandt, Prior, &amp; Kyrios (2007)</td>
<td>19 children (mean age of 11 years) with ASD and 17 children (mean age of 12) with OCD</td>
<td>Repetitive Behaviour Questionnaire (RBQ) Children’s Yale Brown Obsessive-Compulsive Scale</td>
<td>No significant difference between ASD and OCD for total repetitive behaviour, sameness behaviour, or repetitive movements. OCD group reported significantly more compulsions compared to ASD group.</td>
</tr>
<tr>
<td>Zandt, Prior, &amp; Kyrios (2009)</td>
<td>19 children (mean age of 11 years) with ASD and 17 children (mean age of 12) with OCD</td>
<td>Repetitive Behaviour Questionnaire (RBQ) Children’s Yale Brown Obsessive-Compulsive Scale</td>
<td>For the ASD group, higher rates of difficulty in behavioural regulation and general executive functioning were related to higher rates of repetitive behaviours and compulsions. Relationship between executive function and repetitive behaviours in OCD group did not reach significance.</td>
</tr>
</tbody>
</table>
1.10 Emotional Valence of Repetitive Behaviours in OCD and ASD

In OCD, compulsions are generally ‘ego-dystonic’, meaning they are perceived as intrusive, unwanted, and causing discomfort to individuals that experience them. Though there may be a short-lived relief of anxiety while individuals are performing the compulsion, as they reduce the negative emotion associated with obsessive thought, they are not intrinsically pleasurable and provoke clinical discomfort or impairment (American Psychiatric Association, 2013). Furthermore, the obsession that corresponds with the repetitive behaviour can constitute an unwanted thought or worry that reflects exacerbation of common everyday worries, or can be odd, irrational, or seemingly magical in nature (American Psychiatric Association, 2013).

Repetitive behaviours in ASD may lead to a pleasurable affective experience. In contrast to OCD, children and adolescents with ASD may not find the repetitive behaviour as intrusive and unwanted. In individuals with ASD the restricted and repetitive patterns of behaviour are ‘ego-syntonic’. That is, the individual finds it comforting and enjoyable to perform the repetitive behaviour such that it becomes intrinsically motivating and reinforcing (Ghaziuddin, 2005). Furthermore, research indicates that some children may become frustrated, argumentative, or have tantrums when they are asked to inhibit the repetitive behaviour (Scahill et al., 2006; Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011). For individuals with ASD who exhibit restricted interests to a particular activity or object, that activity or object that the patient is strongly attached to is of interest to them (Paula-Pérez, 2013). As such, the content of their intense interest and repetitive behaviours are related. For example, a patient may have an intense restricted interest with trains, and as such, may hoard or arrange toy trains in a particular order that will cause the patient them to become upset if this order is interfered with.

Evaluating the pattern of repetitive behaviours across OCD and ASD is complicated by several factors, including the language that is commonly used when describing these
disorders, and communication impairments associated with these disorders. Children with ASD are often described as being “obsessed” with a specific subject or activity, however, this differs from obsessions associated with OCD in that, to our current knowledge, it is enjoyable and does not provoke anxiety (Szatmari, Archer, Fisman, Streiner, & Wilson, 1995). However, it is possible that individuals with ASD experience anxiety and as a way to cope pursue these restricted interests in an obsessional manner. Though communication impairments and difficulties with introspection in these patients makes it extremely challenging to assess this theory. Furthermore, although it is believed that patients with ASD find the repetitive behaviour pleasurable, the communication challenges makes it difficult to assess whether or not the repetitive behaviour is in fact perceived as intrusive and unwanted. More work is needed to understand the emotional valence and motivation underlying repetitive behaviours in OCD and ASD.

1.11 Pathophysiology of Abnormal Repetitive Behaviours

Recent research efforts have shifted to understanding the pathophysiology underlying repetitive behaviours in children and adolescents with OCD and ASD. The overlapping symptoms as well as the unique patterns that are seen across these disorders raise the question of whether this implies differential pathophysiology. While an exhaustive review of the pathophysiology underlying abnormal repetitive behaviours is beyond the scope of this dissertation, it is important to acknowledge that there are genetic alterations and neurobiological underpinnings associated with atypical repetitive behaviours (Lewis & Kim, 2009).

In a recent article, Muehlmann & Lewis (2012) review the evidence that certain subtypes of abnormal repetitive behaviours may have shared or overlapping pathophysiology. This claim is based on the shared phenotypic similarities across conditions. Specifically, they investigated self-injurious, stereotypy, and compulsive repetitive behaviours.
The cortical basal ganglia circuitry mediates the expression of repetitive behaviours (Lewis & Kim, 2009). This pathway is comprised of multiple, parallel loops, which are anatomically distinct (Alexander, DeLong, & Strick, 1986; Langen, Durston, Kas, & van Engeland, 2011). This may explain the manifestation of different subtypes of repetitive behaviours across neurodevelopmental disorders.

Neuroimaging findings in patients with OCD or ASD also provide support for alterations in this pathway. In a recent meta-analysis, Radua & Mataix-Cols (2009) investigated structural MRI studies in patients with OCD and found that increased gray matter volume in the basal ganglia, including caudate and putamen, was correlated with OCD severity. Furthermore, Kates, Lanham, & Singer (2005) found a decrease in frontal white matter volume but no differences in caudate volumes when comparing males with stereotypies, with no other developmental or neurological disorder, to matched controls. More work is needed to understand the neural correlates as well as the unique and shared neurobiological mechanisms associated with repetitive behaviours in OCD and ASD.

In addition to neuroimaging studies, clinical and animal model studies also link repetitive behaviours to specific genetic mutations (Lewis & Kim, 2009), perhaps providing further evidence for a shared pathophysiology across these neurodevelopmental disorders. However, research examining repetitive behaviours in neurodevelopmental disorders has primarily focused on either OCD or ASD separately. It would therefore be relevant to shift the focus of research to study repetitive behaviours across neurodevelopmental disorders.

1.12 Summary

OCD and ASD are two neurodevelopmental disorders that are marked by the presence of repetitive behaviours. Repetitive behaviours represent a defining feature and source of impairment for children and adolescents with these disorders. Although repetitive behaviours represent a heterogeneous group of behaviours, the clinical presentation of
these disorders illustrates that there are repetitive behaviours that are observed in both OCD and ASD.

Repetitive behaviours are commonly divided into two categories: “lower-order” repetitive behaviours, characterized by repetition of movements, and “higher-order” repetitive behaviours that have a cognitive component characterized by their rigidity and adherence to a specific rule. In addition, factor analyses have found that abnormal repetitive behaviours can be categorized even further into different subtypes. Stereotypy, self-injurious, compulsions, restrictive, rituals, and instance on sameness are common subtypes of repetitive behaviours. Most of the literature investigating repetitive behaviour subtypes has focused on children and adolescents with ASD. Studies that have examined repetitive behaviour subtypes in OCD have only focused on compulsions in general and have not analyzed the specific type of compulsions or repetitive behaviour.

In addition, repetitive behaviours in OCD and ASD are measured using different assessment instruments and parent-report questionnaires, as groups studying different disorders tend to use different measures. The lack of common measures has made delineating similarities and differences of repetitive behaviours across OCD and ASD challenging.

Finally, the study of repetitive behaviours systematically across OCD and ASD is highly under-researched. Moreover, previous research concerning repetitive behaviours across these disorders is mixed, as some studies measure different subtypes of repetitive behaviours and others measure repetitive behaviours using a total repetitive behaviour score. It may be useful to systematically measure repetitive behaviours across OCD and ASD using the same measure. Furthermore, as there is marked heterogeneity in repetitive behaviours, it will be important to investigate specific types of repetitive behaviour when delineating similarities and differences across OCD and ASD.
CHAPTER II
REPETITIVE BEHAVIOURS ACROSS OCD AND ASD IN A PEDIATRIC SAMPLE

This chapter will present the manuscript that is in preparation for publication. A brief introduction, objective, aims, hypotheses, and methodology will be presented first. Next, demographic and clinical information for the participants will be presented, followed by a presentation of the main analysis and a discussion of the findings.

2.1 Introduction

Obsessive-Compulsive Disorder (OCD) and Autism Spectrum Disorder (ASD) are neurodevelopmental disorders, which share the core feature of repetitive behaviours (American Psychiatric Association, 2013). Repetitive behaviours in both disorders also represent a source of impairment. These behaviours are extremely complex and heterogeneous in their presentation.

Although there is evidence for similarities and differences in the heterogeneity of repetitive behaviours in OCD and ASD, systematic comparisons between disorders are lacking. Only a few studies have systematically compared repetitive behaviours in individuals with OCD and ASD and the results are mixed. Using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS), McDougle et al. (1995) compared repetitive behaviours in adults with either OCD or ASD. Differences in repetitive behaviours across disorders were described based on their organization, such that, adults with ASD tend to have less organized repetitive behaviours and adults with OCD have more complex repetitive behaviours. A study conducted by Zandt et al. (2007), demonstrated no significant difference when comparing individuals with OCD or ASD on total repetitive behaviour score, sameness repetitive behaviours score, or repetitive movement score from the Repetitive Behaviour Scale. Furthermore, when measuring compulsions between groups, based on the Children’s Yale-Brown Obsessive-Compulsive Scale (CY-BOCS), the authors found that children with ASD report less sophisticated compulsions, and in comparison, children with OCD endorse more compulsions across all domains of
the scale. More work is needed to understand similarities and differences of repetitive behaviours in OCD and ASD, as limited research is available that systematically compare both disorders in children and adolescents.

Extant research evaluating the factor structure of repetitive behaviours in OCD and ASD has identified as little as two factors to as many as six factors. However, these discrepancies may partly be due to methodological limitations including a lack of consistency in instruments to measure repetitive behaviours. We investigated repetitive behaviours in OCD and ASD by systematically delineating similarities and differences using a common set of instruments that measure various aspects of repetitive behaviours.

2.2 Aims and Hypothesis

The aim of the present study was to describe and compare repetitive behaviours in children and adolescents with obsessive-compulsive disorder (OCD) and autism spectrum disorder (ASD) using a common set of instruments.

Repetitive behaviours are prevalent in both OCD and ASD; however, previous literature shows that certain subtypes of repetitive behaviours are more associated with OCD (e.g. compulsions) while other types are more associated with ASD (e.g. stereotypies). As such, when comparing repetitive behaviour subtypes across the two groups three outcomes are expected to occur: 1) some repetitive behaviour subtypes will be more prevalent in OCD 2) some repetitive behaviour subtypes will be more prevalent in ASD and 3) some repetitive behaviour subtypes will not differ between disorders. We hypothesized that all three outcomes would be observed when comparing repetitive behaviour subtypes between disorders.

To accomplish this aim, we 1) grouped repetitive behaviours into meaningful subtypes in order to reduce the dimensionality of the data and 2) ran repeated measures logistic regression models to compare the occurrence of repetitive behaviour items across
disorders. The models control for age and sex and tested for an interaction between age and diagnosis to look for differences in trajectories between the two diagnoses.

Although this is not the primary aim of the current study, a secondary hypothesis was that repetitive behaviours in children and adolescents with OCD and ASD would remain constant at different ages, however, the type of repetitive behaviour endorsed would be different at different ages.

2.3 Methodology

2.3.1 Study Design

This study used a cross-sectional design that assessed repetitive behaviours in children and adolescents with OCD and ASD using various questionnaires that evaluate repetitive behaviours. The research methodology for this study was approved by the Research Ethics Board at The Hospital for Sick Children.

2.3.2 Recruitment and Study Procedure

Participants involved in this study were recruited from various hospital and community psychiatric clinics in Ontario, Canada. All individuals underwent informed consent and were enrolled in the Province of Ontario Neurodevelopmental Disorders (POND) Network – a multi-site study that involved a multi-disciplinary team of scientists investigating childhood neurodevelopmental disorders. Participants with OCD were recruited from The Anxiety Disorders Clinic at The Hospital for Sick Children (SickKids) and from the Child and Youth Mental Health Program at McMaster Children’s Hospital. Participants with ASD were recruited from the Autism Research Centre at Holland Bloorview Research Institute and Offord Centre for Child Studies at McMaster University and Lawson Health Research Institute. Primary diagnosis was assessed using either the Children’s Yale Brown Obsessive-Compulsive Scale (CY-BOCS) and Kiddie-SADS-Present and Lifetime Version (K-SADS-PL), for participants with OCD, or the Autism Diagnostic Observation Schedule (ADOS) and Autism
Diagnostic Interview (ADI) for participants with ASD. Once informed consent was obtained a battery of parent-report questionnaires were given to families to either complete in the clinic or to take home and were asked to mail the package of completed questionnaires back to the appropriate site.

2.3.3 Inclusion and Exclusion Criteria

All eligible participants were children and adolescents who were at least six years old at the time the questionnaires were completed and had a primary diagnosis of OCD or ASD. A minimum age of six was required based on the age criteria of the questionnaires used in this study. No exclusion criteria were employed in the study.

2.3.4 Assessment Measures

Three parent-report measures were used in this study to assess repetitive behaviours. The measures consisted of the Toronto Obsessive-Compulsive Scale (TOCS), the Social Communication Questionnaire (SCQ), and the Repetitive Behaviours Scale – Revised (RBS-R). See Appendix A for standardized questionnaires. Participants with a primary diagnosis of ASD also underwent IQ testing using age and developmentally appropriate tests.

1) Toronto Obsessive-Compulsive Scale (TOCS; Park 2015, manuscript in preparation)

The TOCS is a 21-item parent-report questionnaire. The content of the questions are derived from the Obsessive-Compulsive Inventory – Child Version (OCI-CV; Foa et al. 2010), the Leyton Obsessional Inventory Child Version (LOI-CV; Bamber et al. 2002), and the Obsessive-Compulsive Scale of the Child Behaviour Checklist (OCS-CBCL; Hudziak et al. 2006). Parents/guardians are asked to select the best rating of how often their child feels or acts compared to other children the same age, based on their observations of their child over the past six months. The items are scored on a 7-point Likert Scale, ranging from “far less often” to “far more often”. The study only included
items from the TOCS that assess repetitive behaviours. As such, nine out of the twenty-one items were included in the study (see Appendix A for specific items used in the study).

2) **Social Communication Questionnaire (SCQ; Rutter et al. 2001)**

The Social Communication Questionnaire is a parent/guardian-report questionnaire that assesses ASD symptomatology and developmental history, and is derived from the Autism Diagnostic Interview-Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003). Previous research validating the SCQ found a sensitivity of 85% and a specificity of 75% when using the cut-off score of 15 to discriminate between pervasive developmental disorders (including ASD) and other psychiatric disorders. Additionally, the convergent validity of the SCQ with the ADI-R is high (Rutter et al. 2001). It consists of 40 questions scored on a binary (yes/no) scale. The SCQ is comprised of two types of questions – those that ask if the child has *ever* engaged in the behaviour and those that ask the parent/guardian completing the questionnaire to focus on the time period between their child’s fourth and fifth birthdays. For the purpose of this study we only included items that measure repetitive behaviours within the child’s lifetime. All items chosen begin with the phrase “Has she/he ever…” and an example of a question following this phrase is “had any objects (*other* than a soft toy or comfort blanket) that she/he *had* to carry around?” A total of eleven items from the SCQ were used in the study.

3) **Repetitive Behaviour Scale – Revised (RBS-R; Bodfish et al. 2000)**

The Repetitive Behaviours Scale – Revised is a 43-item parent/guardian-report quantitative scale that measures the presence and severity of repetitive behaviours on a continuum. This scale measures six subscales of repetitive behaviours: stereotyped, self-injurious, compulsive, ritualistic, sameness, and restricted. Each item in this scale is measured on a 4-point Likert Scale ranging from 0 (“behaviour does not occur” to 3 (“behaviour occurs and is a severe problem”). Items from the scale were categorized into the six subscales based on the authors’ clinical experience and expertise. Furthermore, the
RBS-R performs well in an outpatient setting based on inter-rater reliability (Lam et al. 2007).

4) IQ Measures:

Standardized IQ tests were administered to children with ASD. The specific test administered was selected based on the child’s developmental level. In the current sample, the Wechsler Intelligence Scale for Children, 4th Edition (WISC-IV; Wechsler, 2003 – 6%), the Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 1989 – 2%), the Wechsler Abbreviated Scale of Intelligence, 1st or 2nd Edition (WASI/WASI-II; Wechsler, 1999; Wechsler, 2011 – 11% and 60% respectively), the Stanford Binet Intelligence Scale (Thorndike, Hagen, & Sattler, 1986 – 18%), and the Leiter International Performance Scale – Revised (Leiter, 1996 – 3%) were administered.

2.3.5 Statistical Analysis

Statistical analyses were performed using SAS® v9.3. Copyright (c) 2002-2010 by SAS Institute Inc., Cary, NC, USA. Variables from the TOCS and RBS-R were transformed into dichotomous variables for statistical analyses to be consistent with the SCQ. Forty-three items from the RBS-R and only specific items that measure repetitive behaviours from the TOCS and SCQ, nine items from the TOCS and eleven items from the SCQ, were used in the analysis. The data analyses examined repetitive behaviours across participants with OCD and ASD. First, to reduce the dimensionality of the data, repetitive behavior items from the SCQ were assigned to established factors from the RBS-R (Bodfish et al. 2000), and RBS-R compulsive items were assigned to TOCS factors. Only TOCS factors that include repetitive behaviour items, and the compulsive items themselves, were used (Park et al. 2015, manuscript ready for submission). Cronbach’s Alpha (Cronbach, 1951) was calculated for the selected SCQ and RBS-R compulsion items to determine with which factor they showed the best agreement.

For the primary hypothesis, repeated measures logistic regression analysis was used to model the probability of endorsing an item within each factor, where each item has been
dichotomized to correspond to present or absent. The repeated measures consisted of all the individual items within each factor. The models controlled for age and sex and an interaction between age and diagnosis was tested to look for differences in trajectories between the two diagnoses. Where the age by diagnosis effect was significant, diagnostic groups were compared at fixed age levels to determine the pattern of the differences. Where there was no age by diagnosis effect, the diagnostic groups were compared at age 11 since it was the mean age of both groups, after rounding.

Secondary analyses were also conducted. R was used to plot the prevalence and its 95% confidence limit of each individual item in order to visually assess the consistency of diagnosis effects within each factor. The ASD group was divided into those with an IQ greater than 75 and those with an IQ less than or equal to 75 in order to determine those that would meet criteria for Intellectual Disability (ID). This was done to investigate any possible effects ID might have on the presence of repetitive behaviours. As such, three diagnostic groups were created and compared across all factors: OCD, ASD-ID (IQ >75), and ASD+ID (IQ ≤75).

2.4 Results

2.4.1 Characteristics of the Sample

2.4.1.1 Participation and Clinical Characteristics

Three hundred and thirty two participants took part in this study. All study participants underwent fully informed consent with a Research Assistant. One hundred and fifty nine were recruited from the Autism Research Centre at Holland Bloorview Research Institute (Bloorview) in Toronto, Ontario, Canada. Eighty-five individuals were recruited from the Youth Mental Health Program at McMaster Children’s Hospital (McMaster) in Hamilton, Ontario, Canada. Sixty-six individuals were recruited from The Hospital for Sick Children (SickKids) in Toronto, Ontario, Canada, and twenty-two from Lawson Health Research Institute (Lawson) in London, Ontario, Canada, and. All study participants completed all study questionnaires.
Upon assessment and recruitment into the study, one hundred and five individuals had a primary diagnosis of Obsessive-Compulsive Disorder (OCD) and two hundred and twenty seven had a primary diagnosis of Autism Spectrum Disorder (ASD). Figure 2.1 presents a description of study recruitment.

**Figure 2.1 Study Recruitment**

159 individuals recruited from Bloorview

85 individuals recruited from McMaster

66 individuals recruited from SickKids

22 individuals recruited from Lawson

ASD = 159

OCD = 44

ASD = 41

OCD = 63

ASD = 5

ASD = 22

OCD = 105; ASD = 227

332 participants enrolled in the study
2.4.1.2 Demographics

The mean age of the one hundred and five participants with OCD was 12.6 (SD = 2.8) with a range of 6 – 18.3 years. The mean age of the two hundred and twenty seven participants with ASD was 11.2 (SD = 3.4). The youngest participants were 6 and the oldest participant was 20.8 years.

Fifty-two (50%) participants in the OCD group were male, and one hundred and seventy-nine (79%) in the ASD group were male.

2.4.2 Results for Main Analysis and Additional Analysis

2.4.2.1 Repetitive Behaviour Subscales

Factors from the RBS-R, excluding the compulsive behavior subscale, were used as a starting point as the subscales derived in this measure are based on clinical expertise and a results from a factor analysis (Bodfish & Lewis, 2002) reflect the true heterogeneity of repetitive behaviours. We also used the factor structure for the TOCS repetitive behaviour items (Park et al. 2015, manuscript ready for submission). As such, a total of nine factors were derived from the measures. The nine factors include: Stereotyped, Self-injurious, Ritualistic, Sameness, Restricted, Counting/Checking, Cleaning, Symmetry/Ordering, and Hoarding (Figure 2.2). Cronbach’s Alpha for the SCQ repetitive behavior items with each RBS-R factor and for RBS-R compulsion items with each TOCS compulsion factor were calculated (Table 2.1 – 2.8). All items were assigned to the factor with the highest Cronbach’s Alpha. Because all the items are dichotomous, Cronbach’s Alpha is equivalent to the Kuder-Richardson 20 (KR-20; Kuder & Richardson, 1937). One item, SCQ18, “Has she/he ever had any objects (other than a soft toy or comfort blanket) that she/he had to carry around?” correlated equally well with the Restricted factor (α = 0.28) and Stereotyped factor (α = 0.28). To resolve this issue, kappas (Cohen, 1960) with items across both factors was calculated to determine
the average kappa agreement. It was decided to include this item in the Restricted factor, as the average kappa agreement was the highest with items in this factor (Kappa = 0.18).

**Figure 2.2 Explanation of Subscales from the RBS-R and TOCS**

*Only repetitive behaviours items were included from the TOCS, maintaining the original factor structure of the measure*

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCQ12</td>
<td>Interested in part of toy</td>
<td>0.36</td>
</tr>
<tr>
<td>SCQ14</td>
<td>Unusual sensory interest</td>
<td>0.47</td>
</tr>
<tr>
<td>SCQ15</td>
<td>Odd mannerisms</td>
<td>0.40</td>
</tr>
<tr>
<td>SCQ16</td>
<td>Complex whole body movements</td>
<td>0.44</td>
</tr>
</tbody>
</table>
### Table 2.2 Coefficient Alpha’s for the Self-injurious Repetitive Behaviours Factor

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCQ17</td>
<td>Injured self deliberately</td>
<td>0.40</td>
</tr>
</tbody>
</table>

### Table 2.3 Coefficient Alpha’s for the Sameness Repetitive Behaviours Factors

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCQ3</td>
<td>Odd or repetitive phrases</td>
<td>0.32</td>
</tr>
<tr>
<td>SCQ7</td>
<td>Repetitive phrases</td>
<td>0.32</td>
</tr>
<tr>
<td>SCQ8</td>
<td>Order/rituals</td>
<td>0.37</td>
</tr>
</tbody>
</table>

### Table 2.4 Coefficient Alpha’s for the Restricted Repetitive Behaviours Factors

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCQ11</td>
<td>Odd interests</td>
<td>0.45</td>
</tr>
<tr>
<td>SCQ13</td>
<td>Intense interests</td>
<td>0.35</td>
</tr>
<tr>
<td>SCQ18</td>
<td>Atypical object had to carry</td>
<td>0.28</td>
</tr>
</tbody>
</table>

### Table 2.5 Coefficient Alpha’s for the Counting/Checking Repetitive Behaviours Factor

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBS-R18</td>
<td>Checking</td>
<td>0.35</td>
</tr>
<tr>
<td>RBS-R19</td>
<td>Counting</td>
<td>0.50</td>
</tr>
<tr>
<td>RBS-R21</td>
<td>Repeating</td>
<td>0.33</td>
</tr>
<tr>
<td>RBS-R22</td>
<td>Touch/Tapping</td>
<td>0.24</td>
</tr>
</tbody>
</table>
2.4.2.2 Mean Differences and Item Level Differences of the Models Across Disorders

Our primary hypothesis was that across all the repetitive behaviors, we would observe all three of the following: 1) subscales with items that are more prevalent in individuals with OCD, 2) subscales with items that are more prevalent in individuals with ASD, and 3) subscales with items that are equally prevalent across both disorders.

When analyzing differences across factors, Age by Diagnosis interactions were first investigated. Separate comparisons across ages were considered for factors where there was a statistically significant Age by Diagnosis interaction.
Counting/Checking, Cleaning, and Symmetry/Ordering items were significantly more common in individuals with OCD compared to ASD (Table 2.9). Self-injurious, Sameness, Stereotyped, and Restricted items were more common in individuals with ASD compared to OCD (Table 2.10). However, when we estimated differences at three ages (ages 6, 11, and 16) there was a significant Age by Diagnosis interaction for stereotyped ($\chi^2 (1) = 7.40, p = 0.007$) and restricted ($\chi^2 (1) = 5.56, p = 0.02$) repetitive behaviours. Such that, in both subtypes, these repetitive behaviours are fairly consistent across different ages for participants with ASD, however, younger participants with OCD endorse more of these behaviours compared to older OCD participants in this study. There was no significant difference across groups for ritualistic repetitive behaviours (Table 2.11). Lastly, there was a significant Age by Diagnosis interaction for hoarding ($\chi^2 (1) = 8.22, p = 0.004$). We found a significant difference at age 6 and 16 but no significant difference at age 11 (Table 2.12). In particular, the direction of the difference is opposite at age 6 compared to age 16. As anticipated, repetitive behaviour factors were either more prevalent in individuals with OCD, ASD, or equally prevalent across both disorders.

Table 2.9 Proportion of items endorsed across diagnosis for factors more prevalent in OCD.

<table>
<thead>
<tr>
<th>Counting/Checking</th>
<th>Cleaning</th>
<th>Symmetry/Ordering</th>
</tr>
</thead>
<tbody>
<tr>
<td>%* (95% CL)</td>
<td>%* (95% CL)</td>
<td>%* (95% CL)</td>
</tr>
<tr>
<td><strong>OCD</strong></td>
<td><strong>ASD</strong></td>
<td><strong>p</strong></td>
</tr>
<tr>
<td>28 (23;24)</td>
<td>8 (6;10)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

*Predicted prevalence at age 11.
Table 2.10 – a Proportion of items endorsed across diagnosis for factors more prevalent in ASD.

<table>
<thead>
<tr>
<th>Self-injurious</th>
<th>Sameness</th>
</tr>
</thead>
<tbody>
<tr>
<td>%* (95% CL)</td>
<td>%* (95% CL)</td>
</tr>
<tr>
<td>OCD</td>
<td>ASD</td>
</tr>
<tr>
<td>5 (3;8)</td>
<td>11 (8;15)</td>
</tr>
</tbody>
</table>

*Predicted prevalence at age 11.

Table 2.10 – b Proportion of items endorsed across diagnosis for factors more prevalent in ASD with significant Age by Diagnosis interactions.

<table>
<thead>
<tr>
<th>Age</th>
<th>Stereotyped*</th>
<th>Restricted*</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>OCD</td>
<td>ASD</td>
</tr>
<tr>
<td>6</td>
<td>14 (6-30)</td>
<td>36 (28-43)</td>
</tr>
<tr>
<td>11</td>
<td>4 (3-7)</td>
<td>35 (31-40)</td>
</tr>
<tr>
<td>16</td>
<td>1 (0.4-3)</td>
<td>35 (28-43)</td>
</tr>
</tbody>
</table>

*Significant Age*Dx interaction.
Table 2.11 Proportion of items endorsed across diagnosis for factors with no difference across groups.

<table>
<thead>
<tr>
<th>Ritualistic</th>
<th>%* (95% CL)</th>
<th>OCD</th>
<th>ASD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>22</td>
<td>24</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(16;28)</td>
<td>(20;28)</td>
<td></td>
</tr>
</tbody>
</table>

*Predicted prevalence at age 11.

Table 2.12 Proportion of items endorsed across diagnosis for hoarding repetitive behaviours.

<table>
<thead>
<tr>
<th>Hoarding*</th>
<th>Age</th>
<th>% (95% CL)</th>
<th>OCD</th>
<th>ASD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>52 (25;78)</td>
<td>14</td>
<td>17</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>20 (13;29)</td>
<td>17</td>
<td>17</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>5 (2;14)</td>
<td>20</td>
<td>20</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant Age*Dx interaction.
Item level differences between diagnoses, across each factor, are presented in Figure 2.3 – Figure 2.11. In the Counting/Checking factor, all repetitive behaviour items were more prevalent in individuals with OCD compared to ASD. There was a particularly large difference between groups for TOCS2 item “Feels he/she has to do certain things even though they don’t make sense (like always having to count the steps while going up them).” This large difference is due to the fact that this item is much more common in OCD than any other counting/checking item. This may reflect the fact that this item captures a broader range of behaviours seen in OCD.

**Figure 2.3 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Counting/Checking Repetitive Behaviours**
Similarly, in the Cleaning repetitive behaviour factor, both items were more prevalent in individuals with OCD compared to ASD. Taken together, repetitive behaviours associated with cleaning represents a symptom that is highly endorsed by individuals with OCD.

Figure 2.4 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Cleaning Repetitive Behaviours
Item level differences revealed that individuals with OCD endorse more symmetry/ordering repetitive behaviours compared to individuals with ASD. Interestingly, the item that shows the largest difference, TOCS11, “Has to repeat actions before they seem quite right”, may be a reflection of the fact that repetitive behaviours in OCD tend to be driven by a cognitive rule individuals feel they must follow to relieve associated anxiety (American Psychiatric Association, 2013).

**Figure 2.5 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Symmetry/Ordering Repetitive Behaviours**

![Figure 2.5 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Symmetry/Ordering Repetitive Behaviours](image)
For self-injurious repetitive behaviours, all items are more prevalent in individuals with ASD compared to OCD. Although “Skin Picking” was more prevalent in ASD compared to OCD, the difference between groups was marginal (17% vs. 16% respectively). It is important to note that items from the RBS-R measure current behaviours while items from the SCQ measure if the child has ever engaged in the behaviour. The self-injurious item from the SCQ “Has she/he ever injured her/himself deliberately, such as by biting her/his arm or banging her/his head?” showed the largest difference between diagnostic groups. Furthermore, this item is also more general and captures all self-injurious behaviours. In effect, it corresponds to an overall lifetime prevalence of any RBS-R self-injurious items, as reflected in its higher prevalence for both groups compared to related RBS-R items.

Figure 2.6 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Self-Injurious Repetitive Behaviours
The majority of items from the Sameness factor are more common in individuals with ASD compared to OCD with the exception of one item, RBS-R29, “Insists that things remain in the same place(s) (e.g. toys, supplies, furniture, pictures, etc. is actually more common in individuals with OCD. Again, the largest difference between diagnostic groups is seen with an item that measures behaviours exhibited at any point in time – SCQ3 “ Has she/he ever used odd phrases or said the same thing over and over in almost exactly the same way (either phrases that she/he has heard other people use or ones that she/he has made up)” Interestingly, for items measuring current behaviours, the one that showed the largest group difference is RBS-R36 “Likes the same CD, tape, record or piece of music played continuously…” This finding may be tapping into circumscribed interests often seen in individuals with ASD.

**Figure 2.7 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Sameness Repetitive Behaviours**

![Graph](image)

- **ASD**
- **OCD**
Item level differences across diagnostic groups reveal that stereotyped repetitive behaviours are more prevalent in individuals with ASD. Similar to previous findings, the largest differences between groups are seen for items from the SCQ, reflecting lifetime symptoms as opposed to current behaviours.

**Figure 2.8 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Stereotyped Repetitive Behaviours**
For restricted repetitive behaviours, item level differences reveal that individuals with ASD endorse more of these behaviours compared to individuals with OCD. Specifically, regardless of whether or not the interest/activity might seem odd to other people (SCQ11) or are unusual in their intensity but otherwise age appropriate (SCQ13), these items tend to be endorsed almost equally across individuals with ASD.

**Figure 2.9 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Restricted Repetitive Behaviours**
Item level differences for items measuring ritualistic repetitive behaviours, reveal that some items are more prevalent in individuals with OCD and some are more prevalent in individuals with ASD. Particularly, RBS-R24 (Sleeping/Bedtime – insists on certain pre-bedtime routines; arranges items in room “just so” prior to bedtime) and RBS-R25 (Self-Care: Bathroom and Dressing – insists on specific order of activities or tasks related to using the bathroom, washing, showering etc.) are endorsed more by individuals with OCD. This finding may explain why there was no significant difference when comparing across all items in the factor.

Figure 2.10 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Ritualistic Repetitive Behaviours

![Graph showing prevalence of items endorsed across OCD and ASD for ritualistic repetitive behaviours.](image-url)
Because there was a very interesting Age by Diagnosis interaction for hoarding, estimates at ages 6, 11, and 16, are presented below (Figure 2.11). Specifically, when compared across diagnoses, hoarding repetitive behaviours seem to drastically decrease across age for individuals with OCD, and slightly increase across age for individuals with ASD, with no significant age effect in the individuals with ASD.

**Figure 2.11 Prevalence of Items Endorsed Across Obsessive Compulsive Disorder and Autism Spectrum Disorder for Hoarding Repetitive Behaviours at Ages 6, 11, and 16**
2.4.2.3 Additional Analyses

IQ data was available for one hundred and eighty-two individuals with ASD. The range of IQ score in the ASD sample was 36 to 146. Pairwise comparisons between the three diagnostic groups were analyzed to investigate the effect of ID on the prevalence of repetitive behaviour. Overall, there was no significant difference between ASD-ID and ASD+ID. Furthermore, with the exception of Symmetry/Ordering, when ASD+ID was significantly different from OCD, ASD-ID was as well. For symmetry/ordering, ASD-ID but not ASD+ID was significantly different from OCD. Table 2.13 presents the pairwise comparisons, suggesting that meeting criteria for ID does not affect the occurrence of repetitive behaviours in this sample.
Table 2.13 Pairwise comparisons of the prevalence of repetitive behaviour factors across OCD, ASD+ID, and ASD-ID

<table>
<thead>
<tr>
<th>Factor</th>
<th>Prevalence</th>
<th>95% Confidence Limit</th>
<th>ASD+ID vs. ASD-ID</th>
<th>ASD+ID vs. OCD</th>
<th>ASD-ID vs. OCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereotyped</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD+ID</td>
<td>0.38</td>
<td>0.31, 0.47</td>
<td>0.02</td>
<td>&lt; 0.0001</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>ASD-ID</td>
<td>0.28</td>
<td>0.24, 0.34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCD</td>
<td>0.04</td>
<td>0.03, 0.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-injurious</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD+ID</td>
<td>0.11</td>
<td>0.07, 0.18</td>
<td>0.4</td>
<td>0.006</td>
<td>0.03</td>
</tr>
<tr>
<td>ASD-ID</td>
<td>0.09</td>
<td>0.06, 0.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCD</td>
<td>0.05</td>
<td>0.03, 0.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ritualistic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD+ID</td>
<td>0.22</td>
<td>0.16, 0.3</td>
<td>0.4</td>
<td>&gt; 0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>ASD-ID</td>
<td>0.26</td>
<td>0.2, 0.32</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>OCD</td>
<td>0.22</td>
<td>0.17, 0.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sameness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD+ID</td>
<td>0.29</td>
<td>0.23, 0.37</td>
<td>0.8</td>
<td>&lt; 0.0001</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>ASD-ID</td>
<td>0.3</td>
<td>0.25, 0.36</td>
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<tr>
<td>OCD</td>
<td>0.1</td>
<td>0.07, 0.14</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Restricted</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD+ID</td>
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<td>0.28, 0.44</td>
<td>&gt; 0.9</td>
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<td>OCD</td>
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2.5 Discussion and Conclusions

Using various questionnaires that assess repetitive behaviours in neurodevelopmental disorders, we observed marked heterogeneity of repetitive behaviour subtypes between children and adolescents with OCD and ASD. These repetitive behaviour subtypes included stereotyped, self-injury, ritualistic, sameness, restricted, counting/checking, cleaning, symmetry/ordering, and hoarding. Specifically, the nine subtypes used in the present study were derived from already established subscales from the RBS-R and TOCS (Bodfish et al. 2000, Park et al. 2015, manuscript ready for submission). Including more subtypes of repetitive behaviours when comparing these symptoms between OCD and ASD proved to be extremely valuable as it allowed for a more in-depth analysis of these behaviours across the two groups.

Comparing subtype and item level differences across disorders also revealed significant differences. Counting/Checking, Cleaning, and Symmetry/Ordering were more prevalent in individuals with OCD. This finding is consistent with previous research suggesting that compulsive behaviours associated with counting, checking, and cleaning are common in children and adolescents with OCD (Stewart et al., 2007, Bloch et al., 2008, Butwicka & Gmitrowicz, 2010). Cross-disorder comparisons for symmetry/ordering items revealed small differences between groups. This pattern of findings was expected given previous research that has reported similar rates of symmetry/ordering repetitive behaviours between children with OCD and ASD (Zandt et al., 2007).

Furthermore, subscale level differences revealed that Self-injurious, Sameness, Stereotyped, and Restricted repetitive behaviours were more prevalent in individuals with ASD compared to OCD. Item level differences revealed that all self-injurious items from the RBS-R and SCQ occur more in individuals with ASD. Consistent with previous research, self-injurious behaviours represent a specific subtype of repetitive behaviours in ASD (Mirenda et al., 2010, Bishop et al., 2013), and is less common in individuals with OCD (McDougle et al., 1995). The occurrence of sameness repetitive behaviours across disorders was mixed; as some items showed large differences while others had only a slight difference. Taken together, these results are consistent with previous studies.
supporting similar repetitive behaviours within the context of insisting that things remain the same, or is resisting changes in the environment in individuals with OCD and ASD (Zandt et al., 2007). ASD children and adolescents endorsed more stereotypic repetitive behaviours when measured by items from RBS-R and SCQ. This pattern is consistent with findings of Szatmari and colleagues (2006) who found that as many as 40% of individuals with ASD endorse stereotypic repetitive behaviours. However, one previous study found that stereotyped movements are similarly frequent in individuals with OCD and ASD (Zandt et al., 2007); this is in contrast with the findings of the current study. In the current study, items from the SCQ, which measure lifetime occurrence of repetitive behaviours, were also included in the Stereotyped repetitive behaviour factor. In contrast, Zandt et al. (2007) used the RBS-R to measure repetitive behaviours, which measures the incidence of current repetitive behaviours. The last subtype that showed greater overall prevalence in individuals with ASD compared to OCD is restricted repetitive behaviours. Consistent with previous research, restricted repetitive behaviours are very common in children and adolescents with ASD, and the prevalence increases when measuring the occurrence of these behaviours using lifetime scores (Szatmari et al., 2006).

The lack of a significant difference for ritualistic repetitive behaviours between disorders is of interest, given that item-level differences reveal that some items are more common in individuals with OCD and others are common in individuals with ASD. Specifically, results from the current study specify that ritualistic items within the context of sleeping, bedtime, self-care, and bathroom occur more frequently in individuals with OCD. This result is not surprising given that it is common for individuals with OCD to have specific rituals and routines within this context. Taken together, these findings reflect the importance of including specific ritualistic behaviours in order to comprehensively assess these disorders in a clinical setting.

Lastly, an interaction analysis revealed a significant Age by Diagnosis interaction for Hoarding. Specifically, individuals with OCD coming to attention at a younger age have a high prevalence of hoarding behaviours, whereas individuals with OCD who come to attention at an older age do so because of other OCD behaviours. This finding is also of
interest, given the evidence supporting hoarding as a separate dimension from OCD (Abramowitz et al., 2008 & Wheaton et al. 2011). In interpreting these results, it is important to keep in mind that this was a cross sectional study, and therefore differences in hoarding behaviours over time cannot be concluded. Previous research studies suggest that children with OCD were more likely than children with ASD to endorse hoarding behaviours (Zandt et al., 2007). One possible explanation for this finding may be that age related differences across disorders were not reported in this study. As such, it is possible that if age related differences across disorders were explored the results may have been similar to those in the present study. Future longitudinal work will help clarify changes in hoarding behaviours over time.

We further investigated the effect of IQ on the occurrence of repetitive behaviours in the ASD group, as previous research suggests that repetitive behaviours are significantly correlated with IQ scores (Szatmari et al., 2006). Overall, there was no significant effect of IQ on the presentation of repetitive behaviours confirming that the results from main analyses were not motivated by IQ in study participants with ASD.

Overall, our results are consistent with previous studies of symptom dimensions in OCD and ASD confirming that repetitive behaviours represent a complex, heterogeneous, set of symptoms across these disorders. The present study also converges on the literature indicating key similarities and differences between diagnostic group and occurrence of repetitive behaviour (McDougle et al., 1995; Zandt, Prior & Kyrios et al., 2007; Zandt, Prior & Kyrios, 2009). Taken together, we are contributing an important addition to previous research on the phenomenology of repetitive behaviours in OCD and ASD.

It is important to consider the limitations of the current study when interpreting the results. Unfortunately, other psychiatric co-morbidity data was not available for study participants. This represents a critical limitation, as repetitive behaviours are also present in other psychiatric disorders, such as Tourette syndrome and Intellectual Disability (Matthews et al., 2004; Bodfish et al., 1995). As such, the results from this study may have been influenced by an unknown secondary diagnosis. In addition, due to the lack of
control subjects, our findings can only provide information about differences between OCD and ASD. Comparisons to typically developing children and adolescents, as well as other atypical populations who share similar repetitive behaviour profiles (i.e. Tourette syndrome) will further our understanding about repetitive behaviours that are unique to individuals with OCD or ASD, and help explain characteristic behaviours in these complex groups. It is important for future studies to include co-morbidity data to examine repetitive behaviours, in order to replicate the findings from the current study.

Despite these limitations, findings from the present study have a number of important implications. Repetitive behaviours represent a core feature and source of impairment in both OCD and ASD; however, there remains a gap in the literature delineating similarities and differences across disorders. With respect to our findings of distinct similarities and differences of repetitive behaviour subtypes between disorders, this represents the groundwork for many future studies to build upon. Future cross-disorder genetic and neuroimaging studies should stratify patients based on repetitive behaviour subtype in order to better understand the biological underpinnings associated with repetitive behaviours. Results from such studies would allow us to determine whether patients characterized based on specific types of symptoms have different gene expressions and ultimately respond differently to treatment. Overall, our findings will help guide future pathophysiological studies by localizing dimensional traits of repetitive behaviours across disorders. This information will allow us to identify the nature of these atypical behaviours, which is critical for establishing effective treatment strategies for repetitive behavioural deficits in OCD and ASD.
Chapter III
Discussion

This study was conducted to explore similarities and differences in repetitive behaviours across neurodevelopmental disorders, and address several limitations within the current literature. In particular, few studies have systematically examined the appearance of repetitive behaviours in a cross-disorder sample, as groups focusing on different disorders tend to use different assessment tools to measure such behaviours in a clinical environment. Given that repetitive behaviours are a fundamental diagnostic feature, and a source of impairment, in obsessive-compulsive disorder (OCD) and autism spectrum disorder (ASD), the lack of empirical attention represents a critical concern that prevents an adequate understanding of repetitive behaviours in OCD and ASD. Furthermore, a better understanding could ultimately lead to the development of more effective interventions for children and adolescents with these disorders.

Given the gaps in the literature, the present study was designed to delineate similarities and differences of repetitive behaviours in children and adolescents with a primary diagnosis of OCD or ASD. The primary goals of this study were to 1) systematically study repetitive behaviours in children and adolescents with OCD and ASD and 2) compare how these repetitive behaviour subtypes differ across disorders. The study used three parent-report questionnaires that detect the many subtypes of repetitive behaviours within a clinical sample of children and adolescents with OCD or ASD. In order to explore repetitive behaviours between the two disorders established repetitive behaviour factor structures were used to organize various items from the questionnaires that were administered to all participants. This was done in order to group items across the measures and to examine similarities and differences in clinical presentation of repetitive behaviours across disorders in the primary analysis.
Overall, results of the current study highlight the marked heterogeneity and complexity of repetitive behaviours present in these two neurodevelopmental disorders. As expected, there are specific subtypes of repetitive behaviours that are more common in either OCD or ASD, or, are mutual across disorders. These findings further support the complexity of repetitive behaviours, as well as similarities and differences of repetitive behaviours across disorders, especially within the context of clinical presentation.

The following section will summarize the findings of the study. Limitations of the current findings, strengths of the study, directions for future research, and implications will then be discussed.

3.1 Repetitive Behaviour Subtypes

Three hundred and thirty-two children and adolescents with either OCD or ASD participated in this study. The first step involved grouping repetitive behaviours into meaningful subtypes in order to reduce the dimensionality of the data. An examination of repetitive behaviour subtypes using the Repetitive Behaviour Scale – Revised (RBS-R), the Toronto Obsessive-Compulsive Scale (TOCS), and the Social Communication Questionnaire (SCQ) were organized into nine subscales of repetitive behaviours. The nine subscales were derived from already established subscales from the RBS-R and TOCS (Bodfish et al. 2000, Park et al. 2015, manuscript ready for submission). The Compulsive Repetitive Behaviour subscale from the RBS-R was sorted into the compulsive subscales from the TOCS in order to adequately assess compulsive repetitive behaviours commonly seen in OCD and ASD. Items from the various scales were assigned to the factor that had the highest coefficient alpha. Given that the subtypes utilized in this study were from already established factors, it was expected that items taken from the different measures would agree with at least one of the factors. As such, items in the current study were assigned to one of the nine repetitive behaviour subtypes. In comparison, previous research has used two to six factors when describing the
organization of repetitive behaviour symptoms in OCD and ASD (see Table 1.3 and Table 1.4 for a list of studies); however, repetitive behaviours in our study were sorted and conceptualized into many more subtypes. Including more subtypes of repetitive behaviours when comparing these symptoms between OCD and ASD is extremely valuable as it allows for a more in-depth analysis of these behaviours across the two disorders. Specifically, in the ASD population compulsive items tend to factor together (for example, Lam & Aman, 2007; Mirenda, 2010, Bishop, 2013), while in the OCD population different compulsive items load across multiple factors (for example, Bloch et al., 2008; Stewart et al., 2007; Park et al., 2015, manuscript ready for submission). As such, when discussing compulsive repetitive behaviours, it is important to include different subtypes, as lumping items into one ‘compulsive’ subtype would overlook meaningful information. More importantly, the literature comparing repetitive behaviours in a cross-disorder sample is a highly under-researched area of study. As such, this study represents one of the first studies to analyze repetitive behaviours in a clinical sample of children and adolescents with OCD or ASD.

Results from previous factor analyses that utilize the RBS-R merge two factors together, Ritualistic repetitive behaviours with Sameness repetitive behaviours (Lam & Aman, 2007; Mirenda et al., 2010; Bishop et al., 2013), when studying individuals with ASD. Albeit, these previous studies were only conducted on individuals with ASD, it nonetheless raises an important question. In theory, it is possible to understand that these two factors could be merged, as items from each of these subscales tend to measure similar symptom constructs. For example, as the item such “Self-Care: Bathroom and Dressing (insists on specific order of activities or tasks related to using the bathroom, to washing, showering, bathing, or dressing; arranges items a certain way in bathroom or insists that bathroom items not be moved; insists on wearing certain clothing items),” from the Ritualistic subscale, is very similar to “Insists on same routine, household, school or work schedule every day.” from the Sameness behaviour subscale. As such, it is possible for a parent completing the measure to report similar scores across items. However, since the subscales were partly derived based on clinical expertise, and items from other measures were also included in the analysis, it was important to keep these
subscales separate to prevent a critical oversight. Moreover, the results of the current study demonstrate that when these subtypes are separated and compared across OCD and ASD, marked differences across the two disorders are observed that otherwise would have been neglected had the subtypes been merged.

Furthermore, findings from this study represent one of the first investigations of repetitive behaviour subtypes on individuals with OCD. Previous studies tend to focus on compulsion subtypes (for example, cleaning, counting, hoarding etc.) and do not specifically examine other constructs of repetitive behaviours, such as stereotyped, restricted, or sameness behaviours. It is also common for studies to use OCD specific measures when assessing compulsions, however, results from this study suggest that perhaps a measure that includes specific types of repetitive behaviours would provide a more comprehensive assessment of OCD.

Taken together, this is one of the first studies to analyze repetitive behaviour subtypes across disorders using common assessment measures from each disorder of interest, in addition to using an inclusive number of repetitive behaviour subtypes. The present study adds to the current literature by confirming the marked heterogeneity of repetitive behaviours seen in children and adolescents with OCD or ASD. Specifically, the results support the many different factor structures of repetitive behaviours in ASD that currently exist, and provide a new insight into the factor structure of repetitive behaviours in OCD.

### 3.2 Subtype and Item Level Differences across Disorders

The main goal of the study was to delineate similarities and differences of repetitive behaviours across disorders. Specifically, the primary hypothesis of the current research predicted that all three possible outcomes (repetitive behaviour subtypes are more prevalent in OCD, more prevalent in ASD, or will not differ between disorders) when making comparisons across disorders would be represented by the data. The results of the present research confirm this hypothesis.
When comparing subtypes across disorders, Counting/Checking, Cleaning, and Symmetry/Ordering were more prevalent in individuals with OCD. This finding is not surprising given that these subtypes, including most of the items that derive these subtypes, originated from the TOCS (Park et al. 2015, manuscript ready for submission). Consistent with previous research, compulsive behaviours associated with counting, checking, and cleaning are common in children and adolescents with OCD (Stewart et al., 2007, Bloch et al., 2008, Butwicka & Gmitrowicz, 2010).

Item level differences between disorders across the Counting/Checking subtype also provide support that individuals with OCD engage more in these types of behaviours (20% - 65%). In comparison, the prevalence of individuals with ASD that endorsed these behaviours was less than twenty percent for any individual item. This finding suggests that counting/checking repetitive behaviours are present but not common in ASD. Consistent with our findings, Anagnostou and colleagues (2011) found that only 7.4% and 15.3% of children with ASD endorse counting and checking compulsions, respectively, as measured by the Y-BOCS. However, it is important to note that only verbal individuals reported counting repetitive behaviours. Indeed, counting/checking repetitive behaviours may not be as common in individuals with ASD; they are nonetheless present, which should not be discounted. Furthermore, in contrast to other common OCD compulsions, such as cleaning (in our study prevalence was approximately 5%), counting/checking compulsions seem quite prevalent in comparison. Taken together, this result suggests that traditional OCD behaviours can also be quite high in ASD.

Only two items were included in the Cleaning repetitive behaviour. Item level differences reveal that approximately 40% of individuals with OCD engage in these behaviours compared to the approximate 5% of individuals with ASD. Again, this finding is not surprising given that it has been well established that cleaning compulsions are common in children and adolescents with OCD (Stewart et al., 2007, Bloch et al., 2008, Butwicka & Gmitrowicz, 2010) and are not a major concern for individuals with ASD. Research has also suggested that individuals with ASD have less ‘higher-order’ repetitive
behaviour such as cleaning, counting, and checking, which are commonly reported in OCD (McDougle et al., 1995).

Symmetry and ordering repetitive behaviours were measured using items from the RBS-R and TOCS. Cross-disorder comparisons reveal smaller differences between groups for items from the RBS-R (RBS15: Arranging/Ordering and RBS16: Completeness). This pattern of findings was expected given previous research that has reported similar rates of symmetry/ordering repetitive behaviours between children with OCD and ASD (Zandt et al., 2007). However, one item in particular, “TOCS11: Repeats actions until it feels right”, showed the largest difference between groups (~40% in OCD vs. ~10% in ASD). One possible explanation for this finding is that parents of children with ASD completing the TOCS may recognize the measure as an OCD scale and are biased to reporting that their child does not have OCD, and therefore report less “OCD-like” repetitive behaviours. Alternatively, the wording of the item, particularly the emotional valence portion of the phrase (“feels quite right”) may obscure the item as repetitive behaviours associated with ASD tend to not adhere to a specific rule. Although the prevalence of symmetry/ordering repetitive behaviours were not as high in individuals with ASD compared to OCD, the occurrence of these behaviours was quite common in ASD.

Subscale level differences reveal that Self-injurious, Sameness, Stereotyped, and Restricted repetitive behaviours were more prevalent in individuals with ASD compared to OCD. Item level differences revealed that all self-injurious items from the RBS-R and SCQ occur more in individuals with ASD. Consistent with previous research, self-injurious behaviours represent a specific subtype of repetitive behaviours in ASD (Mirenda et al., 2010, Bishop et al., 2013), and is less common in individuals with OCD (McDougle et al., 1995).

The Sameness subtype included items from the RBS-R and SCQ and contained the greatest number of items overall. The percent occurrence of each item across disorders was mixed, as some items had large differences while others had only a slight difference. For this reason, when interpreting differences across-disorders for this specific subtype it
is important to consider item level differences. Taken together, these results are not surprising given that repetitive behaviours within the context of insisting that things remain the same, or is resistant to changes in the environment is a common behaviour in individuals with both OCD and ASD (Zandt et al., 2007).

Individuals with ASD endorsed more stereotypic repetitive behaviours, compared to OCD, across all items. Interestingly, items from the SCQ, which asks if the individual has ever engages in the behaviour, had the greatest differences between diagnostic groups. This may be a reflection of the scale itself, as the RBS-R is only capturing repetitive behaviours that occurred in the last month whereas the SCQ is measuring if the behaviour has ever occurred, irrespective of whether or not it has happened within the past month. This is consistent with previous findings. For example, Szatmari et al. (2006) found that as many as 40% of individuals with ASD endorse stereotypic repetitive behaviours. However, in contrast to the current findings, one previous study found that stereotyped movements, as measured by the RBS-R, occur equally frequently in individuals with OCD and ASD (Zandt et al., 2007). One possible explanation may be that in our study, items from the SCQ were also included in the Stereotyped repetitive behaviour factor. Furthermore, since these items exhibited a greater discrepancy between groups, these items may have driven our results. Another possible explanation for the discrepancy between groups may be due to differences in sample sizes between the two studies. In the study conducted by Zandt and colleagues (2007) only 19 children with ASD and 17 children with OCD were included. As such, given the larger sample size included in this research, results from this study suggest that there are indeed differences in stereotypic repetitive behaviours across disorders.

The last subtype that showed greater overall prevalence in individuals with ASD compared to OCD is restricted repetitive behaviours. Items in this subscale were divided evenly between the RBS-R and SCQ. Similar to previous findings, items from the SCQ, which measure if the behaviour has ever occurred, showed the greatest difference across disorders. Consistent with previous research, a large number of individuals with ASD presented with restricted repetitive behaviours, which increase in prevalence when
measured using lifetime scores (Szatmari et al., 2006). Furthermore, Zandt et al. (2007) reported that individuals with ASD rated higher on the category ‘limited interests’ compared to those with OCD. However, in contrast to our findings, results from the same study, reported that individuals with OCD rated higher on the category ‘attachment to objects’ compared to individuals with ASD, albeit, the difference across disorders was marginal. As mentioned previously, this discrepancy may be due to the small sample size included in the study conducted by Zandt et al. (2007), and as a result, may not reflect the true nature of restricted repetitive behaviours in individuals with OCD and ASD.

Alternatively, given that items from the SCQ were also included in the Restricted subtype in this study, the results may be driven by a bias in the measure, such that items from the SCQ measure lifetime occurrence of the behaviour. Indeed, the prevalence of restricted repetitive behaviours was more common in individuals with ASD, however, the prevalence of these behaviours in OCD should not be overlooked as the prevalence was elevated.

For both stereotyped and restricted repetitive behaviours there was a significant Age by Diagnosis interaction. Specifically, for both subtypes, behaviours in individuals with ASD remain consistent across the three age scenarios that we examined: ages 6, 11, and 16; however, in OCD these behaviours have a high prevalence at age 6 that is lower in children seen at age 11. It is important to consider that in the present study older adolescents with ASD include a combination of individuals diagnosed at a younger age (and therefore, may have more severe ASD) and individuals with mild ASD who may have been diagnosed at a later age. It may be because of this that repetitive behaviours appear to be less severe in adolescents. For example, if we follow participants longitudinally, it is possible that symptoms do not change at all, but that in our study younger individuals with mild symptoms are not included because they have not been diagnosed yet; these speculations require further research. Conversely, it is also possible that individuals with OCD may have fewer symptoms with age, either because of developmental changes or previous cognitive-behavioural therapy, but they may not be in our sample at older ages, as our sample primarily consists of new cases whose symptoms
are severe enough to bring them to attention. Future longitudinal work will help clarify the trajectory of repetitive behaviour symptoms across ages.

Across both disorders, ritualistic repetitive behaviours showed no significant difference. Previous research conducted on individuals with OCD and ASD have found that individuals with OCD have higher rates than individuals with ASD (Zandt et al., 2007), however, it has also been reported that individuals with ASD do engage in ritualistic behaviours (Szatmari et al., 2006, Anagnostou et al., 2011, Georgiades et al., 2010) and significantly more compared to controls (Szatmari et al., 2006). The discrepancy across studies may be a reflection of different measures used across studies and the way ritualistic repetitive behaviours were measured and calculated. Thus, this pattern of findings highlights the importance of investigating item level differences. Results from this study suggest that some items are more common in individuals with OCD and others are common in individuals with ASD. Specifically, ritualistic items within the context of sleeping, bedtime, self-care, and bathroom occur more frequently in individuals with OCD. This result is not surprising given that it is common for individuals with OCD to have specific rituals and routines within these contexts. In contrast, ritualistic items within the context of eating, play, and communication/social interactions occur more frequently in individuals with ASD. Taken together, these findings reflect the importance of including specific ritualistic behaviours in order to comprehensively assess these disorders in a clinical setting. Furthermore, these findings provide preliminary evidence that ritualistic repetitive behaviours in general are highly prevalent in both disorders.

Lastly, an interaction analysis revealed a significant Age by Diagnosis interaction for Hoarding. Specifically, individuals with OCD coming to attention at a younger age have a high prevalence of hoarding behaviours, whereas individuals with OCD who come to attention at an older age do so because of other OCD behaviours. Interestingly, hoarding is no longer included as a dimension of OCD since important differences between hoarding and other OCD symptom dimension have been reported (e.g., Abramowitz et al., 2008 & Wheaton et al. 2011). For example, hoarding is associated with an earlier age of onset relative to other OCD symptoms (Wheaton et al., 2008). In interpreting these
results, it is important to keep in mind that this was a cross sectional study. As such, we cannot conclude that children with OCD have more hoarding behaviours when they are young, but these behaviours go away as they get older. This area of study remains highly under-researched, resulting in a limited understanding of age differences of hoarding in OCD. Although small, the slope of the prevalence of hoarding behaviours in children with ASD increases with age (p = 0.02). Previous research studies suggest that children with OCD were more likely than children with ASD to engage in hoarding behaviours (Zandt et al., 2007). One possible explanation for this finding may be that age related differences across disorders were not reported in this study. As such, it is possible that if age related differences across disorders were explored the results may have been similar to those in the present study. Furthermore, consistent with findings from this study, previous research has reported that hoarding behaviours are present in 12% (Anagnostou et al., 2011) to 32% (Bishop et al., 2013) of children with ASD. Overall, these findings represent a novel exploration of hoarding behaviours across disorders. Future research should address the aforementioned concerns in an effort to accurately delineate similarities and differences of hoarding behaviours across disorders in order to draw definitive conclusions and enhance our clinical understanding of these two disorders.

Taken together, results from the present research solidify the evidence of heterogeneity in repetitive behaviours across OCD and ASD. Furthermore, significant phenomenological differences were found at both the factor level and item level, which may help characterize patients based on their unique repetitive behaviour symptoms.

3.3 Effect of IQ on Repetitive Behaviours

Many of the study participants with a primary diagnosis of ASD also had IQ data available. Additional analyses were conducted to investigate the effect IQ may have on the presence (or absence) of repetitive behaviours, as previous research suggests that repetitive behaviours are significantly correlated with IQ scores (Szatmari et al., 2006). Incorporating IQ into the analysis shed some insight onto which participants may also meet diagnostic criteria for Intellectual Disability (ID). Although in the DSM-5 severity
of impairment for ID is based on adaptive functioning, study participants with ASD should, in theory, be low in the communication or social domain of adaptive functioning. As such, for the purposes of this research study, it was assumed that individuals with a primary diagnosis of ASD and an IQ < 75 would theoretically meet diagnostic criteria for ID.

This additional analysis was conducted to ensure that the results from the main analysis for study participants with ASD, were not driven by a possible secondary diagnosis of ID. These additional analyses reveal no significant difference of IQ on the presentation of repetitive behaviours. As such, results from the main analyses were not influenced by a potential diagnosis of ID in study participants with ASD.

3.4 Summary of Findings

In summary, results from the current study confirm the heterogeneity of repetitive behaviours across OCD and ASD. Specifically, we characterized repetitive behaviours into nine subtypes, which allowed us to adequately delineate repetitive behaviour subtypes across these two disorders. Moreover, although higher and lower-order repetitive behaviours are present across both groups, current findings indicated key similarities and differences between diagnostic group and occurrence of repetitive behaviour. In particular, cleaning, counting/checking, and symmetry/ordering repetitive behaviours occurred more frequently in participants with OCD, while self-injurious, sameness, stereotyped, and restricted repetitive behaviours occurred more frequently in participants with ASD. There was no significant difference between study groups for ritualistic repetitive behaviours, and hoarding showed a significant Age by Diagnosis effect. Taken together, the results from this study represent an important addition to previous research on the phenomenology of repetitive behaviours in OCD and ASD.
3.5 Limitations and Future Research

The present study has several strengths. Firstly, it is the first study to systematically analyze repetitive behaviours across children and adolescents with OCD and ASD using common assessment instruments. Previous research has concentrated on repetitive behaviours in one neurodevelopmental disorder using disorder-specific assessment instruments. This lack of common measurements prevents an adequate understanding of the phenomenology of neurodevelopmental disorders, which tend to be complex due to the heterogeneity in clinical presentation and etiology. Measures that are commonly used separately for each disorder were administered to the same individuals in the current study, allowing a greater range of repetitive behaviours to be assessed across disorders. This is an improvement from much of the previous work focusing predominately on diagnosis-specific assessment measures. Secondly, research findings from the current study were established with a relatively large sample size in both groups, and one that was greater than previous studies. In addition, the present study recruited participants from various clinical settings and institutions across the province. Using multiple recruitment sites enhances the generalizability of findings from the current study. Lastly, study participants included children as young as six years and adolescents as old as eighteen years, allowing for an assessment of repetitive behaviours across different ages.

It is important to consider the limitations of the current study when interpreting the results. Unfortunately, co-morbidity data was not available for study participants. This represents a critical limitation, as repetitive behaviours are also present in other psychiatric disorders, such as Tourette syndrome and Intellectual Disability (Matthews et al., 2004; Bodfish et al., 1995). As such, the results from this study may have been influenced by an unknown secondary diagnosis. Furthermore, it was unknown whether or not individuals in our OCD and ASD group also had a co-morbid diagnosis of the other disorder. Such studies would allow for delineation between “ASD-only” groups, “OCD-only” groups, and “ASD + OCD” diagnosis groups. It is important for future studies to include co-morbidity data to examine repetitive behaviours, in order to replicate the findings from the current study. In addition, due to the fact that we did not include control
subjects, our findings can only provide information about differences between OCD and ASD. Comparisons to typically developing children and adolescents, as well as other atypical populations who share similar repetitive behaviour profiles (i.e. Tourette syndrome) will further our understanding about repetitive behaviours that are unique to individuals with OCD or ASD, and help explain characteristic behaviours in these complex groups.

Another limitation involves the use of parent-report instruments to assess repetitive behaviours. Although parent-report instruments are best suited for younger children, especially in this sample since some children have impaired communicative abilities, to examine this in further detail, future research should include self-report measures for adolescents who are capable of completing such measures. Acquiring this information from both sources would allow for a more comprehensive assessment of repetitive behaviours.

With regards to study design, the current research utilized a cross-sectional design that impedes the ability to interpret Age by Diagnosis interactions as changes in repetitive behaviours over time. It is important that future research examines repetitive behaviours longitudinally, as presentation or subtype of repetitive behaviours seem to change with age.

Another critical limitation is the lack of measures that assess repetitive behaviours at an in-depth level. Specifically, most of the scales used in the current study measure the frequency of repetitive behaviours, as well as the level of impairment. However, the emotional valence associated with these behaviours, and whether or not they are egodystonic or egosyntonic, is not assessed. Efforts should be made to improve assessment instruments, such as by asking parents and children, when appropriate, about how they feel when they perform the behavior, or when they are interrupted from performing the behaviour, and what motivates them to perform the behavior. A more in-depth measure would provide substantial support and enhance the research on similarities and differences of repetitive behaviours in neurodevelopmental disorders.
3.6 Implications and Conclusions

The present study examined phenomenological differences and similarities of repetitive behaviours across children and adolescents with OCD and ASD. Despite the limitations mentioned previously, the current study has a number of important implications. Findings from the current study add to previous research that repetitive behaviours in these disorders represent a complex, heterogeneous, set of symptoms. As noted in the introduction, the Research Domain Criteria (RDoC) represents a shift in psychiatry research, such that mental disorders should be classified into behavioural dimensions to drive research questions (Insel, 2014). The present study provides a foundation upon which future studies can be built, which will align with the goals and mission of RDoC. For example, stratifying patients based on repetitive behaviour subtype would set the stage for future cross-disorder genetic and neuroimaging studies to better understand the biological underpinnings associated with repetitive behaviours. In particular, it would be interesting to determine whether patients characterized based on specific types of symptoms exhibit different genetic profiles and ultimately respond differently to treatment. Although recent studies have shed light on possible shared or overlapping pathophysiology underlying abnormal repetitive behaviours (Muehlmann & Lewis, 2012), there remains a gap in the literature regarding the link between pathophysiology and clinical symptoms of repetitive behaviours, as current studies fail to systematically study repetitive behaviours across disorders. Ultimately, results from such studies would allow clinicians to better understand repetitive behaviours in their patients and provide more effective and tailored treatment regimens.

Overall, results from the current study contribute to the literature on repetitive behaviours in OCD and ASD. As repetitive behaviours represent a core feature, and source of impairment across these two disorders, future research should continue to investigate the similarities and differences to better understand the nature of these behaviours. This information is critical for establishing more effective treatment strategies for repetitive behaviours in OCD and ASD.
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Appendices

Appendix A Copyrighted Parent Report Measures; freely available to the public.

Repetitive Behaviour Scale – Revised (RBS-R)

<table>
<thead>
<tr>
<th>Child’s name: __________________________</th>
<th>Date of Birth (M/D/Y): <strong>/</strong>/________</th>
<th>Gender: M F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: ____</td>
<td>Grade: ____</td>
<td>Parent’s name: __________________________</td>
</tr>
</tbody>
</table>

Instructions:
Please rate your child’s behaviour by reading each of the items listed and then choosing the score that best describes how much of a problem the item is for him/her. Be sure to read and score all items listed. Make your ratings based on observations and interactions with your child over the last month. Use the following definitions to score each item:

0 = behaviour does not occur
1 = behaviour occurs and is a mild problem
2 = behaviour occurs and is a moderate problem
3 = behaviour occurs and is a severe problem

At the end of each section, there will be three questions asking you to rate that section’s behaviours in terms of (a) how frequently they occur, (b) how upset your child becomes when repetitive behaviours are interrupted, and (c) how much the behaviours interfere with ongoing events. You will indicate the score by marking along each line, which represents a range of frequencies and severities. For example, if a child does these behaviours many times a day, you may put a mark quite close to the right side:

Never

Constantly

I. Stereotyped Behaviour Subscale

(Definition: apparently purposeless movements or actions that are repeated in a similar manner)

<table>
<thead>
<tr>
<th>1. WHOLE BODY (body rocking, body swaying)</th>
<th>0 1 2 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. HEAD (rolls head, nods head, turns head)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>3. HAND/FINGER (flaps hands, wiggles fingers, claps hands, waves or shakes hand or arm)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>4. LOCOMOTION (turns in circles, whirls, jumps, bounces)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>5. OBJECT USAGE (spins or twirls objects, twiddles or slaps or throws objects, lets objects fall out of hands)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>6. SENSORY (covers eyes, looks closely or gazes at hands or objects, covers ears, smells or sniffs items, rubs surfaces)</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>

Please answer the following questions about the behaviours described above (put a vertical mark on the line to show your answer)

How often do they happen?
(If never, skip to Section II)

How upset does your child get when interrupted?

How much do these behaviours get in the way of ongoing events?

Version date: Feb 2, 2012

Page 1 of 6
### II. Self-Injurious Behaviour Subscale

(Definition: 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)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7. HITS SELF WITH BODY PART</strong> (hits or slaps head, face, or other body area)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>8. HITS SELF AGAINST SURFACE OR OBJECT</strong> (hits or bangs head or other body part on table, floor or other surface)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>9. HITS SELF WITH OBJECT</strong> (hits or bangs head or other body area with objects)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>10. BITES SELF</strong> (bites hand, wrist, arm, lips or tongue)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>11. PULLS</strong> (pulls hair or skin)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>12. RUBS OR SCRATCHES SELF</strong> (rubs or scratches marks on arms, leg, face or torso)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>13. INSERTS FINGER OR OBJECT</strong> (eye-poking, ear-poking)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>14. SKIN PICKING</strong> (picks at skin on face, hands, arms, legs or torso)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Please answer the following questions about the behaviours described above (put a vertical mark on the line to show your answer):

**How often do they happen?**

(If never, skip to Section III)

- Never
- Occasionally
- Frequently
- Constantly

**How upset does your child get when interrupted?**

- Not at all
- Somewhat
- Extremely

**How much do these behaviours get in the way of ongoing events?**

- Not at all
- Somewhat
- Extremely

Version date: Feb 2, 2012
III. Compulsive Behaviour Subscale

(Definition: behaviour that is repeated and is performed according to a rule, or involves things being done "just so")

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15. ARRANGING/ORDERING (arranges certain objects in a particular pattern or place; need for things to be even or symmetrical)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16. COMPLETENESS (must have doors open or closed; takes all items out of a container or area)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17. WASHING/CLEANING (excessively cleans certain body parts; picks at lint or loose threads)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18. CHECKING (repeatedly checks doors, windows, drawers, appliances, clocks, locks, etc)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19. COUNTING (counts items or objects; counts to a certain number or in a certain way)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20. HOARDING/SAVING (collects, hoards or hides specific items)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21. REPEATING (need to repeat routine events; in/out door, up/down from chair, clothing on/off)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22. TOUCH/TAP (need to touch, tap or rub items, surfaces or people)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Please answer the following questions about the behaviours described above (put a vertical mark on the line to show your answer)

- **How often do they happen?**
  - Never
  - Occasionally
  - Frequently
  - Constantly

- **How upset does your child get when interrupted?**
  - Not at all
  - Somewhat upset
  - Extremely upset

- **How much do these behaviours get in the way of ongoing events?**
  - Not at all
  - Somewhat
  - Extremely
IV. Ritualistic Behaviour Subscale

(Definition: performing activities of daily living in a similar manner)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>23. EATING/MEALTIME (strongly prefers/insists on eating/drinking only certain things; eats or drinks items in a set order; insists that meal related items are arranged in a certain way)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>24. SLEEPING/BEDTIME (consists on certain pre-bedtime routines; arranges items in room &quot;just so&quot; prior to bedtime; insists that certain items be present with him/her during sleep; insists that another person be present prior to or during sleep)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25. SELF CARE: BATHROOM AND DRESSING (consists on specific order of activities or tasks related to using the bathroom, to washing, showering, bathing or dressing; arranges items a certain way in bathroom or insists that bathroom items not be moved; insists on wearing certain clothing items)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>26. TRAVEL/TRANSPORTATION (consists on taking certain routines/paths; must sit in a specific location in vehicles; insists that certain items be present during travel, e.g. toy or material; insists on seeing or touching certain things or places during travel such as a sign or store)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>27. PLAY/LEISURE (consists on certain play activities; follows a rigid routine during play/leisure; insists that certain items be present/available during play/leisure; insists that other persons do certain things during play)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>28. COMMUNICATION/SOCIAL INTERACTIONS (repeats same topic[s] during social interactions; repetitive questioning; insists on certain topics of conversation; insists that others say certain things or respond in certain ways during interactions)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Please answer the following questions about the behaviours described above (put a vertical mark on the line to show your answer):

How often do they happen?
(If never, skip to Section V)

Never

How upset does your child get when interrupted?

Not at all

Extremely

How much do these behaviours get in the way of ongoing events?

Not at all

Extremely
V. Sameness Behaviour Subscale

[Definition: resistance to change, insisting that things stay the same]

<table>
<thead>
<tr>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>29. Insists that things remain in the same place(s) (e.g., toys, supplies, furniture, pictures, etc.)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>30. Objects to visiting new places</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>31. Becomes upset if interrupted in what he/she is doing</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>32. Insists on walking in a particular pattern (e.g. straight line)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>33. Insists on sitting at the same place</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>34. Dislikes changes in appearance or behaviour of the people around him/her</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>35. Insists on using a particular door</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>36. Likes the same CD, tape, record or piece of music played continually; likes same movie/video or part of movie/video</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>37. Resists changing activities; difficulty with transitions</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>38. Insists on same routine, household, school or work schedule every day</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>39. Insists that specific things take place at specific times</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Please answer the following questions about the behaviours described above (put a vertical mark on the line to show your answer)

**How often do they happen?**
*(If never, skip to Section VI)*

- **Never**
- **Constantly**

**How upset does your child get when interrupted?**

- **Not at all**
- **Extremely**

**How much do these behaviours get in the way of ongoing events?**

- **Not at all**
- **Extremely**
VI. Restricted Behaviour Subscale

(Definition: limited range of focus, interest or activity)

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>40. Fascination, preoccupation with one subject or activity (e.g. trains, computers, weather, dinosaurs)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>41. Strongly attached to one specific object</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>42. Preoccupation with part(s) of object rather than whole object (e.g. buttons on clothes, wheels on toy cars)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>43. Fascination, preoccupation with movement/things that move (e.g. fans, clocks)</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>

Please answer the following questions about the behaviours described above [put a vertical mark on the line to show your answer]

How often do they happen?
(If never, skip to Final Question)

How upset does your child get when interrupted?

How much do these behaviours get in the way of ongoing events?

FINAL QUESTION:

Overall, if you "lump together" all of the behaviours described in this questionnaire, how much of a problem are these repetitive behaviours for your child, as well as for the people around him/her?

Please rate on a scale of 1 – 100, where:

1 = not a problem at all

100 = as bad as you can imagine

Score from 1 – 100: ___________________________

Version date: Feb 2, 2012
Created by Dr. Paul Arnold.

Toronto Obsessive Compulsive Rating Scale (TOCS)  
Parent-Report Version

<table>
<thead>
<tr>
<th>Child’s name: ___________________________</th>
<th>Gender: M  F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Birth (M/D/Y): ____ / ____ / ____</td>
<td>Age: ____</td>
</tr>
<tr>
<td>Parent’s name: _________________________</td>
<td>Grade: ____</td>
</tr>
<tr>
<td>Today’s date (M/D/Y): ____ / ____ / ____</td>
<td></td>
</tr>
</tbody>
</table>

Children and adolescents differ in how they feel and act. For each item below, how often does your child feel or act this way as compared to other children of the same age? Please select the best rating based on your observations of your child over the past 6 months. Please respond to all of the items as best as you can, even if some do not seem to apply. NOTE: This questionnaire has 2 sides, please turn over.

For example, a question might ask how often your child reads books compared to other children his age. If you feel your child reads books slightly more often than other children you would check the appropriate box as follows:

<table>
<thead>
<tr>
<th></th>
<th>Far less often</th>
<th>Less often</th>
<th>Slightly less often</th>
<th>Average amount of time</th>
<th>Slightly more often</th>
<th>More often</th>
<th>Far more often</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads books</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Far less often</th>
<th>Less often</th>
<th>Slightly less often</th>
<th>Average amount of time</th>
<th>Slightly more often</th>
<th>More often</th>
<th>Far more often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<tr>
<td>5.</td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th></th>
<th>Far less often</th>
<th>Less often</th>
<th>Slightly less often</th>
<th>Average amount of time</th>
<th>Slightly more often</th>
<th>More often</th>
<th>Far more often</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>Needs to count objects or actions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Needs things to be symmetrical or ordered a certain way.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Spends time checking and rechecking homework to make sure it is just right.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>9.</td>
<td>Has special numbers or words that he/she says because he/she hopes they keep bad luck or bad things away.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Gets upset if other people interfere with how he/she has ordered or arranged things.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Has to repeat actions before they seem quite right.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Worries a lot if he/she does something not exactly the way he/she likes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Hates dirt and dirty things.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Worries about germs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Needs to wash his/her hands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Worries about being clean enough.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>17.</td>
<td>Feels that if someone else uses or touches something it is ruined for him/her.</td>
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<td>18.</td>
<td>Collects useless objects.</td>
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<td>19.</td>
<td>Has difficulty throwing things away.</td>
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<td>20.</td>
<td>Does certain things like moves or talks in a special way to avoid bad luck.</td>
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<td>21.</td>
<td>Worries about having an illness or disease, even though he/she is healthy.</td>
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