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Understanding Differences in Neurotypical and Autism Spectrum Special Interests through Internet Discussion Forums

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Understanding Differences in Neurotypical and Autism Spectrum Special Interests through
Internet Discussion Forums

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Abstract

Special interests are frequently developed by individuals with autism spectrum disorder, expressed as an intense focus on restricted topics. Neurotypical individuals also develop special interests, often in the form of hobbies. The current study investigated differences in the content, number, and specificity of the special interests held by neurotypical individuals and those held by individuals with autism spectrum disorder, using Internet discussion forums as a data source. Analysis of online forum posts revealed significant differences between the groups. Individuals with autism spectrum disorder reported having more interests in systemizing domains, more specific interests, and a greater number of interests overall than neurotypical individuals. A regression model accurately predicted diagnostic category based on special interest qualities. Special interests may exist on a continuum ranging from neurotypical interests to those of individuals on the autism spectrum, depending on the interest specificity and amenability to systemizing.

Keywords: autism spectrum disorder, Asperger syndrome, special interests, Internet discussion forums

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Understanding Differences in Neurotypical and Autism Spectrum Special Interests through Internet Discussion Forums

Autism spectrum disorder (ASD) is characterized by abnormalities in social communication, social interaction, and repetitive behaviors (American Psychiatric Association, 2000). Among individuals with high functioning autism and Asperger’s syndrome, the latter of these frequently manifests as an intense focus on restricted topics pursued with unusual intensity (Asperger, 1991; Attwood, 2003; Bodfish, Symons, Parker, & Lewis, 2000). Parental and patient interviews about these “special interests” show that they range from the markedly atypical (deep fat fryers, toilet brushes), to those that are unusual in their circumscribed focus (frogs, World War I Biplanes, Star Wars), to topics that overlap with the hobbies of typically developing children, such as horses, swimming, role-playing games, and sculpting (Winter-Messiers, 2007).

Several terms have been used to describe the interests developed by individuals with autism. “Restricted interests” is a term used by the DSM-IV-TR to describe one component of the repetitive behaviors that occur in autism. “Circumscribed interests” refer to interests focusing in an inclusive topic, such as “World War I Biplanes” (e.g., Attwood, 2003), while “obsessions” describe the intense nature of autism spectrum interests (e.g., Baron-Cohen & Wheelwright, 1999). The latter three terms have been more frequently used to describe the interests of low-functioning individuals. Following Winter-Messiers (2007) and Bashe and Kirby (2001), we use the term “special interests”, because we expect that ASD interests exist on a continuum with neurotypical interests and this term does not prejudge the extent of topic restriction. It is also the term most frequently used by ASD individuals themselves on the discussion board forums analyzed in the current study.

Past studies have focused on the role of special interests in youth with autism (e.g., Winter-Messiers, 2007; Baron-Cohen & Wheelwright, 1999). Interests can develop as early as 2-3 years of age (Bashe & Kirby, 2001). Special interests appear to reflect the heightened and exceptional abilities that are unique to ASD, such as systemizing (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003) and understanding of the physical world (Attwood, 2003). For example, Baron-Cohen & Wheelwright (1999) found that the majority of interests held by children with autism were in folk physics domains, such as machines, vehicles, and computers. Special interests are usually manifested in efforts to collect objects and information relevant to the interest topic (Bashe & Kirby, 2001). Neurotypical children also develop intense interests, though with less frequency (DeLoache, Simcock, & Macari, 2007). In the study by DeLoache et al. (2007), about 30% of typically developing children exhibited an intense interest. However, up to 90% of individuals with ASD develop special interests

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(Attwood, 2003), and in some studies 99-100% of participants with ASD reported special interests or related repetitive behaviors (e.g., Bashe & Kirby, 2001; Bodfish, et al., 2000).

Neurotypical (NT) and ASD special interests may exist on a continuum together, characterized by intensity, content, and specificity of individual interests. Jackson (2002) provides an interesting anecdote about special interests, writing, "When is an obsession not an obsession? When it is about football." Jackson notes that it is considered typical for an adolescent boy to be intensely interested in football or other sports, but the equally intense interest in computers of a boy with Asperger syndrome may be considered abnormal and obsessive. The above quote thus reflects the observation that NT interests may share some characteristics of those observed among individuals with ASD. A special interest continuum may span from highly specific interests domains that are highly structured and amenable to systemizing, to interest domains about open-ended and socially relevant domains such as sports, writing, and movies. ASD interests may be overrepresented on the former end of the continuum, while NT interests more frequently occur on the latter end. The interests of NT individuals with propensities for systemizing may occur in the middle range of the continuum and comprise domains such as mathematics and engineering, but would not be otherwise labeled as restricted or obsessive due to the lack of diagnosis of a psychological condition. However, to our knowledge no studies exist directly comparing NT interests to ASD interests.

Gender differences in the content and intensity of special interests have been observed in a number of studies. Among NT individuals, DeLoache et al. (2007) found intense interests were more common in boys than girls. Gender differences have also been observed in topics which are the focus of NT special interests. Boys more frequently hold interests in conceptual domains, while girls more reported more pretend play and other stereotypically female subjects (DeLoache et al., 2007; Johnson, Alexander, Spencer, Leibham, & Neitzel, 2004). Interestingly, NT boys' interests are more similar to the interests of individuals with ASD, consistent with the extreme male brain hypothesis of autism (Baron-Cohen, 1999). Furthermore, in the study by DeLoache et al. (2007) NT boys were twice as likely to develop an "extremely intense interest." Intensity is one of the primary characteristics that may differentiate NT interests from ASD interests (Jackson, 2002). However, gender differences in the content of special interests have been observed among individuals with ASD. Attwood (2003) describes clinical observations that girls frequently developed gender-appropriate interests, such as interests in dolls and fiction, though, like boys, the girls' interests were unusually intense. Winter-Messiers (2007) also found that girls' interests occurred more frequently lay stereotypically female topics, such as horses and art.

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Special interests are often sources of enthusiasm and pride for individuals with ASD (Winter-Messiers, 2007), and serve to reduce stress and anxiety (Winter-Messiers, 2007; Jackson, 2002; Attwood, 2003). The content of special interests that are frequently held by individuals with ASD reflects a common desire for predictability and control (Attwood, 2003), for example, an interest in computers provides more predictability than one in the social realm. Attwood (2003) suggests that the reason for the development of an ASD special interest is unique to the individual, while NT interests may develop due to popularity of the topic with peers or serve as the basis of social relationships. In individuals with ASD, an object may become the focus of a special interest due to specific perceptual features of the object, such as high spatial frequency (Behrmann, Thomas, & Humphreys, 2006; DeLoache, Simcock, & Macari, 2007). The perceptual features theory of special interests is consistent with the observation that individuals with ASD have enhanced perceptual function (Mottron, Dawson, Souliers, Huvert, & Burack, 2006).

The emergence of special interests has also been explained as a result of social deficits and lack of salience attributed to social information (Carruthers, 1996; Sasson, Turner-Brown, Holtzclaw, Lam, & Bodfish, 2008). Turner (1997) disagrees with this explanation, citing evidence that repetitive behaviors, including the expression of special interests, are exhibited at the lowest frequency during social interactions and at the highest frequency when the individual is alone and un-stimulated. However, Sasson et al. (2008) found that children with ASD demonstrated circumscribed attention while viewing a visual array, manifested as decreased exploration, decreased gaze time at social objects such as faces, and increased gaze time at objects that are frequently the subject of ASD special interests (“high-autism-interest” stimuli), such as trains, vehicles, and electronics. The exploration of a visual array of non-social objects by individuals with ASD correlated with the severity of social impairment, suggesting that a relationship between social ability and special interests exists.

It is becoming increasingly appreciated that in the brains of typically developing individuals social rewards activate neural reward circuitry (Izuma, Saito, & Sadato, 2008). In contrast, individuals with ASD may experience decreased activation of reward circuitry in response to social stimuli (Kohls, Peltzer, Herpertz-Dahlmann, & Konrad, 2009). Bodfish (2009) proposes that special interests may activate neural circuitry involved in reward. While selective serotonin re-uptake inhibitors did not reduce repetitive behaviors (King et al., 2009), a more precise definition of sub-types of repetitive behaviors may increase the effectiveness of pharmacotherapy (Bodfish, 2009).

Less research has focused on special interests in adulthood. Among adults with Asperger syndrome, special interests lie primarily in specific ideas or concepts, such as in computers, media, and

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art, and most adults hold more than one interest (Bashe & Kirby, 2001). DeLoache (2007) suggests that the development of adult interests may depend on the degree of social acceptability that is experienced for childhood interests. Winter-Messiers (2007) notes that individuals with ASD are often hesitant to discuss a special interest, out of fear of peer ridicule or rejection. If an interest is socially acceptable, however, parents, caregivers, and peers are likely to provide support, thus effectively shaping children's interests in socially approved directions. We suggest that lack of sensitivity to social shaping is part of the reason that interests evidenced by those on the autistic spectrum are often regarded as unusual.

Understanding special interests in adulthood is important in illuminating the positive role that interests play in adult life. The expertise attained in areas of special interest can lead to employment and rewarding careers (Attwood, 2003; Jackson, 2002; Grandin & Duffy, 2008). Contrary to many observations that special interests inhibit individuals with ASD, recent work suggests deficits associated with autism, such as those in communication and social interaction, are reduced when the individual discusses or engages in their interest (Winter-Messiers, 2007). Special interests can serve as a basis for companionship among individuals with ASD who have interests in common (Attwood, 2003). In children however, special interests may impede development due to their time-consuming nature (Attwood, 2003) and propensity for making the child a target for teasing by peers (Frith, 1991). Parents of children with ASD often find special interests to be the most difficult behavior to accommodate (Mercier, Mottron, & Belleville, 2000), and special interests do not lessen with age like other symptoms of autism (Fecteau, Mottron, Berthiaume, & Burack, 2003). By developing an understanding of these interests, new methods of treatment and education can be developed to utilize special interests as channel for learning, facilitating development in other areas such as language and communication, and assisting in shaping desirable behaviors in children. Insight into special interests in adulthood can provide a better understanding of autistic spectrum individuals as well as of the NT population, and may aid in promoting tolerance for individual differences.

The current study will examine the special interests reported by both NT individuals and individuals with ASD on public Internet discussion forums. Our study contrasts with the bulk of previous research on special interests, which utilized in-laboratory interviews and questionnaires as instruments for data collection. Online communication is a preferred mode of social interaction for individuals with ASD (Jordan, 2009). Large-scale communities of individuals with ASD congregate on Internet discussion boards, where special interests are a frequent conversation topic. Using these discussion boards as a research resource allows access to a large data sample and eliminates the risk of

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influencing participant responses. An important benefit of data collection from online discussion boards for individuals with ASD is that the individuals are prompted by their peers and are responding from a familiar setting such as their own home, rather than interacting in a laboratory environment or completing a questionnaire as in traditional research studies. A familiar setting involving peers may facilitate more accurate and detailed assessments of individuals’ interests, due to a reduction in the anxiety experienced in face-to-face interactions (Mitchell, 2003) and unfamiliar environments (Happe, 1991).

Following Baron-Cohen and Wheelwright (1999), we expect the interests held by individuals with ASD will be primarily in systemizable domains, such as technology and the sciences. In contrast, NT interests are likely to lie in domains that function as vehicles for enhancing socializing, such as interests in people, including the exchange of information about social norms that is part of everyday gossip and obsessions with celebrities, and interest in popular sports teams, as discussion of sports fosters social affiliation. Differences in the total number and specificity of special interests held by the two groups will also be explored, with the expectation that individuals with ASD will report a larger number interests on average and have interests of higher specificity, as observed in children by Bashe and Kirby (2001). A goal of comparing NT interests to those held by individuals with ASD is to characterize a continuum of interest qualities ranging the neurotypical-autism spectrum. This will enhance our understanding of how special interests can become therapeutically useful for education, thus improving quality of life for individuals with ASD while also shedding light on individuals who are mid-way on the continuum between NT individuals and those with ASD.

Methods

Data Collection

Special interests were collected from posts on a popular online discussion forum used by individuals with autism spectrum disorder (ASD), and special interests of neurotypical (NT) individuals were collected from two popular online general discussion forums.¹ Sampled discussion boards were public and did not require a subscription or personal account to be viewed. Collection criteria required that the post include language about specific interests or obsessions. For example, one of the discussion threads on an ASD discussion board contained the query, “What is your special interest?” Posts were sampled from discussion topics that had been created within a year of the date of data sampling. If listed in a public user profile, the individuals’ age, diagnostic category, and gender

¹ Websites are available from the authors.

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was recorded to ensure that the ASD and NT samples were comparable. Individuals on the forums were unaware of our research at the time of data collection.

Coding Criteria

Interest categories. Interests were coded into 18 categories derived from the Cambridge University Obsessions Questionnaire (Baron-Cohen & Wheelwright, 1999), with the following modifications. Interest categories of nature, history and culture, and psychological disorders were added to the coding scheme in order to account for the wide range of reported interests on the forums, which were observed in an initial qualitative examination. The plants interest category was included under the broader nature category. The categories of item attachment and item collection were collapsed into a single group because many individuals expressing attachment to specific objects also reported collecting the objects. Similarly, the categories of creative arts and crafts were collapsed into the overarching creative arts category, because each category was related to interests in arts and creative endeavors. The category of numerical systems was collapsed into the factual information category, because numerical systems interests were often expressed as fascinations with statistical and trivial information, which can be considered interests in facts. The spinning objects interests category was excluded altogether because no individuals expressed this type of interest. The categories were thus defined as follows.

- Machines and technology: Interests in computers, radios, television, clocks, etc., or expresses interest in how things work. This category did not include interests in watching or listening to movies, television, music, etc.
- Information and mechanical systems: Interests in plumbing, light switches or electrical wiring, maps, city planning, subway maps and/or schedules, businesses and organizations, etc., or an interest in creating systems (such as languages or maps).
- Sorting, categorizing, and organizing: Interests in making lists, lining objects up, arranging objects in certain orders or categories, planning, or obsession with neatness or organization.
- Belief systems: Interests in religions or mythologies, political systems, philosophies, alternative beliefs (such as conspiracy theories), etc.
- Sports and games: Interests in football, tennis, walking, biking, tennis, playing cards, chess, board games, puzzles, video games, etc.
- Factual information: Interests in reading or memorizing lists, reading encyclopedias, dictionaries, newspapers, etc., or memorizing statistics and trivial information.

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- Sensory: Interests in touching or feeling certain things, or mentions fascinations with texture, specific sounds, lighting, colors, smells, etc.
- Creative arts: Interests in movies, television shows, art work, painting, playing an instrument, music, writing and reading fiction, creating media (e.g., online films), performing arts, knitting, sewing, carpentry, etc.
- Sciences: Interests in astronomy, chemistry, biology, physics, engineering, mathematics, logic, economics, psychology, meteorology, specific diseases or conditions, etc.
- Animals: Interests in pets, wild or farm animals, insects, fish, birds, etc., also includes animal-related activities (e.g., bird watching), but does not include mythical creatures.
- Nature: Interests in plants, interacting with nature (e.g., hiking, gardening, exploring, etc.), and natural phenomena (e.g., volcanoes, tsunamis, lightning, etc.).
- Item attachment: Interests focusing on a particular item or type of object, as well as interests in certain words or phrases, or expresses interest in acquiring collections of particular items, e.g., bottles, keys, caps, stamps, rocks, etc.
- People: Interests in a particular person, in types or groups of people, or in interacting with people, including participation in online communities.
- Vehicles: Interests in trains, airplanes, buses, boats, cars, etc.
- Food and drink: Interests in consuming or creating a particular food or drink, cooking, baking, etc.
- History and culture: Interests in existing languages, particular countries or civilizations, time periods or eras in history, etc.
- Psychological disorders: Expresses interest in any psychological disorder.
- Other: Interests that did not fit within a specific category.

Coding procedure. Four coders labeled each interest reported on the forums into one of the 18 above categories. Coders were volunteer undergraduate students. Coders were unaware of the age, gender, and diagnostic category of the individual who wrote the post. Inter-rater agreement on the categories of special interests was 93%, confirming the integrity of the coding criteria.

Google search frequencies. The Google search frequency (expressed as logarithm values) of each reported special interest was recorded using Query Google (Ma, 2007). Query Google produces a quantitative measure of the number of search engine queries generated by the phrase used by participants. Interests consisting of multiple-word phrases were entered into Query Google surrounded by quotation marks to ensure return of accurate frequencies of multi-word terms. Individuals'

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described interests were also modified when necessary to reflect the nature of the actual interest; for example, an interest in “House” the television show was entered into Query Google as “House TV” to ensure that a frequency corresponding to the television show was obtained, rather than a house referred to as a building.

Total number of interests and mean descriptor word count. The total number of interests reported by each individual was recorded, as many individuals reported interests in multiple areas. The average number of words, or mean word count, that each individual used to describe their interests was also recorded. For example, an individual with interests in “dancing”, “British pop music”, and “interior design” had a mean count of 2 words.

Participants

Of the NT individuals sampled ($n=213$), the mean age was 24.1 years (range 14-41, $SD=11.1$). The male to female ratio was 14:25 (68 male, 121 female, 24 unreported). Of the individuals with ASD ($n=211$), the mean age was 25.5 years (range 14-72, $SD=9.5$). The male to female ratio was 1:1 (106 male, 105 female); note that posts were not selected for gender and the 1:1 ratio represents the general gender ratio on the Internet sites that were consulted. Of the individuals with ASD, 58% ($n=123$) reported having been diagnosed with Asperger syndrome (AS), 24% ($n=51$) judged themselves to have AS although they had never received an official diagnosis, 11% ($n=23$) reported not being sure whether they had an ASD, and 7% ($n=14$) reported being diagnosed with an ASD other than Asperger syndrome.

Results

Data Analysis

During analysis, diagnostic category of each individual was grouped in two ways. The first grouping compared individuals with autism spectrum disorder (ASD) to neurotypical (NT) individuals. Data collected from individuals on the discussion forum for ASD was compared to data collected from individuals on the discussion forum frequented by NT individuals. The second method of grouping considered the 4 diagnostic categories specified on the discussion forum for ASD in addition to NT individuals, resulting in a between-groups comparison of five different diagnostic categories.

The following dependent variables were analyzed: the categories of special interests, the total number of interests reported by each individual, the mean number of words used to describe interests, and the mean log Google search frequency of each individual’s reported interests. As noted above, each dependent variable was subjected to two separate analyses; one analysis using the dual diagnostic category comparison, and one analysis using the five diagnostic category system.

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Special interests categories were tested for differences between diagnostic groupings using non-parametric t-tests. The total numbers of interests, mean word count, and mean log Google frequency variables were tested using parametric independent-samples t-tests and analyses of variance. Dependent variables were also examined for age and gender effects.

Binary logistic regression was used to test whether the collected variables could predict diagnostic category. Potential predictors were selected based on the results of the analyses on each of the dependent variables and correlations matrices. Selected variables were entered into a logistic regression analysis and a model of the two diagnostic categories was developed.*Special Interest Categories Analysis*

Our primary question was whether differences exist between the categories of special interests of individuals with ASD compared to NT individuals. Figure 1 shows a breakdown of the special interest categories for the two groups. A Mann-Whitney U Test revealed that individuals with ASD reported having more science interests (ASD n=43, NT n=6; $Z=-5.67, p < .001$), more interests in history or culture (ASD n=46, NT n=10; $Z=-5.22, p < .001$), and more interests in belief systems (ASD n=36, NT n=6; $Z=-4.91, p < .001$), as well as more interests in information and mechanical systems (ASD n=20, NT n=2; $Z=-3.97, p < .001$) more interests in machines and technology (ASD n=35, NT n=12; $Z=-3.64, p < .001$), and more interests in animals (ASD n=28, NT n=3; $Z=-4.69, p < .001$). A greater number of NT individuals reported interests in sports and games (ASD n=37, NT n=75; $Z=-4.20, p < .001$). The number of individuals reporting interests in psychological disorders was also significantly different (ASD n=27, NT n=0; $Z=-5.39, p < .001$), however, this occurred because the majority of interests in psychological disorders were of ASDs (24 of 28 interests), reported by individuals in the ASD diagnostic categories. The two groups did not differ in the following 13 special interest categories: sorting, categorizing, and organizing, item attachment, factual information, creative arts, nature, people, vehicles, food and drink, and other. See Table 1 for a summary of these results.

Our second question was whether differences exist between the 5 diagnostic groups in the number of individuals reporting an interest in the special interests categories. Table 2 shows the five diagnostic groups differed in 5 of the 18 interest categories, as indicated by a Kruskal Wallis test. The five diagnostic groups did not differ in the following 13 categories: sorting, categorizing, and organizing, item attachment, factual information, creative arts, nature, people, vehicles, food and drink, and other.

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Given that social impairments are a key diagnostic criterion for autism spectrum disorder, we were surprised that the number of individuals reporting an interest in people did not significantly differ between the ASD and NT groups, or between the five diagnostic categories (for people interests, ASD $n=33$, NT $n=46$; $Z=-1.95$, $p = .143$). To investigate this unexpected finding, we divided the people interest category into the following subcategories based on qualitative examination.

- Online: Interests in participating in online chat rooms, discussion boards, and social games and networking sites (such as Second Life, Facebook, Myspace, etc.).
- Telephone and phone texting: Interests in talking on the phone or texting.
- Romantic: Interests in dating, romantic relationships, or in members or a specific member of the sex to which they are attracted.
- Famous people: Interests in a celebrity or famous poet or writer, historical figure, musician, etc.
- Types or groups of people: Interests in general groups of people rather than a specific person, such as members of a religious group.
- General people: Interests in interacting with people more generally, such as babysitting, spending time with friends or family, etc.
- Other: Interests that do not fit within the above categories.

Inter-rater reliability of three coders for the 7 subcategories of people interests was 97.5%. While differences existed in the percentage of individuals in each diagnostic category reporting interests in each of the people subcategories, a Mann-Whitney U Test revealed no statistically significant effects. This may be a result of higher desire to socialize by individuals with ASD who participate in online communities compared to the social motivation observed in the general ASD population.

Google Search Frequencies Analysis

The interests of NT individuals had higher Google search frequencies on average than the interests of individuals with ASD, as indicated by an independent samples t-test (ASD mean=16.8, SD=2.6, NT mean=17.7, SD=1.9; $t=4.3$, $p < .001$). The effect size was moderate (eta squared=.04). See Figure 2 for a presentation of the data.

The 5 diagnostic categories also showed different mean Google search frequencies in a one-way analysis of variance, $F(4, 419)=5.8$, $p < .001$. Post-hoc Tukey HSD tests revealed that the mean log Google frequency of interests of NT individuals was different from that of individuals with an ASD other than Asperger syndrome (Other ASD mean=16.0, SD=3.76; $p = .041$). NT individuals also differed from individuals diagnosed with Asperger syndrome (AS Diagnosed frequency mean=17, SD=2.5; $p = .031$), and individuals who were unsure whether or not they had the disorder (Unsure of

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ASD frequency mean=16.2, SD=2.3; $p = .015$). The magnitude of these differences was moderate (eta squared=.05). NT individuals did not differ from individuals who presumed they had AS but were undiagnosed, suggesting that this group has a less severe form of AS and are closer to NT, given that high frequency interests co-occurred with higher functioning.

Total Number of Interests Analysis

As predicted, individuals with ASD reported having more interests than NT individuals, according to the results of an independent-samples t-test (ASD mean=4.0, NT mean=2.6, $t = 4.1$, $p < .001$, eta squared .04). Figure 2 presents this data.

The five diagnostic categories differed in total number of posted interests, as revealed by one-way between-groups analysis of variance, $F(4, 419)=5.0$, $p < .001$. Post-hoc comparisons using the Tukey HSD test indicated that AS Diagnosed individuals listed more interests overall than NT individuals (AS Diagnosed mean=4.0, NT mean=2.6; SD=3.9; $p < .001$), though no other significant differences were found between the remaining diagnostic categories. The magnitude of the differences was moderate (eta squared=0.48).

Mean Descriptor Word Count Analysis

The mean number of words used to describe interests by individuals with ASD was higher than the mean number of words used by NT individuals, as shown by an independent-samples t-test (ASD mean=1.71, SD=0.662, NT mean=1.49, SD=0.864; $t=-2.94$, $p < .005$). The effect size was small (eta squared=.02). See figure 2 for a presentation of this data.

Differences were also found between the five diagnostic categories in the mean word count of reported interests in a one-way between-groups analysis of variance, $F(4, 419)=2.6$, $p = .034$. Post-hoc comparisons using the Tukey HSD test found that the mean word count of reported interests of NT individuals was significantly different from that of AS Diagnosed individuals (mean=1.76, SD=0.92; $p = .021$), though the effect size was small (eta squared=0.24). No other statistically significant differences were found between the diagnostic groups.

Examining Potential Mediating Factors

Age did not have an effect on the total number of interests, mean word count of interests, or the mean log Google search frequency of interests in either the NT or ASD group, with all r values $< .055$.

Among NT individuals, males were more likely to report interests in vehicles ($p < .001$), while females were more likely to report interests in creative arts ($p < .005$). No other significant gender differences in special interest category were observed in the NT group. Among individuals from the ASD forums, males reported more interests in machines and technology ($p < .001$) and vehicles ($p < .001$).

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.001), while females were more often expressed interests in animals ($p < .001$). No other statistically significant gender differences in special interest category were observed in the ASD group.

Predicting Diagnostic Category with Regression Analysis

We were interested in whether an individual's diagnostic category, ASD or NT, could be predicted by the variables in which the two groups significantly differed, such as total number of interests, mean word count of interests, and the mean Google search frequency of interests, as well as the special interests categories.

The two category diagnostic grouping was chosen because it showed stronger interactions with the chosen predictors than the five category diagnostic grouping. That is, as described above, post-hoc comparisons showed few significant differences between the four autism spectrum diagnoses, but consistently showed significant differences between one or more of the autism spectrum diagnoses and the NT group

Selection of predictor variables. All variables in which the two diagnostic categories showed significant differences were potential predictors. Variables were first assessed for inter-correlations to avoid multicollinearity. The total number of reported interests did not correlate with the mean word count of interests or with the mean log Google search frequency of interests, both r values were less than $r = .01$. The mean word count of interests showed only a small negative correlation with the mean log Google frequency of interests ($r = -.25$).

As described previously, individuals with ASD and NT individuals differed in several special interests categories. The sciences, history and culture, belief systems, sports and games, information and mechanical systems, and machines and technology categories were selected as potential predictor variables because these categories revealed the highest Z scores in a Mann-Whitney U Test (shown in Table 1), indicative of the greatest between-groups differences, and were of the greatest a priori theoretical interest. While the psychological disorders interest category also exhibited a high Z score, this category was omitted from subsequent analyses because the majority of psychological disorders interests were in ASDs, and no NT individuals reported interests in this category. The animals interest category was likewise omitted.

The sciences, sports and games, information and mechanical systems, and machines and technology interest categories had no or weak correlations in a Spearman's rank order correlation. The history and culture category correlated with the belief systems category ($p = .44$) and was thus omitted from the predictor model.

Interests in the information and mechanical systems category was also significant, having an odds ratio of 9.27 ($p = .004$). Reporting this interest thus dramatically increased the likelihood of an individual's presence in the ASD group. Interests in the machines and technology category was also a significant predictor with an odds ratio of 3.37 ($p < .001$), indicating that having an interest in machines and technology increased the odds that an individual would be in the ASD group. The sports and games interest category was also a significant predictor with an odds ratio of .44 ($p < .001$), indicating that for each additional interest in sports and games, the odds of an individual being in the ASD group decreased by .44 when all other factors are equal. The sciences interest category was less significant ($p = .010$), though had an odds ratio of 2.37. See Table 3 for a report of confidence intervals and other details of the entered variables.

Discussion

The aim of the current study was to determine differences in the content, number, and specificity of the special interests held by neurotypical (NT) individuals and those held by individuals with autism spectrum disorder (ASD), with the prediction that special interests exist on a continuum ranging from NT to ASD depending on the interest specificity and amenability to systemizing. Internet discussion boards were used as sources of data on special interests.

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Analysis of online forum postings revealed significant differences in the special interests held by NT individuals and individuals identifying with an ASD. Individuals with ASD reported having more interests in sciences, history and culture, belief systems, animals, machines and technology, information and mechanical systems, and psychological disorders. NT individuals reported more interests in sports and games. Individuals with ASD reported having more interests overall, and used more words on average to describe their interests than did NT individuals. Individuals with ASD expressed interests with a lower average Google search frequency than NT individuals, indicating that ASD interests may be more specific and less common than NT interests. A model was developed predicting an individual's diagnostic category with reasonable accuracy, based on the category of interests, the number of their interests, the word count used to describe their interests, and the Google search frequency of their interests.

Confirming Special Interest Categories

Autism spectrum disorder has been characterized as the occurrence of an extreme male brain (Baron-Cohen, 1999). Individuals with autism frequently possess high systemizing abilities (Baron-Cohen et al., 2003), elevated spatial and logical reasoning (De Martino, Harrison, Knafo, Bird, & Dolan, 2008), and increased attention to detail (Frith, 2003). Individuals with ASDs may have decreased empathizing ability compared to NT individuals (Baron-Cohen & Wheelwright, 2004). Qualitative observations of individuals with Asperger syndrome have found that their interests often reflect their cognitive strengths. Interests in domains that are amenable to systemizing, such as mathematics, computers, and maps, are common, while interests requiring higher levels of empathy, such as popular culture and literature, are less frequent (Attwood, 2003; Winter-Messiers, 2007).

A strength of the current study is that we used Baron-Cohen & Wheelwright's (1999) coding scheme to identify specific content foci of special interests, while the previous study by Baron-Cohen & Wheelwright used interest categories only in their relevance to general domains such as folk physics and folk psychology. Previously, researchers have identified the domains of science, machines and technology, and information and mechanical systems as the domain types most amenable to systemizing. We thus expected interests collected from the ASD forums to fall primarily in these areas, while interests collected from the NT discussion forums to occur more often in the people, history and culture, and creative arts categories. Our finding that individuals with ASD were also attracted to belief systems and history and culture expands current understanding of what constitutes a systemizable domain. For example, the belief system category, which included philosophical and political systems, could be amenable to systemizing because such systems are highly rule-governed. Interests in history

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and culture may likewise be attractive due to a high level of detail, in the form of specific historical events and dates.

Neurotypical individuals expressed more interests in sports and games compared to individuals with ASD. The sports and games category is an unconstrained domain that is less amenable to systemizing than other interests, making it a less attractive topic to individuals with ASD. Sports and games can serve as medium for social bonding among NT individuals (e.g., Mueller, Agamanolis, & Picard, 2003). Individuals with ASD may be less motivated to pursue this category due to reduced social motivation. Future research could test the prediction that individuals with ASD are more likely to enjoy “loner sports”, such as juggling, running, and cycling, as these do not require a comprehensive understanding of the social domain and are more predictable than sports involving many people.

Contrary to our hypotheses, we did not observe a difference in the frequency of interests in people or creative arts between NT individuals and those with ASD. Although we divided the people interest category into subgroups, no statistically significant differences were found between the diagnostic groups. While individuals with autism experience high levels of anxiety in face-to-face conversations, the use of online communication can circumvent these anxieties and allow individuals with autism to express themselves more comfortably (Mitchell, 2003). Wing and Gould (1979) discuss subtypes of autism, one of which consists of a group of individuals who desire social interaction but who experience difficulty attaining rewarding communication because of anxiety. The individuals from the ASD forums may be in this group, fulfilling a desire for social interaction online and circumventing the anxiety of real-life conversations. This would account for the frequent interest in people. In our sample, individuals with autism also more cited more interests in animals and particularly in pets, which can provide a form of social interaction without the experience of anxiety and the requirement of interpreting social cues from a conversational partner.

Contrary to our expectations, the individuals posting on the ASD forum also displayed interests in movies, music, and literature at similar levels to individuals posting on NT forums. We anticipated that interests in creative arts would be less attractive to individuals with a systemizing cognitive profile because the arts are not governed by clear rules that are amenable to systemizing (Simonton, 2009). NT females tend to be higher empathizers than males (Baron-Cohen, 2003), and in our study NT females reported more interests in the creative arts than NT males. The primary difference between NT and autism spectrum interests in the creative arts category may lie in the specificity and expertise attained in the interest, while the interest category itself occurs at similar frequencies in both groups. For example, one NT individual reported creative arts interests in playing guitar and watching the

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1 television show “Sex and the City,” which have log Google search frequencies of 8.3 and 8.1,
2
3 respectively. An individual with AS reported creative arts interests in playing the mandolin and the
4
5 cartoon “Happy Tree Friends”, which have log Google search frequencies of 6.8 and 7.5, respectively.
6
7 As discussed below, a low Google search frequency indicates a more specific interest, possibly as a
8
9 result of increased expertise. In this example, although the NT and AS individuals’ interests were in
10
11 the same category, the AS interests are markedly more specific than the NT interests. A further
12
13 difference was that ASD individuals expressed desires to create their own media more frequently than
14
15 NT individuals. Creating one’s own media may satisfy systemizing interests. In a separate study by
16
17 our laboratory comparing religious beliefs of ASD individuals with beliefs of NT individuals, many in
18
19 the ASD group reported creating their own religious belief system, an activity reported by almost no
20
21 NT individuals, and one which clearly also takes advantage of systemizing strengths (Caldwell-Harris,
22
23 2009).

Gender Differences in Interest Categories

24
25 The gender ratio collected on the autism spectrum forums was similar to the observed ratio on
26
27 the NT forums, approximately 1:1 male to female. Our study did not reflect the estimated 4:1 male to
28
29 female gender ratio among individuals diagnosed with ASD (Ehlers & Gillberg, 1993). We examined
30
31 the five diagnostic categories to determine whether females reported one diagnosis more than another,
32
33 but the results were not significant ($\chi^2=.078$). One explanation for the observed forum gender ratio is
34
35 that females with ASD are more attracted to online discussion forums than males because of a stronger
36
37 desire to engage in social interactions. Females would thus be overrepresented on autism spectrum
38
39 forums, resulting in the same general gender ratio on spectrum forums as that observed among the
40
41 other Internet discussion boards we reviewed. Future research could determine whether the high
42
43 female presence on discussion boards selects males who feel comfortable with topics that are skewed
44
45 towards social interactivity, and/or whether the high female presence influences males to participate on
46
47 topics with a more social-empathic direction.

48
49 Previous research on the special interests of NT children has shown that boys’ interests were
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51 frequently in conceptual domains, while girls’ interests more often involved fashion and pretend play,
52
53 which are stereotypically female (Johnson et al., 2004). We expected the interests of girls diagnosed
54
55 with ASD might be less likely to follow NT gender dimorphism because of the “extreme male brain”
56
57 characteristics of autism, although gender differences between the interests of children diagnosed with
58
59 ASD have been previously observed in qualitative studies (Winter-Messiers, 2007). However, our
60
61 study found adult gender differences in the ASD group similar to those in the NT group. In both

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groups, males expressed more interests in vehicles than did females. Males in the ASD group also reported more interests in machines and technology than did females, while females from the ASD forums expressed more interests in animals. The latter result is particularly interesting because, as suggested above, animals may provide a means to socialize without experiencing anxiety that can occur in human interactions. Future research could investigate whether females diagnosed with ASD have a stronger desire to engage in social interactions than males diagnosed with ASD, a trend among NT individuals evidenced by the observation that women outnumber men on all major social networking websites (Rapleaf, 2008).

Significance of Mean Descriptor Word Count and Google Search Frequency

Individuals on the ASD forums used significantly more words than NT individuals to define their interests, as indicated by the mean word count of each person’s post on their interests. Increased descriptor use could be a result of more specific interests. For example, one individual with Asperger syndrome reported an interest in “1960’s London pop music”, while a NT individual listed a broad interest in “music”. High specificity is a characteristic that has been previously observed in the special interests of children with autism (Attwood, 2003; Bodfish, 2009; Winter-Messiers, 2007). The greater use of descriptors could additionally indicate a higher level of expertise attained by individuals with ASD. Expertise could be a result of more intense interests and consequently more time spent engaging in the interests. This possibility is illustrated in the posts of several forum users, who write, “It [the interest] is almost an addiction, drawing or writing to extent of not stopping to really eat properly,” and “I spend hours reading and talking about them [interests]... every day.” One ASD forum user explains the intensity of her interests, writing, “I feel like I’m in love when I’m thinking about or engaging in my obsession,” while another describes the expertise he attained in his interest areas, writing, “I can discuss all of these at length. Not always a good thing.”

Alternatively, high descriptor use could indicate that individuals with ASD are less sensitive to social reactions of their audience. Several users on the autism spectrum forums describe talking incessantly about their special interests, regardless of their conversational partner’s level of interest in the topic. One individual with ASD writes, “I ramble about them to the point of giving monologues.” Many forum users also describe having to control their desire to discuss their interests, as one individual with AS describes, “I’ve stopped talking with my family about [my interest] because they are a bit bored by the topic,” while another writes, “at least I learned not to talk about them non-stop.” Interestingly, individuals on the ASD forums are frequently aware that their interests are socially

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eccentric, prefacing their posts with phrases such as “I’m not going to get penalized for saying something like this on [the ASD forum],” and “I’m weird.”

Bodfish (2009) suggests that individuals with ASD may use human relationships as a mode of pursuing their special interest. Using multiple terms to define an interest may be a reflection of the desire to talk excessively about the interest. Participating in online discussion forums requires some self-presentation, so while few individuals wrote at length about their interests, it is not surprising that many used several words to describe their interests as a moderately controlled form of the drive to discuss them. NT individuals often use their interests as vehicles for socializing, as one NT forum user writes, “[My interest is] theatre... you become so close to the people you do it with even if you had never met them before.... so it’s good socially.” Interest and participation in sports likewise facilitates social bonding (Mueller, Agamanolis, Picard, 2003). Neurotypical individuals may have been less likely to use multiple descriptors of their interests because the purpose of displaying an interest was to maintain social interaction on the forums. High numbers of descriptors might discourage conversational partners from replying, or be considered socially abnormal or “geeky.”

The interests of individuals with ASD had significantly lower Google search frequencies than the interests of NT individuals. A high Google search frequency can indicate a high frequency or common interest, while a low Google search frequency can indicate a low frequency, uncommon interest. High search frequencies could also reflect a broad, non-specific category, while low search frequencies might reflect a more specific interest. For example, a reported interest in “computers” corresponds with a log Google search frequency of 8.4, while an interest in “G1 Heatseeker Transformers” corresponds with a log Google search frequency of 4.1. The lower Google search frequencies of ASD interests reflected the significantly higher mean word count of their interests, in that a low search frequency is linked to more specific interests. The lower search frequencies also suggest that individuals with ASD are choosing interests that are less common or less popular than interests chosen by NT individuals. This result is in accordance with the above suggestion that individuals with ASD are less likely to use their interests as a medium for socializing, because uncommon interests are less effective in initiating or sustaining social interactions. One individual with ASD describes modifying his interests so that they were more socially normative, writing, “within the last two years I have taken a new interest in cars. It helps me talk more too because computers are too geeky, and socially unacceptable, but it’s cool to talk about cars.”

Significance of Total Number of Interests

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Individuals from the ASD forums expressed a greater number of interests than NT individuals. Given that the individuals on the autism spectrum forums demonstrated extensive knowledge of ASD, and indeed used the term “special interests”, it is possible that forum users were consciously attempting to conform to their diagnostic category. However, our results are consistent with previous studies showing that individuals with ASD have more numerous interests (e.g., Bashe & Kirby, 2001). Bashe and Kirby also observed that the interests of individuals with autism increased with age. The individuals followed in Bashe and Kirby’s study included children as young as 2 years, while the age range in our study was from 14 to 71 years, with the majority of participants in their twenties. Our data did not reveal an effect of age on the total number of interests. This suggests that the number of interests reaches a ceiling value in adulthood due to constraints on the available time and energy necessary to pursue the interests.

Use of Internet Forums in Research

The use of online forum postings as a medium for data collection is an innovative technique which offers both benefits and limitations. Some benefits, as discussed above, include anxiety reduction for individuals with ASD, and observing participants’ interaction with peers in a natural, familiar setting. Collection of forum postings also allows access to a large data sample without influencing the group being studied, since in our study forum users were unaware of observation at the time of data collection. However, caution must be exercised to avoid violating individuals’ privacy. While the data recorded in our study came from public forums where users were explicitly aware that their audience was not limited to forum users, private forums should only be observed with the explicit permission of the users, following Brownlow and O’Dell (2006).

One limitation of collecting data from online forums is that there is no way to verify that users on the ASD forums have an ASD. Despite this possibility, in our study individuals who claimed to have an ASD showed significant differences on each variable from NT individuals, and the observed differences were generally in accordance with our hypotheses and with existing literature on special interests. Previous studies have also been conducted on websites created by parents of children with autism and on chat groups for individuals with autism spectrum disorder, without verification of an autism diagnosis (e.g., Fleischmann, 2004, 2005; Brownlow & O’Dell, 2006).

Another limitation is that individuals with ASD participating in online discussion forums are likely on the high functioning end of the spectrum, although special interests occur in both low and high functioning individuals with autism (Bartak & Rutter, 1976). Our results are thus more readily generalizable to individuals who already have relatively good social, verbal and computer skills.

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Overall Significance and Future Directions

As the prevalence of autism rises it becomes increasingly important to understand the nature and development of special interests, since enhanced understanding offers considerable therapeutic value. The importance of special interests for individuals with ASD is illustrated in many posts on the reviewed discussion forums, as one user writes, “[my interests] don’t control me, they define me.” The prediction of diagnostic category by special interest qualities in our study suggests that a continuum of interests ranging the NT-autism spectrum can be developed, which could aid in creating therapeutically useful programs to maximize the benefits of attaining expertise in an interest area. Special interests can be used in educational and behavioral programs as scaffolding for shaping social behaviors and acquiring other important skills. A scientific understanding of special interests may help families in their acceptance and tolerance for interests that appear to be obsessive. The expertise often acquired in special interest areas can also serve as springboards for rewarding and successful careers. Individuals on the ASD discussion boards demonstrate the opportunities their special interests provide them, writing posts such as, “I’m a singer, and I’m getting a scholarship”, and “I am able to incorporate it [my interest] into most of my activities. If things go well, I’d like to turn pro.”

Future research will identify factors that contribute to the development and intensity of special interests. We are currently analyzing data collected from an online survey to examine the relationship between the content and severity of special interests and mentalizing and systemizing abilities. An in-laboratory interview is also being developed to supplement the online survey, implementing more sensitive tests of social ability and cognitive style with the goal of developing a multi-causal model of special interests. Future studies will also determine the extent to which special interests can be used as an educational and therapeutic tool for individuals with ASD and their families.

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References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (DSM-IV-TR)*. Washington: American Psychiatric Association

Asperger, H. (1991). “Autistic” psychopathy in childhood. In U. Frith (Ed., Translator), *Autism and Asperger Syndrome* (pp. 37-92). Cambridge: Cambridge University Press.

Attwood, T. (2003). Understanding and managing circumscribed interests. In M. Prior (Ed.), *Learning and Behaviour Problems in Asperger Syndrome* (pp. 126-147). New York: Guilford Press.

Baron-Cohen, S. (2003). *The Essential Difference: Men, Women and the Extreme Male Brain*. New York: Penguin Books.

Baron-Cohen, S., Richler, J., Bisarya, D., Guranathan, N., & Wheelwright, S. (2003). The systemizing quotient: An investigation of adults with Asperger’s syndrome or high functioning autism, and normal sex differences. *Philosophical Transactions of The Royal Society*, 358(1430), 361-374.

Baron-Cohen, S. & Wheelwright, S. (1999). “Obsessions” in children with autism or Asperger syndrome: A content analysis in terms of core domains of cognition. *British Journal of Psychiatry*, 175, 484-490.

Baron-Cohen, S., & Wheelwright, S. (2004). The Empathy Quotient: An investigation of adults with Asperger Syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, 34, 163-175.

Bartak, L., & Rutter, M. (1976). Differences between mentally retarded and normally intelligent autistic children. *Journal of Autism and Child Schizophrenia*, 6, 109–120

Bashe, P.R. & Kirby, B.L. (2001). What Asperger syndrome looks like. In B.L. Kirby & P.R. Bashe, *The OASIS Guide to Asperger Syndrome: Advice, Support, Insight, and Inspiration*. New York: Crown Publishers.

Behrmann, M., Thomas, C. and Humphreys, K. (2006). Autism: seeing it differently . *Trends in Cognitive Science*, 10, 6, 258-264.

Bodfish, J. (2009). A role for interests and reward in the pathogenesis and treatment of autism. Colloquium presented at *The Autism and Developmental Disorders Colloquium Series* at MIT, Cambridge, MA., December 16, 2009.

UNDERSTANDING SPECIAL INTERESTS

24

- Bodfish, J.W., Symons, F.J., Parker, D.E., & Lewis, M.H. (2000). Varieties of repetitive behavior in autism: Comparisons to mental retardation. *Journal of Autism and Developmental Disorders*, 30, 237-243.
- Brownlow, C., & O'Dell, L. (2006). Constructing an autistic identity: AS voices online. *Mental Retardation*, 44, 315-321.
- Caldwell-Harris, C.L. (2009). Born on the wrong planet? Using forum postings to test hypotheses about special interests and religious beliefs of autistic spectrum young adults. Colloquium presented to the Autism Research Center, Cambridge University, UK, March 13, 2009.
- Carruthers, P. (1996). Autism as mind-blindness: An elaboration and partial defense. In P. Carruthers & P.K. Smith (Eds.), *Theories of Theories of Mind* (pp. 257-273). Cambridge: Cambridge University Press.
- DeLoache, J.S., Simcock, G., & Macari, S. (2007). Planes, trains, automobiles—and tea sets: Extremely intense interests in very young children. *Developmental Psychology*, 43, 1579-1586.
- De Martino, B., Harrison, N.A., Knafo, S., Bird, G., & Dolan, R.J. (2008). Explaining enhanced logical consistency during decision making in autism. *Journal of Neuroscience*, 28(42), 10746-10750.
- Ehlers, S. & Gillberg, C. (1993): The Epidemiology of Asperger syndrome. A total population study. *Journal of Child Psychology and Psychiatry*, 34, 1327-1350.
- Fecteau, S., Mottron, L., Berthiaume, C., & Burack, J.A. (2003). Developmental changes of autistic symptoms. *Autism*, 7, 255-268.
- Fleischmann, A. (2004). Narratives published on the Internet by parents of children with autism: What do they reveal and why is it important? *Focus on Autism and Other Developmental Disabilities*, 19, 35-43.
- Fleischmann, A. (2005). The hero's story and autism: Grounded theory study of websites for parents of children with autism. *Autism*, 9, 299-316.
- Frith, U. (1991). Asperger and his syndrome. In U. Frith (Ed.), *Autism and Asperger Syndrome* (pp. 1-36). Cambridge: Cambridge University Press.
- Frith, U. (2003). *Autism: Explaining the Enigma*. New Jersey: Blackwell Publishing.
- Grandin, T. & Duffy, K. (2008). *Developing Talents: Careers for Individuals with Asperger Syndrome and High-Functioning Autism*. Shawnee Mission, KS: Autism Asperger Publishing Company.

UNDERSTANDING SPECIAL INTERESTS

25

Happe, F. (1991). The autobiographical writings of three Asperger syndrome adults: Problems of interpretation and implications for theory. In U. Frith (Ed.), *Autism and Asperger Syndrome* (pp. 207-242). Cambridge: Cambridge University Press.

Izuma, K., Saito, D. N., Sadato, N. (2008). Processing of social and monetary rewards in the human striatum. *Neuron*, 58, 284–294.

Jackson, L. (2002). Fascinations and fixations. In L. Jackson, *Freak, Geeks, and Asperger Syndrome: A User Guide to Adolescence* (pp 43-59). Philadelphia: Jessica Kingsley Publishers.

Johnson, K. E., Alexander, J. M., Spencer, S., Leibham, M. E., & Neitzel, C. (2004). Factors associated with the early emergence of intense interests within conceptual domains. *Cognitive Development*, 19, 325–343.

Jordan, C.J. (2009). The evolution of autism in the World Wide Web. Manuscript in preparation.

King, B.H., Hollander, E., Sikich, L., McCracken, J.T., Scahill, L., Bregman, J.D.,... Ritz, L. (2009). Lack of efficacy of Citalopram in children with autism spectrum disorders and high levels of repetitive behavior. *Archives of General Psychiatry*, 66, 583-590.

Kohls, G., Peltzer, J., Herpertz-Dalhmnn, B., & Konrad, K. (2009). Differential effects of social and non-social reward on response inhibition in children and adolescents. *Developmental Science*, 12, 614-625.

Ma, T. (2007). Query Google. Retrieved from <http://www.linguistics.ucla.edu/people/hayes/querygoogle/>

Mercier, C., Mottron, L., & Belleville, S. (2000). A psychosocial study on restricted interests in high-functioning persons with pervasive developmental disorders. *Autism*, 4, 406-425.

Mueller, F., Agamanolis, S., & Picard, R. (2003). Exertion Interfaces: Sports over a Distance for Social Bonding and Fun. *Proceedings of CHI* (pp. 561-568). Fort Lauderdale, FL: ACM Press.

Mitchell, C. (2003). Autism e-mailing lists: A discussion, from a subscriber, of the pros and cons of autism e-mailing lists for people with Asperger's Syndrome. *Health Information*, 3-4.

Mottron, L., Dawson, M., Soulieres, I., Huvert, B., and Burack, J.A. (2006). Enhanced perceptual functioning in autism: An update, and eight principles of autistic perception. *Journal of Autism and Developmental Disorders*, 36, 27-43.

UNDERSTANDING SPECIAL INTERESTS

26

Rapleaf. (2008, July 29). Rapleaf Study Reveals Gender and Age Data of Social Network Users.

Retrieved from http://www.rapleaf.com/business/press_release/gender_age

Sasson, N.J, Turner-Brown, L., Holtzclaw, T.N., Lam, K.S.L., & Bodfish, J.W. (2008). Children with autism demonstrate circumscribed attention during passive viewing of complex social and nonsocial picture arrays. *Autism Research, 1*, 31-42.

Simonton, D. K. K. (2009). Varieties of (scientific) creativity: A hierarchical model of domain-specific disposition, development, and achievement. *Perspectives on Psychological Science, 4*, 441-452.

Turner, M. (1997). Towards an executive dysfunction account of repetitive behavior in autism. In J. Russel (Ed.), *Autism as an Executive Disorder* (pp. 57- 100). Oxford: Oxford University Press.

Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Developmental Disorders, 9*(1), 11-29.

Winter-Messiers, M. (2007). From tarantulas to toilet brushes: Understanding the special interest areas of children and youth with Asperger's Syndrome. *Remedial and Special Education, 28*, 140-152.

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Table 1

Categorical Differences in the Special Interests of NT Individuals and Individuals with ASD

Interest Category	ASD	NT	Percent Difference (Autism-NT)	Z=
Sciences	20.4%	2.8%	17.6	-5.7*
Psychological disorders	12.8%	0	12.8	-5.4*
History/Culture	21.8%	4.7%	17.1	-5.2*
Belief systems	17.1%	2.8%	14.2	-4.9*
Animals	13.3%	1.4%	11.9	-4.7*
Sports/Games	17.5%	35.2%	-17.7	-4.2*
Information/Mechanical systems	9.5%	0.9%	8.5	-4*
Machines/Technology	16.6%	5.6%	11	-3.6*

Note. Percentage reflects the number of individuals in the diagnostic group with one or more interests in the category. The two groups did not differ in the following special interest categories: sorting, categorizing, and organizing, item attachment, factual information, creative arts, nature, people, vehicles, food and drink, and other. $*p < .001$.

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Table 2

Categorical Differences of Special Interests Between Five Diagnostic Categories

Interest Category	Other ASD	Asperger Syndrome Diagnosed	Asperger Syndrome Undiagnosed	Unsure of ASD	Neuro-typical	χ^2
Psychological disorders	7.1%	13%	7.8%	26.1%	0	38.5**
Animals	35.7%	11.4%	7.8%	21.7%	1.4%	37.3**
Sciences	21.4%	22.8%	17.6%	13.0%	2.8%	34.4**
History/ Culture	28.6%	21.1%	19.6%	26.1%	4.7%	28.4**
Belief systems	7.1%	19.5%	13.7%	17.4%	2.8%	26.9**
Sports/ Games	14.3%	18.7%	19.6%	8.7%	35.2%	18.8**
Information/ Mechanical systems	7.1%	2.4%	5.9%	13%	0.9%	18.2**
Machines/ Technology	14.3%	19.5%	11.8%	13%	5.6%	16.0*

Note. Percentage reflects the number of individuals in the diagnostic group with one or more interests in the category. The five diagnostic groups did not differ in the following special interest categories: sorting, categorizing, and organizing, item attachment, factual information, creative arts, nature, people, vehicles, food and drink, and other. ** $p < .001$, * $p < .005$.

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Figure 1. Top Five Most Frequently Reported Special Interests Category in Individuals with Autism Spectrum Disorder and Neurotypical Individuals

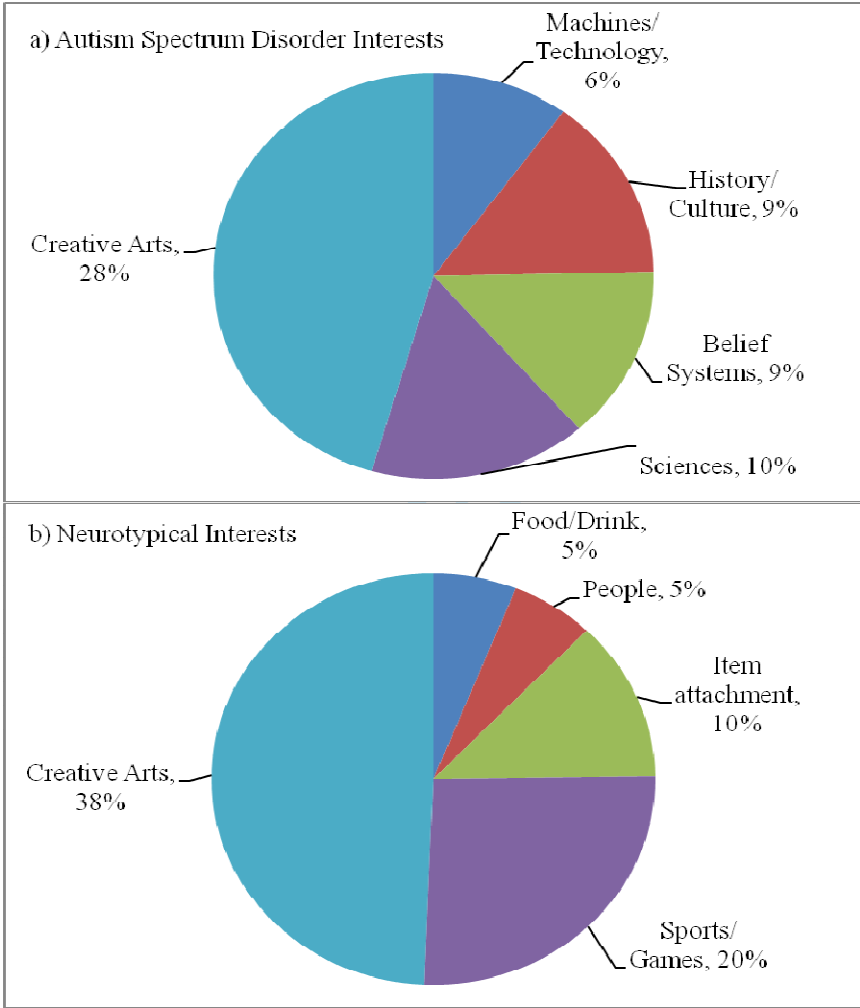


Figure 1. Percentages of the top five most frequently reported interest categories in each group. Percent values were calculated by dividing the number of interests in the category by the total number of interests expressed by the group. a) Individuals with autism spectrum disorder reported most interests in creative arts (28% of the total reported interests), while interests in sciences, belief systems, history and culture, and machines and technology occurred with the next greatest frequencies. b) Neurotypical individuals expressed more interests in creative arts (38% of all reported interests) than any other interest category. Sports and games comprised the second most frequent category (20%). Interests in item attachment, people, and food and drink occurred with the next greatest frequencies.

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Figure 2. The average log Google Search Frequency, Total Number of Interests, and Mean Descriptor Word Count of Interests Reported by Neurotypical Individuals and Individuals with Autism Spectrum Disorder

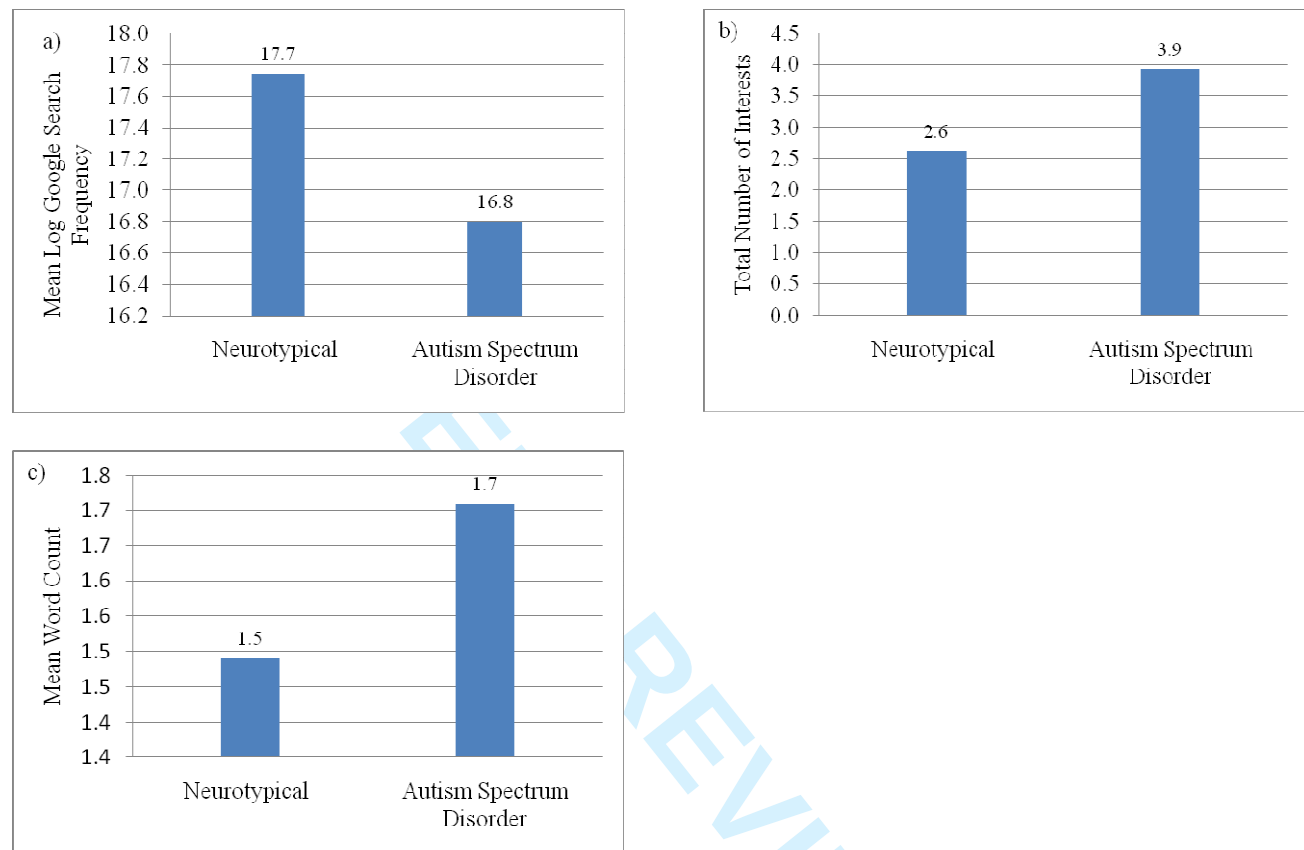


Figure 2. Differences in special interest qualities of neurotypical individuals and individuals with autism spectrum disorder. a) The log mean Google search frequency of neurotypical interests (17.7) and autism spectrum disorder interests (16.8) are significantly different ($p < .001$; eta squared=.04), indicating autism spectrum disorder interests are more specific and less common than neurotypical interests. b) Individuals with autism spectrum disorder report more total interests (3.9) on average than neurotypical individuals (2.6; $p < .001$; eta squared=.04). c) Neurotypical individuals use less words to describe their interests (1.5) on average, compared to individuals with autism spectrum disorder (1.7; $p < .005$; eta squared=.02), further indicating that autism spectrum disorder interests are more specific.