Interests in Adults with Autism Spectrum Disorder

by

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Abstract

Although restricted interests have been one of the key components of ASD diagnosis since the criteria were formed, there has been little research into their nature and how they differ from interests typically-developing individuals hold. This mixed-methods study compared interests in a group of adults both with (ASD group) and without ASD (TD-SI group) who held a special interest. Results indicate that in many ways interests are similar between the groups; for both groups interests lasted many years, at times interfered in their lives, and also had many positive effects such as desirable affect and cognitive rewards. Ways in which the groups differed included the ASD group being more motivated by sensory and biological factors, and the TD-SI group being more motivated by connecting with others and achievement. Another difference was that the ASD group pursued their interest in fewer contexts. Results indicate that although restricted interests are a diagnostic criteria for ASD, like other symptoms there is a group of people without ASD who have interests that are very similar. They also indicate that regardless of diagnostic group membership, people's interests may manifest differently depending on interest content. Interventions targeting changing the content of one's interest could lead to better developmental outcomes.

Keywords: Restricted Interests; Autism Spectrum Disorder; Special Interests; Adults

This work is dedicated to my husband, Arthur Armstrong.

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Table of Contents

List of Tables

List of Figures

Introduction

Autism Spectrum Disorder (ASD) is characterized by social communication difficulties, and restricted and repetitive interests and behaviour (American Psychiatric Association, 2000). Although deficits in both of these symptom domains are needed to meet the criteria for a diagnosis of ASD, most research has focused on the first domain of social and communication deficits. While there is some research on the second domain of repetitive *behaviours*, virtually no research has focused on restricted *interests* in ASD. Restricted interests can be identified as unusual in ASD in two ways: unusual preoccupations, characterized by their unusual content, and circumscribed interests (CIs), characterized by their unusual intensity. Of the two, CIs are most commonly studied in ASD. Therefore, the majority of the review will focus on this one type. However, there is no evidence at this time for a meaningful distinction between unusual preoccupations and CIs. Overall, restricted interests are the least understood and least researched symptom of people with ASD (Attwood, 2003), despite having been identified in the research literature for three quarters of a century and being present in the majority of individuals with the disorder (Klin, Danovitch, Merz, & Volkmar, 2007; Lam, Bodfish, & Piven, 2008; Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011).

This thesis will review what is known about interests in typical development, including the history, etymology, and various theories that have been proposed. A review of restricted interests in ASD will be conducted, and the need for more research will be outlined. The methods section will be followed by the analysis section with the qualitative and quantitative analyses conducted separately. The quantitative analysis will use independent and dependent samples t-tests and the quantitative section will use grounded theory. Finally, the discussion section will amalgamate these lines of analysis into firm conclusions and suggestions for future research.

Interests in Typical Development

History and Etymology

The noun interest first appeared in text in the 14th century as “interesse”, meaning compensation for loss, or to concern something, make a difference, or to be of importance, primarily in the legal or financial sense (Harper, 2013; Merriam-Webster, 1994). Within a psychological context, interests are something that emerge from an interaction between a person and their environment which involves curiosity or attention, and that are of importance to that person. This reflects both the Latin origins of the words ‘inter’ meaning between and “esse” meaning “to be” (Dewey, 1913) and the English usage of the term “a feeling that accompanies or causes special attention to an object or class of objects” (Merriam-Webster, 1994). The word interest translates into fifty languages (Kellogg, 2013), an indication of the universality of this human phenomenon.

Although scholars have been writing on interests in the general population for over a century, research on this topic is still in the early stages (Renninger & Su, 2012). In the early 1900’s there was an academic focus on interests, and many of the earliest psychologists wrote on this topic (Dewey, 1913; James, 1890; James, 1913; Thorndike, 1935). However, research in this area declined steadily for two reasons: 1) understanding of what constituted interests varied significantly, which made it difficult to develop a coherent understanding of the construct, and 2) researchers came to the consensus that *interest* was too broad a topic to study (Krapp, Hidi, & Renninger, 1992). Therefore, they either moved on to other areas of study, or narrowed their research into one specific aspect of interests, such as motivation. In the 1980’s there was a resurgence of research on interests (Krapp et al., 1992), and this has contributed greatly to our understanding of the topic.

Current Understanding

Interests can be conceptualized in a variety of ways (Krapp et al., 1992), and there are still a wide range of opinions and definitions of what having an interest really means. The common consensus is, as mentioned above, that interest is a psychological state (Hidi, 2000) that can be individually-varying but universal (Renninger, 1992), and is

cognitively and affectively motivated (Renninger & Su, 2012). More specifically, interests can be thought of as the relation between a particular psychological state of an individual and their engagement with, or predisposition to return to, a particular object, topic or activity (Renninger, 1992; Renninger & Su, 2012). It is generally agreed that interests result from an interaction between external characteristics of the environment and intrinsic characteristics of a person (Krapp et al., 1992; Krapp, 2002; Renninger & Su, 2012).

To develop, an interest requires a *trigger* and then a number of conditions for *maintenance*. It is not known why certain interests are triggered and not others; however, the interests of people around an individual such as family members have been found to trigger an interest, particularly in young children (Renninger & Su, 2012). Once triggered, an interest is then maintained by a variety of factors. Four factors appear to be important for maintenance: 1) Environmental opportunities to engage in the interest, 2) A person's perceptions of their ability (the more people see themselves as able and skilled at the interest, the more likely it is to be maintained), 3) Wanting to know more about the interest (cognitive reward), and 4) Feeling good when engaging in the interest (emotional reward) (Renninger & Su, 2012). Figure 1 proposes a model based on this literature. There is currently little research on factors that contribute to interests coming to an end.

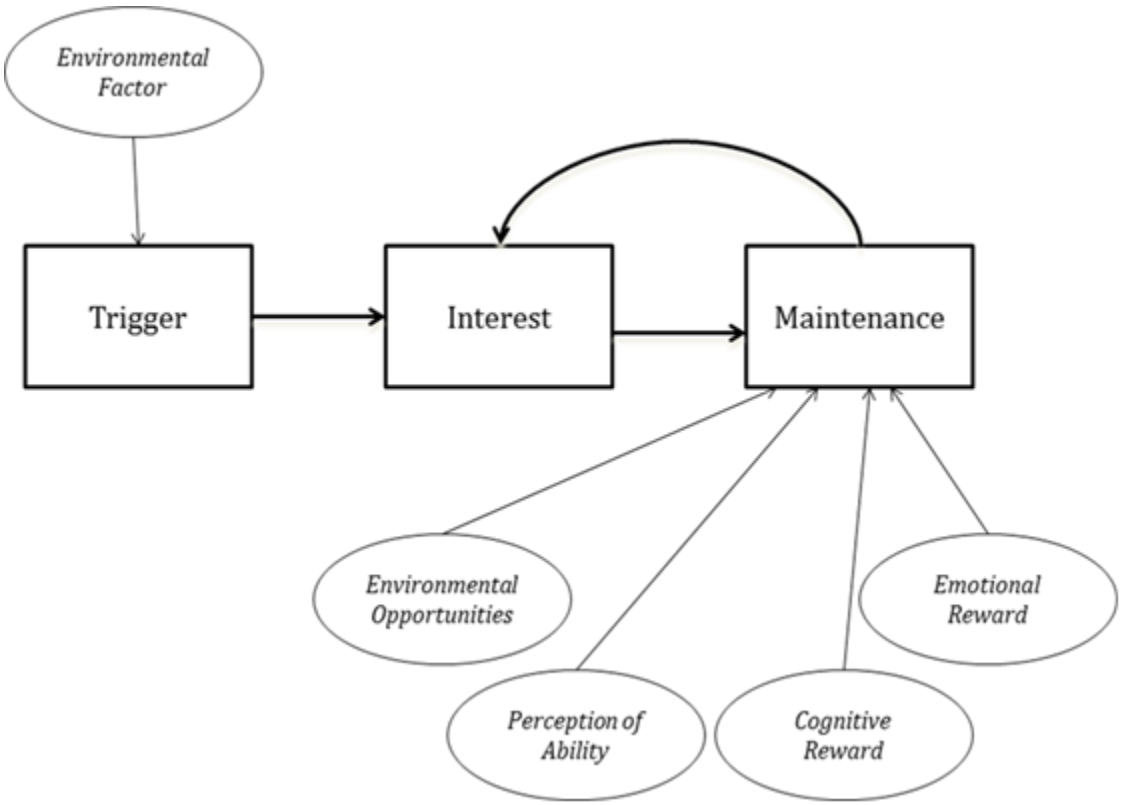

Figure 1. A model of how interests develop.

To distinguish interests from other activities and/or general engagement with objects, theorists have proposed a few essential components of interests (Krapp et al., 1992; Krapp, 2002; Prenzel, 1992). First, there is a *value* component in which the interest is seen as important, meaningful, and personally significant. Second, there is an *intentional* component in which the person engages with, and seeks out the interest, in a self-sufficient way. Once the interest is triggered, the individual is self-motivated and does not rely on external supports from the environment to engage in the interest. Third, the interest has an *affective* component in which the individual is emotionally involved and experiences mainly positive affect when engaging with the interest; the interest makes the person feel good. Fourth, there is a *cognitive* component in which the individual develops in-depth knowledge about the interest and has a desire to learn more about it. Finally, there is a component of *selective persistence* in which the interest is stable for a significant amount of time with the topic or object of interest remaining consistent. See figure 2 for a graphic illustration.

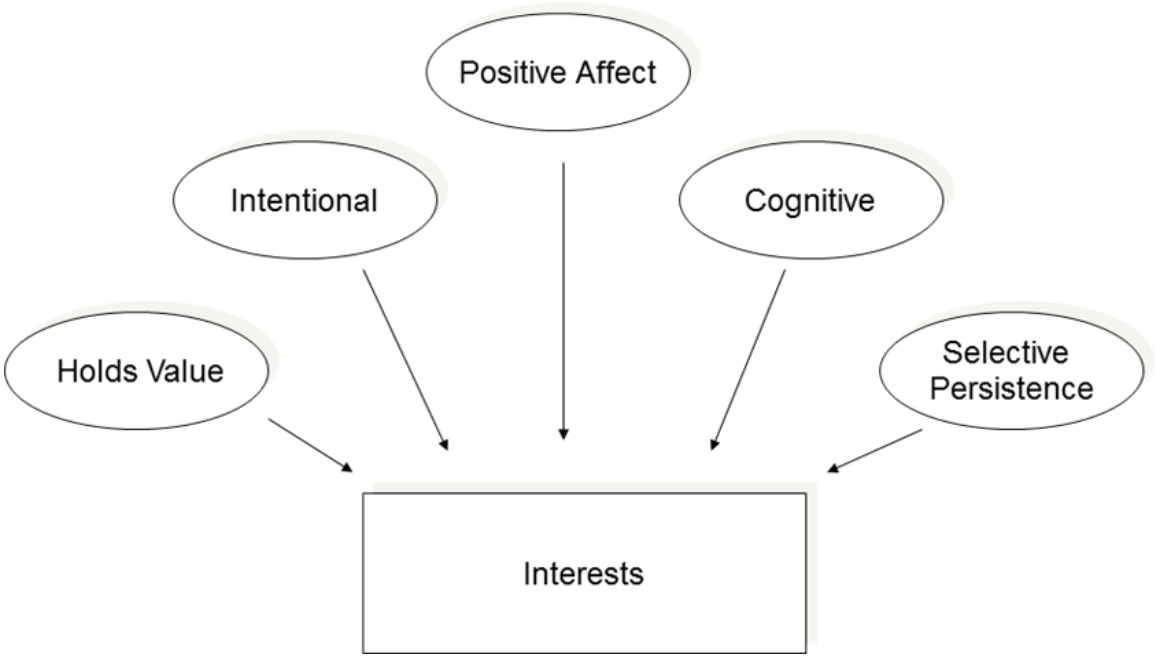

Figure 2. Essential components of interests.

Stages of Development

Models of interest development have mainly applied to vocational interests. However, one model by Eberhard Todt (who primarily writes in German) has been expanded to include general interests and takes into account the cognitive abilities of children at various developmental stages (Krapp, 2002). Todt's model outlines the first stage of interest development as being during the first four years. This stage is characterized by *universal interests* in which all children have very similar interests which contribute to develop age-related mental schemas and cognitive strategies. The second stage begins around four years old when children begin to have awareness of gender. Group-specific interests are held, usually divided among gender lines. Todt refers to this stage as the 'collective interests' stage. The third stage develops during pre- to early adolescence (11-13 years old) when children become more aware of social structure and start to understand themselves within this hierarchy. Their awareness of this structure and their increasing cognitive abilities allow them to begin to develop expectations of themselves and their goals for their future. Thus, their interests become 'personal interests', and better reflect these new understandings of society and themselves within it. These interests are more related to goals of who they aspire to be, whereas interests that do not fit with their new understanding of themselves are rejected.

Finally, later in adolescence, individuals begin to focus on what makes them unique as a person, and interests become more future-oriented. Their 'specific interests' reflect their individuality and become more connected to their future educational and vocational paths. While Todt's model provides an understanding of how typical interests may emerge and how they serve different functions throughout development, there are relatively few studies designed to directly investigate the model. Furthermore, there are ongoing debates about whether identifying stages of typical interest development are even possible given their complexity (Krapp, 2002).

Although there is no definitive evidence that interest development occurs in stages, there is evidence that interests can be triggered, change, or disappear completely during any point in development (Krapp & Fink, 1992). There are also certain characteristics of interests that vary at different ages. For example, young children (up to age six) pursue their interests across many different contexts (Krapp et al., 1992), such as at school, with friends, in play, dressing up, playing computer games, and watching TV related to the interest. Interests are common at this age, with most children exhibiting one or two specific interests (Renninger & Wozniak, 1985) and one third having one or more "intense" interests (DeLoache, Simcock, & Macari, 2007). These "extremely intense interests" consist of similar content as other interests such as vehicles, trains, machines, dinosaurs, and dress-up. However, these interests are pursued with more intensity (i.e., are more noticeable to multiple people in the child's life such as teachers, parents, friends, extended family, etc.).

The home environment plays a strong role in interest development, particularly in the preschool years. Consistency, communication, educational activities, and availability of free play were found to be important factors in interest development (Johnson, Alexander, Spencer, Leibham, & Neitzel, 2004). There are significant differences between genders in terms of both the content and intensity of interest; boys are up to six times more likely to develop intense interests (DeLoache et al., 2007; Johnson et al., 2004).

There is some debate about the stability of interests at this young age, with one study reporting that interests are fairly stable (Krapp et al., 1992) and another reporting that the content of interests changes at this age (Renninger & Wozniak, 1985). However,

there is consensus that interests do increase in complexity and become more differentiated throughout development (Krapp et al., 1992). In older children and adolescents, the environment also plays an important role; peers instead of family have the most influence on the development of interests, and the pursuit of interests occurs in fewer contexts (i.e., they only pursue their interest at home during their leisure time, or as part of an organized club or activity) and their interests are more task-specific as compared to early childhood wherein interests dominate many activities (Krapp et al., 1992).

Overall, interests seem to serve different functions at different ages. From a Piagetian or Vygotskian perspective, for instance, a young child may use an interest as a way to explore objects (Krapp et al., 1992), thus serving an important role in cognitive development. Interests have a strong influence on the attention, recognition, and recall of children (Renninger & Wozniak, 1985), indicating a strong influence on information processing and development. Later on in adolescence and adulthood, interests may serve to create an identity and advance social or vocational areas. Throughout development, interests may serve to guide how an individual is oriented toward, and learns about, the world.

Restricted Interests in ASD

Definition and History

Terminology referring to restricted interests has been quite inconsistent, and there is still no clear consensus. Terms used to describe the nature of interests in ASD have included “restricted interests”, “special interests”, “obsessions”, “all-absorbing interests”, “circumscribed interests”, “circumscribed topics”, “fixations”, “obsessive interests”, “repetitive and narrow interests”, and “special interest areas” (Winter-Messiers, 2007), with some articles using two of the terms in a single study. These terms have been used fairly interchangeably. However, they are often not operationally defined, rendering comparisons across studies difficult.

The term that appears to best capture the unique nature of interests in ASD is “restricted interests” and is one of the two diagnostic symptom clusters of ASD

(American Psychiatric Association, 2013). Restricted interests are broken down into two broad categories based on whether the interest is unusual in its focus or intensity (American Psychiatric Association, 2013; Lord, Rutter, & Le Couteur, 1994). "Unusual preoccupations" are interests that are unusual in their *focus* or *topic* for the child's developmental level such as a 5-year-old child interested in plumbing (Lord et al., 1994). Sometimes these unusual preoccupations may include attachment to particular objects (American Psychiatric Association, 2013), such as a child not wanting to part with a certain toy. Developmentally, a focus and attention to objects (e.g., looking at or playing with toys) develops before interests in particular topics or activities (e.g., an interest in trains, or dance). However, preoccupation with an object is not equivalent to knowing about an object. More research is needed to understand whether preoccupations and CIs should be included in the same diagnostic category. At the very least, both unusual preoccupations and attachment to objects are interests that seem to differ *qualitatively* from the typically-developing population. CIs are usually referred to as interests that are typical in their focus or topic but unusual in their *intensity*. For instance, an elaborate knowledge of facts about trains (e.g., models, history, schedules) that is all-consuming to the exclusion of most other daily and social activities (Attwood, 2003). These are interests that seem to differ *quantitatively* from the typically-developing population.

There is no guidance on which terms are best to use, nor how to distinguish reliably between them (if they are clinically distinct). Although the term 'special interests' is used most by individuals with ASD, it is one of the least descriptive terms. Therefore, for the purpose of this thesis the term 'restricted interests' will be used as a general term to refer to interests in ASD that are unusual either in focus or intensity. When referencing interests that are unusual specifically in focus the term 'unusual preoccupations' is used, whereas when the focus of the interest is typical, but the intensity is unusual, the term 'circumscribed interests' (CI) is used.

Restricted interests were one of the symptoms reported in the original paper describing ASD (Kanner, 1943), and were included as one of the six original criteria of Infantile Autism when the disorder first appeared in the 3rd edition of the DSM (American Psychiatric Association, 1980). They were classified as 'peculiar interests' under the diagnostic symptom 'bizarre responses to various aspects of the environment'. The manual describes restricted interests as: "Music of all kinds may hold a special interest

for the child. The child may be extremely interested in buttons, parts of the body, playing with water, or peculiar topics such as train schedules or historical dates" (American Psychiatric Association, 1980, p. 88). Although not explicitly stated, these examples encompass current understanding of both CIs and unusual preoccupations. Restricted interests were not included in the diagnostic criteria for Childhood-Onset Pervasive Developmental Disorder, although a preoccupation with morbid thoughts or interests was included in the associated features section. This criterion may have been included due to the previous categorization of ASD as a form of childhood schizophrenia, but was dropped in subsequent editions due to the distinction between the two disorders. By the time DSM III-R (American Psychiatric Association, 1987) was released, the manual recognized that Autistic Disorder (previously Infantile Autism) was a more severe form of Pervasive Developmental Disorders (PDD). This revised classification system described children with either diagnosis as often having a "markedly restricted repertoire of activities and interests, which frequently are stereotyped and repetitive. The severity and expression of these impairments vary greatly from child to child" (American Psychiatric Association, 1987, p. 33).

The 4th edition of the DSM (American Psychiatric Association, 1994) described restricted interests in a nearly identical way to how they are currently understood. Restricted interests were included as a diagnostic symptom separated for the first time from other restricted and repetitive behaviours and defined as an "encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus" (American Psychiatric Association, 1994, p. 71). The exact same criterion was applied to the new category of Asperger's Disorder, understood as similar to Autistic Disorder but without delays in communication. For the diagnosis of PDD it was stated that the person may have stereotyped interests.

The recently released DSM-5 (American Psychiatric Association, 2013) uses very similar wording to the previous edition: "Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests)" (American Psychiatric Association, 2013, p. 50). 'Fascinations' are described as possibly relating to sensory hyper or hypo-sensitivity. Additionally, for the first time, the DSM mentions that these interests may lead to educational or vocational opportunities in adulthood. Despite being

included in the DSM criteria for ASD since its inception, the definition itself has not changed substantially, which attests to its importance in this field.

Restricted interests were initially identified separately in the 1940's by Leo Kanner (publishing in English) and Hans Asperger (publishing in German). They each described a group of children who had intense and unusual interests in a variety of areas, along with social and communication difficulties (Asperger, 1944; Kanner, 1943). A few years after Kanner and Asperger described restricted interests in children with ASD, a group of pediatricians documented CIs they described as "a concentration of interest in a specialized field of thought or endeavor such as electricity, astronomy, railroads, art, music, or any of a host of subjects....[that] is pursued with an intensity which limits the establishment of friendships and participation in group activities" (Bakwin, 1955; Robinson & Vitale, 1954). The patients they described in their reports were children who enjoyed talking about their interests and knowledge with adults rather than their same-aged peers, and who strongly resisted attempts by the adults to stop them from engaging in their interests. These children did not establish friendships or engage in group activities, and were more likely to be male.

The children with CIs described by these pediatricians were perceived as being unique and warranted a designation of 'syndrome' (Robinson & Vitale, 1954). However, they were explicitly differentiated from individuals with Autistic Disorder by the author (and in commentary by Leo Kanner) in that they had greater emotional responsiveness, their early development was described by parents as fairly typical, they exhibited less insistence on sameness, and withdrawal from other people. Within our current diagnostic framework and given our understanding of ASD as a spectrum, these children would likely also qualify for a diagnosis of ASD (American Psychiatric Association, 2013). Thus, restricted interests are among the first observed behavioural phenotypes of the disorder, described at both the low and high-functioning ends of the spectrum.

Current Understanding

Classification

Since restricted interests were described in the 1940's and 50's there has been surprisingly little research conducted on interests in ASD. Currently they fall in the ASD

symptom domain of restricted and repetitive behaviours (RRB), which also consists of non-functional routines or rituals, repetitive motor mannerisms and persistent preoccupation with parts of objects (Honey, Rodgers, & McConachie, 2012; Turner-Brown et al., 2011). These four defined subcategories of restricted and repetitive behaviours do not emerge consistently across research findings. For example, in one study an exploratory factor analysis revealed three subcategories: repetitive motor behaviours, insistence on sameness, and CIs (Lam et al., 2008). Despite the number of factors involved, interests usually emerge as an independent factor or are excluded from the factor analysis, indicating a need to study this phenomenon in its own right (Bodfish, 2011).

Interests are unique from other restricted and repetitive behaviours in at least three ways. First, they are the only type of restricted or repetitive behaviour that may not been found to be related to cognitive ability (Lam et al., 2008) but do seem to have a familial link (Smith et al., 2009). Second, while other behaviours in this category are found in other clinical populations (e.g., repetitive motor mannerisms are often prevalent in people with intellectual disability, insistence on sameness is often exhibited in people with obsessive-compulsive disorder) interests unusual in content or intensity seem to be unique to, or a hallmark symptom of, ASD (Gal, 2011). Third, other restricted and repetitive behaviours are almost always viewed as detrimental and undesirable, but CIs are sometimes seen as an area of strength or talent by families of the individuals with ASD (Mercier, Mottron, & Belleville, 2000).

Relation to Social Communication Skills

Most of the research conducted thus far on restricted interests has focused on their relation to social and communication skills. When diagnostic tools are used they have primarily reported no relation of restricted interests to social deficits in ASD. A study which included both low and high functioning individuals with ASD aged 20 months to 29 years old found that while the other restricted and repetitive behaviours were associated with greater impairments in social and communication skills as measured by the Autism Diagnostic Interview-Revised, CIs did not show any association (Lam & Aman, 2007). Similarly, a study which included only high functioning children and adolescents found no association between CIs as measured by the Interests Scale and

the Interview for Repetitive Behaviours (both parent report measures) and the ADI-R social or communication scores (Turner-Brown et al., 2011). In a third study of high functioning individuals with ASD (mean age 14, no age range given) the results were less clear (Klin et al., 2007). A significant correlation was found between a 4-point scale of interference of the CI and the socialization domain on the Vineland Adaptive Behaviour Scale for preschool children but not for elementary school children. From these studies it appears that there may not be an association between parent-reported CIs, and social-communication skills when measured by the ADI-R. However, other parent-report measures may indicate a relation. While using parent-report measures are convenient, examining real-life interactions provides direct information.

Interactive assessments have revealed both positive and negative associations between CIs and social skills. Increased social behaviours were evident while individuals with ASD engage in talk about their CI. In young children, more social initiations and time spent playing with a peer were observed when the children were engaging with a toy related to the CI of the child with ASD versus a toy not of interest (Boyd, Conroy, Mancil, Nakao, & Alter, 2007). In this study, toys related to the CI were determined by prior parent and teacher interviews, as well as an assessment of toy preference measured by the amount of time spent with a particular toy when others were available. In older children and adults, more eye contact (Nadig, Lee, Singh, Bosshart, & Ozonoff, 2010), sustained talking (Attwood, 2003), and more dynamic voice quality (Winter-Messiers, 2007) have been noted when individuals with ASD talked about their CI to an adult researcher.

However, a convincing body of work has also demonstrated that CIs may have a negative impact on social skills and social attention in ASD. For example, one study found when a child with ASD talks about a CI, the interaction tends to be one-sided and focused primarily on their interest (Nadig et al., 2010). Even from the earliest descriptions of CIs it was hypothesized that restricted interests may limit social attention and the development of interpersonal relationships (Robinson & Vitale, 1954), and this explanation has persisted for decades. Recently, in a series of studies, researchers presented high-functioning children (6-17 years) with ASD with an array of objects and social stimuli. Objects included those previously found to be common CIs in children with ASD (high interest objects) and others not commonly found to be CIs in ASD (low

interest objects). The children with ASD showed decreased attention to social stimuli presented in the array when high interest objects (but no low-interest objects) were included (Sasson, Turner-Brown, Holtzclaw, Lam, & Bodfish, 2008). This same pattern of decreased social attention was later found in subsequent studies by the same authors in toddlers with ASD, indicating that this attention bias emerges early (Sasson, Elison, Turner-Brown, Dichter, & Bodfish, 2011). Recently, each participant's own CIs were used as stimuli and the same pattern was found indicating that CIs may be a candidate for reducing social attention (Sasson & Touchstone, 2014). Specifically, attention to CIs may decrease the likelihood that children with ASD with CIs attend to social stimuli and, may contribute to social attention deficits (Attwood, 2003; Turner-Brown et al., 2011).

More research is needed to clarify the relations between interests and social abilities as current evidence is mixed. One approach to better understand the role restricted interests may have in ASD is to consider the role interests play at particular stages of development. Because ASD is a developmental disorder, understanding its nature and effects at each stage could help with understanding developmental cascades over time. For example, if an individual with ASD is so focused on their interest that they miss out on social opportunities at a time when social development is prominent, this will have effects later on in development. Furthermore, because developmental systems change substantially across stages, in order to understand restricted interests in ASD one requires an understanding of how they manifest differently at each stage.

Stages of Development

A developmental approach is useful in understanding how restricted interests in ASD may start, how they are maintained, and whether they serve the same function as interests in typical development. Restricted interests in children with ASD emerge early, often by two or three years of age (Attwood, 2003). There are many aspects of interests in ASD that seem to mirror those of typically developing (TD) children. In both groups they generally start as a preoccupation with objects, such as Thomas the Train or trucks (Boyd et al., 2007) and develop into preoccupations with certain *topics* as the children age (Leekam, Prior, & Uljarevic, 2011). As is the case in typical development, the focus of interests in ASD also changes over time (Attwood, 2003). Intense interests in TD children are common, particularly in boys, and peak during the preschool years

(DeLoache, Simcock, & Macari, 2007). Nevertheless, even at its peak, the rates of intense interests in typical development are not as high as those found in individuals with ASD (DeLoache, et al., 2007; Johnson, Alexander, Spencer, Leibham, & Neitzel, 2004; Turner-Brown et al., 2011). Moreover, the types of items that later become common CIs, such as trains, computers, are more interesting to all young children, but they are particularly interesting to young children with ASD (Sasson, Elison, Turner-Brown, Dichter, & Bodfish, 2011; Sasson et al., 2008)

However, there are also differences in the developmental trajectory of restricted interests in ASD. As compared to TD children, restricted interests in those with ASD involve less sharing with others, occur at a greater frequency and cause more interference and require greater accommodation by family members (Anthony et al., 2013; Turner-Brown et al., 2011). By adolescence, many individuals with ASD reportedly develop interests similar to typically-developing peers such as electronics, computers, or science fiction, but the interests are unusual in terms of intensity or narrowness of the topic (Attwood, 2003).

Restricted interests in people with ASD seem to diminish with increasing age from childhood (Lam & Aman, 2007), through to adolescence (Seltzer et al., 2003; Shattuck et al., 2007) and into adulthood (Esteben et al., 2009). In particular, restricted interests have been found to diminish more with age than any other form of RRB (Esteben et al., 2009), possibly due to the fact that restricted interests are the most frequent RRB in toddlers and by adulthood are at a similar level to other RRBs. However, one study found that restricted interests are *more* frequent in older children with ASD compared to younger groups, although once nonverbal IQ was taken into account there was no change in the prevalence of restricted interests over time (Bishop et al., 2006). Other reports indicate that the number of restricted interests may *increase* over time into adulthood (Attwood, 2003; Fecteau et al., 2003; South et al., 2005). One study reports 17 % of adults with Asperger's Disorder reporting six or more simultaneous interests (Bashe & Kirby, 2001), though more recent reports indicated the number of interests may be comparable between groups of individuals with and without ASDs (Anthony et al., 2013). Moreover, how interests are triggered, maintained, and end, or how long they last in individuals with and without ASD has yet to be explored. To date reports about the number of restricted interests individuals with ASD have over their

lifetime have been conflicting, and more research needs to be conducted to understand whether interests increase, decrease, or remain stable across development.

Measurement of Interests

Typical Development

A wide range of approaches have been used in attempts to measure the various components of interests in typical development. These have included surveys, behavioural measures (such as monitoring what a person looks at online), fMRI, participant observation (both in and out of the lab), content knowledge and participant membership (Renninger & Su, 2012). However, it is very difficult to measure interests because it is such a broad topic and can be defined in so many ways, even when focusing on only one component. For instance, two people may both be interested in World War II, but one might be interested in the psycho-social aspects of people living in concentration camps, while another might be interested in the military aspects such as tactics or aircrafts used and major battles fought. Using a questionnaire on content knowledge would not provide a good measure of interest as the questions asked (e.g. the major contributing factor to survival of a concentration camp vs. number of casualties a particular army suffered in a certain battle) would greatly influence a person's score. Furthermore, it might not necessarily reflect their level of interest in terms of other components such as positive affect experienced when engaging in it. Because of this difficulty there is no widely-used measure of interests at this time, and some researchers have speculated that it may be impossible to develop a measure because of the differences between (and within) interest domains, as well as different foci of what components of interests researchers want to investigate (Renninger & Su, 2012).

Autism Spectrum Disorder

Because of a lack of an operational definition, there has been a plea to consolidate available measurement tools to advance the study of restricted and repetitive behaviours (Leekam et al., 2011). There are currently three types of tools that aim to measure these behaviours in ASD: parent-report questionnaires, parent interviews, and observational measures.

Parent Report Questionnaires

One parent-report measure is The Interests Scale (Turner-Brown et al., 2011), designed specifically to measure interests in ASD. It consists of 39 items that ask questions about overall interest, the amount of time spent on the interest, the degree that it interferes with other activities, how much resistance there is when interrupted, and involvement with other people. However, it is not published, which makes it difficult for other researchers to use, and has only been used to measure interests in children.

The Cambridge University Obsessions Questionnaire was developed for measuring 'obsessions' in ASD, but it only measured the *content* of interests in children (Baron-Cohen & Wheelwright, 1999). The Yale Survey of Special Interests asked parents of children with ASD about their CIs (Klin et al., 2007). While this measure went into significantly more depth about the development of the disorder, it again only reported on children up to age twelve. Furthermore, it also focused on the *nature* of the interests (it did not report on the content), as well as knowledge about the topic and a general measure of interference. This measure was developed for an exploratory study, and while it does cover more areas of interests, it omitted some important components such as the maintaining factors.

Another parent-report questionnaire is the Repetitive Behaviour Rating Scale-Revised (RBS-R)(Lam & Aman, 2007). The RBS-R examines 43 different types of repetitive behaviours in five categories, one of which measures CIs. However, this measure does not go into very much detail regarding CIs, and again, has been developed only for use with children.

Parent Interviews

The Interview for Repetitive Behaviour is a follow-up interview to the RBS-R conducted with the parent, and it includes a set of questions that specifically pertain to CIs (Turner-Brown et al., 2011). The Repetitive Behaviours Questionnaire is another measure which can be administered as either a 33 item questionnaire, or a 55 item parent interview for measuring CIs in children (Honey, McConachie, Turner, & Rodgers, 2012).

Perhaps the most common way of measuring restricted and repetitive behaviours is the Autism Diagnostic Interview- Revised (Lord, Rutter, & Le Couteur, 1994). Because it is often used to confirm diagnosis in research, it is also used as a measure of symptom severity as it is routinely administered to participants. However, while it is a well-validated and reliable diagnostic tool, there are only 12 items that measure restricted and repetitive behaviours, and two that ask about interests specifically. Furthermore, using a score from a tool used for diagnosis to measure symptom severity is problematic since scores would be truncated due to individuals needing a minimum score to receive a diagnosis (Leekam et al., 2011). Therefore, it is not appropriate to use the ADI-R as a measure of interests.

Observational Measures

There are several observational measures of general restricted and repetitive behaviours; however, they have been primarily used with children. Two observational measures of infants have been developed: the Autism Observational Scale for Infants (Bryson, Zwaigenbaum, McDermott, Rombough, & Brian, 2008) and the Communication and Symbolic Behaviour Scales Developmental Profile (Wetherby & Prizant, 2002). The only observational measure of restricted and repetitive behaviours used with older children and adults is the Autism Diagnostic Observation Schedule- Revised (ADOS-R)(Lord et al., 2000); however, it does not have item ratings specifically for interests. Furthermore, similar to the ADI-R it was meant as a diagnostic tool and, thus, has the same drawbacks. More generally speaking, observational measures may be problematic since individuals might change their behaviour if they know they are being observed or are in the presence of others, or the behaviour may not happen during the time that the individual is being observed (Leekam et al., 2011).

Summary

Overall, there are only a small number of restricted and repetitive behaviour measures that have been well validated or widely used, and not one that measure interests specifically that meet these criteria. The measures that ask sufficient questions about the depth and breadth of interests are parent interviews for younger children and are inappropriate for use with adults with ASD. There are no self-report or interview measures for individuals with ASD, yet the perspective of people with ASD would offer

valuable information about the phenomenon of interests and how it is experienced by individuals with ASD (Turner-Brown et al., 2011). Combined with parent interviews this methodology could generate an understanding of how interests develop or are maintained over time and could lead to theoretical explanations of interests and their role in ASD (Leekam et al., 2011).

Current Study

Rationale

This study focused on high-functioning adults with ASD in order to understand the subjective perspective on interests in this population (Leekam et al., 2011). Although previous studies have compared neuro-typical and ASD groups at particular ages (Anthony et al., 2013; Turner-Brown et al., 2011), a retrospective study with adults permitted the investigation of the manifestation of restricted interests across all developmental stages. However, because adults with ASD in this study were required to self-report on their interests, it was necessary that they be able to communicate effectively with the experimenter. Therefore, it should be stated that the results of this study only pertain to high-functioning individuals with ASD.

This study aimed to extend the work of the initial studies investigating interests in ASD in three ways. The first aim was to capture and measure all of the important components of interests outlined in the typical literature, which none of the existing measures currently achieve. The current diagnostic criterion rests on qualifying interests as a symptom of ASD if they are unusual in either intensity or focus. However, few studies have looked at how interests in ASD compare with interests in typical development. Therefore, there is little basis to inform methods of identifying an interest as unusual. The second aim was to develop a better understanding of the interplay between environmental and individual factors in ASD interests. The literature on interests in typical development emphasizes the important contribution individual and environmental factors jointly make in triggering and maintaining the interest. Thus far, the literature on interests in ASD has focused extensively on individual factors of interests (e.g., the intensity of the focus) and less on environmental factors (e.g.,

triggers). The third aim was to obtain the perspective of adults with ASD on their own restricted interests. All existing measures on interests in ASD were developed for, and used with, the parents of children and adolescents. Only one study has investigated interests in adults with ASD. Although an important first step, the study was limited in that it used only one context (internet forums) to measure the content of interests reported online. A retrospective look at interests as they develop overtime in a wide variety of contexts from the perspective of adults with ASD would provide a rich source of information on the development of interests.

This study used a mixed-methods approach to explore interests in ASD with regard to how they are similar to, or diverge, from typical interest development. The study adopted a retrospective approach that involved interviewing both adults with ASD, and their parents, as each has unique information and knowledge to contribute. Unlike most previous research, this study also included a group of typically-developing adults who have a special interest or hobby that they spend a significant amount of time on. This study is important as interests are understood as something that is expected to vary across all people, and are a significant influential factor in human behaviour (Renninger, 1992). Studying what makes interests different in ASD informs our understanding of both typical and atypical development of interests.

Research Question

The research question this study aimed to address was: What is the nature, developmental trajectory, and impact of interests in ASD on social, emotional and physical well-being, as compared to special interests in typical development?

Choice of Methodology

The mixed methods approach included both qualitative and quantitative approaches. Combining approaches can lead to a much deeper understanding of a studied phenomenon than a single approach (Tashakkori, Teddlie, & Sines, 2013). Furthermore, mixed-methods approaches are common when studying interests in the typical population due to the complex and multi-faceted nature of the topic (Renninger, 1992). As there is a lack of consensus on the definition or measurable aspects of interests, mixed-methods approaches are useful in understanding the topic in more

depth. This study used a *parallel* mixed methods design (Tashakkori, Teddlie, & Sines, 2013). The data from each study was analyzed and reported on separately, and then amalgamated in the discussion to answer the research question in an integrated way. This project was approved by the Office of Research Ethics at Simon Fraser University (SFU).

Researcher Bias

Given that there is a qualitative component to this study, researcher bias needs to be acknowledged. This researcher has had extensive background and experience with individuals with ASD, and does have preconceived ideas about restricted interests based on past research and experience. It is understood that this will influence the results of the study; however, measures were taken to ensure that the influence was mitigated. The experimenter had frequent meetings with her research supervisor to ensure preconceived or early theories did not become entrenched. She also discussed major themes with an individual external to the study who also read the transcripts to ensure the same themes were emerging as important, and had a second person code 10% of the interviews with an inter-rater reliability kappa coefficient of above .80.

Methods

Participants

Participants were 18 years or older and consisted of three groups: one of adults with high-functioning ASD, one of parents of participants in the high-functioning ASD group (parent group), and one of typically-developing adults with a self-reported special interest (TD-SI group). There were 22 participants in the high-functioning ASD group, 20 participants in the parent group, and 20 participants in the TD-SI group. The parent group consisted of 17 biological mothers and 3 biological fathers. Two participants no longer had contact with either of their parents and thus they did not have a parent fill out a questionnaire. Participants in the TD-SI group were initially recruited from online web forums pertaining to particular interests, and from word-of-mouth. They were only required to self-report a strong interest in a particular topic to be included.

All participants in the ASD and TD-SI groups were compensated $10 per hour for their participation in this study. Participation time in the high-functioning ASD and TD-SI groups ranged from 2.5 to 6 hours, with most participants completing the study in 3 to 4 hours. Participation time in the parent group ranged from 30 minutes to 4 hours, with most participants completing the study in 1 to 1.5 hours.

Recruitment

The ASD group was recruited from a database of participants with ASD who consented to be contacted for future research by the Autism and Developmental Disorders Lab at SFU, and their parents participated when they were available. The participants were originally added to the database through participating in previous studies, contacting the lab via the website, word-of-mouth, community postings, and a sign-up table at community education events. Once most of the ASD group was recruited (approximately 80%) and themes of interest content of this group was

becoming clear, the recruitment for the TD-SI group began. The goal was to have somewhat comparable interest content between groups because of the depth at which the interests were being explored. The TD-SI group was recruited from local online forums, the Research Participation system (at SFU), and word of mouth (see Table 1).

Table 1. Recruitment Methods of Participants Included in the TD-SI Group

Recruitment Method	Number of Participants Included
Online Web Forums	5
Word-of-Mouth	8
Research Participation System	7

Online web forums refer to web forums on which initial participants were recruited for the TD-SI group. Information about this study was posted to a forum for birders in British Columbia, one for a video game convention, and one for an Anime Convention occurring in Vancouver (due to common interest content being reported in the ASD group being Anime or Japanese Culture, electronic gaming, and animals). Five people in the TD-SI group with a special interest in birds were recruited via this method. Four were included in the study and one was eventually excluded due to being substantially older than anyone in the high-functioning ASD group once all data was collected. Because people with a variety of interests were the focus of this study, participants stopped being accepted from the birding forum after five participants were recruited. However, it should be noted that 35 expressed interest in participating in just three days, indicating the level of passion for their interest.

Information from this study was also posted on the online forum for an Anime convention occurring in Vancouver. This was because it was becoming clear that Anime was an interest for a number of the participants in the ASD group, and comparable content between groups was the aim. From this post, one person was recruited. It is thought that there were fewer responses from this post than the birding forum because the convention was still a few months away at the time of the post. In total five people were recruited directly from online web forums.

Word-of mouth became an unexpected but serendipitous recruiting technique. Word spread from the five participants who had been recruited online and the researcher began being contacted by others who had heard about the study from previous participants and were eager to share information about their special interest. The individual recruited from the Anime forum asked if he could bring other people who also had a strong interest in Anime and were interested in participating, and he brought three others along with him. Although this was an effective recruitment technique, it may have had some effect on the analysis due to potential non-independence of participants in the TD-SI group.

To increase diversity in the content of the interests, and because the participants in the TD-SI group were older on average than the high-functioning ASD group, subsequent participants were recruited from the Research Participation System (RPS) at Simon Fraser University. This is a system in which undergraduate students in introductory psychology classes participate in research for course credit. Participants were required to have a strong interest to participate based on self-report. Once they arrived at the testing session, a discussion occurred to ensure they did have a special interest in a particular area, topic, or activity. Three participants were excluded in the final analysis as they had either not read the description of there being a requirement of having a special interest, or not understood what it meant, and reported they did not in fact have a special interest. All other participants recruited from the RPS system confirmed that they currently had a special interest.

As expected due to the recruitment strategy, both groups reported similar interests. No clear ‘unusual’ interests were reported in this study. An interest could be classified into two themes if that was appropriate. For example ‘Anime and Japanese Culture’ was coded as both the ‘Anime’ and ‘Travel and Culture’; ‘Military Models’ was coded as both ‘Military’ and ‘Toys and Models’. However, most interests were only classified as one theme. See Appendix D for more information regarding the definitions used to classify interest content

Table 2. Number of Interests Reported by Content Area

	TD-SI	ASD- Self Report	ASD- Parent Report
Electronic Gaming	8	10	10
Visual and Performing Arts	5	4	9
Sports	12	4	2
Animals	4	3	7
Non-Electronic Gaming	1	5	7
Reading and Writing	4	2	6
Television Shows	4	4	3
Technology	3	4	3
Music	2	2	4
Politics and Current Affairs	3	1	4
Anime	4	3	0
Movies	4	0	3
History	1	3	3
Travel and Culture	1	5	1
Mathematics and Hard Sciences	1	2	3
Military	2	1	3
Vehicles and Transportation	0	3	3
Toys and Models	0	3	2
Astronomy	1	2	1
Philosophy	1	0	0

Measures

Interests Measure

Due to the lack of an appropriate self-report measure of interests for use with this population (i.e., adults) a measure was created for this study, the Interests

Questionnaire, that captured aspects of interests both quantitatively and qualitatively. Important aspects of intense interests in both ASD and typical populations that had been measured in the past were number, contexts, intensity, and duration of interests, and the degree of interference it causes in their life (DeLoache et al., 2007; Turner-Brown et al., 2011). These aspects were included in the current measure of interests. Given a recent study indicating parents spend a significant amount of money on their child with ASD's special interests (Winter-Messiers, 2007), a monetary measure of amount spent on the interest was also included. The important components of interests, as well as factors in the development of interests (i.e., triggers and maintenance factors) outlined earlier were measured quantitatively. The questionnaire was designed for the best flow of questions. Therefore, quantitative and qualitative questions were mixed, but were separated at the analysis phase.

The numbers of distinct interests reported were counted. As the populations may have very different amounts of free time available to spend on the interest depending on other commitments and activities, intensity of the interest was measured by what percentage of their spare time they spend on their interest, and the percentage of their spare time they would *like* to spend on their interest. Duration was measured in number of years they have held their interest. The monetary measure was dollars spent by the person with high-functioning ASD and their parent on their interest per month. As previously mentioned, even though interests in high-functioning ASD have been defined as unusual in intensity (circumscribed interests) or focus (unusual preoccupations), there is no evidence to indicate these are meaningfully different, or that they should be studied separately. Nor is there any evidence that people with ASD do not have similar interests as those of TD individuals. Therefore, no restrictions were placed on the particular type or number of interests reported. This measure was designed to understand all interests as fully as possible for all participants.

A first draft of the questionnaire was developed and piloted on one parent to test how long it took to complete, and how easy it was to follow. The feedback from this parent was that it was too difficult to follow as it was currently structured with each set of questions being asked in succession for each age group. They reported that it was difficult to keep track of which age for which she was filling out the questions, and in many cases the answers were the same no matter which age she was reporting on.

Thus, the questionnaire was subsequently revised to its final format to include a table (which was in fact the suggestion of the pilot parent) in which the participant could answer the questions for each age period laterally in succession, copying and pasting when appropriate. When the same parent was given the revised questionnaire they reported it was much easier to fill out and that format was kept. The questionnaire was then given to three individuals to pilot the self-report version, on which the table format had also been added. Two of these individuals had a diagnosis of ASD and one did not. They gave no additional feedback, and it took them a reasonable amount of time (1-1.5 hours), so that version was finalized for use in the study. See Appendix A (self-report) and Appendix B (parent report) for the final versions of the Interest Questionnaires.

Other Measures

Wechsler Abbreviated Scale of Intelligence (WASI)

The WASI (Wechsler, 2011) was used to measure cognitive ability for each participant. Any participants with a full-scale intelligence quotient (FSIQ) of below 75 were excluded in order to avoid confounding the effects of ASD and intellectual disability.

Autism Diagnostic Observation Schedule- Generic (ADOS)

The ADOS (Lord et al., 2000) is a semi-structured diagnostic measure using semi-structured tasks to elicit social-communicative difficulties in ASD. This measure was administered to participants with ASD to verify their diagnosis. All participants except for one met the recommended cut-off scores for ASD. This participant scored one point below the cut-off, but was still included for two reasons. First, she had a recent diagnostic report confirming her diagnosis in which a more comprehensive diagnostic assessment was done. This report considered other factors such as development, which was beyond the scope of this study. Second, previous studies have shown that females may be less likely to meet diagnostic criteria on standardized measures (Dworzynski, Ronald, Bolton, & Happé, 2012), especially given the ADOS was normed primarily with males (Lord et al., 2000)

Autism Spectrum Quotient (AQ)

The AQ is a 50-item self-report measure of ASD symptoms that can be used as a screening measure. The range of possible scores is 0-50, and the cut-off recommended for referring a participant for an assessment for ASD is 32 (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Therefore, it was decided that any participant in the TD-SI group with an AQ total score above 32 would be excluded from the final analysis. All participants in the TD-SI group scored below the cut-off.

Background Demographics Questionnaire

A background demographics form was administered to obtain information about the background of participants. Information obtained included language, nationality, occupation, student status, living arrangements, and any psychiatric diagnoses of the participants in both the ASD and TD-SI groups.

Group Comparison

The groups were compared on a number of measured variables. Independent samples t-tests were conducted on parametric variables, and chi-squared analyses were conducted on non-parametric variables. See the table below for more information on the outcomes of these statistical tests. The high-functioning ASD and TD-SI groups were comparable overall, with some expected differences on particular variables. The mean ages of the groups were not statistically different, and the average FSIQ of both groups was well within the average range (although statistically different when using a p cut-off value of.05). The AQ scores were what would be expected, with the high-functioning ASD group scoring significantly higher than the TD-SI group (Baron-Cohen et al., 2001). The majority of both groups lived with their parents, although more of the ASD group participants had this living arrangement, as expected. These living arrangements may initially be surprising, especially for the TD-SI group, but given the younger age of the participants (most were in their early-mid 20's) and the high cost of living in the Metro Vancouver area it is a common scenario (SFU, 2011). No participants in either group had children, also because of their younger age.

There were no differences between the groups on ethnicity. The majority of both groups were Caucasian, a minority were Asian, and a few participants of each group were of mixed or other heritage. More participants in the TD-SI group were employed full-time, although most participants in both groups were either employed part time or not at all. More participants in the TD-SI group were full-time students. Overall there were more participants with anxiety disorders in the ASD group, which is consistent with current research on co-morbid diagnoses (Kanai et al., 2011).

Table 3. Participant Characteristics

	ASD mean (SD), range	**TD-SI mean (SD), range**	**Outcome of Statistical Test**
Gender	15 M, 7 F	15 M, 5 F	X^2 (1, 41) = 0.76, p = .38
Age	24 (7.3), 18-50	25 (5.8), 18-39	F (1, 41) = 0.10, p = .76
FSIQ	99 (13.0), 84-123	108 (13.7), 83-131	F (1, 41) = 7.29, p = .04*
AQ	27 (11.4), 8-30	17 (5.2), 18-46	F (1, 41) = 10.27, p = .00**
Living Arrangement	With Parents: 18 Alone/Roommate:2 Partner: 2	With Parents: 10 Alone/Roommate: 8 Partner: 2	p = .03* p =.19 p = .92
Number of Children	None	None	n/a
Ethnic Background	Caucasian: 14 Asian: 3 Mixed/Other: 5	Caucasian: 8 Asian: 7 Mixed/Other: 5	p = .13 p = .10 p = .86
Employment	Full Time: 0 Part Time: 6 Not Employed: 16	Full Time: 3 Part Time: 7 Not Employed: 10	p = .05* p = .59 p = .23
Student Status	Full-Time: 3 Part-Time: 5	Full-Time: 11 Part-Time: 2	p = .01** p =.27
Psychiatric Diagnoses (other than ASD)	Language Disorder: 1 Attention Disorder: 2 Learning Disability: 2 Anxiety Disorder: 6 Depression: 3	Language Disorder: 0 Attention Disorder: 1 Learning Disability: 2 Anxiety Disorder: 0 Depression: 1	p = .92 p = .61 p = .92 p = .01** p = .34

Procedure

Participants were asked to provide informed consent, were given the opportunity to ask any questions, and informed that they may withdraw at any time. They then completed the WASI, followed by the ADOS (for participants in the high-functioning ASD group), and then the Interest Questionnaire. While the researcher was reading through their Interest Questionnaire to ask any follow-up questions, participants completed the background demographics form to obtain relevant background information on the participants (see Appendix C), as well as the AQ. While the high-functioning ASD participants were completing these tasks, their parent was filling out the parent version of the Interests Questionnaire for participants in the high-functioning ASD group.

Comment boxes displayed on a computer were chosen to obtain information for the Interest Questionnaire instead of interviews because people with high-functioning ASD have difficulty with, and many have anxiety about, social interactions (Müller, Schuler, & Yates, 2008). Therefore, the data obtained in a social interaction may not have been as valid or rich as information obtained in a way that does not involve a social interaction for this population (Preece & Jordan, 2010). Typing is usually not a problem for high-functioning individuals with high-functioning ASD, and is sometimes used to facilitate communication (Ashby & Causton-Theoharis, 2012). Therefore, requiring them to type would not likely compromise validity. Adapting in-person interviews to computer-based questions in order to reduce the impact of social-communication difficulties in high-functioning ASD has been recommended, and used successfully in studies of children with the disorder (Barrow & Hannah, 2012; Preece & Jordan, 2010). To maintain consistency between the groups, the measures were administered in the same way to the TD-SI group and the parent group (i.e., comment boxes). The questions were presented on a computer with comment boxes provided for each question. Participants answered these questions on the computer, and were invited to ask any questions they had. The researcher read through their answers and typed any follow-up or clarification questions with the additional questions highlighted for the participant. The participant then typed their responses to these additional questions. This format allowed

participants to provide information with minimal social-communication demands. Their answers were saved on a secure server for analysis. Participants were given the option of taking breaks whenever they needed them, and were encouraged to do so between tasks. Participants were not restricted in the amount of time they spent on the questionnaire, up to 5 hours.

Trustworthiness

Trustworthiness is important in qualitative research, and is akin to assumption checking in quantitative analysis, particularly related to reliability and validity. For the purposes of this study, the criteria outlined by Shenton (2004) for ensuring trustworthiness in qualitative research were used. These criteria include steps for ensuring credibility, transferability, dependability, and confirmability.

Credibility

Credibility is to what extent the findings of a qualitative study are congruent with reality; there are a number of provisions under which the credibility of a study is determined (Shenton, 2004). The first is the adoption of research methods that are well-established, which means that the method of data collection has been successfully used in previous studies similar to the current study. Only a small number of studies with the ASD population have used qualitative approaches. However, some guidance was provided by one study that recently attempted in-depth interviews with children with ASD and suggested that another approach may be better suited to the population. Given that social-communication difficulties are criteria for a diagnosis for high-functioning ASD, if an in-depth interview was used, these difficulties may systematically compromise the information obtained from the high-functioning ASD group but not the TD-SI or parent group. Therefore, comment boxes were used instead, in which all participants typed their responses into a word document. This limited the social-communicative demands on participants, which is a strategy used and recommended with this population (Barrow & Hannah, 2012). Participants also had to have an IQ of over 75 to participate in the study, to ensure they had the ability to report on their interests.

A second provision of credibility is developing an early familiarity with the culture of participating organizations before data collection takes place. This involves communication and interaction with participants to ensure a relationship of trust is established, in order to get the most credible information. This step was taken with the high-functioning ASD and parent group, as most of the participants in this study have previously participated in past research with this lab. The relationship of trust has been built over time (some participants have been involved in our research for over 10 years). The lab sends out yearly updates to all participants about the work we have been doing. The lab has also given back to this community through public forums and providing a free summer camp. Thus, most participants in the high-functioning ASD and parent group have long been engaged in the research process, and a relationship of trust has been established. The TD-SI group have not necessarily had the same level of engagement with the lab, but the lead researcher was an undergraduate student at SFU and thus is familiar with that culture. She also has ties with particular communities in which she recruited from, such as TD-SI participants interested in Anime and video games, and is somewhat familiar with those cultures as well.

It is suggested that random sampling be used in order to ensure credibility. Unfortunately, because ASD is a low-incidence disorder, participants are difficult to recruit and thus a convenience sample was used. However, it was ensured that participants from a wide range of ages and geographical locations were used (within reason). For example, the age range of the high-functioning ASD sample was from 18-50 years old, and participants were recruited from all over the Greater Vancouver area. In addition, one participant was recruited from the interior and two were from Vancouver Island, which increased geographical diversity. In terms of the TD-SI group, participants were recruited in a number of different ways in order to diversify the sample. For example, participants had a range of special interests and were of many different ages and backgrounds. Overall, although a random sampling method was not used, efforts were taken to ensure there was as much heterogeneity as possible in each group.

Another provision of credibility is the use of triangulation, which involves investigating the phenomenon being studied in multiple ways. In this particular study, triangulation was used through obtaining both parent and self-report of high-functioning ASD interests, which increases the credibility of the study. A wide range of individuals

were included, as previously mentioned, and a comparison TD-SI group was also included in the study in order to discern what may be unique to high-functioning ASD.

Tactics to help ensure the honesty of participants were also employed. Participants were given ample opportunities to refuse to participate in the study, and were informed they could discontinue the study at any time without providing an explanation. Rapport was established early on, though asking if they needed the restroom or water, emphasizing they could take breaks whenever they chose, and by starting the testing session by discussing things enjoyable to the participant (e.g., an activity they brought to the testing session such as a book or hand-held game). Participants were informed that there were no correct answers, but rather the researcher was interested in their experience of having strong interests, whatever that may be. Most of these procedures were required by the SFU ethics board, but also increase the credibility of this study by ensuring participants felt comfortable to report truthfully.

Iterative questioning was used to ensure the accuracy of statements made. While it was unlikely participants were deliberately lying given the subject matter and the fact that their answers are unlikely to have a direct impact on their lives (as it may in a workplace satisfaction study, for example), iterative questioning was used in some interviews when information was unclear. In this study, this type of questioning was used primarily to confirm timelines, particularly when interests started and how long they lasted. Sometimes information in the interviews contradicted other information (e.g., a parent would report his interest started at age seven but then later referred to an incident regarding the interest when he was five) and in such cases follow-up questions were used to confirm these timelines. Given the fluid nature of interests it is most likely that the contradictions were simply due to memory errors, and iterative questioning was useful for increasing the credibility of the study in this regard.

Negative and positive case analysis was also used in this study to increase credibility. Because data analysis began before data collection had been completed, additional questions were asked of later participants who did and did not fit with the emerging themes. This actually turned out to be one of the most fruitful steps in the study, and incredibly rich information was obtained regarding why certain participants did *not* fit the standard emerging profile of interests within a particular group.

Frequent debriefing sessions were held between the experimenter and her research supervisor in order to ensure that experiences and initial perceptions were not too narrow. The experimenter and research supervisor remained in consistent contact throughout the data collection and analysis phases, and met regularly to discuss the emergent findings. The experimenter discussed her developing ideas and hypotheses, and the supervisor asked questions and provided alternate interpretations. This ensured the experimenter did not become too narrow in her thinking too early on in the process, and drew attention to possible biases and preferences.

Peer scrutiny of the research project is another method of ensuring credibility. For this project, initial findings from the high-functioning ASD group only were presented at the Brain Development Conference in September 2013, which was an opportunity for peer scrutiny to occur. Two well-respected researchers who are experts in qualitative analyses and ASD spent 15 minutes discussing the findings with the primary researcher and questioning the processes and interpretations. Overall, they agreed with the way the study had been conducted and the analyses, and offered some additional interpretations on one of the themes (social isolation).

Reflective commentary was used to keep track of emerging ideas and impressions throughout the analysis process. These reflections were then used to probe positive and negative examples of emerging themes with later participants. Memos in particular were used to keep track of the researcher's thoughts and impressions throughout the process.

Background qualifications and experience of the researcher are also seen to improve credibility of a qualitative study, as it is that person who is primarily responsible for the data collection and interpretation (Patton, 1990). It has been suggested that the qualifications of the primary researcher be included in any write-up to improve credibility (Maykut, 1994). The experimenter on this project has extensive experience and training in the field of ASD. She worked first as a behavioural interventionist with the population for five years, and then as a researcher for eight years in two different labs. She also was awarded a one-year doctoral trainee placement through NeuroDevNet through which she received training in neurodevelopmental disorders generally, and a three-year doctoral trainee placement in Autism Research Training through which she received

further specialized training in ASD. The experimenter also grew up with an extended family member with ASD, so has personal experience with the disorder.

Member checks were conducted in this study. As previously mentioned, the experimenter discussed themes emerging from the data with later participants. Parents were asked if they could offer reasons for certain patterns observed, and they wrote down their answers for later reference. This process was used to probe positive case examples, negative case examples, and cases where particular emerging themes were prominent, or notably absent.

Thick description of the phenomenon under scrutiny was also used as a method of improving credibility in this study. A detailed description of the history and current state of theory and evidence on restricted interests in ASD and interests of people without ASD was provided in the introduction to provide a context for the study. In the qualitative analysis section, rich descriptions and quotes were extracted from the actual transcripts to represent and convey the emerging themes.

Finally, an assessment of how congruent the results of this study are with previous findings was conducted in the discussion section. Being able to relate one's findings to previous research is considered one of the key aspects of credibility. Overall, this study employed each of the key provisions recommended for improving the credibility of a qualitative study.

Transferability

Transferability is akin to external validity in quantitative research, and measures to what extent the findings of a particular study can be applied to other situations. Extensive detail was provided in the introduction section in order to enable the reader to make an estimate of transferability themselves, including recruiting strategies, data collection methods, number and length of data collection sessions, time over which the data was collected, setting, the nature and background of the participants included, as well as exclusion criteria. As the researcher does not know the contexts of potential future studies, extensive detail has been provided to allow future researchers to make the estimate of transferability to their populations and contexts.

Dependability

Dependability is similar to reliability in quantitative methods, and requires the researcher to demonstrate that if the study would be replicated with the same participants using the same methods in the same context the results would be replicated. There are concerns about this being possible due to the changing nature of phenomena studied by qualitative research (Marshall & Rossman, 2006). Therefore, it is recommended that the processes that were used during the study be reported in detail so that future researchers could at least replicate the study, even if they do not obtain the same results. As previously mentioned, this has been done in detail, including the recommended aspects of the research design and implementation, the operational detail of data gathering, and a reflective appraisal of the project.

Confirmability

Confirmability is taking the necessary steps to ensure that the results of the study are a result of the participant's experiences and reports, and are influenced by the characteristics and preferences of the researcher as little as possible. The method of triangulation is utilized here as described previously. Potential biases of the researcher were discussed, and weaknesses in the techniques used were outlined. Meticulous notes were kept regarding the steps during the analysis process in order to ensure confirmability.

Coding in Grounded Theory

Analysis of the qualitative data was conducted using NVivo 10 analysis software using grounded theory. This is a theory that does not make any assumptions about what will emerge from the qualitative data, but rather aims to analyze the data in such a way that recurrent themes become clear (Guest, Namey, & Mitchell, 2013). Although the review of the neurodevelopmental literature indicated some specific themes that researchers in that area felt were important to distinguish interests, this study relied on the participant's words for identifying emerging themes. It is important in grounded theory for the themes that emerge to remain grounded in the qualitative data itself, and this was achieved through a systematic and exhaustive comparison of text segments to

build thematic structure in the results section, which is what distinguishes grounded theory from inductive thematic analysis (Guest et al., 2013). These themes were then linked in the discussion section. The data was coded in a progression beginning with small sections and repeatedly analyzing the data working up to larger sections, utilizing memos and the constant comparison method characteristic of grounded theory (Charmaz, 2006).

First, the answers to the qualitative questions were read to obtain a detailed understanding of the data collected. Next, the answers were coded for themes line by line to ensure no information was lost during analysis. Potentially useful concepts were identified as line-by-line coding was conducted to fragment data into conceptual components (Bernard & Ryan, 2010). Once conceptual components were outlined, discussions between the researcher and her supervisor occurred to group together conceptual components into meaningful themes used for the second read-through of the transcripts. Some of these themes were amalgamated as deeper understanding developed. For example, earlier separate themes of developing skills and improving one's self were amalgamated into self-development. Once common themes became clearer, a coding scheme was developed by the primary researcher, and discussed with an independent coder. The experimenter then coded all of the transcripts, and the independent coder (another graduate student with extensive experience with ASD) also coded 10% of the data (two randomly selected interviews from each group). Inter-rater reliability was calculated for each theme. All themes had inter-rater reliability k=.80 or higher.

Analysis

Quantitative Analysis

Prevalence of Circumscribed Interests in ASD Group

Because there is no item to code specifically for circumscribed interests or unusual preoccupations on the ADOS, and the ADI-R was not administered, verification of participants having a restricted interest in this sample using a gold-standard tool was not possible. However, using the in-depth questions on the Interests Questionnaire, it was possible to evaluate whether participants met criteria for an unusual preoccupation or circumscribed interest based on the criteria in the ADI-R (Lord et al., 1994). Using the unusual preoccupation criteria that the interest must be unusual or odd, none of the participants in this study would currently meet criteria. Using the criteria for circumscribed interests in which they have an interest that is intense and causes interferences with family or individual activities and/or social functioning, twenty of the twenty-two participants clearly met criteria.

This makes the prevalence rate in this study 91%, which is directly in line with the prevalence of circumscribed interests in previous samples (Klin, Danovitch, Merz, & Volkmar, 2007; Lam, Bodfish, & Piven, 2008; Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011). The two participants with ASD who did not meet criteria for circumscribed interests on the Interest Questionnaire were asked along with their parents whether they had ever had an interest that met the specified criteria, and both the participant with ASD and their parent reported that although they knew it was a symptom commonly associated with ASD they/their child had never had one. Because this study was interested in the nature of interests in high-functioning ASD generally, these two participants were not excluded from the final analysis reported in this study.

Group Comparisons

Participants were asked to report their most important interest first. In the ASD and TD-SI groups this was always their current restricted or special interest. However, the researcher was also interested in whether interests *overall* differed across groups. Therefore, for each quantitative variable, each participant's first reported (i.e., most important) interest was analyzed first. Then the mean of each participant's responses across interests were compared for each variable at each developmental period to see if their interests differed overall. For each quantitative factor, descriptive statistics (mean, standard deviation and range) were generated for current (adult) interests, and historical interests throughout development. Where appropriate, developmental periods were divided into the following: toddler (up to age 2), preschool (age 3-5), school age (6-12), and adolescence (13-17). Descriptive data was generated separately for each group (TD-SI, ASD, and parent report).

Graphs were created to depict the results. Further statistical analyses of the data were conducted when they were warranted from visual inspection of the data (i.e., standard error bars were not overlapping).Since not all participants reported at all three time periods for each interest, using within-subjects repeated-measures ANOVAs were not deemed appropriate for this data set (Howell, 2010). Using procedures to estimate missing data was not appropriate with this particular data set as the values are not "missing" per se, but rather it was the case that the interest did not exist at that time period. Therefore, when looking at differences between groups for each variable, t-tests were used. Independent samples t-tests were used to examine differences between the ASD self-report and TD-SI groups. Dependent samples t-tests were used to examine the differences between the ASD self-report and parent reports. Because this was a new comparison group (people who also have an intense interest) that had not been compared to a group with ASD, no hypotheses were made about directionality of the t-tests. See Table 4 for results of these analyses. Because of the large number of comparisons when making examining group differences at each developmental period, statistical analyses were only conducted when warranted by visual inspection of the graphs wherein the standard error bars did not overlap. See Table 5 for results of these analyses.

Number of Interests

The ASD group (as well as their parents) and TD-SI groups reported the same number of interests. The mean number of interests reported by the ASD group was 2.7 (SD = 1.4, range 1-7), the TD-SI group was 2.8 (SD = 1.4, range 1-6), and the parent group was 2.8 (SD = 1.4, range 1-6).

Age Interest Started

First Interest Reported

There was a large range in the age participants' first reported interest started. The average age the interest started was 10 years old (SD = 7.3, range 2-36 years) in the ASD group, 11 years old (SD = 5.7, range 2-24 years old) in the TD-SI group, and 7 years old (SD = 5.7, range 0-22 years) in the parent group.

All Interests Reported

There was also a large range in the mean age initiated for all interests combined, and the parents reported interests starting earlier. The average age reported for the initiation of the interest was 11 years old (SD = 5.0, range 4-21 years) in the ASD group and 13 years old (SD = 5.2, range 4-26 years old) in the TD-SI group. Parents reported an average start age of 7 years old (SD = 4.1, range 0-17 years). Analysis indicated parents reported an earlier start age for interests than their adult children.

Age Interest Ended

First Interest Reported

Because participants first reported on current interests, no end dates were identified.

All Interests Reported

When looking at all interests reported, participants reported a wide range of ages at which their interests ended. The average age interests ended were 17 years old (SD = 6.0, range 12-25 years) in the ASD group, 21 years old (SD = 7.4, range 16-36 years) in the TD-SI group, and 16 years old (SD = 3.0, range 10-20 years) by parents.

Duration of Interests

First Interest Reported

All groups reported that they had had their first reported interest for similar amounts of time, although duration varied considerable *within* each group. The ASD group reported a mean interest duration of 13.8 years (SD = 6.7, range 2-33 years), the TD-SI group reported a mean interest duration of 13.6 years (SD = 9.6, range 1-37 years) and the parents reported a mean interest duration of 15.36 years (SD = 6.0, range 1-30 years).

All Interests Reported

When looking at all interests reported, it was also found that the duration lasted about the same amount of time in each group. The ASD group reported an average duration of 12 years (SD = 7.7, range 1-29 years), the TD-SI group reported an average duration of 11 years (SD = 6.0, range 1-27 years), and the parents reported an average duration of 12 years (SD = 4.4, range 4-19 years).

Peak of Interests

First Interest Reported

The interests questionnaire asked participants to report when their (or their son/daughter's) interest "peaked" and the participant determined the meaning of "peak". Eleven participants in the ASD group (as well as 11 parents) and 15 participants in the TD-SI group reported that their first reported interest had a defined peak. The other participants reported that there was no particular peak or that it was "always very strong".

The mean peak of the ASD group's interest was 15 years old (SD = 6.0, range 5-28); the TD-SI group's interest was 18 years old (SD = 3.4, range 10-23). The parents reported their son/daughter's most important interest peaked at 15 years old (SD = 4.7, range 6-22), which is equivalent to the reports by their son/daughter.

All Interests Reported

Where participants indicated that any of their interests reported had a peak, a mean peak score was calculated. A mean peak was calculable for 17 participants in the

ASD group, 19 participants in the TD-SI group, and for 16 participants in the parents. The average peak reported in the ASD group was 17 years old (SD = 6.3, range 7-31 years), in the TD-SI group was 19 years (SD = 4.5, range 14-34 years), and was 14 years (SD = 3.4, range 10-22 years) for parents.

Summary

Overall, interests were comparable for all variables measured. The one exception was that parents reported an earlier start age for all interests reported. This may reflect a true difference in that parents remember interests starting earlier than the ASD group do, or parents may be reporting interests their child had earlier in their life due to better memory for that time period.

Table 4. Statistical Analyses for Non-Developmental Variables

Variable	ASD versus TD-SI (Independent Samples T-Test)	ASD Self-Report versus ASD Parent Report (Dependent Samples T-Test)
Number of Interests	t (1, 40) = -2.71, p =.78, d = -.08	t (1, 18) = -0.81, p =. 43, d = -.21
Age Interest Started (1st)	t (1, 39) = -0.62, p =.54, d = -.20	t (1, 17) = 1.09, p = .29, d = .28
Age Interest Started (All)	t (1, 39) = -1.12, p =..24, d = -.37	t (1, 17) = 2.26, p =.04*, d = .70
Age Interest Ended (All)	t (1, 8) = -0.87, p =.41, d = -.57	t (1, 8) = 1.50, p = .23, d = .73
Duration (1st)	t (1, 38) = 0.06, p =.96, d = .02	t (1, 14) = 0.97, p =.35, d = .14
Duration (All)	t (1, 39) = 0.326, p =.75, d = .11	t (1, 17) = -0.66, p =.51, d = -.18
Peak (1st)	t (1, 34) = -1.23, p =.23, d = -.47	t (1, 5) = -2.0, p =.10, d = -.56
Peak (All)	t (1, 34) = -1.26, p =.21, d = -.41	t (1, 13) = 1.55, p = .14, d = .57

Number of Contexts or Activities Across Developmental Periods

Participants were asked how many contexts they pursued their interest in (e.g., joining groups, reading about it, participating in chat rooms online, etc.).

First Interest Reported

Parents reported that the average number of contexts their child engaged in was 1.5 as a toddler (SD = 1.1, range 1-4) and 1.6 in preschool (SD = 1.0, range 1-4). The

average number of contexts reported in school age in the ASD group was 2.1 (SD = 2.2, range 0-9), in the TD-SI group was 1.7 (SD = 1.1, range 1-5), and by parents was 1.9 (SD = 1.2, range 1-6). The average number of contexts reported in adolescence in the ASD group was 1.7 (SD = 0.8, range 0-3), in the TD-SI group was 2.7 (SD = 1.1, range 1-5), and by parents was 2.0 (SD = 1.3, range 1-6 years).). The average number of contexts reported currently in the ASD group was 2.5 (SD = 1.7, range 1-8), in the TD-SI group was 3.8 (SD = 1.2, range 2-7), and by parents was 2.3 (SD = 1.4, range 1-6 years).

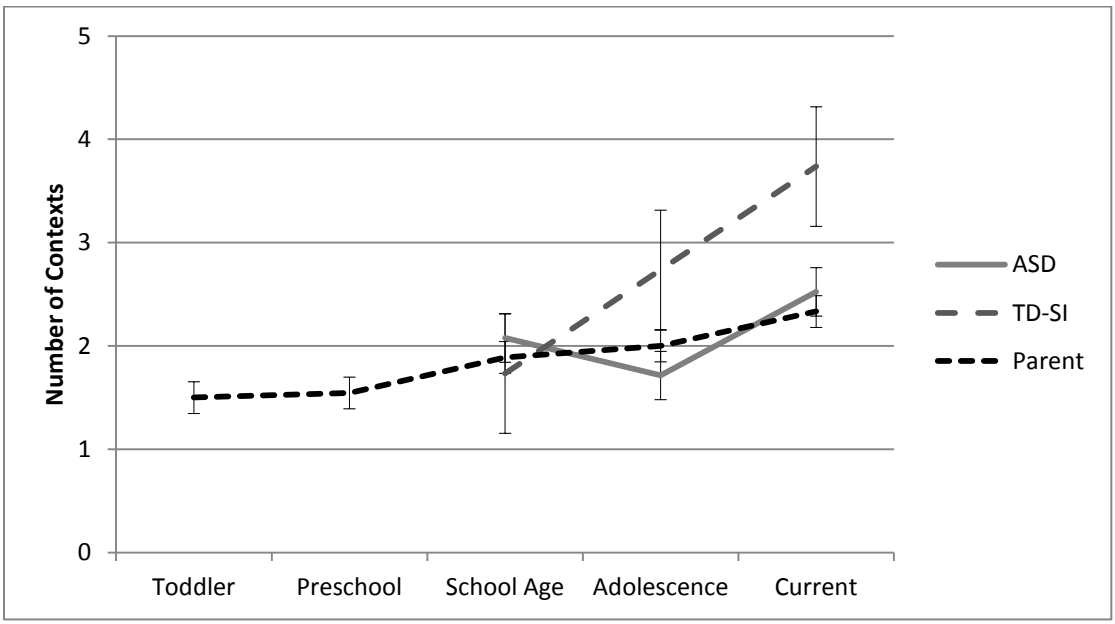

Figure 3. Number of Contexts of First Interest Reported

Because of the non-overlapping standard error bars, an independent samples t-test between the ASD and TD-SI groups was conducted to determine if there was a significant difference in the number of contexts in which they currently pursued their interest. Visual inspection of qq plots indicated that the data was normally distributed, and Levine's test indicated that the assumption of equal variances was maintained ($F(1, 39) = .54$, $p = .47$). The t-test indicated there was a significant difference in the number of contexts ($t(39) = 7.24$, $p = .01$), indicating the ASD group pursues their interest in significantly fewer contexts in adulthood.

All Interests Reported

Parents reported that the average number of contexts their child engaged in was 1.6 as a toddler (SD = 1.1, range 1-4) and in preschool (SD = 1.0, range 1-4). The average number of contexts reported in school age in the ASD group was 1.9 (SD = 1.5, range 1-7), in the TD-SI group was 1.9 (SD = 0.8, range 1-4), and by parents was 1.2 (SD = 1.0, range 1-5). The average number of contexts reported in adolescence in the ASD group was 2.3 (SD = 1.3, range 1-7), in the TD-SI group was 2.6 (SD = 0.8, range 1-4), and by parents was 1.2 (SD = 1.0, range 1-5 years). The average number of contexts reported currently in the ASD group was 2.5 (SD = 1.1, range 1-5), in the TD-SI group was 3.5 (SD = 1.0, range 2-5), by parents was 2.3 (SD = 1.0, range 1-4 years).

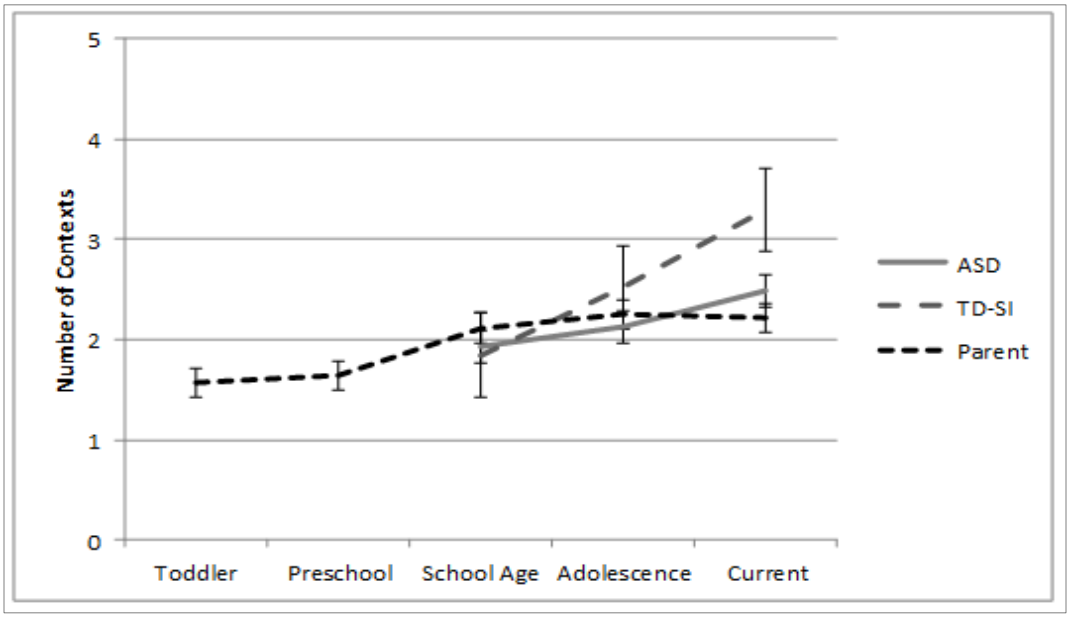

Figure 4. Number of Contexts for All Interests Reported

Because of the non-overlapping standard error bars, an independent samples t-test between the ASD and TD-SI groups was conducted to determine if there was a significant difference in the number of contexts in which they currently pursued their interest. Visual inspection of qq plots indicated that the data was normally distributed, and Levine's test indicated that the assumption of equal variances was maintained ($F(1, 39) = .48$, $p = .52$). The t-test indicated there was a significant difference in the number of contexts ($F(1, 39) = 7.15$, $p = .01$), indicating the ASD group pursues their interest in significantly fewer contexts in adulthood.

Percentage of Spare Time Actually Spent on Interest Across Developmental Periods

Participants were asked to report on how much spare time they (or their son/daughter) spent on their interest. Many participants preferred to report the number of hours they spent per week, instead of a percentage. When this was the case, in the follow-up questions participants were asked to provide an estimate of how many hours of spare time they had in a week and a percentage was then calculated during the analysis process. Sometimes participants would report that they spent an average of 0% of their spare time on it as their interest was spent during working hours (for example, if it was a focus of their profession) or if for the majority of that developmental period it wasn't a major focus.

First Interest Reported

As a toddler, parents reported the amount of spare time spent by their son/daughter on their first reported interest ranged from 20-100% in both toddlerhood and preschool. During school age the percentage of spare time spent on their interest ranged from 15-95% in the ASD group and 0-100% in the TD-SI group. Parents reported that their child spent 20-100% of their spare time on the interest. In adolescence, the amount of time spent in the ASD group was 0-96% and the TD-SI group was 0-100%. Parents reported the amount of spare time their son/daughter spent in adolescence was 23-100%. Currently, the amount of spare time spent in the ASD group ranged from 0-100% and in the TD-SI group it was 5-100%. Parents reported the amount of spare time their son/daughter currently spends on their interest is 9-100%. Overall, the amount of spare time participants spent on their interest varied dramatically, and there were no statistical differences between groups. See the figure below for the average amount of spare time spent by each group at each developmental period.

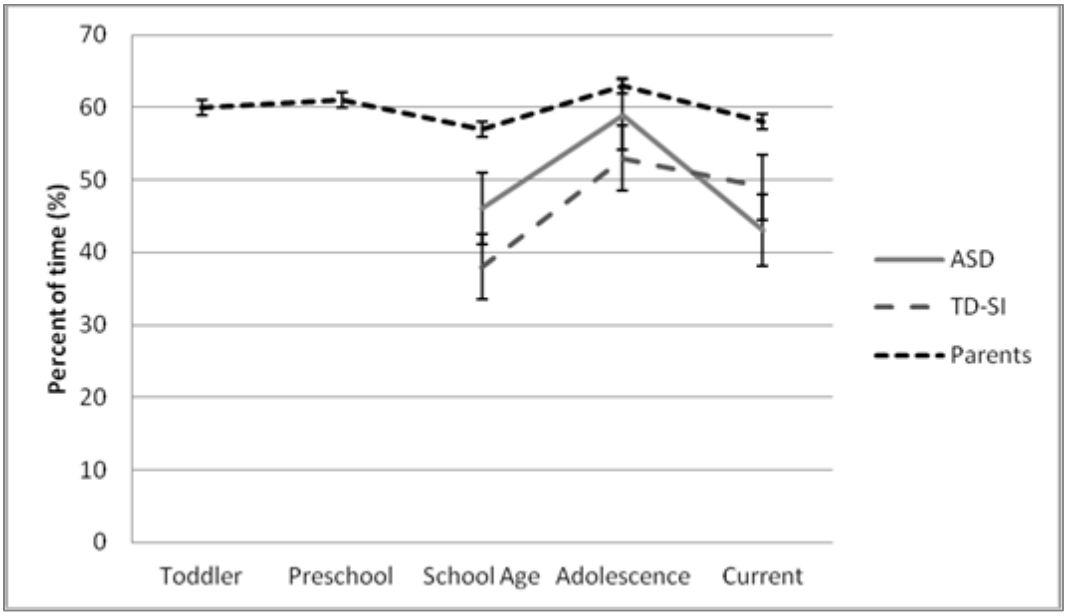

Figure 5. Percentage of Spare Time Actually Spent on First Interest Reported

All Interests Reported

As a toddler, parents reported that the average amount of spare time spent by their son/daughter on their first reported interest ranged from 30-100%, and in preschool they reported the average amount of spare time spent ranged from 5-100%. During school age the percentage of spare time spent on their interest ranged from 5-100% in the ASD group and 6-100% in the TD-SI group. Parents reported the average amount of 10-100% of spare time spent on the interest. In adolescence, the average amount in the ASD group was 0-100% and the TD-SI group was 10-100%. Parents reported the average amount of spare time their son/daughter spent in adolescence was 5-100%. Currently, the average amount of spare time spent in the ASD group ranged from 0-100% and in the TD-SI group it was 7-100%. Parents reported the average amount of spare time their son/daughter currently spent on their interest was 9-95%. There were no differences between groups. See the figure below for the mean percentage of spare time spent by each group at each developmental period.

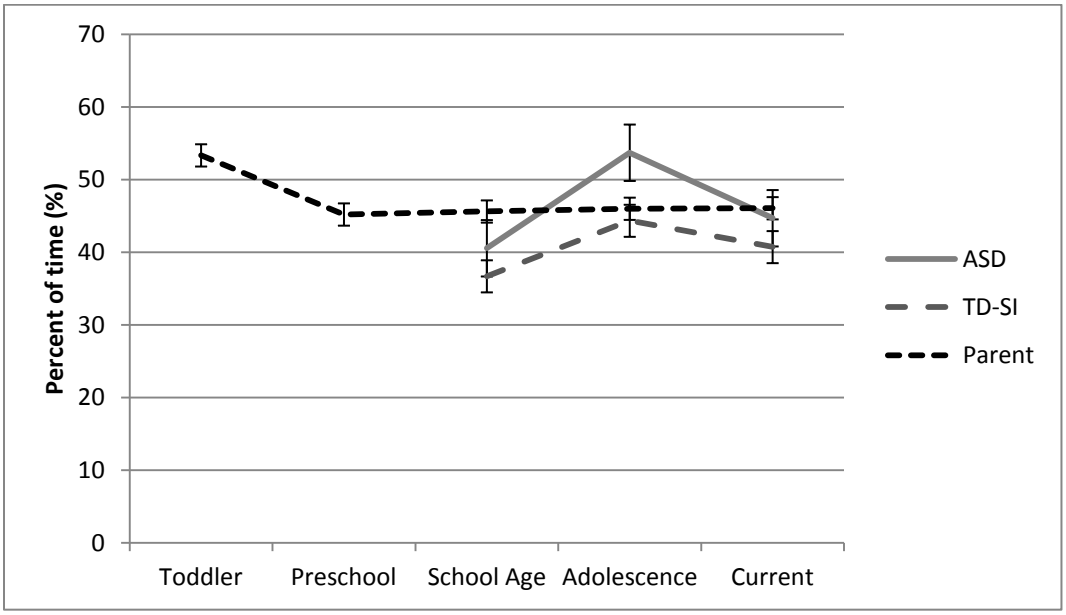

Figure 6. Percentage of Spare Time Actually Spent on All Interests Reported

Desired Percentage of Spare Time Across Developmental Periods

First Interest Reported

Participants were asked to report on how much spare time they (or their son/daughter) *would like* to spend on their interest (if they could spend as much time as they wished). As a toddler, parents reported the amount of spare time their son/daughter would have liked to have spent on their interest ranged from 25-100%, and in preschool they reported it would have ranged from 5-100%. During school age the percentage of spare time participants would have liked to have spent on their interest ranged from 25-100% in the ASD group and 0-100% in the TD-SI group. Parents reported 10-100% as being the amount of spare time their child would have liked to have spent in school age. In adolescence, the amount of time the ASD group would have liked to have spent ranged from 0-100% (one participant with ASD even reported 120%, which was converted to 100%) and the TD-SI group ranged from 0-100%. Parents reported 25-100% as the amount of time their child would have liked to have spent in adolescence. Currently, the amount of spare time the ASD group would like to spend ranged from 0-100% and the TD-SI group ranged from 10-100%. Parents reported 10-100% is the amount of spare time their child would currently like to spend on their interest. There

were no differences between groups. See the figure below for the mean percentage of spare time spent by each group at each developmental period.

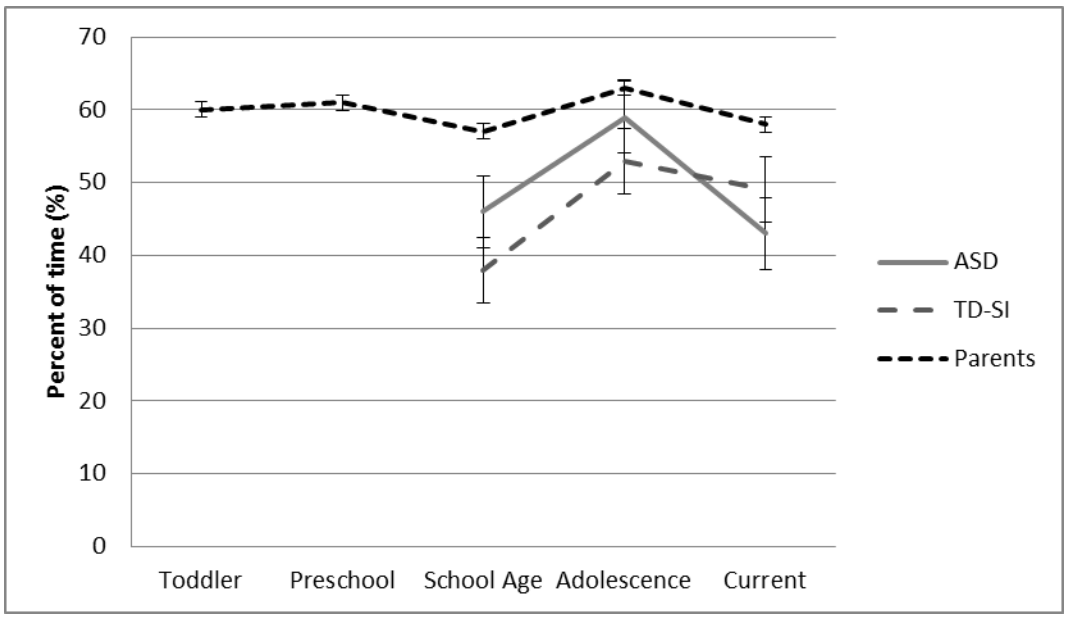

Figure 7. Percentage of Spare Time Participants Want to Spend on First Reported Interest

All Interests Reported

As a toddler, parents reported the amount of spare time their son/daughter would have liked to have spent on their interest ranged from 5-100%, and in preschool they reported it would have ranged from 15-100%. During school age the percentage of spare time participants would have liked to have spent on their interest ranged from 13-100% in the ASD group and 17-100% in the TD-SI group. Parents reported 15-100% as being the amount of spare time their child would have liked to have spent at school age. In adolescence, the amount of time the ASD group would have liked to have spent ranged from 0-100% and the TD-SI group ranged from 4-92%. Parents reported 18-100% as the amount of time their child would have liked to have spent in adolescence. Currently, the amount of spare time the ASD group would like to spend ranged from 0-100% and the TD-SI group ranged from 5-90%. Parents reported 30-100% is the amount of spare time their child would currently like to spend on their interest. There were no differences

between groups See the figure below for the mean percentage of spare time each group would like to spend at each developmental period.

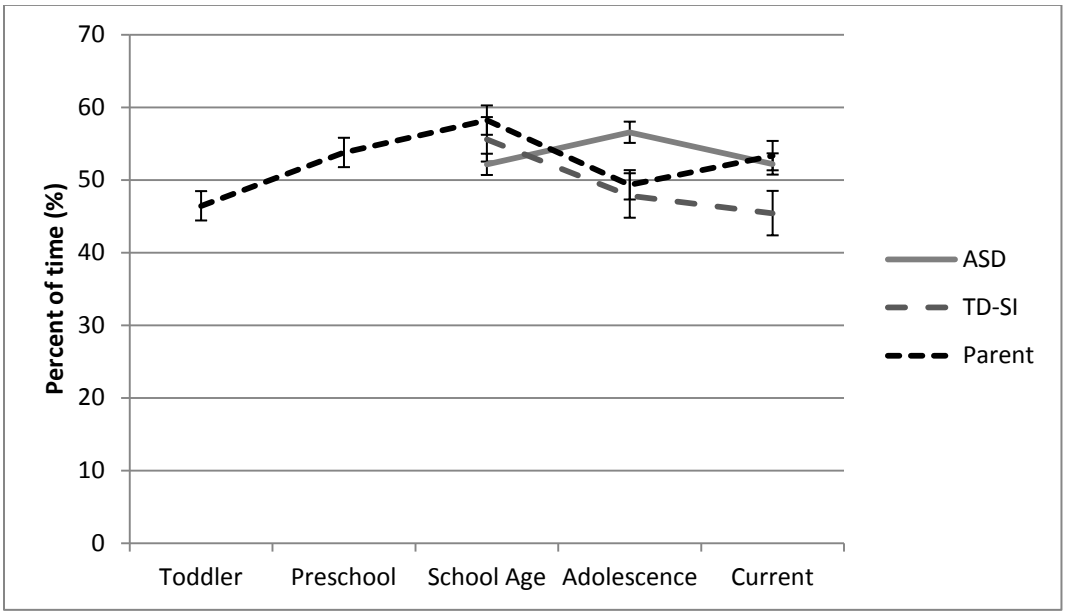

Figure 8. Percentage of Spare Time Participants Want to Spend on All Reported Interests

Number of People Interest Shared With Across Developmental Periods

Participants were asked to report the average number of people they shared their interest with. After the first few participants completed the questionnaire it became clear that there was a need to specify that they had to be people they interacted with face-to-face and not just online, as some participants were reporting an “infinity” or “thousands” of people with regard to massively multi-player online games (“MMO’s”). Follow-up questions clarified the number of people these initial participants engaged with face-to-face. Reported below is the number of people participants interacted with face-to-face regarding their interest.

First Interest Reported

Parents reported that the number of people their child engaged with about their interest ranged from 0-20 in both toddlerhood and preschool. The ASD group reported they engaged with 0-10 people, and the TD-SI group reported 0-20 people when they

were school age. Parents also reported their child interacted with 0-20 people during this time. In adolescence, the ASD group reported interacting with 0-50 people with regard to their interest, and the TD-SI group reported 0-35 people. The parent group reported 0-20 people during this time. Currently the ASD group reported interacting with 0-40 people regarding their interest, while the TD-SI group reported 0-50 people. Parents reported their son/daughter currently interacted with 0-50 people. There were no differences between groups See the figure below for the average number of people participants engage with regarding their interest as reported by each group at each developmental period.

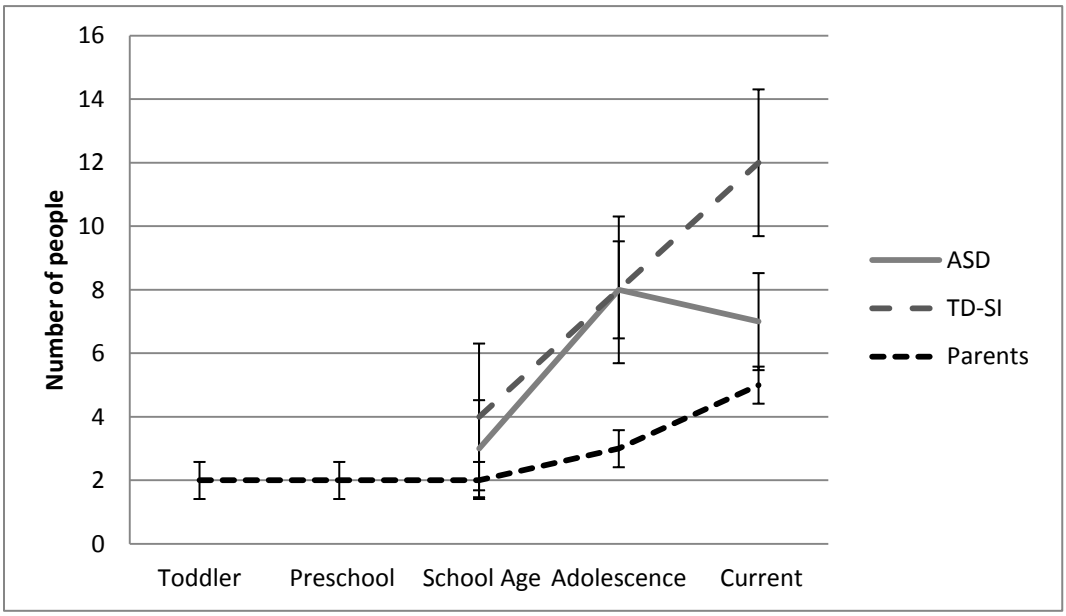

Figure 9. Number of People First Interest Reported is Shared With

An independent samples t-test between the ASD and TD-SI groups was conducted to determine if there was a significant difference in the number of people an interest was currently shared with. Visual inspection of qq plots indicated that the data was normally distributed, and Levine's test indicated that the assumption of equal variances was maintained ($F(1, 32) = .23$, $p = .64$). The t-test indicated that there were no significant differences between the groups at this time point ($t(1, 32) = -1.09$, $p = .28$).

All Interests Reported

Parents reported that the number of people their child engaged with about their interest ranged from 0-20 in both toddlerhood and preschool. The ASD group reported they engaged with 0-25 people, and the TD-SI group reported 0-20 people when they were school age. Parents also reported their child interacted with 0-19 people during this time. In adolescence, the ASD group reported interacting with 0-50 people with regard to their interest, and the TD-SI group reported 0-27 people. Parents reported 0-45 people during this time. Currently the ASD reported interacting with 0-50 people regarding their interest, whereas the TD-SI group reported 2-23 people. The parent group reported their son/daughter currently interacts with 0-25 people. There were no differences between groups. See the figure below for the average number of people participants engage with regarding their interest as reported by each group at each developmental period.

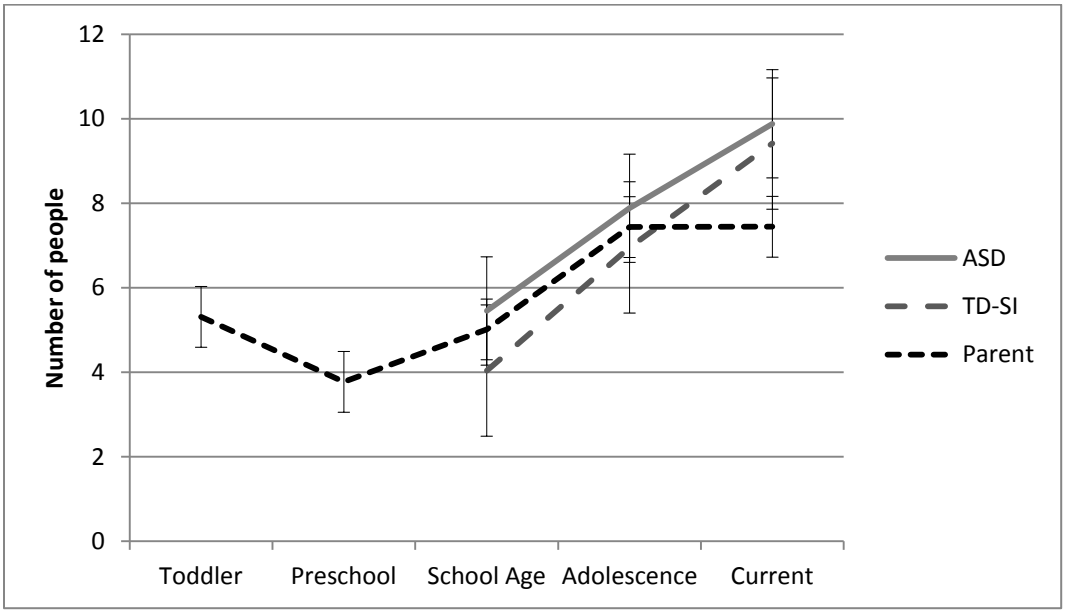

Figure 10. Number of People All Interests Reported are Shared With

Money Spent on Interest Across Developmental Periods

Participants were asked to report how much they and their parents combined spent on their interest per month. Sometimes participants reported a yearly fee (e.g.,

membership fees for a club) in which case this was converted to a monthly fee for comparative purposes.

First Interest Reported

The amount of money spent ranged considerably between participants. Parents reported spending between $0-500 per month on their son/daughter with ASD's interest in both the toddler and preschool years. Participants reported spending between $0-75 per month in the ASD group, and $0-42 per month in the TD-SI group in the school age years. Parents reported spending between $0-200 per month on the interest during this time period. In adolescence, participants reported spending between $0-150 per month in the ASD group and $0-500 per month in the TD-SI group. Parents also reported spending $0-500 per month on their son/daughter's interest during this time. Currently, the ASD group reported that $0-200 was spent monthly on their interest, whereas the TD-SI group reported $0-333. Parents reported $7-750 per month was currently spent on their son/daughter's interest. There were no differences between groups. See the figure below for the average amount spent per month as reported by each group at each developmental period.

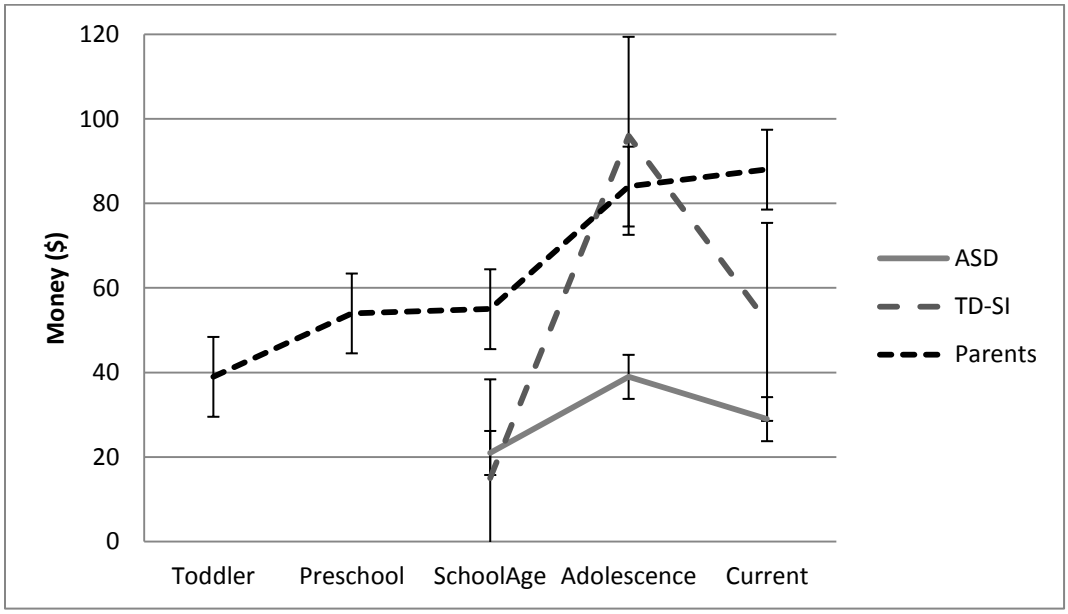

Figure 11. Amount of Money Spent Per Month on First Interest Reported

The graph indicates much greater variability in the TD-SI group compared to the ASD group in the amount of money they spend,

All Interests Reported

Parents reported spending between $0-500 per month on their son/daughter with ASD's interest in both the toddler and preschool years. Participants reported spending between $0-125 per month in the ASD group, and $10-350 per month in the TD-SI group in the school age years. Parents reported spending between $10-300 per month on the interest during this time period. In adolescence, participants reported spending between $0-150 per month in the ASD group and $0-500 per month in the TD-SI group. Parents also reported spending $16-400 per month on their son/daughter's interest during this time. Currently, the ASD group reports that $0-200 is spent monthly on their interest, while the TD-SI group reports $0-167. The parent group reports $0-750 per month is currently spent on their son/daughter's interest. There were no differences between groups. See the figure below for the average amount spent per month as reported by each group at each developmental period.

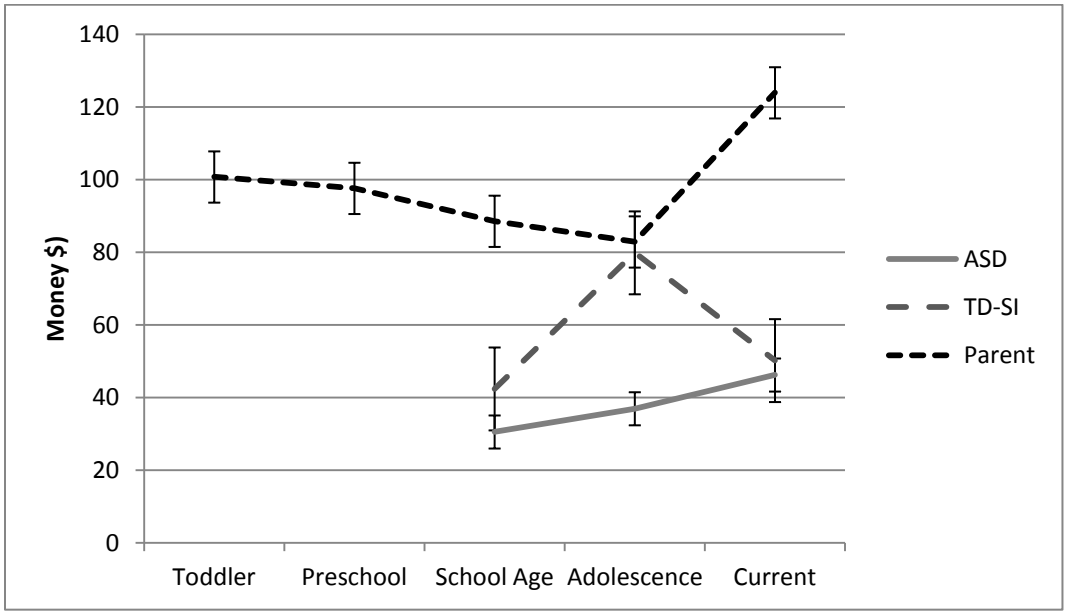

Figure 12. Amount of Money Spent Per Month on All Interests Reported

Summary

Analyses of developmental variables indicated that there were very few differences between groups. The only variable that was statistically different was ASD group reported pursuing their interest in a fewer number of contexts than the TD-SI group. This may indicate a possible variable on which to measure the "restricted" nature of interests.

Table 5. Statistical Analyses of Selected Variables at Each Developmental Period

	TD-SI versus ASD Self-Report			ASD Self-Report versus Parent-Report		
	Childhood	**Adolescence**	**Currently**	**Childhood**	**Adolescence**	**Currently**
Contexts (1st)			.01**			
Contexts (All)			.01**			
Time (1st)				.46		.35
Time (All)		.29			.33	
Time Desired (1st)	.92		.82	.73	.89	.98
Time Desired (All)		.42	.46		.23	
People (1st)			.28			

People (All)						
Money (1st)		.29		.28	.57	.24
Money (All)		.25		.23	.44	.17

Analysis Across Interests

In addition to comparisons between groups, it was decided to compare interests, with the ASD and TD-SI groups combined, as this would provide valuable insights into the nature of various interests, regardless of whether these individuals have a diagnosis or not. The top three interest areas each had at least four participants from each group self-reporting on that interest, so these were the interests used in the analysis. Since parents and participants with ASD both reported on the same person's interests only one group was used for this analysis. There is evidence of differences when adults report on their own versus another person's behaviour (e.g., Achenbach et al., 2005). Therefore, the ASD self-report data was used to maintain consistency of the person reporting for this analysis. The top three interests reported included electronic gaming (10 ASD and 8 TD-SI; 18 total), visual and performing arts (4 ASD and 5 TD-S; 9 total), and sports (4 ASD and 12 TD-SI; 16 total). Unfortunately, because the numbers of individuals with the same interests were low, there was not sufficient power to detect even large differences (Cohen, 1992). However, some indication of trends can be taken by looking at the means and ranges, and by inspecting the graphs visually.

Course of Interest Content Areas

Similarly to the data analysis between groups, when looking at data between content areas, there was significant variation of the course of the interest. The mean age the interest started was 9 years old (SD = 4.8, range 3-21 years) for electronic gaming, 13 year old (SD = 8.5, range 3-30 years) for visual and performing arts, and 14 years old (SD = 6.7, range 5-26 years) for sports. The mean age at which their interest peaked was 15 years old (SD = 6.7, range 7-23 years) in the electronic gaming group, 13 years old (SD = 8.5 years, range 15-36 years) in the visual and performing arts group, and 18 years old (SD = 3.8, range 14-27 years) in the sports group. The mean duration was 15 years (SD = 6.6, range 2-28 years) in the electronic gaming group, 9 years (SD = 7.5,

range 2-24 years) in the visual and performing arts group and 8 years (SD = 7.1, range 1-26 years) in the sports groups. Only one person reported an end age for their interest (sports group; 18 years).

Number of People

The number of people the interest is shared with varied between the groups. At school age, the number of people ranged from 0-3 in the electronic gaming group, 0-10 in the visual and performing arts group, and 0-50 in the sports group. In adolescence, the number of people ranged from 0-15 in the electronic gaming group, 0-50 in the visual and performing arts group, and 1-50 in the sports group. Currently, the number of people ranged from 0-15 in the electronic gaming group, 0-60 in the visual and performing arts group, and 0-50 in the sports group. The ranges and means indicate there may be a difference in the number of people the interest is shared with based on content. See the figure below for the average number of people participants shared their interest with for each type of interest at each developmental stage, with standard error bars.

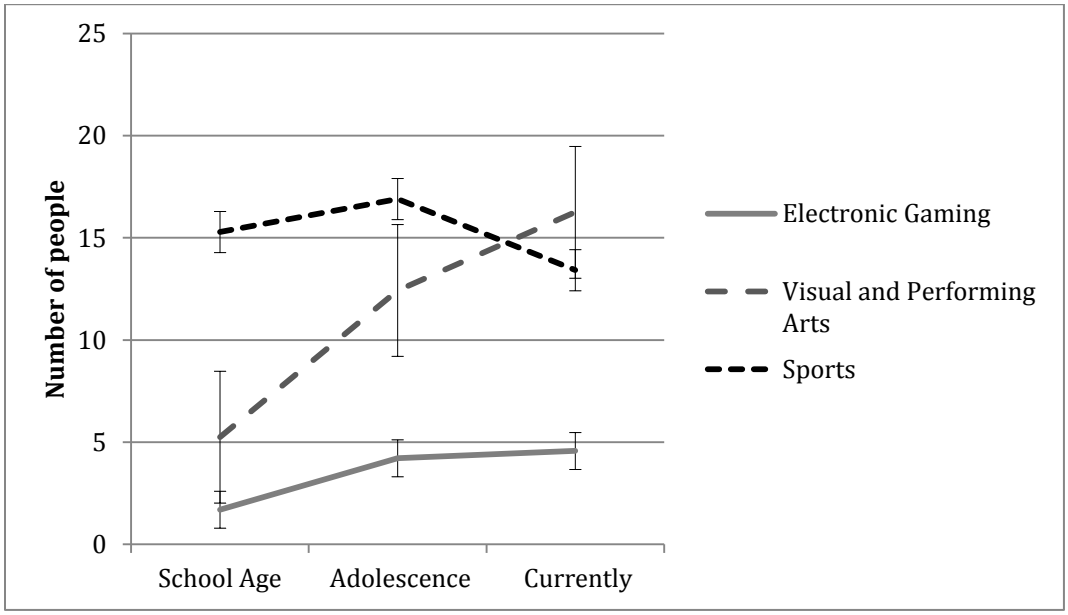

Figure 13. Number of People Interest is Shared with by Content

Percentage of Time Actually Spent on Interest

The percentage of time participants spend on each type of interest varied between groups. At school age, the percentage of time actually spent on the interest ranged from 5-100% in the electronic gaming group, 1-30% in the visual and performing arts group, and 0-50% in the sports group. In adolescence, the percentage of time ranged from 20-100% in the electronic gaming group, 1-90% in the visual and performing arts group, and 0-65% in the sports group. Currently, the percentage of time spent on the interest ranges from 0-100% in the electronic gaming group, 5-80% in the visual and performing arts group, and 10-95% in the sports group. See the figure below for the average percentage of time participants spent on their interest for each type of interest at each developmental stage, with standard error bars.

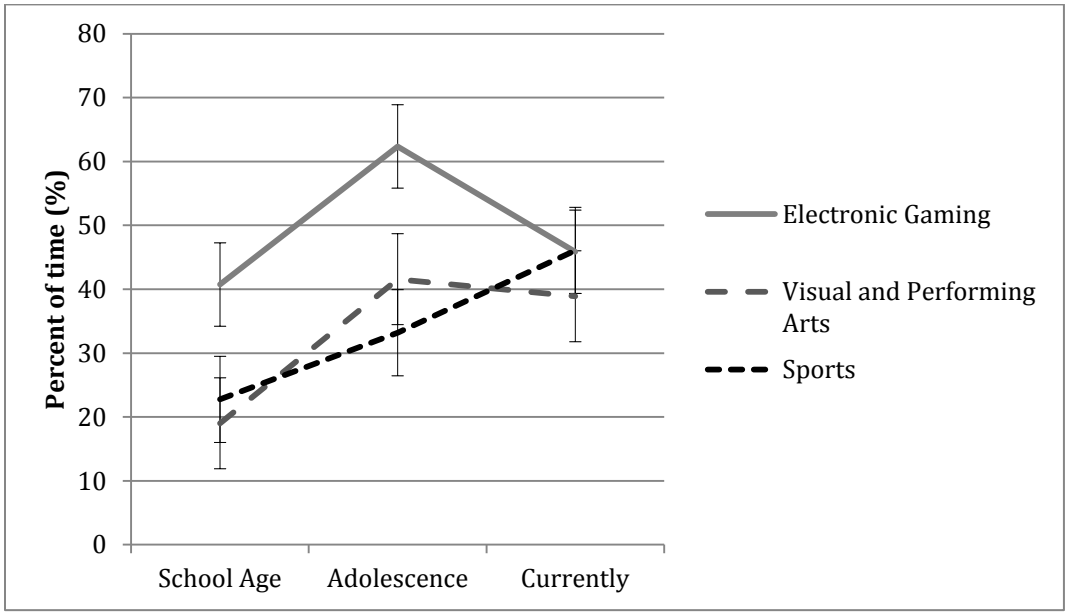

Figure 14. Percentage of Spare Time Actually Spent on Interest by Content

Percentage of Time Desired to Spend on Interest

The percentage of time participants *would like* to spend on each type of interest varied between groups, particularly at school age and in adolescence. At school age, the percentage of time participants would like to spend ranged from 10-100% in the electronic gaming group, 20-30% in the visual and performing arts group, and 10-100%

in the sports group. In adolescence, the percentage of time participants would have liked to spend ranged from 13-100% in the electronic gaming group, 1-90% in the visual and performing arts group, and 10-100% in the sports group. Currently, the percentage of time spent on the interest ranges from 2-100% in the electronic gaming group, 5-85% in the visual and performing arts group, and 10-100% in the sports group. See the figure below for the average percentage of time participants spent on their interest for each type of interest at each developmental stage, with standard error bars.

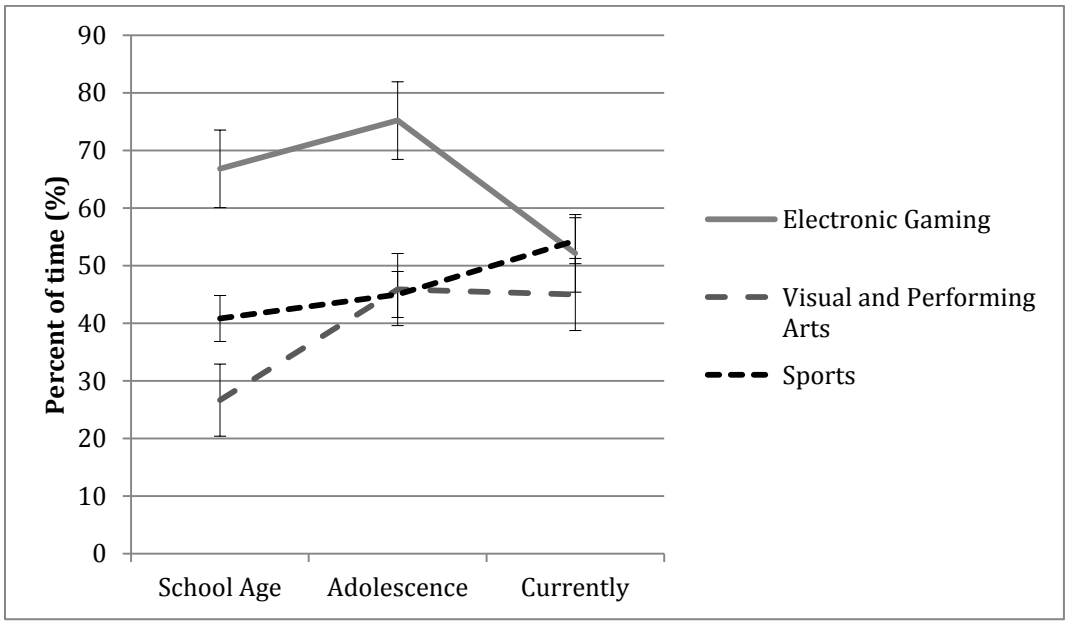

Figure 15. Percentage of Spare Time Desired to Spend on Interest by Content

Money Spent on Interest

The money spent also varied by interest content. At school age, money spent on the interest ranged from $0-700 in the electronic gaming group, $0-3 in the visual and performing arts group (restricted range due to limited number of participants at this developmental period), and $0-300 in the sports group. In adolescence, money spent on the interest ranged from $0-300 in the electronic gaming group, $0-149 in the visual and performing arts group, and $0-500 in the sports group. Currently, money spent on the interest ranges from $0-200 in the electronic gaming group, $0-100 in the visual and performing arts group, and $0-333 in the sports group. See the figure below for the

average amount of money participants spent on their interest for each type of interest at each developmental stage, with standard error bars.

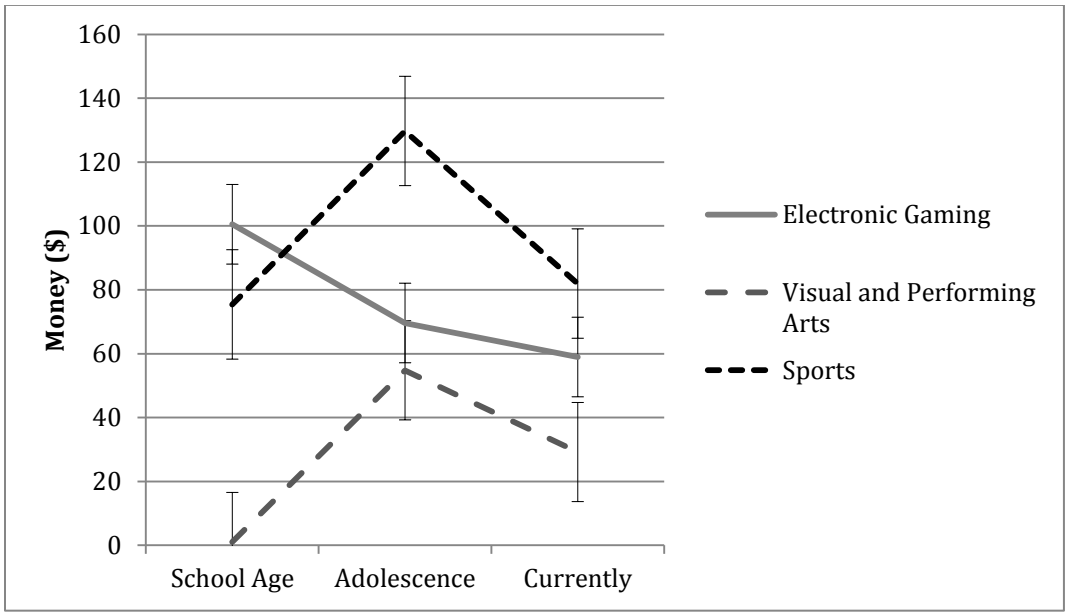

Figure 16. Money Spent on Interest by Content

Overall, the graphs indicate that there may be differences between groups of people who have particular interests on a number of variables. Firm conclusions cannot be made because there were not enough participants with each interest in this study to conduct statistical analyses; however, more research is warranted to explore these different types of interests and how they may impact the individual's life.

Qualitative Analysis

The goal of the qualitative analysis section was to understand the developmental trajectory of interests, including how they start (triggers), how they are maintained (e.g., motivation, environmental opportunity), and how they end. The goal was also to understand how they affect the lives of the participants (both positively and negatively), and how interests are similar and different in the TD-SI and ASD groups.

How the Interest Started

There were six ways that participants identified their interest starting. For both groups (by self and parent report), the majority of interests started by being introduced to it by a family member. For the TD-SI group, being introduced by a friend was the next most common way an interest started. The ASD group (and parents) also reported friends as being a factor in starting their interest, but only about half the number of times reported by the TD-SI group. The ASD group reported no particular trigger for the interest almost as often as family introducing them. Parents also identified there being no particular trigger about a third of the time, while the TD-SI group could almost always identify a trigger. This theme was where the biggest discrepancy between the groups occurred. The three other reasons identified for starting an interest were reported much less frequently. School, another interest, and being good at it were identified only a handful of times as the reasons for interests starting in each group, but all of these reasons were reported more by the TD-SI group than the ASD (or parent) group.

Motivating Factor of Interests

There were many motivating factors identified, and this topic was one of the two overarching topics focused on by participants most during the interviews. The most commonly identified motivating factors were consistent across groups; the factors identified by fewer people were mostly particular to specific groups.

Major Themes of All Groups

There were four major themes emerging as motivating factors. Two were reported by half of all participants, and two were reported by a third of all participants, with equivalent numbers of participants reporting each theme in all groups. The two motivating factors emerging most from the data were enjoyment and knowledge, with half of all participants identifying each of these as reasons they engaged in their interest.

Enjoyment seemed particularly difficult to explain for people, with a number stating that, “It’s really hard to describe” why they like their interest but that it was “Because it’s fun!” or “I just love it!” Others simply stated “enjoyment” as their reason for liking their interest without much elaboration. Overall, this theme was often identified but was not discussed in any length.

With regard to knowledge, participants identified learning about their interest as a very strong motivating factor. For instance, one participant from the ASD group described: “The thing that makes me the happiest is that there is no end to things I could learn about space.” Another participant from the ASD group stated:

> I just love learning about stuff like this (trains). It’s kind of like being in some elite club – everybody else takes it for granted, but there’s just so much to learn if you put just a little bit of effort into research! An hour on Wikipedia clicking through manufacturers, types and companies can yield amazing results.

A participant from the TD-SI group described knowledge as being a critical factor in the maintenance of his interest stating, “It (birding) has held my interest solidly for its duration. I often pick up new hobbies with intensity and they burn out quickly...usually once the learning or creativity has stopped.” Enjoyment (affective reward) and knowledge (cognitive reward) are consistent with previous research findings suggesting that these factors play a strong role in maintaining interests (Krapp et al., 1992; Krapp, 2002).

Two other factors emerging as motivating factors from the data, were self-development, and escaping reality/experiencing other selves. Each of these were mentioned by a third of participants in each group. Participants described self-development as an important motivating factor. Examples of self-development included expanding the mind, self identity (e.g., contributing to who I am today), increased independence, and developing and improving skills. One parent wrote: “She loved being part of the group in the community… and her new independence of walking on her own (to the theatre).” while a participant in the TD-SI group said: “I’m studying or learning this discipline because I think it might improve myself as a person.” Another stated:

> Video games have considerably affected my life. It has been the great motivator from which I have learned about programming and maths and physics, because I have been interested so much in making games. The reason I am in computer science currently is because I want to be able to program games (for) myself as well as others.

Escaping reality/experiencing other selves was an unexpected motivating factor, but one that emerged in all groups. Participants described their interest as being an

escape from their own reality, and allowing them to experience other selves and worlds that were better than their own lives. Quotes from interviews best portray this deeply felt motivator. One participant from the ASD group described:

> Like any other 'sona, Aero is a character that represents me. I have many other Kirby characters besides him, too. One of the reasons I have so many fan-characters is because of one of my other interests that has stemmed from my Kirby obsession – role-playing. Using text-based chat, we act out a play-like script that we make up as we go along. It's really great fun to get into character and play around – for a while, it formed a sort of escape for me from the living hell that was high-school life. We had a whole group – four people, all with several Kirby fan characters, all playing in the same fictional location. It was great.

Another participant in the ASD group made the following statement regarding the beginning of her interest in ASD itself:

> I had just had a very intense year and there were a lot of unanswered questions about myself. My whole life I had felt ashamed of my past selves and all my past interests, each time I got a new one I couldn't understand the old ones. I didn't know why I was like this and all the other things that were different about me. I had never fit in and it had seemed like there was no one like me. My teens had mainly been about covering up my oddness... all my other interests were things that I wished I was and that I thought were better than my reality. With this one, I actually get to really "be" the thing and I can finally accept myself how I really am.

Parents also corroborated this idea by making statements such as "I think he feels powerful. His character does things he can't... I think he likes to think of himself being in the game, and doing heroic things that are not possible in his real life." Another parent stated: "I say he feels happy, for the most part – he's able to escape the real world and be in a place that is safe." A third parent corroborated this by stating, "(He) does not like interacting with other people especially strangers therefore with a computer he does not have to worry about how to communicate with people. I think it is a form of escapism." This idea was also described by many members of the TD-SI group:

> My interest in video game design specifically immerged [sic] from my interest in creating immersive virtual experiences… which were rooted in my strong passion to one day share/communicate my personal experiences, thoughts, and opinions. I started out generally interested in storytelling as I thoroughly enjoyed role-playing games (RPG's) in my

> childhood. I started imagining myself as another character, who I would be, and what I would have done if I were in those stories. It was my favourite way to escape from reality during my childhood... I would say my negative experiences at school and home affected the direction of my interests. I was a victim of bullying. I didn't communicate much with my family because they seemed unwilling to understand me. I made some meagre attempts at communication but felt rejected quite quickly. I "escaped" into my fantasies (video games) every night before falling asleep during my childhood because it allowed me to imagine myself as a more important/significant person than I thought I could ever be in reality.

There are many more quotes rich in detail and heavy with emotion from participants in all groups regarding this theme. Not all participants who mention experiencing other worlds do so from such a negative place, but certainly escaping difficult realities was described many times.

Minor Theme of All Groups

A minor theme that arose in approximately a quarter of participants in each group, was that of stress relief. Participants stated that an important motivator of their interest was to reduce stress in their everyday lives, which is related to the major theme of escaping reality and experiencing other selves. One parent wrote, "(His interest had) a huge calming effect when stressed," and a participant from the TD-SI group wrote "When I'm stressed, I use it for relief."

Themes Specific to ASD and Parent Groups

For both the ASD and parents, sensory aspects were the next most often described motivator, with a quarter of participants in each group describing these as a motivating factor. They were described as managing overstimulation, or providing enjoyable sensory stimulation. For example, one participant from the ASD group wrote:

> I've always liked listening to music, in school I always had my headphones on or at least with me, it helped me shut out external distractions thus making it easier to focus on what I was doing. It also helps me to deal with going to the mall or other places where I may encounter large crowds.

Another theme that emerged for a quarter of people in the ASD group was biological factors. These were references to adrenaline, or a “rush”. As one participant describes:

> It feels great. Getting a rare locomotive, a high-speed passenger train, or a loud and powerful freight train on camera is quite a rush, especially if you’re close to the tracks. Just something about the cacophony of locomotive and train, coupled with the shaking ground and flashing railway signals... it’s an amazing feeling, honestly. You really have to be there to understand!

A quarter of people in the ASD group could not identify a motivator for their interest. This is not necessarily surprising given past findings that this group often has limited insight into their own behaviour (Barkhem, Gunasekaran & Lovelock, 2013).

Themes Specific to the TD-SI Group

Two themes emerged as motivating factors specific to the TD-SI group. One of these was sociability, which was described by participants as having the opportunity to interact with others socially and make friends. For example, one participant said: “I make many friends through baseball because it is a team sport and I can share positive feelings with them. In fact, I have made precious friends in my life through baseball.” Another participant stated:

> (The Harry Potter fan community) is a very accepting, respectful environment…very open and friendly. I belong to something, and I no longer feel alone or transparent. I belong to a group of people who are deeply creative and self-aware, who are in allegiance with love and light.

Another theme that emerged for half of participants in the TD-SI group, but rarely for people in the ASD or parent group was achievement. Many TD-SI participants stated that they were motivated to engage in their interest because they wanted to achieve something. Some examples include: “When getting to practice in gym class, I found that I was above average at it, but also knew that I could get better. I wanted to keep getting better,”; “My personal drive to compete, have fun, and most importantly win, motivates my interest..”; “There is a competitive component to birding, in that you are trying to see more species than your friends.”

Effect of Interest

Along with motivating factors for engaging in their interest, the effect the interest had on their life was the second overarching theme that was most discussed in the interviews. Responses were coded into themes of the interest having either an effect or no effect. If it did have an effect that was broken down into sub-themes: affecting their whole life, positive effects, and negative effects.

Effect

Affects Whole Life

Three people in the ASD group and parent group stated that their/their child's interest affects their whole life. No participants in the TD-SI group described this experience.

Positive Effects

There were four positive effects identified by participants. The first was very positive feelings and emotions when engaging in their interest. In fact, this theme was so strong that all participants in the ASD and TD-SI groups (as well as 18 of 20 parents) identified good emotions as being an effect of their interest. Emotions identified included "happy", "ecstatic", "exuberant", and "joyful". This was the most prevalent effect across groups.

The second positive effect identified was self-development, similar to the *motivation* for engaging in the interest. Participants explained that an effect of the interest is that they gain confidence and skills, or learn or develop themselves in some way. For example, one participant with ASD noted, "A good outcome is that I learn how to be responsible for something …" Another participant from the ASD group stated:

> I had a lot of free time when I was at home, so I used it to pursue my interest in a variety of ways like playing outside, drawing, and making story books. I began repeatedly making story books about dogs from the time I was as young as three. I wanted them to have words, and my mom helped me write and spell the sentences I wanted to put in my stories. In this way, I think my passion for dogs (or just having a strong interest like that at all) helped me learn to read and write much earlier than I may have otherwise.

One TD-SI participant noted that, "I think one important thing about my interest is the fact that it really improved my self-confidence," while another stated their interest, "Helps me better understand the people around me."

The third positive effect identified was that they are or feel more connected with others. This theme was described by 14 participants in the ASD group, 14 parents, and 19 in the TD-SI groups. While the TD-SI group had social connection to others being an effect of their interest more often, it was present in over half of the participants in the ASD group as well. For instance, a participant from the ASD group stated, "I can talk about it with my friends," and another wrote "It has allowed me to meet people who shared the same interest as me." A third elaborates by stating,

> When I am with my friends who are also into firearms and understand how I feel about them is very refreshing. When we are done at the range we go hangout at a sushi restaurant and talk like any other group of guys and they respect me like I'm one of their peers, which for someone who has grown up with ASD is a wonderful thing.

A parent states that, "Animals always give common ground to opening discussions, otherwise there was usually silence." A participant from the TD-SI group stated,

> I play with two teams and while playing I've met various kinds of people. Since I am the captain I have to micro-manage these groups who came from a pool of pre-existing friends…players that weren't friends before became friends shortly afterwards, so it's been keeping my friends closer to me.

The only additional question in the parent interview was "How does this interest affect your family?" which was added upon the suggestion of the first participating parent. Therefore, the question elicited the fourth positive effect identified: that the interest has a positive effect on the family. This was identified by nine parents but no participants in the ASD or TD-SI group (as they were not asked about family specifically). Parents articulately described the positive effects on their family, stating that it gave them the opportunity to spend quality time together, and that they used the interest at times as a way to positively connect with their child. For example, one parent stated:

> (Trains) was a fun interest before and during elementary school. Always exploring publications, books, visiting train themed locations, going to train yards or any place where a train might pass. Was a consideration for family outings, i.e.: if going out for dinner – location of restaurant and time would be decided by train routes and schedules. We researched and enjoyed finding unique surprises with railroad themes.

Negative Effects

There were four negative effects that emerged from the interviews. The first was social isolation, which 11 ASD group participants, 5 TD-SI group participants and 10 parents identified. They described how their interest would often result in social isolation, such as turning down opportunities to go out with friends. Although this theme appears contradictory to the connection to others theme under positive effects, many participants described both of these themes in the same sentence. For example, a parent commented that, "He would sometimes become completely isolated but other times he would have friends over to play (video games) with him." A participant from the ASD group adeptly described how social connection turned into social isolation over time with regard to her interest in Aboriginal culture:

> People thought I was pretty weird for wearing the headband all the time but they didn't seem to care too much either. I had one friend …who was my age, and whenever I visited with her I only wanted to play make believe about natives (building houses out of blankets, gathering food, making costumes, etc.). For about a year she was really into it with me whenever we had play dates. I had this native doll that my mom had made a really nice costume for and I played with this doll constantly. My friend got the same doll and her mom made it some clothes too and I was really happy about this. However, one time when I went to her house for a sleepover and started preparing to play with the dolls she told me that she was too old to play with dolls anymore and she didn't care about imaginary play, and that she was generally tired of always playing about the same thing. I realized she had "grown out of it" and was beginning to be interested in boys and girly stuff…I was on my own after that.

The second negative effect identified was that it impaired daily functioning in some way. Eight participants in the ASD group and 14 parents identified this as being an issue, while 11 TD-SI group participants also identified it. Impaired daily functioning referred to forgetting to eat or sleep, or when participants engaged in the interest to the point where it interfered with their homework or other responsibilities. Although it may be

surprising that more TD-SI participants identified this as an issue, it may be that it occurs to a lesser degree in the TD-SI group, and these nuances were not captured in the interviews. It is clear, however, that daily functioning impairment does occur to a significant degree in some participants. For example, one member of the TD-SI group reported the following:

> I often spend 16 hours a weekend, and so I have less time to finish my homework. Even if I have a test/exam the next day, I still spend 2 hours to play games. Therefore, I do not have time to review for exam. I will review all the night, and I cannot sleep, then I go to have an exam. These situations have happened many times. If I want to play a game, I will ignore (my friends) or lie and tell them I have something important to do. Because of this, I lost a friend…he thought I was a liar.

This was the most extreme example of the interest interfering in the life of a participant without ASD. Overall, it seemed that although the TD-SI group reported it interfering with their daily functioning, it was less pervasive than in the ASD group, in that it mostly seemed limited to restricting sleep, whereas in the ASD group it more often impacted multiple areas of their daily functioning (e.g. personal hygiene, eating, sleeping).

The third, and also perhaps surprising, negative effect that emerged was negative emotions. Three participants in the ASD group, 12 participants in the TD-SI group, and nine parents reported negative feelings such as frustration or anger as an effect of their interest. Most of the negative emotions were attributed to achieving something that one has been working toward (such as losing a video game). Given that a motivating theme that emerged for the TD-SI group was achievement, it follows that negative emotions such as frustration are more common in this group.

The fourth theme that emerged is that the interest had a negative effect on the family, and was identified by 9 parents. Parents described the negative effects of the family as being related to making concessions so their child could engage in their interest, the interest itself being disruptive to the family, or the interest pulling their child away from family time. Because this theme emerged early on in the interviews, when a parent reported that the interest had a positive effect on their family, the experimenter asked her a follow-up question of why she thought that was, or what the determining

factors might be in making a restricted interest a positive or negative experience for the family. The participant replied that:

> I look at it as a gift, not a challenge. What has made a difference with (him) in using his interest to engage with the world is family support. We always just tried to use his interests to engage him. We took family vacations and went to every roller coaster along the west coast, for example. We approached it as 'how can we have fun with your passion'? I have learned so much about how to be focused on the present and just be absorbed in something without worrying about the past or future. To be able to just be immersed in his passion...we should all be so lucky.

Therefore, it appears that it may be the approach of the parents that plays some role on the effect the interest has on the family, although this is a theme that certainly needs to be explored in more detail in future research.

No Effect

A number of participants expressed that one or more of their interests had no effect on their life, particularly on their social life. Interestingly, 12 participants in the ASD group, five participants in the TD-SI group, and three parents reported this to be the case. While this may be initially surprising, the explanations shed more light on this issue. For instance, one parent hypothesized that her son's interest may *replace* his social life, rather than affecting it in any way. A participant with ASD stated, "I don't have a social life, so (my interest) can't affect it." At least on a conscious level, participants with ASD do not see an effect of their interest on their social life in an apparent way. Indeed, the relation between social time and restricted interests, and the influence they play on each other are complex. This will be discussed at length in a later section.

Why the Interest Ended

Because so many of the interests reported were ongoing interests, many people did not identify how their interest ended. The most often identified reason for an interest ending for both groups (by both self and parent report) was that they became interested in something else, which caused their original interest to diminish. The next most common reason an interest ended was that their priorities changed and their interest no longer fit with their new priorities. There were a maximum of three people in each group who reported this theme. Other reasons identified for an interest ending included

frustration with the interest (one person in the ASD group and two parents), there being nothing else to learn (one person in each of the ASD and TD-SI groups), injury (one person in the TD-SI group and one parent), and the interest simply diminishing (one person in the ASD group).

Other Emerging Themes

There were three additional themes that emerged from the data that was not in response to any particular question, but were mentioned by a number of participants. Five people in the ASD group, seven people in the TD-SI group, and eight parents discussed feeling absorbed and focused by their interest. For example, one participant with ASD stated, “I was so engrossed by the sheer wealth of background material that I could just spend hours reading about it.” A participant from the TD-SI group stated, “I do sometimes get so absorbed in a book that I am reading that I will read until very late and I will be tired for the next day.” A parent had a positive perspective on this theme stating, “I think they feel in the moment. Engaged and fulfilled. I think that having an opportunity to be immersed in your passion is something we all would be lucky to experience.”

Another emerging theme was interests relating to an atypical developmental level. These were references to their interest being unusual for someone their age. Four participants with ASD and four parents reported this, and one participant from the TD-SI group. Examples were a person in their early 20’s interested in birding, a person in their 30’s interested in knitting, and a person in their late 20’s interested in Pokémon.

A theme that emerged for only two participants in each group, but still seemed important to capture, was addiction. The term “addiction” was chosen as it was the word they most often used to describe this theme, and grounded theory strives to remain grounded in the language participants use. These participants used the word addiction when reporting engaging in their interest was something that they felt they could not control or stop. One participant with ASD said:

> Originally this interest was extremely negative. I would spend days without eating or sleeping or doing anything else except playing this game until someone would physically remove and hide the N64. I would feel relieved because I didn’t feel like I could stop myself. Now, I’m far more balanced and can stop on my own after reasonable periods of time. I still love this game though.

A TD-SI participant identified addiction as possibly being more relevant to certain interests:

> I started to be addicted to (video games). I think gaming is really a kind of hobby which is easier to be addicted than most other hobbies. You will feel tired when you play sports, but you won't for gaming. Also, you always need to catch up if there are some updates of the game that you are playing, but you will not need to catch up on the updates of soccer.

As a probe of a negative case example, a participant with ASD who did not seem to have intense interests (they reported a large number of different interests and spending a low percentage of time on them) was asked why they thought that was, when many other participants with ASD report intense interests. They responded as follows:

> Oh I know why that is- if I let myself I will spend 100% of my time on one thing, and I know that's not necessarily something I want, so I put restrictions on myself. When I was younger anything I was interested in would become my entire focus and I wouldn't do anything else for days and days. So now that I know I don't let myself get that far- I know if I let something get to 100% I know that won't be good so I don't. Like last spring when I started getting into astronomy again I knew it was starting to get not good again (e.g. reading about it for 24 hours straight) and it was getting in the way of sleeping and eating and stuff. When I was in adolescence I didn't know any better, but now as an adult I make a point of mindfully diversifying so things don't become my whole life. Otherwise I get 'sucked' into things and so I need to be very cognizant about doing a lot of different things. A few years ago I got addicted to 'puzzlecraft' (an iPhone app) as an adult which resulted in 1-2 months of doing little else. That was probably my worst one in adulthood of being sucked in to things.

This example indicates that even though the sense of being addicted did not necessarily emerge for many people in the ASD group it is certainly something a few experience. If this participant had not been asked follow-up questions, this theme would not have emerged for her. This indicates addiction is a factor worth considering.

Discussion

This study uncovered many relevant aspects of restricted interests in high-functioning ASD, both in terms of the nature and course, and of the lived experiences of people with them. Overall, the interests studied were quantitatively and qualitatively similar between the high-functioning ASD group and the TD-SI group, with a few notable differences. People in the TD-SI group were more motivated by achievement, for example, while the high-functioning ASD group was more motivated by sensory aspects, such as avoiding unwanted noise, or enjoying the way something looks. Social aspects also seem to be different in some ways, such as that the TD-SI group reports sociability as a motivating factor while the high-functioning ASD group did not. But generally the groups actually were remarkably similar in the way they reported their interests, and there was certainly much more variability within the groups than between them.

Parents were actually remarkably in-tune with their adult child, as similar themes came up in both groups, and parents seemed to have great insight into the motivations and the effects of their child's interest. In this study it was very beneficial to have both perspectives. In terms of future studies, it would be useful to have both the adult with high-functioning ASD and their parent reporting in order to get a most in-depth understanding of their interests, rather than just one or the other, as each group has unique perspectives and information to offer. The parent-report is particularly important in obtaining information about their child's interests when they were younger, as many individuals with high-functioning ASD stated they did not remember their interests very well from that time, and so they were providing answers based on their best estimate. The adult with ASD's self-report is also important; however, as they usually have more information to offer about their current interests, and have important and unique insights about the nature of their interests.

It is not surprising that the TD-SI group had interests similar to those termed "restricted interests" in high-functioning ASD, given that the goal of the study was to

compare the high-functioning ASD group to a group who did not have ASD but had similar types of interests. It has been argued that the disorder itself describes a group of people at the high end of the spectrum for all three symptom domains (or two following the new DSM 5 criteria) (Happé, Ronald, & Plomin, 2006). It is hypothesized that there are people who have repetitive motor behaviours, for example, who do not have social or communication difficulties, or people with communication difficulties who do not have social difficulties or repetitive behaviours. Along the same lines, this study shows that there is a group of people without high-functioning ASD symptoms, but who do have interests that look very similar to the restricted interests in this population. This provides further support for the idea that the diagnosis of ASD might be a combination of traits that all occur individually in the typical population. Clinically, it implies that using the diagnostic criteria of an interest meeting criteria based on being "unusual in intensity" may not be specific enough for distinguishing ASD, and that focusing on how many contexts in which one pursues their interest may be a better differentiating factor.

Models of Interests

This study provides valuable information on how interests in high-functioning ASD develop, insights into the important components of interests for this group, and how they differ from the typically-developing population. Although models of interests have not been applied to restricted interests in the past, they are helpful tools for better understanding interests in high-functioning ASD. One of the biggest issues with research into this area thus far is that it has focused primarily on *behavioural* aspects of the symptom. While this logically follows from the behaviourally based criteria used in the DSM, it is less helpful for understanding the etiology, motivation, or underlying factors that influence interest. The concept of equifinality is the idea that a single behaviour or end-point can have many causes. It is therefore important to describe the characteristics/traits of restricted interests in a way that may not be achieved through behavioural definitions alone. The literature on typical interests understands interests as a psychological concept. Applying models proposed for typical interest development can help researchers understand restricted interests in a more comprehensive, less behaviourally-defined way. It also highlights important psychological factors that have historically been overlooked, such as motivating and maintaining factors.

Model of Interest Development

The model of interest development described earlier (Figure 1, p. 5) suggests that there is an environmental factor that triggers an interest. The interest is then maintained by four factors including environmental opportunity, the perception of ability, cognitive rewards, and emotional rewards. Overall, this model appears to apply well to how restricted interests develop in high-functioning ASD with some exceptions.

Trigger of Interest

While the environmental factor triggering the interest was always identifiable in the TD-SI group, this was not always the case in the ASD group who often reported no identifiable trigger. This may be for two reasons. First, they may not actually have an identifiable trigger for the interest in a particular way, which may be a distinguishing feature of restricted interests in some cases. Alternatively, it may be that the ASD group has less insight or poorer memories as to what the trigger was for their interest. The parent group responses give some insight into this issue. The parent group reported no identifiable trigger about half as often as the ASD group, indicating that the answer may lie somewhere in the middle. Some of the responses that offered no identifiable trigger may be due to an insight or memory issue, while others may truly not have one. In terms of the trigger itself, the majority of interests in both groups were initially introduced by a family member. Usually this was triggered by a family member buying them something related to the interest (e.g., a video game console, art supplies, a pet) or enrolling them in an activity (e.g., sports, specific camps).

In the TD-SI group, a large proportion of interests were triggered by friends, especially as participants got older. This was not the case for people with high-functioning ASD, which is not particularly surprising, and may be due to a few reasons. People with high-functioning ASD typically have fewer friends due to their social difficulties, which may result in fewer opportunities for friends to trigger interests. It could also be that people with high-functioning ASD do not adjust their interests to match their peers, and thus they have fewer friendships. Regardless, the main finding in this study regarding environmental triggers is that the vast majority of times, interests were introduced by another person for both the high-functioning ASD and TD groups. In other words, other people seem to be quite an influential factor in triggering interests, although

a substantial number of people with high-functioning ASD may not have an identifiable environmental trigger stimulating an interest.

Maintenance Factors

Environmental Opportunities

Environmental opportunities to engage in an interest were not specifically studied, though they are identified as a maintenance factor in the model. When investigating how interests ended, participants reported most often becoming interested in something else or a shift in priorities which no longer fit with that particular interest. A lack of opportunity was rarely mentioned except in the event of an injury. In these cases, it makes sense that environmental opportunities to engage in the interest would be necessary, and appears to apply to both the high-functioning ASD and TD-SI group.

Perception of Ability

Perception of ability is an interesting maintenance factor given the results of this study. The themes of being good at the interest as a starting factor, as well as achievement as a maintenance factor did emerge from the data, but much more so for the TD-SI group than for the high-functioning ASD group. This is reasonable, given that an evaluation of one's own abilities and achievements inherently requires an understanding of other people and the ability to make social comparisons, which are impaired skills in ASD. The results of this study indicate that the perception of ability is more of a maintaining factor for the TD-SI group, and that other factors may be more important for maintaining an interest for the ASD group.

Cognitive Reward

Cognitive rewards were certainly an important motivating factor for both groups, with half of all participants in each group reporting this as a maintaining factor for them. Knowledge and fact accumulation, and learning as much as they could about their interest was a strong motivating factor that did not differ between groups. It would be useful in the future to look at whether cognitive rewards are an important aspect of interests for everyone, or whether it is just a motivating factor for people with strong interests (both with and without ASD).

Emotional Reward

Emotional rewards were by far the most important maintaining factor for the participants in this study, with every single participant (and all except two parents) reporting positive feelings as an important aspect. A novel finding emerging from the results of this study suggests that positive feelings are not the only emotional rewards that motivate an interest, but also avoiding negative feelings. Escaping reality and stress relief were unexpected themes that emerged for both groups, and contributed strongly to the emotional rewards that maintain interests. The model of interest development did not specify what factors trigger the end of an interest, but from the data collected in this study, it is evident that the starting of another interest is most often responsible for the end of an existing interest.

Important Components of Interests

The components of interests discussed in the introduction (Figure 2, p. 6) apply well to interests in ASD, and provide a framework from which to systematically compare them to typical interests.

The components propose that the interest holds value, is intentional, is associated with positive affect, has a cognitive component (the person wants to learn more about the interest), and involves selective persistence (the interest is stable and maintained for a significant period of time).

Holds Value

Although the participants were not asked directly about the value of their interests, this certainly seemed to be an important characteristic of their interests. Value emerged particularly with the theme of escaping reality/experiencing other selves. Participants described their interest as being almost akin to a lifeline at certain times in their lives. Self-development also emerged as an important motivating factor and as a positive effect of the interest, indicating the interest's personal significance to them. Even just the process of recruiting and running participants through the study gave clear indications of the importance and value these interests hold for participants (and their families). Unlike many studies, recruitment for this study was surprisingly easy, especially for the TD-SI group. Within a couple of days of posting an ad on the birding

forum, for example, there were over 35 birders who had expressed interest in participating in the study—enough to constitute a group of their own! Word-of-mouth quickly became a primary recruitment method as participants asked if they could tell other friends about their study who met the criteria, and those friends quickly contacted the researcher excited about the opportunity to share about their interest. One of the individuals interested in anime created an anime image for the study, demonstrating their clear enthusiasm. The sheer length of time some participants spent on the interests questionnaire also indicated enthusiasm. A few participants needed to be stopped after they had been working on the questionnaire for 4-5 hours as the researcher became concerned about their need for a break (and food). Although not explicitly expressed by most participants, it was clear to the researcher that their interests held great value to the participants in this study.

Intentionality

Intentionality was also not asked about directly, but some indication was observed in the information provided by the interviews. About half of all participants indicated, for example, that their interest interferes with their daily functioning, meaning that engaging in their interest was very intentional. No participants indicated an external influence forcing them to engage in their interest (if it was required for work, for example) as a maintaining factor, indicating that engaging in their interest was voluntary. As the participants were adults, it is assumed the choice to engage in their interest was intentional (and nothing in the interviews suggested otherwise). Therefore, this component appears to hold true for the participants from both groups in this study.

Cognitive and Affective Components

The cognitive and affective components were discussed at length in the previous model. Suffice it to say that participants certainly seemed to develop an in-depth knowledge of their interest and that this seemed to be an important component for them. As previously discussed, an additional condition should be included in role of the affective component of this framework, which stipulates that it can include avoidance of negative affect.

Selective Persistence

Finally, the selective persistence component does seem to apply to the participants in this study. All had interests that lasted and remained stable for a great many years. The results of this study indicated that selective persistence is certainly an important component of interests in high-functioning ASD.

Conclusions

Overall, the main differences found from these models is that the environmental triggers appear to be less identifiable in high-functioning ASD, friends are more often a trigger for interests in the TD-SI group than the ASD group, and the perception of ability is more important in the TD-SI group. The five proposed components that distinguish interests from other activities in the typical literature also seem to apply when distinguishing interests in high-functioning ASD from other activities.

Stages of Development

Although the questionnaire was designed to obtain information about interests across development, most participants reported on current and most recent interests and less information was obtained from earlier stages of development (toddlerhood to school age) than later ones (adolescence and adulthood). A few parents reported on interests their child had when they were younger, but even parents were reporting mostly on interests their child currently had. Therefore, the majority of information up to age 12 in this study was usually on interests that still existed, with the majority of information obtained focusing on adolescence and adulthood.

When considering Todt's model which argues that family plays a large role in interest development, it was indeed found that the home environment played a role in interest development for both groups, and perhaps even more so for the high-functioning ASD group. While family members were the primary way an interest started in both groups, friends were almost as common as family in the TD-SI group in starting an interest, whereas for the ASD group it was family alone, or an unidentifiable trigger. Todt argues that interests in adolescence become 'personal interests' that relate to the

person's understanding of themselves in society. Then, in later adolescence and into adulthood, their specific interests reflect their individuality and their interests become more connected to future vocational and educational paths. While this was true of a number of TD-SI group participants and one high-functioning ASD participant who identified their interest as playing a role in their educational or vocational path, many participants viewed their interest as more of a past time that was influenced by affective experiences and cognitive rewards rather than self-identity. These findings did not support Todt's theory, although different results may be found by asking about the relationship between their interest and self-identity specifically.

Restricted Interests in ASD

So, what do the results of this study tell us about the nature of restricted interests in high-functioning ASD? Overall, results corroborated previous research that indicates restricted interests are a prevalent symptom in high-functioning ASD. The number of interests reported in this study by both participants with high-functioning ASD and their parents was comparable to the number of special interests reported in the TD-SI group. This could be due to time constraints; the Interests Questionnaire asks participants to answer comprehensive questions for each interest at various time points, and it may be that participants in each group had the same stamina for how many interests they were able to report on. However, participants with and without high-functioning ASD having the same number of interests corroborate another recent study which found the same result (Anthony et al., 2013). Therefore, converging evidence indicates number of interests may be similar between groups. The main quantitative ways in which the groups differed was that the high-functioning ASD group pursued their interest in fewer contexts, which is consistent with previous research (Turner-Brown et al., 2011).

Restricted interests have been proposed as a potential "hallmark symptom" of ASD as a symptom that, unlike other RRBs, only occurs in ASD (Gal, 2011). Based on the participants with high-functioning ASD in this sample, this study suggests that there is a group of people in the typical population who also have interests that look very similar in many ways to restricted interests in high-functioning ASD, suggesting it may not be appropriate to designate this symptom as a unique or distinguishing symptom of

high-functioning ASD. This study also supports previous reports that families see restricted interests in a positive way, unlike many other symptoms. This study demonstrated that it is not only families and parents who see restricted interests in this way, but also people with high-functioning ASD themselves who see it as a positive influence on their life. Moreover, all groups acknowledged and recognized that there were negative effects of their interest as well.

Another important insight this study provides is in regards to measuring restricted interests in high-functioning ASD. This study indicates that behavioural or quantitative measures may not provide the best information about restricted interests in adults with the disorder. Because of a negative case analysis in which follow-up questioning was used to discover why a participant was not reporting interests that were restricted, it was discovered that she did have restricted interests as a child. As she grew up, she reported still having the propensity for restricted interests, but that she learned to over-ride her natural tendencies for immersing herself in her interests. Rather than "giving in" to her interests she set limits on them to ensure they did not become restricted. Incidentally, this participant was one of the two participants with high-functioning ASD in a long-term relationship, indicating this strategy may be successful. Although this is just one person's experience, it indicates that current behavioural measures may not be the best way to measure current restricted interests in adults with high-functioning ASD, and may miss important features of the symptom. Although developmental histories are already required for a diagnosis of high-functioning ASD, this study reinforces the importance of this type of assessment, particularly with regard to accurately assessing this symptom.

The connection between social skills and motivation, and restricted interests, are another important area to examine. This may provide insight into the underlying nature of the disorder if the relation between the two broad symptom domains of high-functioning ASD (social-communication and RRBs) could be understood. Previous research found both positive and negative associations between social skills and restricted interests, as discussed earlier. The results of this study corroborated this finding. Both positive effects in the form of connecting with others and negative effects in the form of social isolation emerged for both groups. One difference was sociability, which emerged as a motivating factor for the TD-SI group but not the high-functioning

ASD group, indicating that the interests in the TD-SI group are more socially *motivated*. This was also reflected in the quantitative analysis where the TD-SI group reported they shared their interest more than the high-functioning ASD group. However; three-quarters of individuals in the high-functioning ASD group who noted that their interest had the positive effect of increasing their connection with other people. Perhaps while their interests are not socially motivated they could be directed to use their interests to connect to others and, in some cases, this seemed be a positive experience.

Perhaps an even better indication of how interests affect one's opportunity to connect with others was the between-content analysis of interests. Since this was conducted after the initial analysis, there were only a small number of people in each group with the top three interests and so formal statistical analyses and firm conclusions about the participants in this study cannot be made. However, the graphs indicate that there may be differences with regard to how particular interests manifest that could impact people's the lives. For instance, people with an interest in electronic gaming seem to spend more time on it, *want* to spend more time on it, share it with fewer people, and have the interest for longer than people with an interest in sports or the visual and performing arts in this sample. This is important to consider, because although the prevalence rates of people reporting electronic gaming in this study was equivalent in the high-functioning ASD and TD-SI groups, previous research on electronic usage which surveyed over 3000 participants found that the percentage of participants with ASD in their study spending "most" of their times on video games was over 40%. This was more than double the percentage in the typical population, and much higher than the other groups in the study including youths with an intellectual or learning disability (Mazurek, Shattuck, Wagner, & Cooper, 2012). This study indicates that a restricted interest in video games may indeed be higher in the ASD population.

Thus, electronic gaming may not be the best interest to encourage in people with high-functioning ASD who already have social difficulties. Of course it is unknown whether people interested in video gaming already have poorer social competence or video gaming makes social competence worse, but it is most likely a combination of the two which results in decreased social competence. In either case, knowing that particular interests may have poorer outcomes is useful from an intervention perspective. Because this study found that people, and in particular family members in

the high-functioning ASD group, have a strong role to play in introducing interests, they could be encouraged to introduce interests other than electronic gaming. In this case, it may be that all interests are *not* created equal and that the content of the interest does have different effects on the person's life. Further, the results of this study show that another interest being introduced is the most common way for a current interest to end, so even if people with high-functioning ASD already have a restricted interest in electronic gaming or another interest that may reduce social opportunities, introducing a different interest may provide more optimal opportunities for socialization. This may have the potential to change their developmental trajectory in a beneficial way.

However, there are a few caveats to this argument that should be acknowledged. First, the issue of interacting with people online should not be ignored. In this study, the number of people a person engages in their interest with was calculated as the number of people in real life, or that they knew in real life but with whom they also played online. Admittedly, many participants playing video games in this study verbally reported that they played with many people virtually. Preliminary research evidence suggests that excessive video game playing can create social isolation (Karlsen, 2013). But how online interactions mimic the complex nature of real-life social interactions is not yet understood.

Second, this study did not have a large number of participants in each interest area so firm conclusions cannot be made; indications of possible trends were simply taken from the graphical data. It was originally decided that better comparisons could be made between groups with similar interests and this would assist with the validity of the study. An aim was also to fill a gap in the literature, as many other studies have looked at only the content of interests but not their development over time or compared to a typically-developing group. However, in doing so some of the differences between the groups may have been masked in this study. A different approach for a future study might be to investigate differences between larger groups of people with the same interest, which may shed light on a different aspect of interests. Certainly, this would be a worthwhile endeavour for future research. If the birding group is any indication, it should not be too difficult to recruit 30+ people with the same interest.

Limitations

This study had some limitations. The sample of participants with high-functioning ASD was restricted to younger adults for the most part, and as such the perspective of older adults with ASD was not adequately represented. The ASD sample only included high-functioning individuals, and therefore the perspectives of lower-functioning individuals were also not represented. There were also more males than females in this sample, which is typical of the ASD population as a whole, but resulted in females with ASD being underrepresented as well. Although the study attempted to investigate interests across development, because most participants reported on current or recent interests, not as much information was obtained about interests that ended before adolescence. Moreover, because parents reported on more earlier interests and the adults with ASD reported more on current interests, it is difficult to know whether differences found were due to some different interests being reported, or due to genuine differences. Also, as recruitment focused on the groups of participants having similar interests, it was not well-suited to making conclusions about the *content* of interests. Fortunately, there are other, larger scale studies that have focused on the content of interests and thus can shed light on this issue (e.g. Klin et al., 2007).

Another limitation of the study was that the ADI-R was not used to verify whether participants met criteria for restricted interests. It was decided that it was not appropriate to use this tool with this sample of high-functioning adults because the experimenter did not want to limit the high-functioning ASD sample to participants who still were in contact with their parents (at the very least this would restrict the ability of older adults to participate). However, it would have been useful to verify the presence of a restricted interest using a gold-standard measure.

A limitation that resulted as a consequence of gathering data on variables that have not previously been studied was that for some of the variables, post-hoc analysis revealed that for one of the variables (number of people) there was not enough power to detect the effect size obtained with the sample sizes included in the study. This was not detected before the study began because it was thought that the range of people reported would be much narrower than it actually was (0-50 people), but it did consequently limit the conclusions that could be made about the quantitative analysis.

Finally, because the between-interests analysis was conceived after recruitment had finished, there were only three interests that had enough participants to compare between, and there were significantly different numbers of participants from each of the ASD and TD-SI groups. It would have been beneficial to have larger numbers of participants with particular interests, with equal representation from each group to make comparisons between groups *and* content of interest.

Conclusions

This study gave the first insight into how individuals with high-functioning ASD view their own restricted interests. Consistent with previous studies (Klin et al., 2007; Winter-Messiers, 2007), what emerged is that their interests are far more than a set of behaviours with which to quantify, classify, and possibly use to diagnose a disorder. Interests are also in many cases something that provides joy and happiness and helps them cope with their everyday lives. Their interests affect their lives in many different ways, and are deeply meaningful to the individuals.

This study had many strengths. This is only the second study to investigate restricted interests in adults with high-functioning ASD. The first focused solely on the content of the interest. It is also the first study to ever investigate the perspectives of people with high-functioning ASD regarding their own interests. This provides the opportunity to highlight many important aspects of interests, with perhaps the most novel being the role interests play in coping in adverse circumstances for many people, including people without ASD. Another strength of this study is that it bridged previous lines of research that have historically been separate—the theory and understanding of typical interest development and atypical restricted interests in high-functioning ASD.

This study identified a wide range of possibilities for future directions of research. Looking more exclusively at the differences between groups of people with particular interests would be an important research priority. This would provide more information on the effects of having certain types of interests on particular developing systems, such as social and emotional development. Understanding this could in turn help uncover the relation between ASD symptom domains, which have so far remained elusive.

As mentioned earlier, identifying possible effects of the family's approach to their child's interest would be another worthwhile endeavor. If the preliminary findings from this study were corroborated and it is the case that a family's acceptance rather than rejection of an interest leads to better family dynamics and social outcomes, this would be important information for families and clinicians to be aware of. It would also be useful to conduct a study looking at triggers of restricted interests in high-functioning ASD in order to understand whether triggers are truly less identifiable in this group, or to learn more about why they were more difficult to identify in the ASD group in this study.

It would also be important to learn more about the possibility of introducing different interests, particularly to high-functioning individuals with ASD. If this were possible, it would support the idea of changing their interest as a possible intervention to nudge them onto a more optimal developmental trajectory. For instance, if a child with high-functioning ASD was doing quite poorly socially and had a restricted interest in video games, enrolling them in a sport, a class related to visual and performing arts, or a different activity in which they may develop an interest may change their social experiences and improve their development over time. This may result in a more optimal outcome than if they had remained playing video games alone. Relatedly, evaluating what effect changing a person's restricted interest has on their lives may provide useful insights into this issue. Finally, researching whether introducing a broader range of coping skills mitigates the intensity of restricted interests at all would be a worthwhile endeavour. For many participants in this study, immersing themselves in their interest seemed to be a coping strategy for escaping difficulties in their lives. While it is a more adaptive coping strategy than some people use for escape (alternatives may be drugs or alcohol, or self-harm) providing these individuals with other coping skills to deal with stress theoretically may lessen the intensity of their restricted interest. If engaging in their interest was a person's coping strategy and they were taught different evidence-based emotion-regulation and/or anxiety reduction skills instead, this may be a more effective way of coping with distress. A number of participants reported feeling like they wanted to stop but could not do so. Thus, introducing these skills may be a way of supporting their desire to stop.

The process of conducting this study highlighted key methodological procedures that would be useful for future researchers in this area. First, taking the advice of

previous researchers and using comment boxes instead of in-person interviews for the qualitative portion of this study was highly successful. Many participants with high-functioning ASD commented that they were happy they could type out their answers instead of discussing them verbally. Second, for researchers studying people without ASD with special interests, using word-of-mouth and/or internet forums as a recruitment method was also successful in this study. Therefore, these should be considered as useful recruitment tools in the future, particularly if researchers are looking into differences between particular interests.

Third, for researchers studying adults with high-functioning ASD, it is important to keep in mind that many of these adults will have learned compensation strategies that have the potential to mask differences that may be more observable earlier on in development. Originally, part of this study was going to include an in-person social interaction involving the researcher discussing the person's interest with them that was filmed for analysis. This was unsuccessful for a number of reasons. The participants with high-functioning ASD were reluctant to talk verbally about their interests, and many reported this was due to people telling them in the past that they talked too much about their interest and so now they do not talk to others about it at all. This was also emphasized by the participant with high-functioning ASD who in response to the follow-up questions indicated that although she would like to engage in her restricted interests, she ensures she doesn't get "sucked in" by them. Thus, studying restricted interests in adults may have to involve more in-depth questions than simply asking about behaviours, or attempting to video record them. About half of the participants with high-functioning ASD also expressed reluctance to be filmed due to anxiety, and thus using video recording with adults with high-functioning ASD in future research might systematically restrict the sample researchers are able to obtain. This also emphasizes the utility of comment boxes versus in-person recorded interviews for future qualitative research with this high-functioning population.

This study also demonstrated that interests are a huge and difficult topic to study, although breaking them down according to theoretical models was helpful and made it more manageable. Given time constraints, participants tended to report mostly on current interests, so little information was gained overall about interests that had already ended, or occurred early in childhood. Therefore, in order to obtain a clearer

developmental picture, researchers may need to specify this in the instructions. In this study the first reported interest was more extreme on some variables but overall fairly comparable to interests reported later on. Therefore, it could be useful in future studies to ask about only the most important interest at each developmental period. Finally, prospective studies would provide valuable information regarding interests. Using this type of design it would be possible to discern whether social deficits are a cause, a result, or both, of engaging in particular types of interests. It would also provide more comprehensive information on the number of special/restricted interests individuals hold over time, as well as how they change over the course of development.

This study demonstrates that interests are flexible and the way they manifest is dependent on many factors such as family influence, availability of activities to engage in, and self-awareness. The way families respond to their child's interest can be very important, and parents who use the interest of their child with high-functioning ASD as an opportunity to connect with their child can be very successful and rewarding. Interests vary considerably in the way that they lead to social interaction, and so for individuals with high-functioning ASD, taking up an interest that leads to more social interaction is a helpful intervention. In conclusion, conducting mixed-methods or qualitative studies on adults with high-functioning ASD about their interests is important, fascinating research into which one obtains a window into their personal struggles and achievements.

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Appendices

Appendix A.

Interests Questionnaire- Self Report

All people have interests- please list the main interests you have had over your lifetime. These can include, but are not limited to, hobbies, vocational interests, and areas of expertise.

For each interest, please answer the following sections. Start with the most important interests.

Interest: _____

When did it start?

Please describe in as much detail as you can *how* your interest started. Specifically, did your interest start from you being introduced to it by someone, by encountering it accidentally, or did it just emerge without a particular trigger?

Please describe in detail how your interest affects/affected your life (e.g. positively or negatively at school, home, work, sleep, personal hygiene, etc.).

Please describe in detail how your interest affects/affected your social life?

How do you feel when engaging in your interest?

How long did it last (e.g. 2002-2006, or ages 7-11)?

When did this interest peak?

When did it end?

Why did it end?

Please describe in as much detail as you can what motivates/motivated your interest.

Please answer the following questions about your interest at different stages of your life. If you didn't have the interest at that stage, please leave it blank.

	Currently	Adolescence (13-18)	School Age (6-12)
What is/was the focus of your interest? (e.g. reading about trains, playing with trains, learning facts about trains, train schedules, types of trains, cargo of trains, etc.)			
In what ways do/did you engage in your interest? (e.g. reading about it, taking classes, joining groups, solitary play, role-playing, playing			

with a friend, etc.)			
Do/did you engage in your interest with other people? If so who?			
With how many people do/did you engage in your interest?			
What percentage of spare time do/did you spend on your interest?			
What percentage of time would you like/have liked to spend on your interest?			
How much do/did you and/or your parents spend on your interest per month?			
What happens if you are/were interrupted while engaging in your interest?			

Is your interest different from other people's interests in any way? Please explain.

Is there anything else you think is important about your interest that you haven't told me about?

Appendix B.

Interests Questionnaire - Parent Report

All people have interests- please list the main interests your son/daughter has had over their lifetime. These can include, but are not limited to, hobbies, vocational interests, and areas of expertise.

For each interest, please answer the following sections. Start with the most important interests.

Interest: _____

When did it start?

Please describe in as much detail as you can *how* their interest started. Specifically, did their interest start from being introduced to it by someone, by encountering it accidentally, or did it just emerge without a particular trigger?

Please describe in detail how their interest affects/affected their life (e.g. positively or negatively at school, home, work, sleep, personal hygiene, etc.).

Please describe in detail how their interest affects/affected their social life?

How do they feel when engaging in their interest?

How long did it last (e.g. 2002-2006, or ages 7-11)?

When did this interest peak?

When did it end?

Why did it end?

Please describe in as much detail as you can what your sense is of what motivates/motivated their interest.

Please answer the following questions about your son/daughter's interest at different stages of their life. If they didn't have the interest at that stage, please leave it blank.

	Currently	Adolescence (13-18)	School Age (6-12)	Preschool (3-5)	Toddler (0-2)
What is/was the focus of their interest? (e.g. reading about trains, playing with trains, learning about trains, learning facts about trains, train schedules, types of trains, cargo of trains etc.)					

In what ways do/did they engage in their interest? (e.g. reading about it, taking classes, joining groups, solitary play, role-playing, playing with a friend, etc.)					
Do/did they engage in their interest with other people? If so who?					
With how many people do/did they engage in their interest?					
What percentage of their spare time do/did they spend on their interest?					
What percentage of their spare time would they like/have liked to spend on their interest?					
How much do/did they and/or you spend on their interest per month?					
What happens if they are/were interrupted while engaging in their interest?					

Is your son/daughter's interest different from other people's interests in any way? Please explain.

How does your son/daughter's interest affect the family?

Is there anything else you think is important about your interest that you haven't told me about?

Appendix C.

Family Demographics Questionnaire

Please note that the all of the data gathered from you today is strictly confidential and will only be used for research purposes

Date_____

Identification Information

Name: _____

Date of birth: _____ Age: _____

Gender: □ Male □ Female

Address: _____

Please list both and check which form of contact is most preferred

□ Telephone _____ □ Email _____

Background Information

Gender: □ Male □ Female

Please select handedness:□ Left □ Right

Primary language spoken at home_____

Other language(s) spoken_____

What is your cultural or ethnic background? (e.g., Italian, Métis, Cantonese, English, Canadian):

_____

Marital status (circle one): Married, Common Law, Divorced, Separated, Single, Other

Do you have children? □ Yes (Number of children:_____) □ No

Living situation (circle one): Alone, With roommate(s), With parents, Other _____

Employment status (circle one): Part-time Full-time Not employed

If you work, what is your approximate personal gross annual income? (I.e. You and if applicable, your spouse) (Please select one)

□ Less than $20,000 □ $20-49,999 □ $50-79,999

□ 80-109,000 □ $110- 140,000 □ Greater than $140,000

Do you take recreational drugs? □ Yes □ No Type of drug: _____

When was the last time you did recreational drugs? _____

Have you ever been diagnosed with a psychiatric or mental health problem?

(E.g. Autism Spectrum Disorder, ADHD, Anxiety Disorder, Learning Problem, etc.)

□ Yes □ No

Please specify: _____

Do you take any prescription medication? (Please specify)_____

Do you have any medical conditions? (E.g., Seizures, Tourette's syndrome etc.)

□ Yes □ No (if Yes, what are they?)

Do you have a close family relative with Autism Spectrum Disorder?

□ Yes □ No

What is your relationship to this person? (E.g. Sibling, cousin) _____

Educational Information

Student status: □ Part-time student □ Full-time student

What year of study are you in? □1 □ 2 □ 3 □4 □ 5

What is your academic major (if you have not yet declared your major, what is your intended academic major)? If you have a dual major, or a major and a minor, please list all, but specify which is your major and which is your minor.

Is there anything else we should know about you?

Appendix D.

Coding Definitions.

Content of Interest

Animals

Any interest relating to animals, excluding people

Anime

Any interest that is in some way related to Anime (Japanese Animation- defined either as named as such by the person reporting, or by wikipedia classification)

Astronomy

Any interest related to objects or matter not present on the Earth

Electronic Gaming

Any interest related to video games or computer games

Food-Related

Any interest related to gathering, preparing, eating, or learning about food

History

Any interest relating to past events

Mathematics

Any interest related to the study of numbers, quantities and shapes, and the relations between them

Military

Any interest in any aspect of the military or war

Movies

Any interest related to viewing, making or learning about movies

Music

Any interest related to viewing, making, or learning about music

Non-Electronic Gaming

Any game that is not played on an electronic console or computer, including tabletop games, Yu-Gi-Oh, Magic Cards, etc.

Philosophy

Any interest related to the study of ideas about knowledge, truth, the meaning of life, etc. (Webster Dictionary)

Politics and Current Affairs

Any interest related to political systems or current events

Reading and Writing

Any interest related to reading and/or writing including books, comics, fanfiction, and internet forums

Sports

Any interest related to doing, watching, or learning about sports

Technology

Any interest related to the use of science in industry, engineering, etc., to invent useful things or to solve problems (Webster Dictionary)

Television Shows

Any interest in a particular television show, television shows in general, or an interest in something that has a television dedicated to it (e.g. Pokeman cards also have a Pokeman show so it would also be coded at this theme)

Toys and Models

Any interest related to toys or models, including cars, robots, and military models

Travel and Culture

Any interest related to travelling or learning about different cultures at any time period

Vehicles and Transportation

Any interest related to methods of transportation (e.g. trains, motorcycles)

Visual and Performing Arts

Any interest related to visual and performing arts, including dance, singing, theatre, crafts, sewing, photography, videography

How It Started

Another Interest

Any reference to the interest starting due to its relation to another interest

Family

Any reference to the interest starting due to being introduced to it or encountering it through a family member

Friends

Any reference to the interest starting due to being introduced to it or encountering it through a friend

No Particular Trigger

Any reference to the interest starting without an identifiable trigger

Motivating Factors

Enjoyment

Any reference to enjoyment being a motivating factor of the interest (e.g. liking it, loving it, its being fun, entertainment, etc.)

Escape Reality and Experience Other Selves

Any reference to being able to escape reality or experience other selves as being a motivating factor of the interest (e.g. dressing up, cosplay, escaping reality, etc.)

Knowledge Accumulation

Any reference to acquiring knowledge as being a motivating factor of the interest (e.g. learning facts, reading, etc.)

No Known Motivation

Any reference to their being no motivating factor of the interest (e.g. "I just like it") or reporting not knowing what the motivating factor is

Self Development

Any reference to developing or improving one's self as being a motivating factor of the interest (e.g. expanded the mind, contributed to who I am today, helped me do something better)

Sensory Aspects

Any reference to sensory aspects (presence or absence of) as being a motivating factor of the interest (e.g. like the way it looks, sounds, it makes things quite, etc.)

Sociability

Any reference to the interest providing social outlets or a personal connection as being a motivating factor of the interest (e.g. something to do with friends, allows for meeting new people, connection to person who has passed away, etc.)

Stress Relief

Any reference to stress relief as being a motivating factor of the interest (e.g. coping)

Achievement

Any reference to winning or achievement as being a motivating factor of the interest (e.g. becoming a professional)

Effect of Interest

Effect

Effects my whole life

Any explicit reference to the fact that the interest has had an effect on all or the majority of their life, either positively or negatively

Positive Effects

Connecting with Others

Any reference to connecting with others on a social or personal level being an outcome of the interest

Family

Any reference to the interest having a positive effect on the family (e.g. spending more time together)

Feelings

Any reference to positive feelings being an outcome of the interest, including, happiness, creativity, exhilarated, relaxed, interested

Self-Development

Any reference to the interest leading to positive self-development, including confidence and work-life balance

Negative Effects

Feelings

Any reference to negative feelings, including frustrated or angry

Impairs Daily Functioning

Any reference to impacting the person's ability to complete daily living tasks (e.g. hygiene, chores, do not get enough sleep, schoolwork suffers)

Social Isolation

Any reference to the interest causing social isolation, either by others (e.g. bullying, look at me funny) or the self (e.g. I turn down doing other activities)

Family

Any reference to the interest having a positive effect on the family (e.g. spending more time together)

No Effects

Any explicit reference to the fact that the interest does not have an effect on their life (including explicit references to their social life)

Ended Because

Interest in Something Else

Any reference to the interest ending due to the person becoming interested in something else instead

Priorities Changed

Any reference to the interest ending because their priorities changed (e.g. starting school, realizing they shouldn't be spending that much time on their interest, etc.)

Other Emergent Themes

Addiction

Any time someone uses the terms “addiction” or “obsession or a lack of control over their behaviour in relation to their interest.

Atypical Developmental Level

Explicit or implicit reference to the fact that their interest is enjoyed more by people at a different developmental stage (either significantly older or younger).

Feel Absorbed and Focused

Any reference to feeling absorbed by and/or focused on the interest (e.g. absorbed, engrossed, thinking about it all the time, etc.)