Opportunity for success: Website evaluation and scanning by students with Autism Spectrum Disorders

by

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ABSTRACT

Diagnoses of Autism Spectrum Disorders (ASD) are becoming more prevalent, both in the US and the world. The U.S. Center for Disease Control and Prevention estimates that about 1 in 88 eight-year-olds today have ASD (2012). Despite autism's frequent appearance in the media as a childhood disease, children with the disorders have nearly typical life expectancies and live well through adulthood (Shavelle & Strauss, 1998). As the Internet becomes increasingly prevalent and is necessary to fully participate in today's society, it is critical for people with ASD to be able to access and use online content and services. While there is a plethora of anecdotal evidence to indicate successful outcomes, there is very little scientific research that examines the specific effects, opportunities and risks of Internet usage for people with ASD.

This pilot study compared students' cognitive traits associated with ASD, as reported in a survey, to their performance in a lab study that asked them to scan and evaluate web content. By observing eye-tracking data and differences in responses between participants, this study aimed to quantify key differences between content evaluation between individuals with or without autism. Participants were recruited from the population of 18-24 year old students attending Iowa State University.

The results suggested little to no difference in the ways that participants with or without ASD scanned or evaluated websites. Correlations between the eye fixation metrics and Autism Quotient scores were near zero. Other classifying factors like the Style of Processing score and gender had larger correlations with fixation metrics. The ability of participants to deduce purpose, advertising, and authorship from the site's design did not vary between the control group and the group with ASD. Previous work has shown that people with ASD have an affinity for using the Internet. This study demonstrates people with ASD have an equal opportunity to successfully evaluate and scan websites as their neurotypical peers, even at a subconscious, eye-movement level. These findings suggest that the Internet makes an effective content delivery platform for young adults with High-Functioning Autism or Asperger's who are able to attend college.

CHAPTER 1. OVERVIEW

1.1. Introduction

The Internet has revolutionized the way people work, play, and learn. As the Internet grows into a necessary part of life, it is important to make sure it is accessible to all populations. While accessibility regarding visual, physical and auditory impairments has been researched heavily, very little research has been done to establish best practices for people with social and language impairments. This pilot study was developed to reveal new insights into differences in the ways that individuals with Autism Spectrum Disorders (ASD) approach and analyze web content. The Internet has the potential to provide tremendous opportunities to people with ASD, where they can learn, communicate, and join communities without the hindrance of social impairments. While deficits in both exhibiting and reading appropriate amounts of eye contact and non-verbal cues prevent people with ASD from fully participating in face-to-face communication, the Internet affords more time and explicit emotional cues (like emoticons) to make communication more effective. Understanding details about the ways these individuals access and evaluate the Internet can be used to inform guidelines and further research to create more usable websites for persons with ASD.

1.2. Thesis Summary

This pilot study compared students' cognitive traits, as reported in a survey, to their performance in a lab study, which asked them to scan and evaluate web content. Specific traits include social skills, communication, imagination, attention to detail, attention switching, and information processing styles–traits that are commonly associated with ASD and Asperger's syndrome. Participants were asked to examine a series of existing websites and deduce purpose and authorship from the design. Also, they were asked to identify key site components such as navigation and advertisements. By observing eye-tracking data and differences in responses

between participants, this study aims to quantify key differences of content evaluation between individuals with or without autism, and answer these research questions:

RQ1: *How well do people with or without ASD assess purpose, authorship and advertising on websites?*

RQ2: *Are there differences in the ways people with or without ASD evaluate web content?*

Chapter 2 reviews existing literature on the subjects of Autism Spectrum Disorders (2.1), Internet accessibility, opportunities and risks for people with disabilities (2.2), and methodology used in the pilot study (2.3). Chapter 3 outlines the preliminary survey of parents of children with ASD to identify areas of interest, opportunity and concern for the pilot study. Chapter 4 provides the experimental design of the pilot study, including descriptions of the participants (4.2), procedures (4.3) and measures (4.4). Chapter 5 details the findings of the pilot study and a discussion of the results (5.4). Chapter 6 concludes with an overview of the findings (6.2) and suggestions for future research (6.4). The Appendices contain complete survey questions, study stimuli and supporting data for further review.

1.3. Broader Impact and Significance

Autism Spectrum Disorders (ASD) are increasingly prevalent in frequency of diagnoses, and public awareness. The U.S. Center for Disease Control and Prevention estimates that about 1 in 88 eight-year-olds today have ASD (Centers for Disease Control and Prevention, 2012). Despite its frequent appearance in the media as a childhood disease, children with the disorders have almost typical life expectancies and live well through adulthood (Shavelle & Strauss, 1998). As the amount of people with ASD rises, and the population with diagnoses ages, there is an increasing demand for therapies, services and products for these individuals at all points in life. However, due to the large amount of idiosyncrasy within the diagnoses, it can be challenging to design and research outcomes of people with ASD.

The Internet is an arena that holds considerable of promise for people with ASD. In the last 20 years, the Internet has played a large role in the autism self-advocacy movement, giving people with social deficits the ability to express themselves without the stress of in-person signals and distractors. Yet while there is a plethora of anecdotal evidence to indicate successful outcomes, there is very little scientific research that examines the specific effects, opportunities and risks of Internet usage for people with ASD. In accessibility discussions, cognitive and communication disabilities are often overshadowed by visual and physical disabilities. When suggestions for cognitive accessibility exist, they are typically much less specific (eg. "Make text content readable and understandable," or "Make Web pages appear and operate in predictable ways") than the clear-cut guidelines for visual accessibility (e.g. "Provide text alternatives for any non-text content") (W3C, 2008).

Research comparing the abilities of people with or without ASD to access and assess websites is critical for providing quality sites and services to the growing ASD population.

1.4. Definitions of Key Terminology and Abbreviations

Area of Interest (AOI)

areas of a stimulus that are specified to allow for eye-tracking analysis

Asperger's Syndrome (AS)

condition similar to the clinical diagnosis for autism, but without the delay in language or cognitive development (Wing, 1981a)

Aspie/Autie

slang terms for Asperger's (aspie) and Autism (autie) used frequently within diagnosed online communities

Autism Spectrum Disorders (ASD)

a range of conditions characterized by social impairments, communication deficits, and repetitive, restrictive behavior (American Psychiatric Association, 2008)

Autism Quotient (AQ)

metric developed by Baron-Cohen et al. to assign a quantitative value to the amount of autistic traits an individual has; 32 and higher indicates significant presence of autistic traits (2001)

Diagnostic and Statistical Manual of Mental Disorders (DSM)

guidelines published by the American Psychiatric Association on the standard classifications and methods of diagnoses for mental disorders

Fixation

moments when the eye is relatively still, lasting anywhere from several milliseconds to seconds

High-Functioning Autism (HFA)

a sub-classification of autism for individuals who meet the diagnostic criteria for autism but have an IQ above 65-70 (Gillberg, 1998)

Human-Computer Interaction (HCI)

the study of how people interact with technology

Neurotypical (NT)

neurologically typical, characteristic of people without autism

Neurodiversity

alternate view of cognitive differences as a variety of cognitive styles, as opposed to disorders

Saccade

rapid eye-movements between fixations

Style of Processing (SOP)

metric developed by Childers, et al. to quantify preferences for visual or verbal processing (1985)

Time to First Fixation (TFF)

time it takes for a person to fixate on a particular area of the stimulus

User Experience (UX)

the way a person feels about using a system, most commonly a digital interface; includes dimensions of usability, emotion, desirability, and credibility

CHAPTER 2. REVIEW OF LITERATURE

2.1. Autism Spectrum Disorders

Autism Spectrum Disorders (ASD) compose a category of neurodevelopmental disorders, that were simultaneously proposed by psychologists Leo Kanner (1943) in the United States and Hans Asperger (1944) in Austria. Independently, Kanner and Asperger observed children in their practices diagnosed with schizophrenia, and noted similar key differences in some of the patients' behavioral symptoms. Kanner noted that the "combination of extreme autism, obsessiveness, stereotypy, and echolalia" formed a syndrome with extremely unique manifestations, but with a core consistency in development pattern and specific features (1943, p. 248). At the time, he believed the condition to be fairly rare. Since then, the prevalence and awareness of autism has grown significantly, inspiring greater research interest. The most recent report by the U.S. Center for Disease Control and Prevention (2012), estimated that about 1 in 88 eight-year-olds in their study sites met the diagnostic criteria for ASD. It is unclear if this dramatic rise is the result of better diagnostic strategies, greater public awareness, or an increase in the prevalence of the condition itself (Centers for Disease Control and Prevention, 2012).

2.1.1. Diagnosis

Currently, autism cannot be detected using any biological markers or physical testing. Instead, autism is diagnosed based on the presence of a certain number of coinciding behavioral traits, usually detected through interviews, observations and screening instruments (Wing, 1997). The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) identifies autism as a triad of impairments: social interaction, communication, and repetitive, restrictive behavior (see Table 2.1) (American Psychiatric Association, 2008). These characteristics manifest in a variety of ways, leading to an axiom within the autism community: "If you've met one child with autism, you've met one child with autism." Each symptom can range from mild to severe, producing a spectrum that covers "nonverbal children needing intensive

Table 2.1: *Characteristics of Autism Spectrum Disorders from DSM-IV (American Psychiatric Association, 2008)*

social interaction	marked impairment in the use of multiple nonverbal behaviors, such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
	failure to develop peer relationships appropriate to developmental level
	a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)
	lack of social or emotional reciprocity
communication	delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime)
	in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
	stereotyped and repetitive use of language or idiosyncratic language
	lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level
repetitive, restrictive behavior	encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
	apparently inflexible adherence to specific, nonfunctional routines or rituals
	stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting or complex whole-body movements)
	persistent preoccupation with parts of objects

therapy for basic life skills to highly intelligent adults who live independently but have trouble with social communication" (Burke, 2009, p. 425).

2.1.2. Treatments and Interventions

As with many other neurodevelopmental disorders, there is no cure for ASD, but treatment and therapies can improve outcomes. Often the primary goal of therapy is to promote socially acceptable behaviors, reduce harmful or inappropriate behaviors, and increase independent living skills (Myers & Johnson, 2007). Formal and informal support from peer groups and family is strongly correlated with quality of life in adults with ASD, more so than the intensity of their

symptoms (Burke, Kraut, & Williams, 2009). Appropriate application of validated methods like ABA (applied behavioral analysis), TEACCH (Treatment and Education of Autistic and Related Communication Handicapped Children), and physical, speech and occupational therapies can improve outcomes for both individuals and families (Myers & Johnson, 2007).

The life expectancy for five-year-olds diagnosed with ASD is only reduced from that of their typically developing peers by 6.1 years for males and by 12.3 years for females (Shavelle & Strauss, 1998). This is important to note, for although the media often focuses on children affected by autism, these children grow into adults who live long lives. Young adults with enough language and social skills are entering universities and the workforce (Harmon, 2011; Hastwell, Martin, Baron-Cohen, & Harding, 2012; Madriaga, Goodley, Hodge, & Martin, 2008). Research and services need to expand beyond childhood interventions in order to serve this growing adult community.

2.1.3. Prevalence

Recent studies in the United States examining diagnostic and special education data have shown increases in the prevalence of ASD, though the rate shows signs of stabilizing in recent years (Croen, Grether, Hoogstrate, & Selvin, 2002; Maenner & Durkin, 2010; Newschaffer, Falb, & Gurney, 2005). The prevalence of ASD varies widely by location. The latest CDC study examined prevalence at 14 sites, and found that 2.12–4.8 per 1,000 8-year-old children were evaluated to have ASD (Centers for Disease Control and Prevention, 2012). In an examination of 43 studies from 17 countries since 1996, Fombonne found prevalence of between .07 (Wisconsin, US) to 4.64 (Mölnlycke, Sweden) per 1,000 children (2009).

The prevalence of ASD is markedly higher among males than females. The CDC survey found male-to-female prevalence ratios ranging from 2.7 in Utah to 7.2 in Alabama (Centers for Disease Control and Prevention, 2012). Wing also found that males are affected around three to four times more often than females (1997). However, in groups with lower IQ, the ratio goes down to 2:1, similar to the prevalence of Down's syndrome or cerebral palsy in children. The cause of this

discrepancy is unknown; researchers have proposed genetic causes, inherent sex differences, or environmental factors (Wing, 1981b).

Though persons with ASD display deficits in social intuition, they often have improved understanding of object, mechanisms, and physical systems (Baron-Cohen et al., 1998). This, coupled with obsessional, narrow interests, creates an affinity between ASD and specific occupations and skills. Baron-Cohen et al. found that scientists scored higher on their Autism-Spectrum Quotient (AQ) survey tool than both humanities and social scientists. In particular, mathematicians scored highest, followed by engineers, physical and computer scientists, and lastly medicinal scientists and biologists (2001). (The AQ survey tool is discussed in greater detail in Section 4.3.1) A study of hacker conference attendees found that the group mean AQ score indicated many participants fell into the high-functioning area of the autism spectrum (Schell & Melnychuk, 2010). The symptoms are so prevalent in many software development and engineering industries that Douglas Coupland, in his novel Microserfs, asserted, "I think all tech people are slightly autistic" (Silberman, 2001).

2.1.4. Asperger's Syndrome and High-Functioning Autism

DeMyer et al. (1981) first used the term "high-functioning autism" (HFA) to describe individuals that met the diagnostic criteria for autism but had an IQ above 65-70 (Gillberg, 1998). Lorna Wing (1981a) proposed a broader clinical diagnosis of autism, that included individuals who met the clinical diagnosis for autism, but without the delay in language or cognitive development. DSM-IV introduced Asperger's Syndrome (AS) in 1994 as an official diagnosis under Autism Spectrum Disorders.

Since its inclusion, AS has been the focal point of much research and debate. One facet of this debate is whether or not AS and HFA are mutually exclusive conditions (Frith, 1991; Gillberg, 1998). Baron-Cohen postulates that "autism and AS lie on a continuum of social-communication disability, with AS as the bridge between autism and normality" (2001, p. 6).

The impending revision to the DSM (DSM-5) calls for an elimination of the AS diagnosis,

categorizing it under the broader description of Autism Spectrum Disorders. This decision has been met with resistance from some researchers, concerned that individuals with AS will no longer meet the full diagnostic criteria. Ghaziuddin points to aspects of the Asperger's diagnosis that are distinct from autism: "quality of social impairment (active but odd rather than aloof and passive); idiosyncratic interests (often sophisticated and intellectual); communication style (often pedantic and verbose); and age of onset/emergence of symptoms (often around 7–8 years)" (2010). Wing, Gould & Gillberg raise concerns that shifting criteria could lead to a misleading increase in published prevalence rates (2011).

Advocates for the revisions argue that most individuals currently diagnosed will retain their diagnosis under the DSM-5, and that there should be fewer misdiagnoses under the revised criteria (Huerta, Bishop, Duncan, & Hus, 2012). Ari Ne'eman, member of National Council on Disability & cofounder of the Autistic Self Advocacy Network, believes the revisions will improve individuals' abilities to get state-funded services: "There are states that will pay for services for people with a diagnosis of autistic disorder, but not for people with Asperger's or PDD-NOS, even if the individuals have precisely the same needs. That's the problem that the DSM-5 is intended to solve." (Silberman, 2010)

2.1.5. Neurodiversity

Another point of debate within public policy is the framing of AS as a disability. At what point, if any, should the symptoms of AS be considered a disorder, as opposed personal cognitive styles, sometimes referred to as neurodiversity?

Baron-Cohen acknowledges that viewing autism as a disability may help provide resources to support a child's special needs; however, focusing exclusively on the impairments causes society to overlook positive characteristics and discriminate unfairly (see Table 2.2). "For example, I do not spend much, if any, time thinking about mathematics problems, but I spend quite a lot of time thinking about people... Yet I do not describe myself as having a disability in mathematics. I would instead say that I simply prefer to spend time thinking about people—they are more

Table 2.2: *Contrast in wording between symptoms in DSM-IV (American Psychiatric Association, 2008) vs. behavioral features (Baron-Cohen, 2002)*

DSM-IV Criteria for Autistic Disorder and Asperger's Disorder	**Asperger's Syndrome Behavioral Features Removing Implication of Disability**
Failure to develop peer relationships appropriate to developmental level.	The child tends to follow his or her own desires and beliefs rather than paying attention to, or being influenced by, others' desires and beliefs.
Marked impairment in the ability to initiate or sustain a conversation with others.	The child communicates less than other children do.
A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people.	The child shows relatively little interest in what social groups are doing, or in being a part of them.
Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.	The child has strong, persistent interests. The child may be fascinated by patterned material, be it visual (shapes); numeric (dates, time-tables); alphanumeric (license plates); or lists (of cars, songs, etc.).
Apparently inflexible adherence to specific, nonfunctional routines or rituals.	The child has a strong preference for experiences that are controllable rather than unpredictable.
(not covered by DSM-IV)	The child is very accurate at perceiving the details of information. The child notices and recalls things other people may not.

interesting to me. To say that a person has a disability because he or she rarely does something could be seen as unreasonable" (Baron-Cohen, 2002, p. 188).

Autism & Asperger's communities are fighting against commonly held perceptions about autism, particularly the focus on finding a cure. Self-advocacy groups like Autistic Self Advocacy Network, Aspies for Freedom and Autism Network International have staged protests at large Autism Speaks benefit walks (Autism Network International, 2012). "Most of this discussion tended to describe autism as an epidemic and therefore focused almost exclusively on finding a cure for autism... Some adults with autism began to fear increased intolerance of their way of being if not outright eradication of their lifestyles and preferences" (Baker, 2011). These groups would like the money given to groups like Autism Speaks to be put towards the educational and support services for families and individuals with autism needs, instead of expensive genetic

research and awareness advertising. These groups also fight against the misconception that autism masks the true person underneath, or as Ne'eman puts it "that there was or is a normal person somewhere inside me, hidden by autism, and struggling to get out. How can I draw a line around one part of my brain and say that this is the autistic part, and the rest of me is something else?" (Silberman, 2010).

Critics of this movement note that arguments are typically centered on High-Functioning Autism and Asperger's syndrome. Parents of lower-functioning children argue that this debate is pulling resources and attention away from research and treatments that could dramatically improve their child's quality of life. Blogger Harry Doherty, whose blog called "Facing Autism Symptoms in New Brunswick" explores topics around life with his autistic son, laments that the neurodiversity movement is confusing parents by ignoring the medical condition in favor of a social rights issue. "Neurodiversity harms children with autism by promoting the view that autism should not be treated and influencing the decisions of parents such as those in the case commentary to refuse available autism treatment for their son" (Doherty, 2012). Slate writer and mother to a son with ASD, Amy Lutz, questions the impact of low-functioning autistic celebrities (like Amanda Baggs, Sue Rubin, Tracy Thresher, Larry Bissonnette) who have changed public perception by revealing their "intact minds" through their writing (2013). She is skeptical about authors that claim to have severe autism and have used Facilitated Communication to write their books, a method of supported typing where a facilitator holds the writer's wrist, elbow or shoulder. The validity of Facilitated Communication has been debated intensely for years, and many controlled studies have found that often the person with disability is unable to accurately respond when the stimuli is not seen by the facilitator (Jacobson, Mulick, & Schwartz, 1995). Writings and videos of these individuals has shifted the public perception of people with ASD, away from one of disability, to one of personality, which Lutz views as a dangerous thing for lower-functioning individuals, who have very different needs. "Entirely missing here," Judith Warner, author of , writes, "is the notion that there is a world of difference between unique personality traits that may be quirky, annoying, or charming, and actual signs of pathology.

Or that the difference between personal style and pathology resides in pain, distress, and impairment" (as cited in Lutz, 2013).

Despite the controversy, some companies are recognizing ways that the characteristics of autism and Asperger's can make excellent employees. Danish entrepreneur Thorkil Sonne founded an IT consulting company, Specialisterne (Danish for "Specialists") that hires mostly people with ASD. He points out that they make great software engineers since, "as a general view, they have excellent memory and strong attention to detail. They are persistent and good at following structures and routines" (Bennett, 2009).

Temple Grandin, diagnosed with autism at two-years-old, is a highly recognized consultant in the livestock industry. One-third of the cattle and hogs in the United States are moved through handling facilities she designed. She credits her success to her different style of thinking that allows her to understand the minute details that make livestock balk. "Visual thinking has enabled me to build entire systems in my imagination... Language-based thinkers often find this phenomenon difficult to understand, but in my job as an equipment designer for the livestock industry, visual thinking is a tremendous advantage" (Grandin, 2008, p. 3). She believes there needs to be a balance between treating the most severe forms of autism, which do not allow individuals to live independently, while allowing the milder forms to survive. "After all, the really social people did not invent the first stone spear. It was probably invented by an Aspie who chipped away at rocks while the other people socialized around the campfire. Without autism traits, we might still be living in caves" (Grandin, 2008, p. 122).

2.2. The Internet

The Internet has revolutionized the way that people can access and share information. Built upon the capabilities of its media predecessors, the telephone, print, radio and television, the Internet has revolutionized the way that people access and share information. First conceptualized by J.C.R. Licklider in 1962, this global network was the first "common medium that can be contributed to and experimented with by all" (Leiner et al., 2009; Licklider & Taylor,

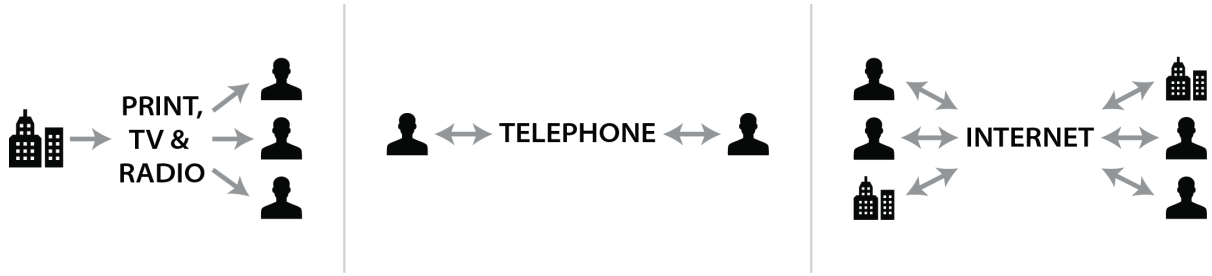

Figure 2.1: *Production and consumption relationships of various media*

1968). Unlike its predecessors, the Internet democratizes production of content, where each user is in equal parts consumer and producer, and broadens the audience to include people around the globe (see Figure 2.1). The Internet has become arguably indispensable to modern life, informing decisions, facilitating business transactions, and connecting individuals (Hoffman, Novak, & Venkatesh, 2004). This ubiquity is not without its risks, as privacy and security become growing concerns in the mainstream consciousness (Madden, Cortesi, Gasser, & Lenhart, 2012).

2.3. Prevalence and Usage

In the last two decades, use of the Internet has grown from about one-in-ten adults (18-years-old and older) to over eight-in-ten (see Figure 2.2). Among teens (12-17-year-olds) the prevalence is even higher, around 95% in 2012 (Zickuhr & Smith, 2012, p. 4). Also, the ways that people access the Internet has evolved over the last two decades. High-speed broadband connections in the home have increased from almost 0% to over 60% in the last 10 years, while

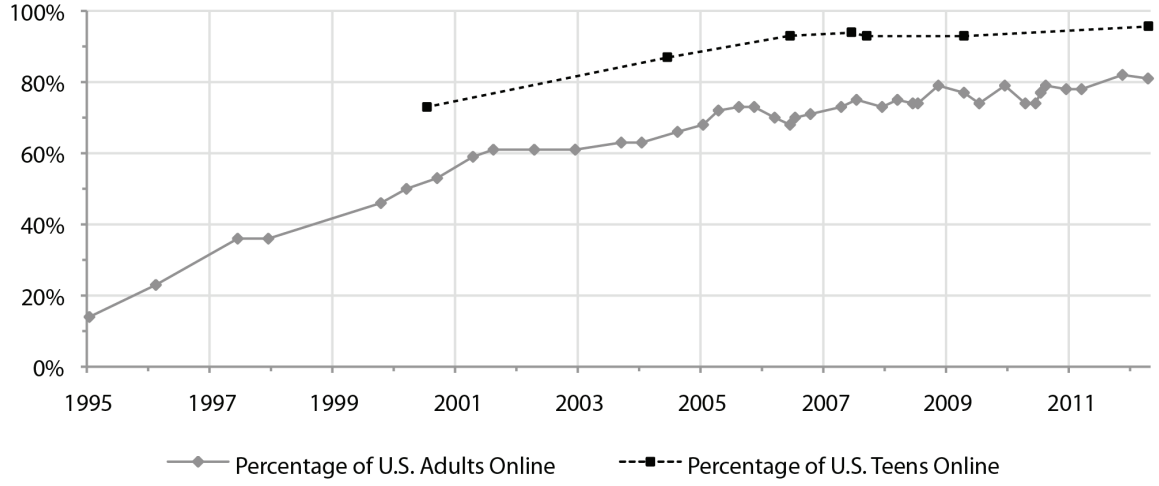

Figure 2.2: *Internet Adoption in the U.S from 1995-2012, Pew Internet & American Life Project Surveys, March 2000-April 2012*

dial-up connections have dropped to around 3% (Zickuhr & Smith, 2012, p. 8). As of 2011, 38% of adults accessed the web through their cell phone, a percentage that skews higher for younger generations. 63% of Millennials, adults ages 18-34, access the Internet through their cell phones (Zickuhr, 2011, p. 8). 74% of teens access the Internet on mobile devices (like cell phones & tablets), with 25% of teens preferring their cell phone as the primary way by which they access the Internet (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013, p. 7).

Most activities now have digital, online equivalents, so the types of Internet usage are almost infinite. The latest Pew survey on Internet usage found that over 90% of Internet users use search and email, while 71% have bought products online, 64% use social networks and 61% use online banking services (Zickuhr & Smith, 2012, p. 13). 80% of teens that use the Internet use social media sites (Lenhart et al., 2011, p. 2).

Few researchers have investigated Internet usage by people with ASD, especially those with lower cognitive and communication skills. Li-Tsang et al. conducted a study in 2005 of 353 adults with intellectual disabilities, finding that only 9.1% of participants were able to get onto the Internet (Li-Tsang, Yeung, Chan, & Hui-Chan, 2005). They found that participants that had ASD (11%) typically had higher competency with computers than participants who did not, especially in their abilities to browse the Internet. In a 2008 dissertation study of 138 people with Asperger's and HFA in the UK, Benford found that 91% of respondents used the Internet, a much higher percentage than the general population at that time. She also found that 83% of the respondents used the Internet to communicate, with sites like email, chat rooms, and bulletin boards (Benford, 2008, p. 186). 71% used the Internet to look for information about hobbies or interests (Benford, 2008, p.191). While the main Internet access location was at home like in the general population, a larger percentage of HFA/Asperger's respondents accessed the Internet in public places, such as cafes and the library (Benford, 2008, p. 209).

Investigating screen-based media use among youths with ASD, Mazurek et al. found that the majority of respondents with ASD spent most of their free time using non-social media,

like television and video games, and very few spent time on social media, like email and instant messaging (2011). They found a direct correlation between cognitive abilities and conversation skills and the likelihood that the youth would use email or chat rooms (Mazurek et al., 2011).

2.3.1. Accessibility

Tim Berners-Lee, the inventor of the World Wide Web and the director of W3C, stated, "The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect" (Berners-Lee, 2013). In order for a site to be accessible, everyone, regardless of ability level, should have equal or equivalent access to a site's services and information (Jaeger, 2006, p. 170). This concept usually involves discussion around the ability of people with disabilities or special needs to be able to access sites using assistive technologies, like screen-readers or screen enlargers. Despite the fact that the disabled make up 19.3% of the U.S. population (Loiacono, Romano, & McCoy, 2009, p. 128), studies have shown that the majority of websites do not meet even the simplest accessibility requirements (Lazar, Dudley-Sponaugle, & Greenidge, 2004; e.g. Loiacono et al., 2009). Guidelines, such as the Web Content Accessibility Guidelines (WCAG) by W3's Web Accessibility Initiative (WAI) and government regulations like the U.S. Government's Section 508, set up specific ways developers can make their sites accessible. Also, there are automated software tools, like Bobby, RAMP, InFocus and A-Prompt, that analyze sites and identify existing issues (Lazar et al., 2004, p. 270).

The most popular accessibility guidelines, however, focus heavily on visual disabilities, and cannot ensure equal access for all disabled people (Loiacono et al., 2009, p. 129). A review of the WCAG 1.0 found that 70% of checkpoints were targeted to help the blind, while around 25% targeted low comprehension and low reading abilities (Bartlett, 2001). Analysis of Section 508, which are legal requirements for government agency websites to follow, found an even larger skew, with 81% of checkpoints targeting the blind and only 6% targeting low comprehension and low reading abilities. Unfortunately, because of the high level of idiosyncrasy amongst persons with cognitive disabilities, it is difficult to specify exactly what developers need to do to make sites accessible to people with cognitive disabilities. Unlike the very concrete, testable instructions for

visual accessibility (e.g. “Provide text alternatives for any non-text content.”), instructions that would assist cognitive accessibility are usually much less specific (eg. “Make text content readable and understandable,” or “Make Web pages appear and operate in predictable ways”) (W3C, 2008).

Some advocacy and expert groups, like Nielson-Norman Group and WebAIM (Accessibility in Mind), have published their own guidelines to try to fix this problem. The most common issues that individuals with cognitive disabilities have while using the web are due to limits in memory, attention, perception and reading comprehension (Rowland, 2004). Friedman and Bryen conducted a review of twenty such guidelines, attempting to find areas of agreement to advocate for universal guidelines for cognitive web accessibility (2007). Four recommendations were included in over half of the guidelines:

1) Use pictures, graphics, icons and symbols along with text (75% agreement)

2) Use clear and simple text (70% agreement)

3) Use consistent navigation and design on every page (60% agreement)

4) Use headings, titles, and prompts (50% agreement) (Friedman & Bryen, 2007, p. 205)

Unfortunately, there is very little scientific research to support or refute any of these accessibility guidelines. The absence of consistent research-based approaches to web guidelines has been criticized by the U.S. Department of Health and Human Services’ (HHS). In their they note, “Most Web design guidelines are lacking key information needed to be effective. For example, many guideline sets: 1) Are based on the personal opinions of a few experts; 2) Do not provide references to support them; 3) Do not provide any indication as to whether a particular guideline represents a consensus of researchers, or if it has been derived from a one-time, non-replicated study; and 4) Do not give any information about the relative importance of individual guidelines” (U.S. Department of Health and Human Services, 2006 p. xv). To date, satisfactory answers have not been found. Further research is needed to identify the effects of following these guidelines for web users with cognitive disabilities.

2.3.2. Digital Literacy

Richard Lenham suggested that "literacy" was broader than the literal definition of "the ability to read and write," and had expanded to "the ability to understand information however presented" (as cited in Lankshear & Knobel, 2008, p. 2). In the late 1990s, as the computer and Internet was finding its way into people's home, there was a rising awareness that simply being literate in writing was not sufficient in the digital age. Literacy in the digital world is not limited to text; understanding visuals can be almost equally important. Lankshear provides the example of skillfully "Photoshopped" images. While an "illiterate" person may view such images as depictions of truth, "literate" people understand the technical process and view it as an interesting testament to the creator's skill, but not as a literal image (Lankshear & Knobel, 2008). Paul Glister was the first to define "digital literacy" in 1997 as "the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (as cited in Lankshear & Knobel, 2008, p. 6).

Today digital literacy is focused on the critical examination of content, understanding that media is not a neutral delivery of information, but is filled with assumptions, biases and special interests. The functional definition begins with a foundation of computer competences and basic skills, but the full concept encompasses much more than this (Buckingham, 2008). For example, a person needs to understand how to use a browser, hyperlinks and search engines, before they can advance to more complex evaluation of sources and content. Some have suggested that digital literacy is actually a series of many literacies that are necessary, one of which may be computer literacy (Lankshear & Knobel, 2008). In the analysis of the UK Children Go Online project, Livingstone et al. identify three basic blocks of "Internet literacy":

1. access to hardware and online content and services,
2. effective, discerning and critical understanding of information, and
3. creation or interactive participation and production of content (2005, p. 6).

Buckingham insists that the evaluation and critical use of information is necessary to convert

information into knowledge. Internet users need to ask questions about "the sources of that information, the interests of its producers, and the ways in which it represents the world; and understanding how these technological developments are related to broader social, political and economic forces" (2008, p. 78).

2.3.3. Online Opportunities and Risks for Persons with ASD

The Internet presents tremendous opportunities and risks for everyone, and those effects are magnified for people with disabilities. Given accessible, usable websites, the Internet opens up a variety of new ways for people with physical, social and cognitive disabilities to participate in society. Individuals can learn, work, shop, contribute creatively and participate in discussions without having to leave their homes (Brownlow, 2007). At the same time, each of these activities opens individuals to significant risks, including encountering violent or disturbing content, harassment, cyberbullying, identity theft, fraud and grooming for abduction (Livingstone & Helsper, 2010). These risks are even more severe for people with lower levels of cognitive skills, social understanding, or emotional vulnerability.

For people with ASD, the Internet affords a new way of communicating and socializing that has been extremely empowering. While deficits in both exhibiting and reading appropriate amounts of eye-contact and non-verbal cues prevent people with ASD from fully participating in face-to-face communication, the Internet affords more time and explicit emotional cues (like emoticons) to make communication more effective. In a 2009 study by Newton et al., examination of word usage by ASD and neurotypical bloggers revealed almost no notable differences (Newton, Kramer, & McIntosh, 2009). In 2007, Amanda Baggs, a non-verbal 26-year-old with autism, posted a video describing how she experiences and communicates with the world around her (Baggs, 2007). Along with her blog, this video has profoundly impacted the view of non-verbal people in the media (i.e. Gupta, 2007). A study by Benford in the UK found that email was a more popular means of communication than face-to-face communication among people with HFA and Asperger's (2009). Participants expressed a feeling of liberation, and that the Internet allowed them to interact with people on a more equal level: "There was a strong sense of control over

communication which could be gained online compared to face-to-face situations: control over one's emotional responses as well as the reactions of other people; control over the structure of conversations in terms of pace, topic and turn taking" (Benford & Standen, 2009).

In addition to communication, the Internet is also improving people with ASD's sense of community and support. Autism e-mailing lists, like Autism Network International's list (ANI-L), Independent Living on the Autistic Spectrum (INLV) and Autuniv-l, a list for university students with ASD, have existed since the 1990's

(Mitchell, 2003). WrongPlanet, a public online forum for people with ASD, was founded by two high-school students with ASD, Dan Grover and Alex Plank, in 2004 (Robertson & Neeman, 2008). As of March 2013, the site has over 70,000 registered users with over 5 million posts, about diverse subjects like diagnoses, politics, dating, education, parenting and video games. Naughty Auties is a virtual resource center on Second Life, created by David Savill, a 22-year-old with Asperger's, to serve people with ASD and their friends and families (Saidi, 2008). These communities have allowed people with ASD to self-advocate by sharing their experiences and creating a discourse around neurodiversity and acceptance. One person wrote, "It was through the Internet that I discovered AS [Asperger's Syndrome] and the whole concept of neurological differences. Without the Internet, I'd still be seeing myself as the cause of my own 'failure' (failure to be NT [neurotypical])... it wasn't until I met other Aspies on the Internet that I was able to gain a deeper understanding of what being Aspie means" (as cited in Blume, 1997a, p. 7).

Though the benefits of online communication and community are plentiful, there are also specific risks for people with ASD using the Internet. Benford asked the individuals she interviewed what risks they perceived of communicating online (2009). One participant mentioned concerns over naiveté and honesty online: "People with Asperger Syndrome can be very nieve [sic] and gullible and easily led. They are literal so they believe what people say. They could get themselves into danger if they are not given guidelines as to how to use the chatrooms" (Benford & Standen, 2009). Her participants also voiced a concern that online communication

could replace valuable practice at face-to-face interactions. In his analysis of autism e-mail lists, Mitchell identified the same concern, that use of Internet mediated communication would limit development of in-person social skills (2003). Howlin advocated requiring social interaction in any use of computers with people with ASD, "otherwise an obsession with the technology may take over" (1998, p. 313). Despite these observations, little research has quantitatively measured the risks of the Internet for people with ASD, or come up with methods to minimize the perceived risks. Independent developers, such as Developing Minds Software and Zac Browser, have created simplified, protected web browsing experiences designed for kids with ASD. However, the effects of these projects have not been validated beyond testimonials. More research needs to be done to evaluate online risks to people with ASD and compare them to neurotypical individuals.

2.4. Methodology

2.4.1. Eye-tracking

Eye-tracking, the recording and analysis of eye movements, has been used in a wide array of different disciplines since the late 1800s (Holmqvist et al., 2011, p. 9). As the technology has grown less invasive, less expensive and more accurate, eye-tracking has become a popular method for providing insight into cognitive processes. Within Human-Computer Interaction (HCI) and user experience (UX) research, there has been a lot of debate about the merits and validity of using eye-tracking measures. In the book , Nielsen & Pernice summarize the benefits and drawbacks to using eye-tracking in user research. "Eyetracking informs our understanding of how people approach the content on your site and how they react to your words and pictures," however, "a pure count of fixations can't tell us whether users are productive, happy, or confused when they look at certain things and not at others" (Nielsen & Pernice, 2010).

There are currently two basic types of eye-tracking systems, head-mounted and static (Holmqvist et al., 2011, p. 51). Static eye-trackers can either be tower-mounted, where the eye-tracker is close to the participant and rigged to a base that restricts head movement, or remote, where the eye-tracker is close to the stimuli and not attached to the head. Remote static eye-

trackers are generally easier to operate and less invasive, though they are also less accurate due to the amount of noise from changes in head position.

Most eye-tracking analysis looks at two key events, called fixations and saccades. Fixations are moments when the eye is relatively still, lasting anywhere from several milliseconds to seconds. Saccades are the rapid motions between fixations, and most research has concluded that people are pretty much blind to information passed over in a saccade (Holmqvist et al., 2011, p. 21). Another unique eye-movement relevant to this research is smooth pursuit, an eye motion slower than saccades that are made as the eye tracks movement. While saccades can be made with no object to attend to, smooth pursuit requires an item to track (Holmqvist et al., 2011, p. 23).

One of the key difficulties in analyzing eye movement is the lack of consensus on the specific definition of a fixation in the data. The distinction between a saccade and a fixation are not always clear-cut, and vary from individual to individual. Lack of a standard threshold makes it hard to compare different studies and analyze data objectively: "Use of different saccade size and fixation duration cutoff criteria may have a profound effect on the description of readers' eye movements during reading. Cutoffs may also determine effect sizes and their reliability… Currently, there are no comparisons of the effectiveness of different cutoff values" (Inhoff & Radach, 1998, p. 35).

Despite these and other technical difficulties, eye-tracking remains an attractive metric, especially in HCI research, due to the luring eye-mind hypothesis. Posited by Just and Carpenter, the eye-mind hypothesis states "there is no appreciable lag between what is being fixated and what is being processed" (1980, p. 331). The ability to understand the subconscious processes and link them to conscious behaviors and verbalizations has motivated eye-tracking use in HCI research for decades.

In web usability studies, eye-tracking has been used to improve positioning and information displays in many studies. Microsoft Research investigated how attention is distributed over search results, prior to the release of their search engine Bing (Dumais, Buscher, & Cutrell, 2010). They found that most users focused primarily on the top three results, with some attention given to the

next three results and the ads, but little across the rest of the page. Nielsen and Pernice devoted an entire book to eye-tracking and web usability, revealing interesting insights into design, but mostly cautioning researchers from reading into the results too much (Nielsen & Pernice, 2010). Their comprehensive study of over 300 people, with both open-ended and site specific tasks, established some key principles in navigation, web element placement, and advertising.

Eye-tracking has also been used in research on cognitive disabilities, especially in face evaluation. Participants with social phobias tend to hyper-scan faces (with longer saccades) and avoid fixations on the eyes (Horley, Williams, Gonsalvez, & Gordon, 2004), while participants with schizophrenia exhibited more restrictive scanning (with shorter saccades and longer fixations) than neurotypical participants (Green, Waldron, Simpson, & Coltheart, 2008). In studies of persons with autism, many studies found that participants with ASD fixated less on facial features (like eyes, nose, and mouth) compared to other areas of stimulus (de Wit, Falck-Ytter, & Hofsten, 2008; Jones, Carr, & Klin, 2008; Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Riby & Hancock, 2009). Participants with higher social and communication abilities often spent more time looking at the mouth (de Wit et al., 2008). These differences are being considered as possible methods of very early detection, as even infants that are later diagnosed with ASD display differences in fixation patterns (Klin & Jones, 2008).

2.4.2. Usability Testing

The most commonly referenced definition of usability comes from the International Organization for Standardization (9241-11): "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (as cited in Barnum, 2010, p. 11). Methods to improve a system's usability include ethnographic research, participatory design, focus group research, surveys, card sorting, heuristic evaluations, and usability testing (Rubin & Chisnell, 2011, p. 16). The concept of specific goals, users and context permeates methods of usability testing. Usability testing involves a researcher observing participants' use of a specific system, typically focusing on tasks or scenarios that are meaningful to the users and the system (Barnum, 2010, p. 13). Common measures in

usability tests include time on task, success rates, errors, efficiency, click paths, and questionnaire responses (Barnum, 2010). On the web, usability is viewed as especially critical due to the amount of competition and low barrier to entry (Nielsen, 2000, p. 10).

In recent years, the term "user experience" has broadened the focus of usability in industry (Wilson, 2009). While usability focuses mostly on ease of use and efficiency, user experience adds dimensions of emotion and value to the foundation of usability (see Figure 2.3).

2.4.3. Think Aloud

There are two basic types of think aloud methods used in usability studies: concurrent & retrospective. Concurrent think aloud involves the participant verbalizing his or her thoughts

Figure 2.3: *Morville's User Experience Honeycomb combines usability with other dimensions of user experience (Morville, 2004)*

while performing the task. Retrospective involves the participant recalling thoughts at the end of the study, usually prompted by video (called cued retrospective). A study of Danish usability specialists by Clemmensen found that the think aloud method was the most frequently used technique (used by about 25% of respondents) (as cited in Nielsen, Clemmensen, & Yssing, 2002). Using think aloud in conjunction with other methods can provide a deep understanding of user needs and behaviors (Jaspers, Steen, van den Bosb, & Geenen, 2004). However, requiring

participants to introspect adds a certain amount of cognitive load on the existing tasks, which is usually manifested in longer time to complete the task (Nielsen et al., 2002). Johansson, Holsanova and Holmqvist have demonstrated that verbalizations are connected to eye movements, especially when recalling complex pictures and descriptions (2005). While the act of talking can add some noise to eye-tracking data, think aloud is often used in eye-tracking studies in order to provide necessary context to eye movements (Holmqvist et al., 2011, p. 102).

CHAPTER 3. PARENTAL NEEDS SURVEY

3.1. Objectives and Survey Design

While there exists a plethora of anecdotal media coverage on the affinity between autism and technology, very little research has been done to thoroughly investigate this area. In order to gain insights into the access, usage, risks and opportunities of the Internet, parents and caregivers of children with ASD were asked to participate in focus groups and a survey. The goal was to provide direction for research-focused web usability for persons with ASD.

3.1.1. Focus Groups

During 2011-2013, the researchers conducted small focus groups with parents and teachers in central Iowa and California (Satterfield & Kang, 2012). The main focus of these discussions concerned issues that negatively impact the relationships between children with ASD and their NT peers. One question asked participants to describe technologies used for social and communication assistance, as well as the effectiveness of those technologies. While many ASD-specific devices were mentioned, an overwhelming amount of participants talked at length about common gadgets, especially the iPad:

> *"The boys are all drawn to the technological stuff: the computer and the Wii and the TV. [Child]'s most favorite thing in the world is the TV… We don't have an iPad yet, we don't have an iTouch but I think we're going to go that route for Christmas because they're all drawn to that stuff and there is so many apps… Focus and attention is another big issue that we have... but with the computer and all it just seems like everything is just, they can really zone in and do that." (mother of three boys with ASD)*

> *"He has a hard time writing; that is a big thing for kids. He has no small motor skills in his fingers and he doesn't have it in his tongue. So he looks normal but his writing is cerebral palsy type writing. So any keyboards, he can do much better on a keyboard… Reading is always a challenge… But the Kindle, he will read off the Kindle… He can*

do anything on the computer pretty much. They like that kind of technology… he's always open to gadgets and screens and stuff like that." (mother of two children with developmental disabilities)

"We have tried the iPad with him but it just doesn't… he is using it for some science and things like that at school but he is just not terribly interested… he is just not as interested in technology, and I don't know if he thinks it is too much work or if he thinks pictures are for babies… He makes my husband use the Wii for a half an hour to an hour every night but it is to entertain him. He does not want to do it, he wants to watch his dad do it." (mother of son with ASD)

These discussions reinforced the technological affinity that has been covered in many media articles (i.e. Silberman, 2001; Saidi, 2008; Blume, 1997b). They also instigated further questions regarding the usage of devices and Internet use among children, teens and adults with ASD.

3.1.2. Research Questions

The primary research questions this survey sought to answer were:

RQ1: *How are children, teens and adults with autism accessing and using the Internet?*

RQ2: *How are parents regulating their children's use? How does this regulation compare with that of typical children?*

RQ3: *What Internet opportunities and risks do parents perceive for their children with autism?*

3.1.3. Survey Design

The survey consisted of 45 questions (see Appendix A), which included a combination of original questions and questions from other studies, to allow comparisons between this survey's results and existing data pools. Pew's 2007 report on "Parent and Teen Internet Use" provided a NT baseline for household rules (Q21) and Internet perceptions (Q32-Q33) (Macgill, 2007).

Simple scoring of the individual with ASD's communication, social and functional cognitive skills (Q10-Q12) were derived from a survey comparing social and non-social media usage (Mazurek et al., 2011). The 2007 National Survey of Children's Health supplied demographic questions (Q43-Q45), in order to determine if the volunteers from the survey were representative of the broader population of families affected by ASD (Kogan et al., 2009). A UK Survey on Internet regulation in homes was the basis for questions on risks and opportunities online (Q20), rules against certain activities (Q22), and parental monitoring practices (Q23) (Livingstone & Bober, 2006).

Parents and primary caregivers of persons with ASD were invited to take the survey online, using SurveyMonkey.com. As adults in everyday contact with the affected individuals, they could provide valuable insights while not being limited by communication disabilities or maturity. Since this was a survey of volunteering adults in which the information obtained was entirely anonymous, this study was given exempt status by Iowa State University's Institutional Review Board (ID 12-451). It is worth noting that although parents and guardians have a good perspective into the online lives of their children, their view is not flawless. As a part of the UK Children Go Online project, researchers Livingstone and Bober demonstrated discrepancies in parent's perceptions of their children's online activities and children's self-reports, especially in very risky experiences (2006). The matter of perspective was taken into account when examining the results. Future research should be done to compare the parents' responses to those of their children.

3.1.4. Participants

Parents and caregivers were invited to participate in the survey via the Iowa State Design Information Research Group autism mailing list. Around 35 ASD parental support groups from around the United States were also asked to inform their members of the survey. 19 participants completed the survey, and their demographic breakdown is shown in Table 3.1 (for full demographics see Appendix B). Participants who had more than one child with ASD were asked to take the survey with their oldest child in mind. While a comparison to the 2007 study

Table 3.1: *Comparison of survey participant demographics to demographics in national survey (Kogan et al., 2009)*

	Number in Survey Sample	Percentage of Survey Sample	Percentage of Sample Population with ASD (Kogan et al., 2009)
Total	19	-	-
Child's Age, y			
6-11	12	63%	41%
12+	7	37%	42%[1]
Child's Gender			
Male	16	84%	82%
Female	3	16%	18%
Child's Ethnicity/Race			
White	17	90%	72%
Multiracial	1	5%	5%
Black or African American	1	5%	6%

National Survey of Children's Health shows that the respondents do not make up a representative sampling, their perceptions and insights provide an interesting look into potential research areas within web accessibility for people with autism.

Participants were also asked questions to indicate their child's communication, social and functional cognitive level (see questions 10-12 in Appendix A). Responses were coded and summed to give a score out of 16 in each category. Participants who's responses added up to 7 or lower were classified as "low," and participants who's responses added up to greater than 7 were classified as "high." The mean scores were 9.3 for communication, 5.1 for social, and 10.9 for functional cognitive. Communication and social scores were the most strongly correlated ($\rho = .59$).

3.2. Key Findings

3.2.1. Access and Usage

RQ1: *How are children, teens and adults with autism accessing and using the Internet?*

1 Kogan et al. did not collect data from participants with children older than 18-years-old. This survey did.

All participants (n=19) reported that their child with ASD had frequent access to a computer and a television, all but one had access to the Internet, and 47% had access to a cellphone. Of those who didn't have access to a cellphone, all but one were under the age of 12.

The most popular devices were the iPad (47% access), the Wii (47%), the iPod Touch (36%) and the Nintendo GameBoy (36%). Time spent on various technological systems varied widely across respondents (see Table 3.2). The systems for which respondents reported the most average hours per week logged were the Internet (13.7 hrs/wk), the computer (12.9 hrs/wk), handheld gaming devices like the Nintendo Gameboy or PlayStation Portable (9.1 hrs/wk), and the television (8.2 hours/wk). Average hours spent with the computer, the Internet, game consoles, and handheld gaming devices increased as children get older.

The most popular types of websites were video sites (79%) and game sites (53%). 74% of respondents said their child has watched videos online, and listened to music online. 74% also said their child played single player online games, while only 21% played games online with friends. Most respondents' children did not use email (26%) and social networking sites (16%), though those that had higher social or communication scores reported higher usage of those sites.

Table 3.2: *Average hours per week spent on various systems*

		Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score[2]	
	All	6-11 (n=12)	12+ (n=7)	Male (n=16)	Female (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Computer	12.9	8.6	20.8	13.2	11.7	12.0	13.3	13.2	20.0	5.0	15.8
Game Console	7.4	5.8	10.0	7.8	5.0	10.8	5.8	8.1	5.0	3.3	10.8
Handheld Game Device	9.1	5.0	16.7	8.7	12.5	9.2	9.1	8.7	20.0	3.3	16.7
Internet	13.7	8.8	22.1	14.1	11.7	10.8	15.0	14.1	20.0	6.7	16.7
Mp3 Player	5.3	6.1	4.3	5.0	6.7	9.2	3.0	5.4	10.0	5.0	9.2
Smartphone	2.7	4.4	0.0	2.7	2.5	4.0	2.0	2.7	0.0	6.7	1.0
Tablet	6.6	7.0	5.8	6.8	5.0	4.0	7.7	6.8	5.0	6.7	5.0
Television	8.2	8.3	7.9	8.4	6.7	4.2	10.0	7.8	5.0	10.0	8.3

2 Two participants did not provide enough data to calculate a functional cognitive score.

This trend also carried to activities, where respondents with children with higher social scores reported use of instant messaging with friends, and posting photos or stories to websites. No respondent reported that his or her child had been bullied online.

3.2.2. Parent Regulation

RQ2: *How are parents regulating their children's Internet use? How does this regulation compare with that of typical children?*

The percentage of respondents who had rules about Internet, television and video game usage were fairly similar to the 2007 Pew Survey of Parents of Teens (Macgill, 2007) (see Table 3.3). Notably there were more rules about content that is or is not allowed, versus the time spent on these systems. Fewer respondents of this survey, however, had rules on the types of television shows permissible, while more respondents had rules about permissible sites and video games. Over 70% of respondents do not allow their children to buy anything online, give out personal information, or use chat rooms. About half do not permit their children to fill out forms or quizzes, download things, use instant messaging or use email. None had rules against playing games online.

Table 3.3: *Comparison of household rules between survey participants and participants in 2007 Pew survey (Macgill, 2007)*

	Percentage of Survey Sample (n=19)	**Percentage of All Parents of Teens from 2007 Pew Survey (n=935) (Macgill, 2007)**
Do you have rules on the following: (content)		
Internet sites your child can visit	74%	68%
What kinds of television shows your child can watch	68%	77%
What kinds of video games your child can play	74%	67%
Do you have rules on the following: (time)		
How much time your child can spend online	47%	55%
How much time your child can spend watching TV	63%	58%
How much time your child can spend playing video games	53%	58%

When asked how much assistance their child needs using various systems, respondents on average said "rarely" to "never" across all systems. Game consoles required the most amount of assistance. Respondents of children with low functional cognitive scores were most likely to need assistance very often or almost always for all systems. Most of the respondents reported actively monitoring their child while using the Internet. Supervising by asking what the child is doing (63%) was most common, closely followed by keeping an eye on the screen (53%) and staying in the same room (53%). Less than half said they actively help (42%) or sit with the child (32%) while online. A smaller percentage responded that they check up after the child is off the computer (16%) or monitor the child's email account (37%).

3.2.3. Opportunities and Risks

RQ3: *What Internet opportunities and risks do parents perceive for their children with autism?*

Respondents described their children as finding the computer "instinctive," especially when it comes to finding games, videos, and images that relate to their interests. Many view the Internet as having huge potential for their child's education, presenting alternative teaching methods (especially for visual learners) and perspectives. It allows their children to do in depth research about their interests. A few also mentioned that it has allowed their children to connect with other kids who share interests. A respondent with an 11-year-old son commented, "It's great; he can connect with other kids of like interests, and that he isn't as judged online as he is in 'in person' social situations." One respondent was optimistic about how the Internet would help her 13-year-old daughter in the workforce: "[She] can work from home if she is more comfortable doing that instead of an office."

Many respondents expressed concern about their child accidentally stumbling onto sites or videos that are not appropriate. A respondent with an 8-year-old son remarked, "He has not yet learned what the safe boundaries for exploration are and when he's in 'inappropriate' territory." A few respondents noted the lack of instinctual boundaries in time spent on the Internet, especially

compared with the real world. One said, “We have to limit the time because he would never stop playing Minecraft.” Another remarked, “I worry about creating a stereotypical neckbeard basement dweller who can only deal with online social interaction instead of directly engaging the world.” Another concern was the children’s ability to understand the risks and dangers. “He is very naïve,” said one respondent about a 10-year-old boy. A respondent with an 11-year-old boy commented, “His level of discernment is very, very low.” Others brought up concerns about clicking on advertisements, giving away personal information, child predators and cyber bullying.

When asked to comment on concerns about how easy the Internet was for their child to use, respondents had very little to say. One commented, “None really. I’m glad it’s relatively easy for him as he loves it.” Others reiterated safety concerns.

3.2.4. Insights for Pilot Study

The survey revealed that general accessibility is not a large concern to parents and caregivers of children with ASD. When the respondents were asked to compare their child’s ability to do certain computer related tasks to that of a neurotypical child of the same age, they ranked input device related tasks (use of mouse, trackpad, touchpad and keyboard) as the same level of skill as their peers. In fact, they often ranked their ability to use a touchpad (like on most tablets) as better than their peers. Due to these responses, the priority of investigating overall accessibility of computers and websites was lowered.

Parents and caregivers noted that the largest deficiency in their children’s skill was the ability to understand privacy or safety concerns online, and understand the difference between ads and content. This, along with comments from Section 3.2.3, motivates the investigation of larger digital literacy concerns among persons with ASD.

CHAPTER 4. PILOT STUDY METHODS AND PROCEDURES

4.1. Experimental Design

Very little prior research has explored the differences in digital literacy or website content assessment between persons with or without ASD. Accordingly, it was decided to conduct an exploratory pilot study using a non-experimental design to identify potential patterns and motivate further investigation.

The study consisted of a combination of two validated survey tools and a laboratory study. Participants completed a survey to score the strengths of various cognitive traits like social skills, communication, imagination, attention to detail, attention switching and information processing styles. These traits are commonly associated with ASD. Survey questions were taken from two validated survey tools: the Autism-Spectrum Quotient (AQ) tool from Baron-Cohen, et al. (2001) and the Style of Processing (SOP) tool from Childers, et al. (1985). The participants were separated into two groups based on their responses to the Autism Quotient survey. Using the scoring method from the survey tool, a score of 32 or greater indicates clinically significant levels of autistic traits. Therefore, participants who scored 32 or more formed the group of students with ASD, and participants who scored less than 32 formed the control group of neurotypical students. The SOP questions were added to indicate each participant's preference for visual and verbal processing, and to correlate with the AQ score.

The laboratory portion of this study employed a within-subject design. All participants were exposed to the same set of stimuli: groups of four questions, with eight websites per question and four scan sets (a 4 x 4 grid of verbal or visual elements). The questions were randomly ordered and the sites within the questions were also randomly ordered, to reduce learning effects. The scan sets were inserted between questions, also in a random order. Participants were asked to verbalize their process of finding answers to the questions, and pupil movements were recorded by eye-tracking equipment. Recruitment and research protocols for this study were approved by

Iowa State University's Institutional Review Board, which reviews all research involving human participants (IRB ID #12-550).

The primary research questions this pilot study sought to answer were:

RQ1: *How well do people with or without ASD assess purpose, authorship and advertising on websites?*

RQ2: *Are there differences in the ways people with or without ASD evaluate web content?*

In addition, the researchers also wanted to assess the feasibility of running this kind of study at Iowa State University and form specific testable hypotheses around which to design later experiments.

Due to the large amount of parental concern over advertising discernment, it was hypothesized that participants with ASD would either have trouble with identifying advertising or be more distracted by it than their peers. Guides into making websites for people with ASD indicate a preference for visual content over verbal content. Therefore, it was also hypothesized that participants with ASD would spend more time looking at visual content than verbal content.

4.2. Participants

4.2.1. Inclusion and Exclusion Criteria

In order to reduce variance based on education, age, and experience with computers, participants were selected from the limited population of 18-24 year old Iowa State University undergraduate and graduate students. The selected participants represented a variety of disciplines and backgrounds. All participants had enough web experience to successfully communicate with the researchers via email and complete the online survey. All volunteers were asked to take the survey portion of the study, and then were divided into two groups based on their Autism-Spectrum Quotient score. Volunteers who scored under 32 were categorized as the neurotypical control group, while those who scored 32 or higher were categorized as in the ASD

group. Participants were randomly selected from the volunteers to fill 10 spots in the control group. Due to the limited number of volunteers who qualified to be in the autism group, all 4 volunteers with scores of 32 or higher were invited to participate in the study.

4.2.2. Recruitment

Volunteers for the study were recruited through multiple means. A mass email was sent out to 26,320 graduate and undergraduate students, with 4,531 of them opening the message and 299 volunteering to participate. Flyers were hung on bulletin boards around campus, inviting those interested to email the researchers (3 volunteers). In an attempt to elicit more students that might have autistic traits, e-mails were also sent to departments and groups, such as Computer Science, Computer & Electrical Engineering, and the Virtual Reality Application Center (8 volunteers). The Student Disability Resources Center also sent an email out to 271 students broadly identified as having "learning disorders" which includes ASD and Asperger's (1 volunteer).

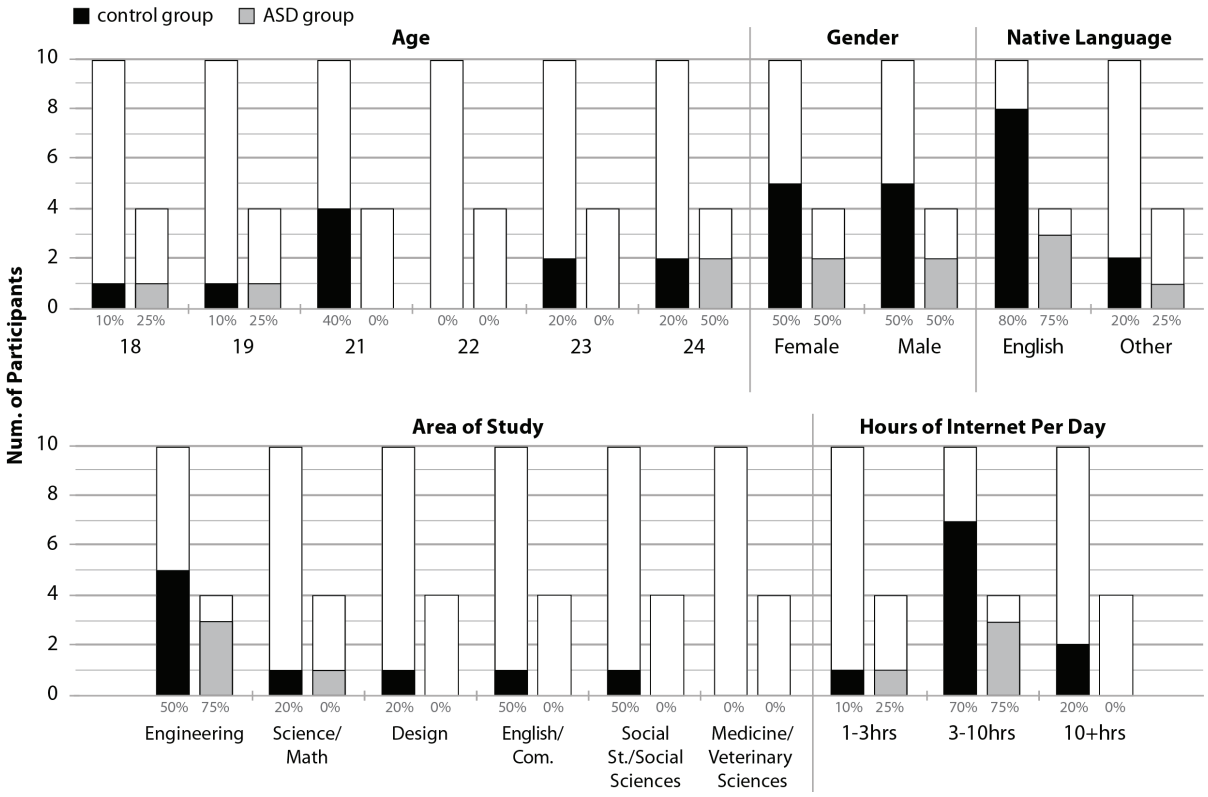

Figure 4.1: *Demographics of participants in pilot study*

4.2.3. Demographics

335 students volunteered to participate in the study. Out of those 152 completed the initial survey. 144 volunteers were eligible for the control group (scored under 32 and were 18-24 years old); 5 volunteers were eligible for ASD group (scored 32 or higher and were 18-24 years old). 2 volunteers self-identified as having Asperger's (no one was asked to give any medical information), though only one of those volunteers had an AQ score of 32 or higher. From the group of control volunteers, 10 were randomly selected to complete the lab study. All of the volunteers who were eligible for the ASD group were invited to the lab, though one was unable to complete the lab study due to problems calibrating the eye-tracker. Participants represented a variety of disciplines and backgrounds, as shown in Figure 4.1.

4.3. Procedure

4.3.1. Survey

Students that responded to the recruitment methods were sent an email with a link to the online survey. This survey was composed of 79 questions, combining the 50 questions from Autism-Spectrum Quotient (AQ) survey, the 22 questions from the Style of Processing tool and a few questions about demographics and Internet usage (see Appendix C for full survey). Participants took an average of 10 minutes to complete the survey. Any participant who did not complete the survey was not invited to move on to the laboratory study.

4.3.2. Lab Eye-tracking Study

Participants who completed the online questionnaire were invited to come to the lab to complete the study. Participants were first introduced to the study process, given an incentive (a $10 gift card to the campus cafes), and asked to sign an informed consent document. They were then seated at a computer equipped with a static remote eye-tracker (EyeTechDS VT2 Eyetracker system). Eye-tracking data was collected through iMotion's Attention Tool, and each participant's screen and comments were recorded using Camtasia. Attention Tool was used to calibrate the eye-tracker to each participant, using a 12-point grid.

Once the eye-tracker was calibrated, participants were asked four questions about eight websites (see Figure 4.2). The websites were chosen to provide a range of familiarity, content types (visual or verbal) and subject matter. Five sites were from US AlexaRank's top 10 sites, making it likely that the participants had spent time visiting these sites. The other three sites were less popular sites with which participants were unlikely to have had much experience. The websites were:

- Amazon (online shopping) – product page (AlexaRank #9)
- Facebook (social network) – front page (AlexaRank #2)
- Google (search engine) – results page (AlexaRank #1)
- YouTube (video-sharing) – music video player (AlexaRank #5)
- Wikipedia (crowd-sourced encyclopedia) – article (AlexaRank #3)
- NBC News (news) – home page
- Munchin with Munchkin (recipe blog) – front page
- Minneapolis Metro Transit (government transit) – train schedule

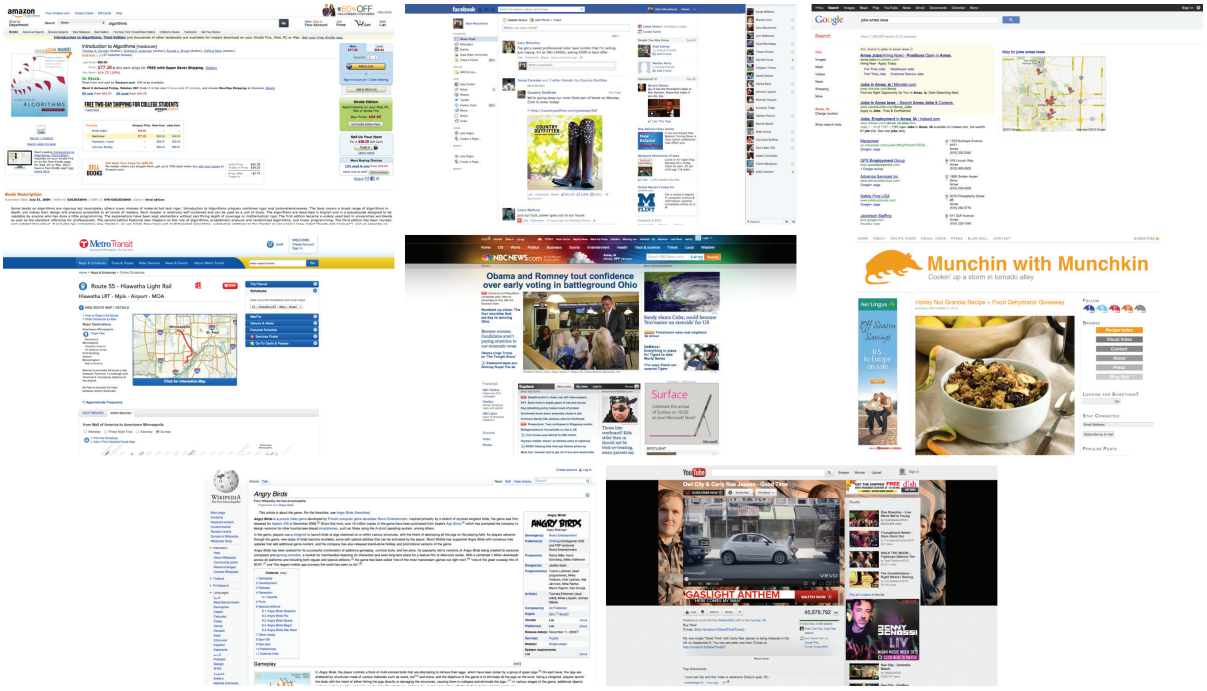

Figure 4.2: *Websites used for eye-tracking study*

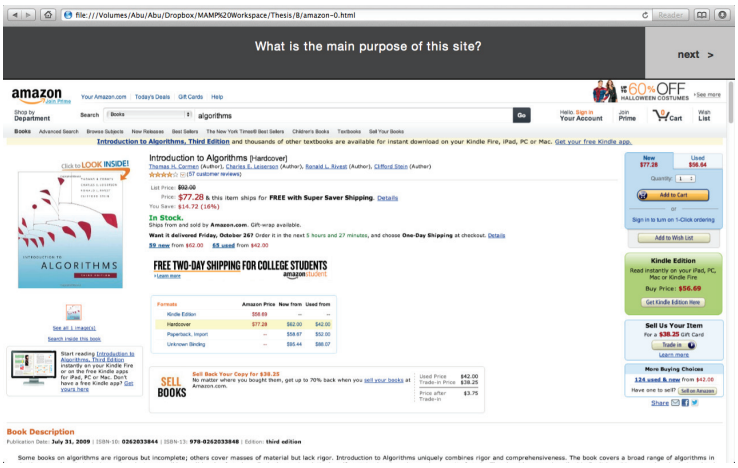

Figure 4.3: *Presentation of stimuli within web browser*

Participants were asked to answer four questions that focused on different aspects of digital literacy. The questions were:

- What is the main purpose of this site?
- Who wrote or made the main content on this page? If you can't tell from this page, how would you find out?
- Where is the navigation on this page?
- Is there any advertising on this page?

Questions were displayed above the web pages (see Figure 4.3), to avoid testing memory or retention. Questions were asked in a random order, and the sites were randomized within each question in order to avoid a learning bias. Pages were initially covered and then revealed after the participant had read the question. This was done for a consistent visual reset between sites.

Between each question set, there was a seeking task where participants were shown 4 x 4 grids of elements, and asked to find specific elements as they were listed by the study facilitator. The four scan sets showed distinct types of elements: images of people, miscellaneous images, words, and words with visual borders. Participants were asked to find three distinct elements on each page. These seeking tasks provided a break from the websites and questions.

The last portion of the study asked participants to find specific information on the website screenshots, given the following scenarios:

- What time would you have to leave the Mall of America to get to the airport by 3:00pm? (on Minneapolis Metro Transit)
- You want to make this 'honey nut granola'. What do you need to add to your shopping list? (on Munchin with Munchkin)
- You wake up and wonder if you should wear a coat today. How would you find how warm it will be on this page? (on NBC News)
- Your friends and you were debating about when Angry Birds came out. According to this page, what year did it come out? (on Wikipedia)
- If you really liked this video, how would you express what you thought of it to others? (on YouTube)
- If you needed to get a reference book on algorithms, would you get this one? Why or why not? (Amazon)

The laboratory study concluded with a short open interview to ask any follow up questions about the study and debrief the participants on the full nature of the research. Studies took place from December 2012 to March 2013. Participants took 30-60 minutes to complete the laboratory portion of the study.

4.4. Measures

4.4.1. Survey Scores

As was mentioned previously, the survey participants took was made up of questions from Simon Baron-Cohen's Autism-Spectrum Quotient Survey (2001) and Childers' Style of Processing survey (1985). The survey was scored in accordance with each survey design to produce overall AQ and Style of Processing scores and subscores in specific areas of interest.

The AQ survey (see Appendix C) provided subscores for attention to detail (1, 6, 15, 27, 43,

45, 55, 58, 63, 70), attention switching (4, 5, 7, 16, 34, 35, 39, 49, 51, 54), communication (8, 9, 11, 29, 31, 33, 36, 57, 60, 68), imagination (8, 9, 11, 29, 31, 33, 36, 57, 60, 68), and social skills (12, 24, 25, 32, 47, 52, 56, 59, 61, 72). Questions where responses that concurred with autistic traits were scored 1, regardless of whether the participant responded "definitely dis/agree" or "slightly dis/agree." Each of the subscores could have a minimum score of 0 and a maximum score of 10. The highest score possible for the AQ questions was 50, however, Baron-Cohen determined that a good cutoff point was 32. In their study 80% of the adults with ASD and only 2% of the controls scored 32 or higher (2001, p. 14).

The visual (17, 21, 22, 38, 41, 44, 46, 48, 64, 65, 67) and verbal (3, 18, 19, 20, 23, 26, 28, 40, 66, 69, 71) questions were coded on a scale of 1-4 and summed to give the Style of Processing score. This score could range from 22-88 with more visual processers receiving higher scores and more verbal processers receiving lower scores.

4.4.2. Eye-tracking Fixations and Time on Task

The iMotions Attention Tool software uses a duration dispersion method of identifying fixations. Gazes that were within a 1-degree radius for at least 100 ms were considered fixations. Fixation centers were calculated based on all the gazes in the fixation, not just the initial point of fixation (iMotions, 2012).

The total time each participant took on each task was measured in milliseconds from the moment the participant clicked to reveal the site to the moment they clicked the next button (these events were recorded through Attention Tool). These times were summed with respect to each site, task and participant, and compared between groups.

4.4.3. Eye-tracking AOI Analysis

One of the most common measures used in eyetracking is the area of interest (AOI) hit, which indicates how many times a participant fixated on a particular area of the screen (Holmqvist et al., 2011; Poole & Ball, 2005). In addition to the AOI hit, the total time spent in each AOI (in ms) was measured, along with the percentage of time spent in each AOI and the time to the first fixation

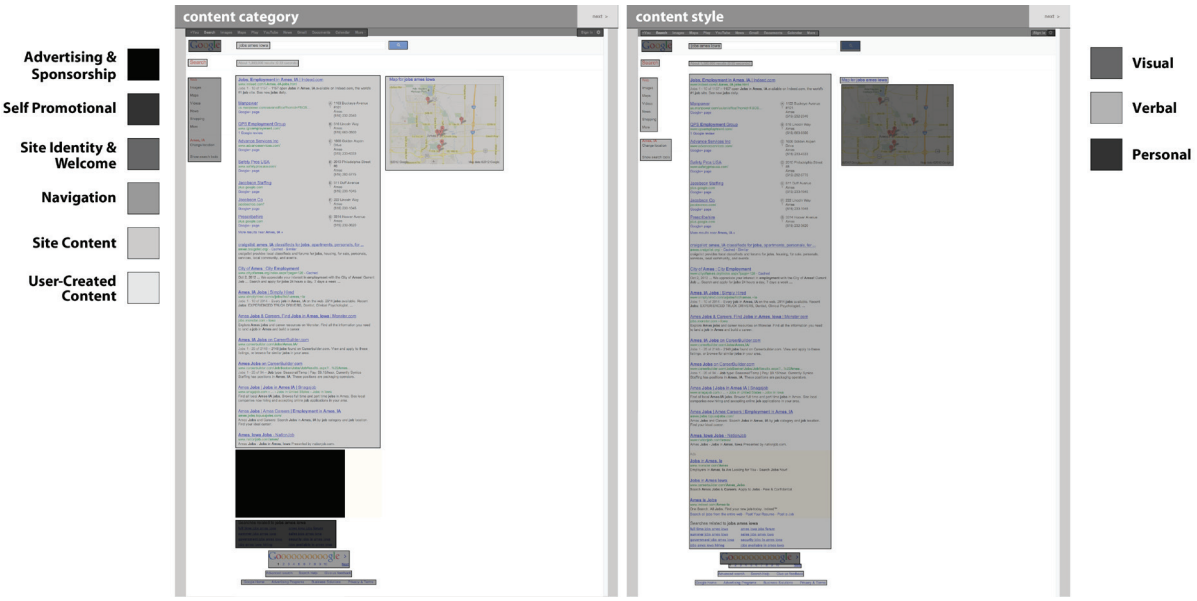

Figure 4.4: *AOI mapping of Google.com based on content category (left) and content style (right)*

(TFF) on each AOI. Fixations were only measured after the participant had revealed the site (after they had first read the question).

AOIs were defined and analyzed according to the content style (verbal, visual, or personal) and the content category (advertising, self promotional, site identity, navigation, content, or user-created content) (see Figure 4.4). In this context, verbal typically refers to text content, "visual" refers to image content, and "personal" refers to images with people in them. AOI mappings for each site can be found in Appendix F. Content categories were based off of the categories used in Nielsen's evaluation of homepage elements (Jakob Nielsen & Tahir, 2001).

Raw gaze and fixation data was exported from Attention Tool for each participant. By running this data through a custom script, each data point was matched with both a content category and content style. Points were also adjusted based on scrolling events to account for the changing position of the page relative to the screen. Any instances of smooth pursuit were not counted as fixations.

4.4.4. Task Success

Participants' responses to each of the study's questions were coded as "success" or "failure"

based on whether or not they correctly identified the purpose, author, advertising, or navigation on the page. Task based questions were coded as “success” or “failure” based on if the participant correctly completed the task or indicated how they would complete the task.

In addition to basic success/fail results, participants’ responses were also coded in more detail to identify aspects of the site they verbally acknowledged. For example, many participants noted that though the Wikipedia page shown in the study did not have any advertising on it, Wikipedia sometimes runs banner ads across the top urging readers to donate. Mentions of this banner were recorded across all participants.

CHAPTER 5. KEY FINDINGS AND DISCUSSION OF RESULTS

5.1. Survey Findings & Correlations

The responses from each participant's survey were summed according to the respective survey's scoring design (see Section 4.4. The mean Autism Quotient (AQ) score for all participants was 23.7 (SD: 10.0), with the mean score of the control group at 17.5 and the mean score of the ASD group of 36.0 (note that the cutoff for the ASD group was a score of 32 or higher). The mean Style of Processing (SOP) score was 57.7 (SD: 8.2), with the mean score of the control group at 55.9 and the mean score of the ASD group 61.4 (see Table 5.1). The SOP survey had a maximum possible score of 88 and a minimum possible score of 22. Higher scores indicate a stronger preference for visual processing, lower scores a preference for verbal processing, and little preference for scores in the middle.

Scores were also analyzed to discover patterns and correlations within the groups. The strongest correlations between the AQ scores, AQ subscores, the SOP and other coded categorical variables, are between the AQ Score and the AQ subscores communication (ρ=.96), social skills (ρ=.91), and attention switching (ρ=.84) (see Figure 5.1 and Appendix G for more correlation statistics). Other subscores (imagination & attention to detail) were not very strongly correlated to the total AQ score. Participants' SOP, gender and native language were also not highly correlated. These findings may suggest a way to cut back the number of questions in the AQ

Table 5.1: *Autism Quotient (AQ) & Style of Processing (SOP) Score Statistics*

	All (n=15)	Control Group (n=10)	ASD Group (n=5)
Mean AQ	23.7	17.5	36.0
Standard Dev. AQ	10.0	5.6	2.8
Max AQ	41.0	27.0	41.0
Min AQ	8.0	8.0	33.0
Mean SOP	57.7	55.9	61.4
Standard Dev. SOP	8.2	7.2	8.9
Max SOP	72.0	72.0	67.0
Min SOP	42.0	42.0	51.0

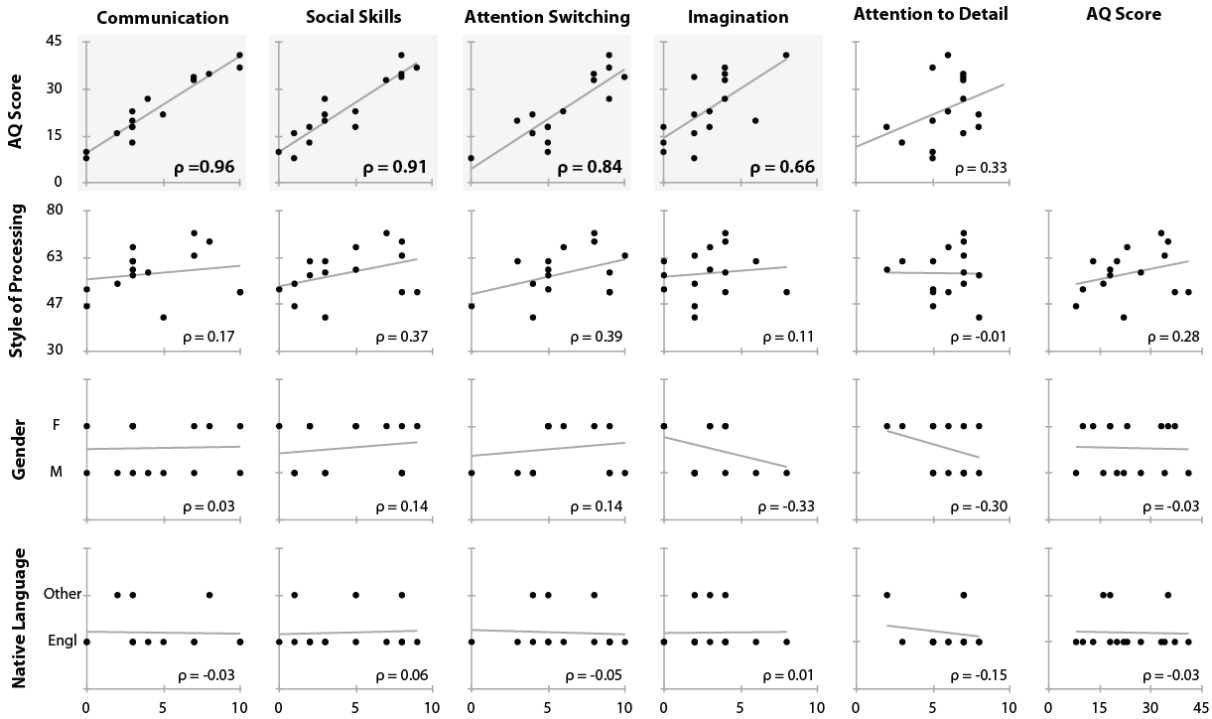

Figure 5.1: *Correlations between various scores and subscores from pilot survey (correlations with significant p-values are highlighted)*

survey, or place more priority on communication and social skills (part of the ASD diagnostic criteria) over attention to detail and imagination.

Analysis of the average response to the personality trait questions within each group also revealed some interesting trends. Each participant's responses were scored from 1-4 with a "definitely disagree" as 1 and "definitely agree" as 4 (regardless of the original scoring design). These responses were then averaged for each question and in each group. The type of questions with the largest difference between the averaged responses of the control and the ASD groups were verbal and communication questions (average difference = 1.07). The type of questions with the smallest difference between the averaged responses was attention to detail (average difference = 0.46).

The following statements had the largest difference in the average response between the two groups:

1. "I find making up stories easy." (ASD group – disagree)

2. "I enjoy doing work that requires the use of words." (ASD group – disagree)
3. "When I talk on the phone, I'm not sure when it's my turn to speak." (ASD group – agree)
4. "I find it difficult to imagine what it would be like to be someone else." (ASD group – agree)
5. "I spend very little time attempting to increase my vocabulary." (ASD group – agree)

The three statements that all five participants in the ASD group definitely disagreed with were "I find making up stories easy," "I would rather go to the theatre than a museum," and "I prefer to do things with others rather than on my own." The statements the participants in the ASD group most agreed with were "I am fascinated by numbers," "I notice patterns in things all the time", and "I do a lot of reading." The statements that the ten participants in the control group most disagreed with were "When I talk on the phone, I'm not sure when it's my turn to speak," "I am fascinated by dates," and "When I'm reading a story, I find it difficult to work out the characters' intentions." The statements that the participants in the control group most agreed with were "I often make written notes to myself," "There are some special times in my life that I like to relive by mentally "picturing" just how everything looked," and "I do a lot of reading."

5.2. Eye-tracking Analysis

The average total time the lab study tasks took for all participants was 23.38 minutes (SD=12.08 min), with the control group (n=10) taking an average of 21.06 minutes (SD=7.64 min) and the ASD group (n=4[3]) taking an average of 29.20 minutes (SD=19.84). During that time, less than half was spent fixated on any point on the page. The correlation between the percentage of time participants' eyes were fixated and the participants' AQ scores were almost

3 Note: The size of the ASD group is different between the survey (n=5), think-aloud (n=5) and eye-tracking metrics (n=4) due to an error calibrating the eye-tracker for one participant in the ASD group. She completed the survey and the lab study but could not provide eye-tracking data.

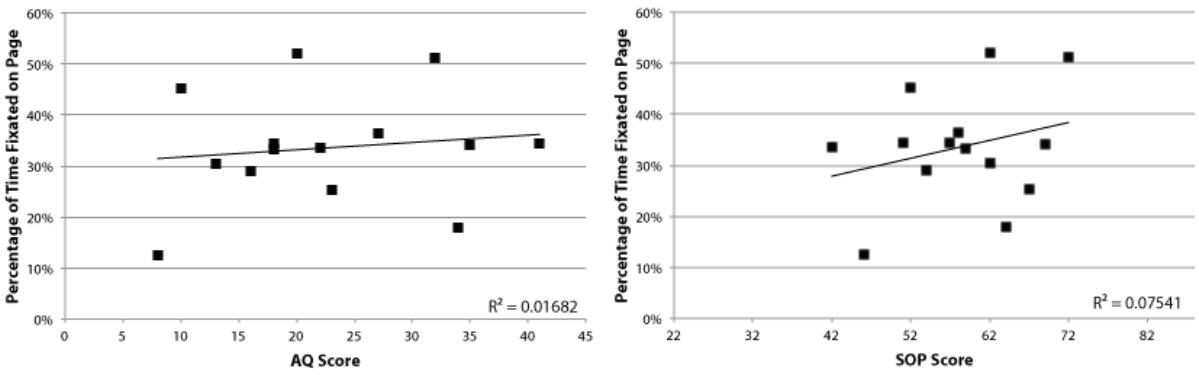

Figure 5.2: *Correlation between survey scores and percentage of time the eyes were fixated on the webpages*

nonexistent (ρ=.01). The correlation between the percentage of time fixated and SOP score was slightly stronger, but still was negligible (ρ=.08, see Figure 5.2).

5.2.1. AOI Measures

Examining the AOI measures, the ASD group (n=4), on average, had more and longer fixations than the control group (see Figure 5.3). However, the measures are fairly similar if the fixation durations are examined as the average percentage of the total time on the site (see Figure 5.4). The biggest mean differences between the fixation durations of the two groups were in verbal areas ($\mu_C - \mu_A$ = -54506 ms, 95% CI [-176489 ms, 67477 ms]) and page content ($\mu_C - \mu_A$ = -42910 ms, 95% CI [-139136 ms, 53316 ms]) (note that the confidence intervals of each of these measures do not rule out the null hypothesis). This difference was most pronounced in questions which asked about the author, purpose and asked participants to perform a specific task, and for sites Amazon, NBC, and Munchin' with Munchkin. Wikipedia actually flipped the difference, with the control group having longer and more fixations on user content and verbal areas.

There was also very little difference in the average time to first fixation between the two groups. Removing the extreme outliers in the time to first fixation (TFF) on advertising AOI for the advertising task (see Figure 5.5), the difference in means was about one second ($\mu_C - \mu_A$ = -1040 ms). A larger difference can be found between the TFF of males and females ($\mu_M - \mu_F$ = 4753 ms). This pattern also held when analyzing navigation AOI for the navigation task. The difference in means between the AQ-based groups was less than one second ($\mu_C - \mu_A$ = 738 ms), and the

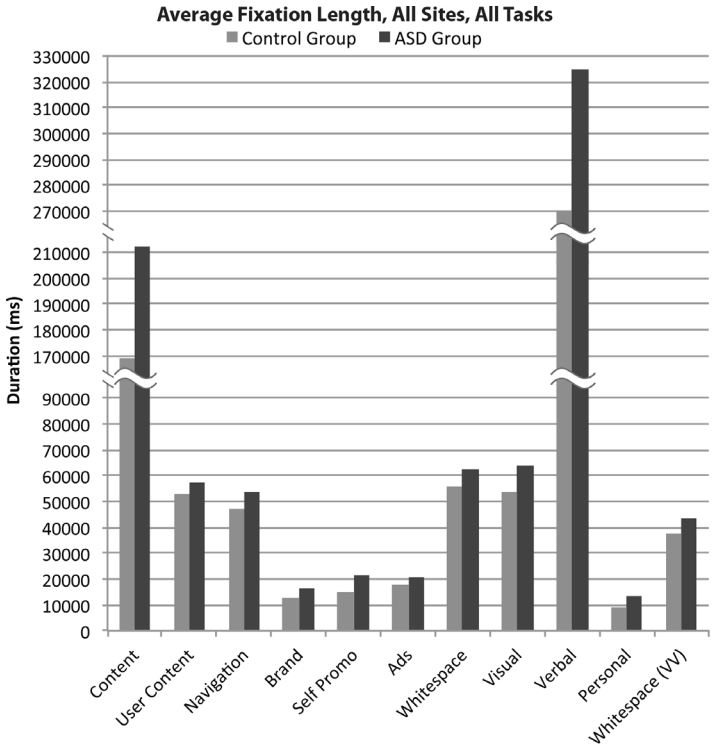

Figure 5.3: *Average fixation length (in ms) for each type of content and content style, over all sites and all tasks*

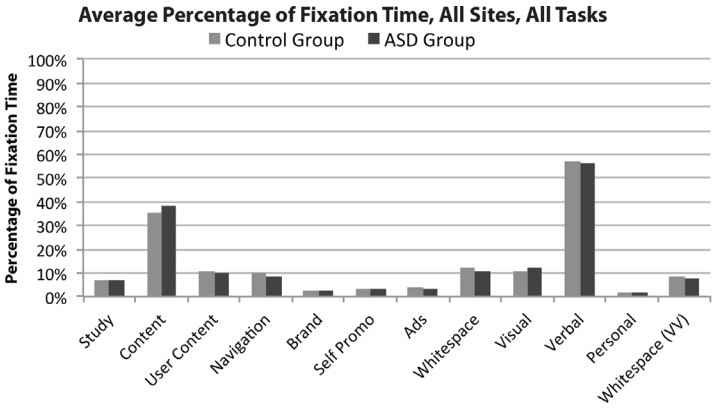

Figure 5.4: *Average percentage of total time fixated on each type of content and content style, over all sites and all tasks*

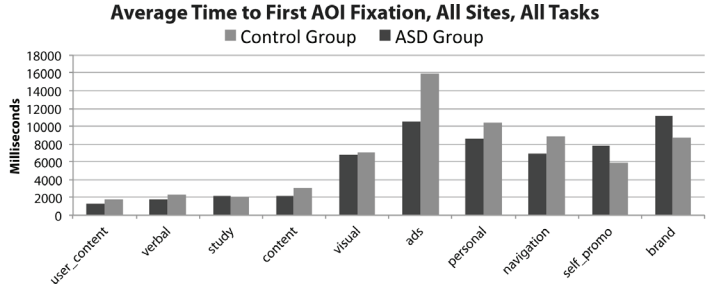

Figure 5.5: *Average time to first fixation on different AOI for all tasks*

difference in means between the gender-based groups was more than twice that ($\mu_M - \mu_F$ = -1823 ms).

5.2.2. Content vs. AQ Scores Correlation

In order to determine if the participants' AQ scores had any effect on the types of content (visual or verbal) the participants fixated on, the fixation measures were correlated with the participants' SOP scores and AQ scores (see Figure 5.6). In each measure, the SOP score was a better predictor than AQ score for the amount of time that participants would spend fixated on both visual and verbal content. Higher SOP scores indicated greater preference for visual processing, and were positively correlated on all three measures (number of fixations, fixation duration, and percentage of fixation time) for both visual (ρ=.35; ρ=.28; ρ=.20) and verbal (ρ=.32; ρ=.33; ρ=.16). While none of these correlations can be considered a strong indicator, they were certainly stronger than the non-existent correlation between AQ scores and visual (ρ=-.01; ρ=-.01; ρ=.01) or verbal (ρ=0; ρ=-.01; ρ=0) areas of interest. Separating out the visual areas that had human subject matter (faces, bodies, silhouettes) revealed the same trend of SOP exhibiting stronger correlations, though the correlations with the AQ scores was marginally higher (ρ=-.13; ρ=-.08; ρ=.03).

Similarly, the AQ and SOP scores were correlated with the fixation measures of content and advertising areas of interest (see Figure 5.7). As with visual style, the SOP score was a better predictor than AQ score for the amount of time that participants would spend fixated on both content and advertisements. Higher SOP scores were positively correlated for both content (ρ=.27; ρ=.26; ρ=.11) and advertising (ρ=.46; ρ=.36; ρ=.21), though none of these values could be considered a strong correlation. The AQ score, again, was minimally correlated with the amount of fixation on content (ρ=-.03; ρ=-.03; ρ=0) or ads (ρ=.02; ρ=.01; ρ=.06).

The small correlation of fixations to SOP might indicate that while there were text areas on the page, the web is primarily visual media that those with visual processing preferences find more engaging. Also, the tasks participants were asked to do did not require much reading or verbal

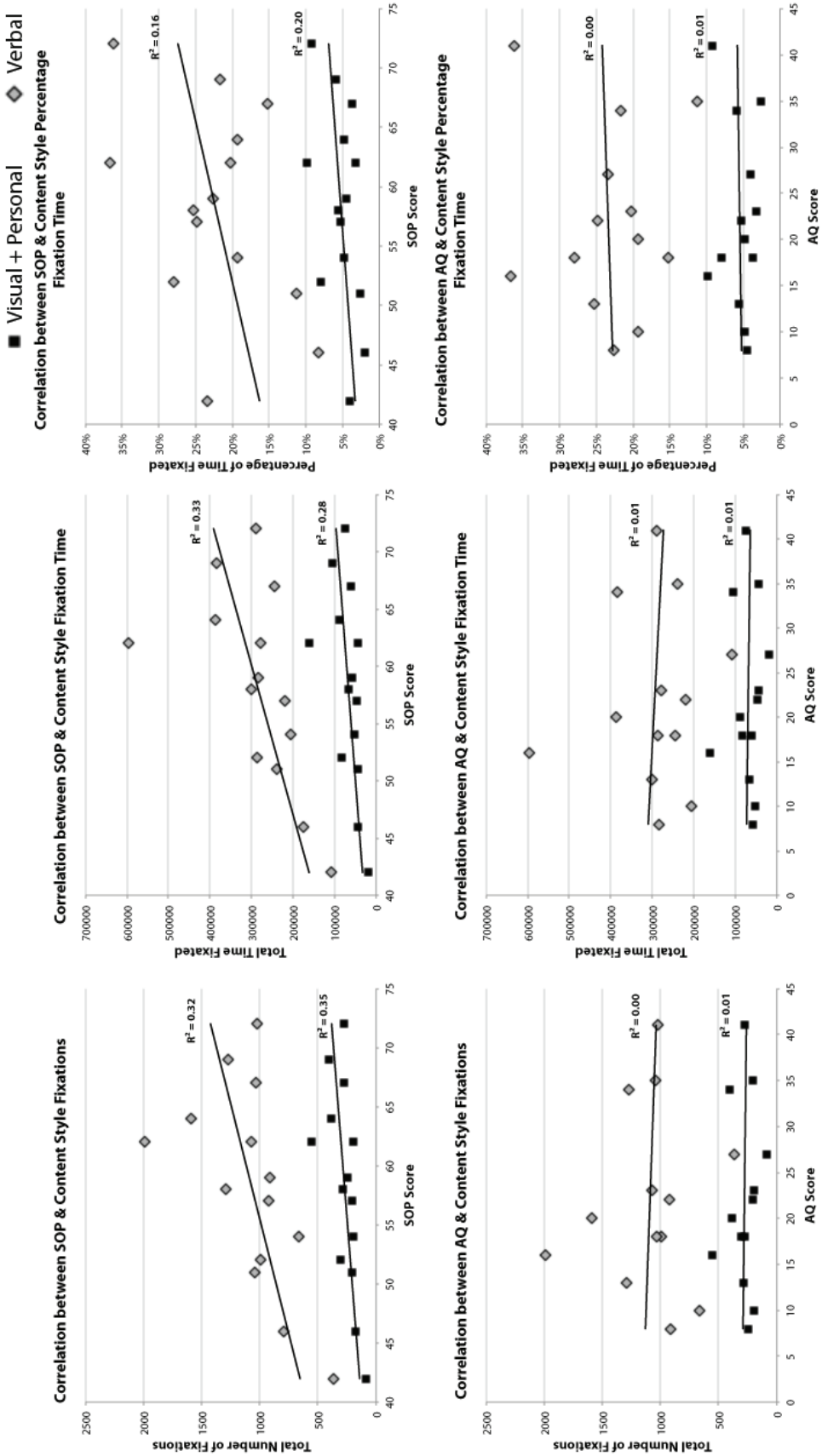

Figure 5.6: *Comparison of correlations between survey scores and fixations on visual and verbal content*

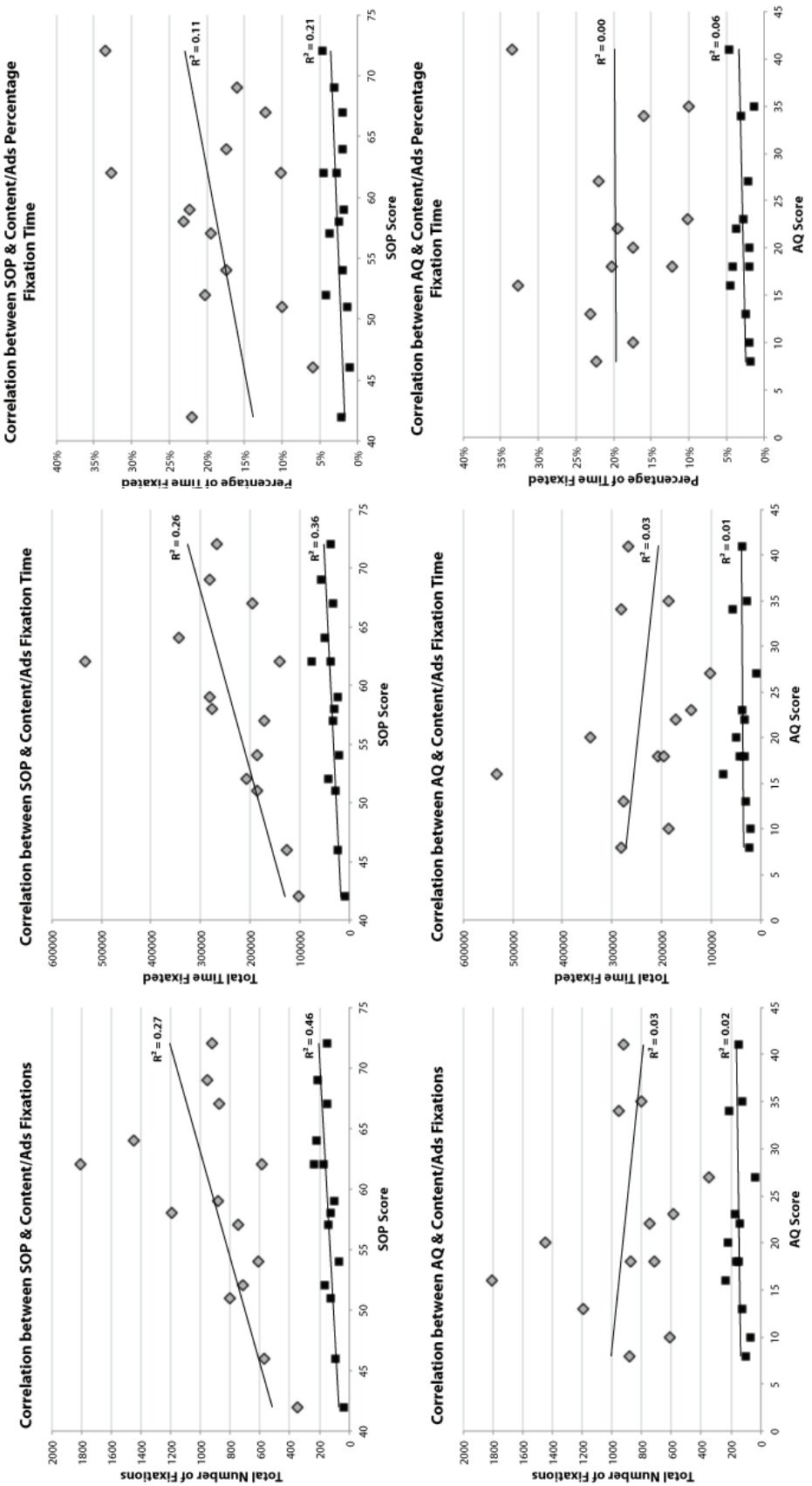

Figure 5.7: *Comparison of correlations between survey scores and fixations on content and advertising*

processing, but instead involved scanning the pages to discern various attributes. Had there been a more verbal–intensive task, these results may have been different.

Whatever the effect of the SOP scores, these metrics show very little difference, from a subconscious, eye-movement perspective, in the ways that people with or without ASD view the Internet.

5.3. Task Success and Comments

The think-aloud method revealed the conscious ways that participants went about answering the task questions. The ability to clearly articulate thoughts was fairly equal across the control group and the ASD group. The participants that had the greatest trouble thinking aloud were participants whose native language was not English. The average time on task was generally higher for the control group than the ASD group ($\mu_C - \mu_A = 3.99$s; see Figure 5.8), however this could be attributed to the unequal sample size in the two groups. The control group (n=10) had a higher standard deviation (SD_C=15.78s) than the ASD group (n=5; SD_A=12.02).

Occasionally, a failure on a task did not necessarily correspond to a lack of understanding, but was simply the participant failing to answer the original question after getting distracted by thinking aloud or website elements. This distraction-based failure happened with participants in both groups.

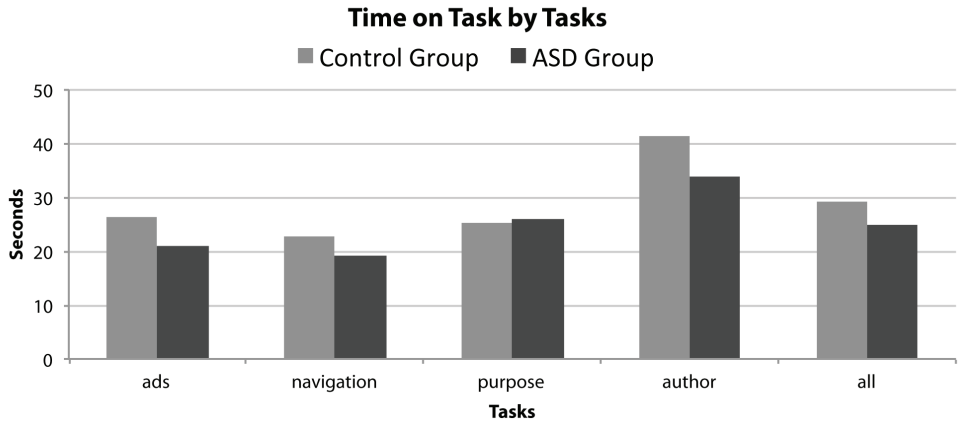

Figure 5.8: *Average time on task for control group and ASD group divided by task type*

Table 5.2: *Task success rate for groups, with rates under 75% highlighted*

	Control Average (n=10)	ASD Average (n=5)	Overall Average (n=15)
Is there any advertising on this page?			
amazon	100%	80%	93%
facebook	90%	100%	93%
google	**50%**	**40%**	**47%**
metro	90%	100%	93%
nbc	100%	100%	100%
recipe	100%	100%	100%
wiki	100%	100%	100%
youtube	100%	100%	100%
What is the main purpose of this site?			
amazon	100%	80%	93%
facebook	100%	100%	100%
google	**70%**	100%	80%
metro	80%	100%	87%
nbc	100%	100%	100%
recipe	100%	100%	100%
wiki	100%	80%	93%
youtube	90%	100%	93%
Where is the navigation on this page?			
amazon	90%	80%	87%
facebook	100%	100%	100%
google	100%	100%	100%
metro	100%	100%	100%
nbc	100%	100%	100%
recipe	80%	100%	87%
wiki	100%	100%	100%
youtube	90%	100%	93%
Who wrote or made the main content on this page?			
amazon	**40%**	**40%**	**40%**
facebook	90%	100%	93%
google	**30%**	**40%**	**33%**
metro	100%	80%	93%
nbc	80%	**60%**	**73%**
recipe	100%	100%	100%
wiki	**40%**	**20%**	**33%**
youtube	90%	80%	87%

5.3.1. Purpose Tasks

Participants had a fairly easy time deducing the purpose of the sites from the screenshot stimuli. The one site participants had some trouble on was the Google search results page, which displayed results of the search query "jobs ames iowa." The three participants (all control group) who failed this task for Google, described it as a site to get information on jobs: "The main purpose of this site is to look for job opportunities in Ames" (Participant K, control group).

One interesting aspect of this task was the technical jargon that was and was not used to label the sites. Only one participant described Amazon as an "online retailer" (from the control group), and none used the term "e-commerce." Five participants (3 from the ASD group) used the term "search engine" to describe Google. Five participants (2 from the ASD group) called the Munchin' with Munchkin site a "blog." The largest usage of a jargon term was Facebook, where nine (3 from the ASD group) participants described it as a "social network", and one (from the ASD group) as "social media." Web designers and developers use these labels frequently; however, the participants mostly used verbs (like "shopping," or "finding") to describe the sites. The popularity of the term "social network" could be attributed to the popularity of the movie entitled (2010), about Mark Zuckerberg and the creation of Facebook.

While most participants mentioned the name of the website when analyzing purpose (often verbatim off the logo), participants made very few fixations on branding. The average fixations on branding for analyzing purposes did not differ between the two groups. Sites that were more familiar to participants (Amazon, Google, Facebook and YouTube) received an average of 0-2 fixations on branding AOI. Sites that were only moderately familiar (MetroTransit, NBC News, and Wikipedia) received 2-6 fixations. The recipe blog, with which no participant was familiar, had an average of 8 fixations on branding AOI. It is reasonable to assume from this data that participants were able to recognize and recall more familiar sites using other site elements, not just the logo.

5.3.2. Author Tasks

The authorship task proved to be the most difficult for participants, especially on pages that were dynamically generated (like Google, Amazon, and NBC). Many participants, in both groups, incorrectly attributed the content to "code" or "programmers." On Amazon, where the listings are created by the seller with content typically originating from the items' manufacturers or producers, 60% of participants attributed it either to Amazon programmers or to the authors of the book. Participant H (ASD group) said, "It's probably generated by programming code rather than someone per se." Only 4 participants (2 ASD group) correctly attributed the content from the Google search results as coming from the websites they link to. "No one made it, because it's just a big database," claimed Participant A (ASD group), and Participant F (control group) similarly said, "It's generated automatically." Two participants (both from control group) joked about Googling for the answer:

> *"They just use an algorithm for this. I suppose it's chosen by an algorithm not by an individual person…I guess to find out I'd Google, 'who did the algorithm for Google'." (Participant J, control group)*

Most (87%) participants correctly understood that Wikipedia was made up of user-generated material, and that anyone can edit it. Only 33% of participants determined where they could find who edited the page, while 27% claimed there was no way to tell who edits the pages.

5.3.3. Advertising Tasks

Most participants verbalized their strategy for finding ads as searching along the top of the page and down the sides. There were generally no problems finding advertisements, though Participant J (control group) felt uncertain about text ads: "I don't know if that counts though because usually I think of ads as images."

Google presented the most failures, due mostly to participants' preconceptions that the ads (if there were any) would be on the top or right side. For example Participant G (control group), who

eventually found the ads, commented, "There weren't ads up above, which I was expecting, or along the right side." Participant O (ASD group) made a similar comment, though he somewhat mistook the organic results for advertisement:

> *"When Google puts ads, they usually put them up here [mouse over top of listings] or right here [mouse over right side]. But I don't see any, because the search is looking for advertisements anyway, so the advertisements are going to be in the main content anyways, there aren't going to be extra ads."*

The ads on the Google page were on the bottom of the results, and, of the six participants who failed this task, two of them didn't even scroll down that far before saying there were no ads. Most of the participants did scroll to the bottom, however, and simply missed the yellow box with the ads. Participant F (control group) even confirmed, "Yeah, there's nothing on the bottom."

Four participants indicated that they thought Google's organic search results were advertisements or were paid for by the website's owners. Participant D (control group) confidently remarked:

> *"This is sneaky advertising, because technically there are no ads on here they're just providing you with links to whatever I am supposedly interested in. And yet I do know that those that pay the most money by Google get the top priority and are the first ones that I see when I type in my search. So it's not a completely altruistic search engine any more."*

Amazon was also a source of some confusion regarding the extent of advertising. A few participants felt the whole site qualified as an ad, due to its sales nature: "Amazon itself kind of is an ad" (Participant M, ASD group), "Technically this whole thing is an advertisement…" (Participant J, control group), and "I guess you could consider the whole page an advertisement since it's advertising its product" (Participant H, ASD group). Participant D (control group) felt

the recommended items were ads because "it is advertisement for something I didn't come to the site to get."

While all the participants were able to identify the advertising found on the sidebar of Facebook (the one failure was due to a participant skipping the question), very few noticed the advertisement embedded in the "News Feed," or main content of the page. 2 participants (1 in ASD group) identified the large "Country Outfitters" image as an ad. Participant B (control group) even scanned the "News Feed" specifically, commenting that they occasionally put ads there and did not find it.

Lack of advertising is a part of Wikipedia's identity, and 7 participants (2 in ASD group) indicated previous knowledge about Wikipedia's stance on ads ("Wikipedia prides itself in having no ads," said Participant O, ASD group). Four of the participants also mentioned the call for donation banners Wikipedia sometimes has at the top of the page, though that banner was not shown on the presented stimulus.

5.3.4. Navigation Tasks

The biggest issues that arose in the navigation tasks were different conceptions of what qualifies as navigation. When participants asked the study facilitator to define navigation, she instructed that it was the primary area you use to get from one part of the site to another. Many of the failures on this task were from participants identifying links on the page and never indicating the primary navigation bars at the top or sides. This was a particularly prevalent issue on YouTube, where 60% of participants classified the featured videos along the right side as navigation.

The search bar (which existed on all of the pages) was also inconsistently labeled as navigation. Anywhere from 0% to 33% of participants specifically mentioned the search bar on various sites.

Participants very rarely scrolled down to the bottom of the page on this task, and if they did, most did not acknowledge the footer material as navigation.

5.4. Discussion

5.4.1. Digital Literacy Assessment

RQ1: *How well do people with or without ASD assess purpose, authorship and advertising on websites?*

Participants had a relatively easy time assessing purpose, advertising and navigation on both the familiar and unfamiliar sites in this study. The ability of students to deduce these elements from the site's design did not vary between the ASD and control group.

Looking specifically at advertising, all participants were able to recognize visual ads, especially when they were set apart from the main content. In fact, participants were eager to apply the label to elements that were not advertising, including social networking elements, and the entire page (when it was selling something). Many participants noticed when an element was labeled "Sponsored" or "Advertising," which may help prevent false positives. Ads that were embedded in the main content (e.g. Facebook) were sometimes overlooked. There were no differences in the abilities of the ASD group and the control group to identify ads, which counters the concerns from the parental needs survey (see Section 3.2). Though this study cannot be generalized to younger children, it suggests that if taught properly, young adults with Asperger's or HFA are at no more risk to misunderstand advertisements than their neurotypical peers.

A large concern in both groups was the ability to identify authors of websites that were dynamically generated. While the pages with explicit authors (like the blog) were fairly straightforward to identify, sites like Google and Amazon caused some trouble. The largest and most commonly used sites today are often generated dynamically, based on searches, web crawlers, or database contents. However, all content originates from somewhere, and the ability to assess authorship is a key component to critically understanding the biases and motives for web pages. Participants often sidestepped the author question by claiming that the page was made by "code" or "algorithms," without diving further into who wrote the content delivered by the algorithm. Comments like, "No one made it, because it's just a big database," indicate a large gap

in digital literacy. As the participants in this study were young, university students, a demographic that is often identified as being the most technologically savvy, this finding is somewhat troubling.

5.4.2. Differences Between ASD and Control Groups

RQ2: *Are there differences in the ways people with or without ASD evaluate web content?*

Overall, this pilot study did not demonstrate a large difference in the assessment of websites by students with or without ASD. In the quantitative examination of the eye-tracking data, the participant's AQ score had little to no correlation with any of the fixation metrics. Other classifying factors like the SOP and gender had larger correlation to fixation metrics. Examination of task success and think-aloud comments also reveals very little difference between groups. All participants had equal likelihood of running into particular issues evaluating sites' purpose, authorship, advertising and navigation. Participants in the ASD group had very similar task success rates (see Table 5.2) to those in the control group.

While the findings of this study cannot be generalized to people with lower cognitive and language skills, they suggest that the Internet makes a good content delivery platform for young adults with HFA or Asperger's. With no significant differences in the way students with or without ASD perceive purpose, authorship, and advertising, there is not any evidence that the web presents barriers to access. These findings suggests that not only do people with ASD have an affinity for using the Internet, but that they have an equal opportunity to successfully evaluate and scan websites as their neurotypical peers, even at a subconscious, eye-movement level. This supports the theories that the Internet is a tool of empowerment and communication for individuals with HFA and Asperger's. Martijn Dekker, founder of one of the earliest ASD support e-mail lists, stressed the importance of the Internet to people with ASD, "The Internet is for many high-functioning autistics what sign language is for the deaf" (as cited in Jordan, 2010). This has significant implications for methods of teaching and creating social groups for young adults with ASD.

CHAPTER 6. CONCLUSION

The Internet provides an interesting opportunity for people with ASD, as it minimizes the non-verbal social cues that can be so difficult for them to understand. It also provides access to a global community of people who may not be geographically close, but share interests and perspectives. With the increasing number of ASD diagnoses, the need for accessible products and methods for teaching and communicating with these individuals is growing. This pilot study was conducted to uncover differences in the ways that individuals with ASD assess web content, and to provide direction for future research in this area.

6.1. Summary of Objective and Methods

This pilot study drew connections between the cognitive traits that students reported via a survey and the eye-tracking and think-aloud data gathered in the lab study, which asked them to assess purpose, authorship, and advertising on various websites. The traits measured included social skills, communication, imagination, attention to detail, attention switching, and information processing styles, traits commonly associated with ASD and Asperger's syndrome. The overall goal was to provide answers to these research questions:

RQ1: *How well do people with or without ASD assess purpose, authorship and advertising on websites?*

RQ2: *Are there differences in the ways people with or without ASD evaluate web content?*

Fifteen Iowa State University students, ages 18-24, participated in the study. Participants were divided into two groups based on their scores on the ASD Quotient survey. Ten students made up the control group, with scores under 32, and 5 students made up the ASD group, with scores of 32 and higher.

6.2. Overview of Key Findings

Participants had a relatively easy time assessing purpose, advertising and navigation on both the familiar and unfamiliar sites in this study. The ability of students to distinguish these elements from the site design did not vary between the ASD and control groups. Determining authorship presented a larger challenge to participants in both groups, especially for dynamically generated pages. Participants often sidestepped the author question by claiming that the page was made by "code" or "algorithms," without diving further into who wrote the content delivered by the algorithm. Critically assessing authorship is a key component of digital literacy, as it allows users to understand the inherent biases and motives for the content that was included or left off the web page. Comments like, "No one made it, because it's just a big database," indicate a large gap in digital literacy.

The study also revealed very little difference in the assessment of websites by students with or without ASD. Participants' AQ scores had little to no correlation with any of the fixation metrics, while other classifying factors like the SOP and gender presented larger correlations. In the task success rates and think-aloud comments, there was also very little difference between groups. Participants had equal likelihood of running into particular issues evaluating sites' purpose, authorship, advertising and navigation.

These findings suggest that the Internet makes a good content delivery platform for young adults with HFA or Asperger's. With no significant differences in the way students with or without ASD perceive purpose, authorship, and advertising, evidence that the web presents barriers to access was not found. This study suggests that not only do people with ASD have an affinity for using the Internet, it also gives people with ASD equal opportunities to successfully evaluate websites, even on a subconscious, eye-movement level. They are able to grasp this medium on an equal level to their neurotypical peers. These findings support the hypothesis that the Internet is a tool of empowerment and communication for individuals with HFA and Asperger's. Martijn Dekker, founder of one of the earliest ASD support e-mail lists, stressed the importance of the

Internet to people with ASD, "The Internet is for many high-functioning autistics what sign language is for the deaf" (as cited in Jordan, 2010). This has significant implications for online learning opportunities, online work opportunities, and opportunities to meet like-minded young adults with ASD.

6.3. Challenges

6.3.1. Recruitment of Persons with Autism

Finding enough participants to fill each group was critical to the external validity of this study. Unfortunately, despite many methods of recruitment, very few students who volunteered tested into the ASD group through the AQ survey. Recruitment was limited to 18-24 year old students in order to remove compounding variables like IQ or education. However, Iowa State University does not have any clinical or specialized programs that would have provided easier access to persons with ASD. Social and communication impairments inherent in ASD could have contributed to the low volunteer rate.

In order to improve the statistical viability of future studies, recruitment should be expanded either to accept individuals that may not be attending universities, or to more universities. Collaborations across multiple universities could provide enough data to make stronger assertions about the ways adults with ASD view the Internet.

6.3.2. AQ Survey

The AQ survey tool created by Baron-Cohen, et al. (Baron-Cohen et al., 2001) was used in the pilot study due to its reputation, length, and design. The survey has been used in many other studies as a means of ranking and comparing autistic traits in adults. The survey was designed to be self-administered and has been previously used in online studies. During the progression of the study, concerns emerged relating to the accuracy of using the AQ survey as a screener.

Three volunteers for the pilot study self-identified as having been previously diagnosed with ASD. Of those three, only two tested into the ASD group through the AQ survey. The other participant scored 13, far from the cutoff of 32. During the lab study, this participant displayed

increased levels of social anxiety, non-typical mannerisms and unusual eye contact, supporting her self-identification. On the other hand, a participant who scored a 33 on the AQ survey demonstrated very typical non-verbal behavior, and comfort interacting with the researchers.

One deficit of the survey is that it only accounts for the present feelings of the individual. Unlike the RAADS survey[4] which asks participants to indicate if the statement is true now, true now and when he was young, only true when he was young, or never true, the AQ survey simply asks participants how strongly they agree or disagree with a statement (Ritvo et al., 2010). As a result, any individual who has gone through extensive therapies may not currently exhibit the targeted traits. Participants could also have an inaccurate perception of their communication or social skills.

6.3.3. Eye-tracking

As a fairly new technology, the eye-tracker hardware and software presented multiple challenges. According to Holmqvist et al. the minimum frequency required for statistically valid effect sizes is 250 Hz (data points per second) (2011, p. 30). The EyeTechDS VT2 Eyetracker system in the lab supplies 80+ Hz, far below the necessary amount for statistical reliability. Also, it is possible that the use of the mouse and think aloud protocol introduced other elements of noise, which should be reduced to achieve more accurate data.

Scrolling AOI also introduces challenges that stretch the limits of current eye-tracking systems. Moving stimuli, like scrolling webpages, require algorithms that support smooth pursuit detection (Holmqvist et al., 2011, p. 76). They also require sophisticated mouse event detection that factors in the multiple ways to scroll along the vertical axis of a page, along with the inertial effects, which are present in most modern scroll wheels.

Limitations also exist in the ability to accurately analyze patterns within the collected data. Originally the goal was to analyze scanpaths from the study, but the logistics of doing so were

4 The RAADS survey was not used in the pilot study due to its design. It was developed as a tool to be administered by a clinician in person (not online).

cumbersome and likely to be highly biased. Previous studies that used automated statistical methods eventually reverted to visual examination (Holmqvist et al., 2011; Josephson & Holmes, 2002). There is also a lack of theoretical support connecting scanpaths to cognitive models. One of the most frequently criticized theories is scanpath theory, which predicts that a participant will consistently use the same scanpath on identical stimuli (Holmqvist et al., 2011, p. 257).

6.4. Suggestions for Future Research

As a pilot study, the primary focus was to motivate and direct future research in the area of web accessibility for people with ASD. Given the indications from this study that the Internet can level the playing field for people with HFA and Asperger's, it represents an exciting prospect for research. Comparisons with other media (like television, phone, magazines) should provide context for how much more effective the Internet is for equalizing people with ASD. This research should also be extended to lower-functioning individuals on the Autism Spectrum who may have more challenges than students who have enough language and independent living skills to attend Iowa State University.

This research has significant implications for the ways that universities and schools can better cater delivery of educational content to people with ASD. Online education holds tremendous promise, and investigating the efficacy of different online delivery methods for people with ASD could help boost the standard of living for this population. While assessment of various websites showed few differences, various education based delivery methods might reveal surprises. For example, is there a difference between a recorded lecture versus a transcript? Which is better, synchronous communication with peers (instant messaging) or asynchronous communication (forum posts)?

An important finding of this study that warrants further investigation is the digital literacy gap in understanding authorship on dynamically generated pages. The inability to identify the source of content on websites impacts a person's ability to understand the biases and motives that went into creating that content, and recognize content or perspectives that may not be

represented equally. The largest and most commonly used sites today are often generated dynamically, based on searches, web crawlers, and database content. A broader survey of a representative group of people (not just with ASD) would lend valuable insight into the ways we can better educate people about the origins of dynamic content.

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APPENDIX A. PARENTAL SURVEY QUESTIONS

Internet Usage and Perceptions for People with Autism Spectrum Disorders

This survey aims to determine Internet and computer usage and perceptions for people with Autism Spectrum Disorders (ASD). Technology provides valuable opportunities and unique risks to people with ASD and our research aims to improve those experiences. As a parent or caregiver to an individual with Autism Spectrum Disorder you have unique insight into the interests, skills and frustrations your child finds when using the Internet or computers.

In this survey Autism Spectrum Disorder (ASD) refers to individuals diagnosed with Autistic Disorder, Asperger's Disorder, Pervasive Developmental Disorders, and Not Otherwise Specified. This survey is open for parents and primary caregivers to children, teens and adults with ASD.

For simplicity, from now on "your child" refers to your son, daughter or individual with ASD. If you have more than one child with ASD, please complete the survey with your oldest child in mind.

This survey is made up of about 45 questions, that examine your child's current Internet access and usage, your perceptions of the risks and opportunities online, and general demographic questions to provide some context for your responses. Your participation is completely voluntary, and you are able to leave the survey at any time. You are free to skip any questions you do not feel comfortable answering. All of the data you share will be completely anonymous. If you have concerns or questions about this survey, please contact Debra Satterfield at debra815@iastate.edu or Hannah Deering at hjhunt@iastate.edu.

Thank you for your time. Your responses are greatly valued.

1. I am a parent/caregiver to an individual with Autism Spectrum Disorder (ASD)?

- Yes, I am a parent/caregiver to an individual with ASD.
- No. (If "No", please disregard this survey.)

2. What is the gender of your child? (If you have more than one child with ASD, please complete the survey with your oldest child in mind.)

- Male
- Female

3. How old is your child?

- 1 - 40+

4. In what state does your child reside?

- Outside the US
- [select state]

5. What is the ethnicity/race of your child?

- American Indian or Alaska Native
- White
- Asian
- Multiracial
- Black or African American
- Other
- Native Hawaiian or Other Pacific Islander
- Hispanic or Latino
- Prefer not to say

6. Which of the following best describes your child's school?

- No longer in school
- Public school
- Private school
- Charter school
- Home based ABA/autism specific program
- Home school
- Online school (pre-college)
- College, on-campus
- College, online
- Other _____

7. Which of the following best describes your child's classroom type?

- Inclusive classroom without extra staff support
- Inclusive classroom with one-on-one or additional support staff

- Special education classroom
- ASD specialized classroom
- Individual tutor
- Other ___

8. Is your child on an IFSP or IEP?

- Yes
- No
- Don't know

9. Which of the following best describes your child's home?

- Lives with me all the time
- Lives with me part of the time
- Group home
- Supported independent living
- Lives independently
- Other _____

10. How well can your child do the following?

(don't know, easily, with little difficulty, with some difficulty, with great difficulty, cannot)

- understands others' communication
- takes turns when speaking
- communicates his or her own thoughts
- contributes thoughts that are appropriate to the conversation

11. How often does your child do the following?

(don't know, almost always, very often, sometimes, rarely, never)

- joins groups without being told to
- makes friends easily
- seems confident in social situations
- starts conversations rather than waiting for others to initiate

12. How well can your child do the following tasks without help?

(don't know, easily, with little difficulty, with some difficulty, with great difficulty, cannot)

- tell time on an analog clock
- read and understand common signs
- count change
- use a telephone

13. Which of the following areas are your child highly interested in? (Check all that apply.)

- Music
- Skateboards/Scooters/Bikes
- Theater
- Trains
- Video Games
- Art (i.e. Drawing, Painting, Sculpting)
- Animals
- History
- Fashion/Clothing
- Nature
- Comics
- Legos/Building Materials
- Other _____
- Playing Sports
- Watching Sports
- Television
- Movies
- Card/Board Games
- Reading
- Cooking
- Space
- Computers
- Math
- Cars
- Dating

Section 2: Internet & Computer Usage

14. Does your child frequently use the following devices? (Check all that apply.)

- Wii
- XBox
- Nintendo GameBoy
- Zune
- iPhone
- Windows7 Smartphone
- Android Tablet
- Other _____
- XBox Kinect
- Playstation
- iPod Touch
- Mp3 Player
- Android Smartphone
- iPad
- Kindle Fire

15. Does your child have frequent access to the following systems?

(don't know, yes, no)

- Cell Phone
- Internet
- Computer
- Television

16. What types of sites does your child frequently visit? (Check all that apply.) (Skip this question if your child does not use the Internet.)

- Social networking sites (like Facebook)
- Video sites (like YouTube, Hulu)
- Shopping sites (like Amazon, eBay)
- Forums/Chatrooms (like WrongPlanet)
- Humor sites (like ComedyCentral, Cracked)
- Dating sites (like Match, eHarmony)
- Email (like GMail, Hotmail)
- Search engines (like Google)
- Music sites (like LiveFM, Spotify)
- Blogging/Journaling sites
- News sites (like CNN)
- Game sites (like AddictingGames)
- Sports sites (like ESPN)
- Other _____

17. How many hours a week does your child use the following systems?

(don't know, 0, 1-5 hours, 5-10 hours, 10-20 hours, 20-30 hours, more than 40 hours)

- Computer
- Game Console (like Wii, XBox)
- Handheld Game Device (like Gameboy, PSP)
- Internet
- Mp3 Player (like iPod Touch, Zune)
- Smartphone (like iPhone, Galaxy S)
- Tablet (like iPad, Galaxy Tab, Kindle Fire)
- Television

18. How often does your child need supervision or assistance when using the following systems?

(don't know, very often, often, sometimes, never)

- Computer
- Game Console (like Wii, XBox)
- Handheld Game Device (like Gameboy, PSP)
- Internet
- Mp3 Player (like iPod Touch, Zune)
- Smartphone (like iPhone, Galaxy S)
- Tablet (like iPad, Galaxy Tab, Kindle Fire)
- Television

19. How often does your child need to use the Internet for school?

- very often
- often
- sometimes
- never
- don't know
- my child is no longer in school

20. Has your child ever done the following online?

(don't know, yes, no)

- Been bullied online
- Used instant messages or chat with friends
- Used instant messages or chat with strangers (people he/she has not met before)

- Watched/Listened to music/videos
- Sent/Received email
- Play games online with friends
- Play games online alone
- Posted photos/stories to website
- Made new friends online
- Bought product online

21. In your household, do you have rules about any of the following things?

(yes, no)

- Internet sites your child can or cannot visit
- What kinds of television shows your child can or cannot watch
- What kinds of video games your child can or cannot play
- How much time your child can spend online
- How much time your child can spend playing video games
- How much time your child can spend watching TV
- Other ___

22. Are there any things which your child is not allowed to do on the internet? (Check all that apply.) (Skip this question if your child does not use the Internet.)

- Buy anything
- Use chat rooms
- Download things
- Use email
- Give out personal information
- Fill our forms or quizzes
- Use instant messaging
- Play games

- Other ___

23. What supervision, if any, do you typically provide when your child is using the Internet? (Check all that apply.) (Skip this question if your child does not use the Internet.)

- Ask what child is doing
- Help child
- Check computer later
- Check child's email
- Keep and eye on the screen
- Stay in same room
- Sit with child
- Other ___

Section 3: Internet & Computer Perceptions

24. How would you view your child's ability to do the following compared to a neurotypical child (without ASD) his/her same age?

(is not able, is much worse, is worse, is the same, is better, is much better, don't know)

- Play repetitive games
- Discover new sites independently
- Use a trackpad
- Type on a keyboard
- Navigate websites
- Understand privacy or safety concerns online
- Understand the difference between ads and content
- Create content for the web (like videos, blog post, photos)
- Play exploring games
- Use a mouse
- Use a tablet (like iPad)
- Instant message or chat online
- Understand web content
- Find and watch videos
- Find and listen to music

25. What are other things related to Internet and computer usage that your child can do well? _____

26. What are other things related to Internet and computer usage that your child has trouble with? _____

27. How often do you use the internet from home or work?

(Daily, Weekly, Every few weeks or less, Never)

- Home
- Work

28. How important is the Internet to your home life and work?

(very important, very unimportant)

- Home
- Work

29. How important is your child's ability to use the Internet to you?

- Very important
- Important
- Not important or unimportant
- Unimportant
- Very unimportant

30. How important is your child's ability to use the Internet to your child?

- Very important
- Important
- Not important or unimportant
- Unimportant
- Very unimportant

31. For children, in general, would you say that the Internet has been a good thing, a bad thing, or it hasn't had much effect one way or the other?

- Good thing
- Bad thing
- No effect one way or the other
- Don't know

32. For your child, would you say that the Internet has been a good thing, a bad thing, or it hasn't had much effect one way or the other?

- Good thing
- Bad thing
- No effect one way or the other
- Don't know

33. What opportunities do see for your child on the Internet? _____

34. How safe is the Internet, in general, for your child?

- Very safe
- Safe
- Not safe or unsafe
- Unsafe
- Very unsafe

35. What safety concerns do you have about your child using the Internet? _____

36. How easy is the Internet to use, in general, for your child?

- Very easy to use
- Easy to use
- Neither easy nor difficult to use
- Difficult to use
- Very difficult to use

37. What concerns do you have about how easy the Internet is for your child to use?

_____

38. Do you have any other comments about the Internet, computers and persons with ASD? _____

Section 4: Demographics

39. What browser do you mainly use at home? _____

40. Which of the following have you done online in the last 6 months? (Check all that apply.)

- Purchased something
- Registered a new user account
- Read the news
- Downloaded something

- Use instant messaging
- Use email
- Play games

41. Which of the following best describes your feelings about computers?

- I love computers, and can't wait to learn and use the newest products and features.
- I use computers frequently, and feel confident in doing the things I need.
- I use computers a lot, but sometimes need help from others to do what I want.
- I sometimes use computers, and often need help doing the things I need.
- I don't like to use computers, but I use them when I have to.
- I would prefer not to use computers.
- I never use computers.

42. How many children do you have or care for? _____

43. How many of your children have ASD? _____

44. What is the highest degree or level of school you have completed? (If currently enrolled, mark the previous grade or highest degree received.)

- No schooling completed
- Middle School
- High School, no diploma
- High school graduate - high school diploma or the equivalent (for example: GED)
- Some college credit
- Associate degree (for example: AA, AS)
- Bachelor's degree (for example: BA, AB, BS)
- Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)

- Professional degree (for example: MD, DDS, DVM, LLB, JD)
- Doctorate degree (for example: PhD, EdD)
- Prefer not to say

45. What is your total household income?

- Less than $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 to $149,999
- $150,000 or more
- Prefer not to say

46. Which of the following best describes your family structure?

- 2 biological or adoptive parents
- 2 parents, with 1 or more step-parent(s)
- Single parent, joint custody
- Single parent, sole custody
- Other family structure __
- Prefer not to say

Thank you for completing this survey! Your responses are critical to our research.

If you are interested in being notified about the results of this survey, or other studies related to this topic, please contact Hannah Deering (hjhunt@iastate.edu) or Debra Satterfield (debra815@iastate.edu).

APPENDIX B. PARENTAL SURVEY RESULTS

1. Demographics

Table 7.1: *Full comparison of survey participant demographics to US demographics of parent-reported diagnosis of ASD, 2007 (Kogan, 2009)*

	Number in Survey Sample	Percentage of Survey Sample	Percentage of Sample Population with ASD (Kogan, 2009)
Total	19	-	-
Age, y			
6-12	12	63%	41%
13+	7	37%	42%[5]
Gender			
Male	16	84%	82%
Female	3	16%	18%
Ethnicity/Race			
White	17	90%	72%
Multiracial	1	5%	5%
Black or African American	1	5%	6%
Region			
Northeast	3	16%	24%
Midwest	12	63%	25%
South	1	5%	27%
West	1	5%	24%
Not Specified	2	10%	-
Highest level of education achieved by parent			
High school graduate or less	2	10%	20%
More than high school	16	85%	78%
Not Specified	1	5%	-
Family income			
≤ 100% of poverty level[6]	0	0%	13%
>100% to ≤ 200%	2	10%	17%
>200% to ≤ 400%	6	32%	37%

5 Kogan, et al. did not collect data from participants with children over the age of 18. This survey did.

>400% of poverty level	7	37%	32%
Not Specified	4	21%	-
Family Structure			
2 biological or adoptive parents	16	85%	64%
2 parents, ≥ 1 step-parent	1	5%	7%
Single parent	1	5%	21%
Other family structure	0	0%	8%
Not Specified	1	5%	-

Table 7.2: *Percentage of participants with high & low communication, social and functional cognitive scores (sum of responses from Q10-Q12)*

		Child's Age		Gender		Com. Score		Social Score		F. Cog. Score	
	All	6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Communication Score (mean = 9.3)											
0-7 (low)	32%	42%	14%	38%	0%	-	-	38%	0%	67%	21%
8-16 (high)	68%	58%	86%	63%	100%	-	-	63%	100%	33%	79%
Social Score (mean = 5.1)											
0-7 (low)	84%	92%	71%	94%	33%	100%	77%	-	-	67%	86%
8-16 (high)	16%	8%	29%	6%	67%	0%	23%	-	-	0%	7%
Functional Cognitive Score (mean = 10.9)											
0-7 (low)	16%	25%	0%	19%	0%	33%	8%	13%	0%	-	-
8-16 (high)	74%	58%	100%	69%	100%	50%	85%	75%	33%	-	-

Table 7.3: *Correlations between communication, social and functional cognitive scores*

Communication & Social	0.59
Communication & Functional Cognitive	0.39
Social & Functional Cognitive	0.34

6 Assuming the U.S. Department of Health and Human Services 2007 poverty guideline for a family of 4 in the lower 48 states of $20,650 (Source: Federal Register, Vol. 72, No. 15, January 24, 2007, pp. 3147–3148)

2. Survey Responses

Participants were grouped by the child's age, gender, communication score (according to Q10), social score (according to Q11) and functional cognitive score (according to Q2). Results were analyzed by either examining the percentage of participants in each group who gave particular responses or by averaging participants responses on relevant questions. Higher consensus or higher values are highlighted by the darker cells in the tables below.

14. Does your child frequently use the following devices?

		Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
	All	6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Wii	47%	42%	57%	38%	100%	17%	62%	44%	33%	33%	21%
XBox Kinect	11%	8%	14%	6%	33%	17%	8%	13%	0%	0%	7%
XBox	16%	25%	0%	13%	33%	33%	8%	19%	0%	33%	7%
Playstation	16%	8%	29%	19%	0%	33%	8%	19%	0%	33%	7%
Nintendo GameBoy	37%	42%	29%	38%	33%	33%	38%	38%	0%	67%	14%
iPod Touch	37%	42%	29%	31%	67%	67%	23%	38%	33%	67%	21%
Zune	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mp3 Player	11%	8%	14%	6%	33%	17%	8%	13%	0%	0%	7%
iPhone	26%	42%	0%	31%	0%	50%	15%	25%	0%	100%	0%
Android Smartphone	11%	17%	0%	6%	33%	0%	15%	13%	0%	0%	7%
Windows7 Smartphone	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
iPad	47%	67%	14%	44%	67%	50%	46%	44%	33%	100%	14%
Android Tablet	11%	8%	14%	6%	33%	0%	15%	13%	0%	0%	0%
Kindle Fire	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Other:

"Likes to watch others use the Wii" *[male, 11 yr old, low com., low soc.]*

15. Does your child have frequent access to the following systems?

		Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
	All	6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Cell Phone	47%	25%	86%	44%	67%	50%	46%	44%	33%	0%	36%
Computer	100%	100%	100%	100%	100%	100%	100%	100%	33%	100%	43%
Internet	95%	92%	100%	94%	100%	83%	100%	94%	33%	100%	43%
Television	100%	100%	100%	100%	100%	100%	100%	100%	33%	100%	43%

16. What types of sites does your child frequently visit?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Social networking sites (like Facebook, Twitter)	16%	8%	29%	13%	33%	0%	23%	13%	33%	0%	14%
Search engines (like Google, Yahoo!)	32%	17%	57%	25%	67%	17%	38%	31%	0%	0%	7%
Video sites (like YouTube, Hulu)	79%	67%	100%	75%	100%	33%	100%	75%	33%	67%	36%
Music sites (like LiveFM, Spotify)	11%	8%	14%	6%	33%	17%	8%	6%	33%	33%	7%
Shopping sites (like Amazon, eBay)	11%	8%	14%	6%	33%	0%	15%	6%	33%	0%	7%
Blogging/Journaling sites	16%	8%	29%	19%	0%	17%	15%	19%	0%	0%	14%
Forums/Chatrooms (like WrongPlanet)	11%	0%	29%	13%	0%	17%	8%	13%	0%	0%	7%
News sites (like CNN)	5%	0%	14%	6%	0%	0%	8%	6%	0%	0%	0%
Humor sites (like ComedyCentral)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Game sites (like AddictingGames, Club Penguin)	53%	58%	43%	56%	33%	33%	62%	63%	0%	0%	29%
Dating sites (like Match, eHarmony)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sports sites (like ESPN)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Email (like GMail, Hotmail)	26%	8%	57%	19%	67%	17%	31%	19%	33%	0%	21%

Other:

"Homework and games for school" *[male, 10 yr old, mid com., mid soc., mid f. cog.]*

"American Girl, Discovery Girls" *[female, 13 yr old, mid com., low soc., mid f. cog.]*

"technology related podcasts" *[male, 14 yr old, mid com., low soc., mid f. cog.]*

"educational sites: star fall, abcya" *[male, 6 yr old, low com., low soc., mid f. cog.]*

17. How many hours a week does your child use the following systems? ***(average hours per week)***

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Computer	12.9	8.6	20.8	13.2	11.7	12.0	13.3	13.2	20.0	5.0	15.8
Game Console	7.4	5.8	10.0	7.8	5.0	10.8	5.8	8.1	5.0	3.3	10.8
Handheld Game Device	9.1	5.0	16.7	8.7	12.5	9.2	9.1	8.7	20.0	3.3	16.7
Internet	13.7	8.8	22.1	14.1	11.7	10.8	15.0	14.1	20.0	6.7	16.7
Mp3 Player	5.3	6.1	4.3	5.0	6.7	9.2	3.0	5.4	10.0	5.0	9.2
Smartphone	2.7	4.4	0.0	2.7	2.5	4.0	2.0	2.7	0.0	6.7	1.0
Tablet	6.6	7.0	5.8	6.8	5.0	4.0	7.7	6.8	5.0	6.7	5.0
Television	8.2	8.3	7.9	8.4	6.7	4.2	10.0	7.8	5.0	10.0	8.3

18. How much supervision or assistance does your child need when using the following systems? ***(0=never need assistance, 4=almost always need assistance)***

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Computer	1.3	1.8	0.6	1.3	1.3	1.8	1.1	1.4	0.0	1.7	0.7
Game Console	1.4	2.0	0.7	1.6	0.7	2.4	0.9	1.6	0.0	2.5	1.0
Handheld Game Device	0.6	0.8		0.7	0.5	1.0	0.4	0.8	0.0	1.0	0.4
Internet	1.3	1.6	0.9	1.3	1.3	1.4	1.3	1.3	0.0	2.0	0.8
Mp3 Player	0.8	1.2	0.3	1.0	0.3	1.0	0.5	1.0	0.0	1.5	0.5
Smartphone	1.0	1.3		1.1	0.5	1.0	1.0	1.1	0.0	1.3	0.3
Tablet	1.0	1.3	0.0	1.0	1.0	1.0	1.0	1.1	0.0	1.3	0.3
Television	1.0	1.3	0.3	1.1	0.3	1.7	0.7	1.1	0.0	1.3	0.7

19. How often does your child need to use the Internet for school?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
almost always	11%	0%	29%	6%	33%	0%	15%	6%	33%	0%	7%
very often	11%	8%	14%	0%	67%	0%	15%	6%	0%	0%	0%
often	21%	33%	0%	25%	0%	17%	23%	19%	0%	67%	7%
rarely	16%	25%	0%	19%	0%	0%	23%	19%	0%	0%	0%

don't know	11%	17%	0%	13%	0%	33%	0%	13%	0%	33%	7%
my child is no longer in school	21%	0%	57%	25%	0%	17%	23%	25%	0%	0%	21%

20. Has your child ever done the following online?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Been bullied online	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Used instant messages or chat with friends	16%	17%	14%	6%	67%	0%	23%	13%	33%	0%	7%
Used instant messages or chat with strangers	11%	8%	14%	13%	0%	17%	8%	13%	0%	0%	7%
Watched/Listened to music/videos	74%	83%	57%	69%	100%	83%	69%	75%	33%	67%	36%
Sent/Received email	42%	8%	100%	38%	67%	17%	54%	38%	33%	0%	29%
Play games online with friends	21%	17%	29%	19%	33%	17%	23%	25%	0%	0%	7%
Play games online alone	74%	75%	71%	69%	100%	50%	85%	69%	33%	33%	36%
Posted photos/ stories to website	16%	0%	43%	13%	33%	17%	15%	13%	33%	0%	21%
Made new friends online	21%	8%	43%	25%	0%	17%	23%	25%	0%	0%	14%
Bought product online	32%	17%	57%	38%	0%	17%	38%	38%	0%	0%	21%

21. In your household, do you have rules about any of the following things?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Internet sites your child can or cannot visit	74%	92%	43%	69%	100%	67%	77%	69%	33%	100%	21%
How much time your child can spend online	47%	67%	14%	44%	67%	50%	46%	44%	0%	100%	7%
How much time your child can spend on the computer	47%	67%	14%	44%	67%	50%	46%	44%	0%	100%	7%
What kinds of television shows your child can or cannot watch	68%	92%	29%	69%	67%	67%	69%	69%	0%	100%	14%
How much time your child can spend watching TV	63%	75%	43%	63%	67%	50%	69%	63%	0%	100%	14%
What kinds of video games your child can or cannot play	74%	92%	43%	75%	67%	67%	77%	75%	0%	100%	21%
How much time your child can spend playing video games	53%	67%	29%	50%	67%	50%	54%	50%	0%	100%	7%

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Other:

"Not necessary, since he is interested in playing with people rather than spending time on the computer." *[male, 11 yr old, low com., low soc.]*

"With the exception of club penguin, all Internet/tv/electronics use takes place with me

in the room. His tablet is being used as a cheap AAC [Augmented & Alternative Communication], and has an HDMI out - everything gets broadcast onto the large family TV." *[male, 7 yr old, low com., low soc., mid f. cog.]*

22. Are there any things which your child is not allowed to do on the internet?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Buy anything	74%	83%	57%	75%	67%	67%	77%	75%	0%	100%	29%
Give out personal information	79%	83%	71%	75%	100%	67%	85%	75%	33%	100%	36%
Use chat rooms	74%	92%	43%	69%	100%	67%	77%	69%	33%	100%	21%
Fill our forms or quizzes	58%	75%	29%	56%	67%	67%	54%	56%	0%	100%	14%
Download things	47%	75%	0%	50%	33%	67%	38%	50%	0%	100%	14%
Use instant messaging	58%	83%	14%	56%	67%	67%	54%	56%	0%	100%	14%
Use email	42%	67%	0%	44%	33%	67%	31%	44%	0%	100%	7%
Play games	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

23. What supervision, if any, do you typically provide when your child is using the Internet?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Ask what child is doing	63%	75%	43%	63%	67%	33%	77%	63%	0%	67%	14%
Keep and eye on the screen	53%	58%	43%	50%	67%	33%	62%	50%	0%	67%	14%
Help child	42%	58%	14%	38%	67%	33%	46%	38%	0%	67%	7%
Stay in same room	53%	67%	29%	50%	67%	50%	54%	50%	0%	67%	14%
Check computer later	16%	25%	0%	13%	33%	17%	15%	13%	0%	67%	0%
Sit with child	32%	42%	14%	25%	67%	17%	38%	31%	0%	33%	7%
Check child's email	37%	33%	43%	31%	67%	17%	46%	25%	33%	67%	14%

24. How would you view your child's ability to do the following compared to a neurotypical child (without ASD) his/her same age? ***(2=is much better, 0=is the same, -2=is much worse)***

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Play repetitive games	0.5	0.7	0.1	0.6	-0.3	0.8	0.3	0.6	0.0	1.0	0.5
Play exploring games	-0.1	-0.2	0.1	0.1	-1.0	0.2	-0.2	0.0	0.0	0.7	0.7
Discover new sites independently	0.2	0.1	0.3	0.3	-0.7	0.0	0.2	0.3	0.0	0.7	0.0
Use a mouse	0.1	0.0	0.3	0.1	0.0	0.3	0.0	0.3	0.0	0.0	0.3
Use a trackpad	-0.1	-0.1	-0.1	0.0	-0.7	-0.2	-0.1	-0.1	0.0	0.7	0.0
Use a touch screen (like on an iPad or iPod touch)	0.3	0.3	0.3	0.4	-0.3	0.3	0.2	0.4	0.0	1.0	0.3
Type on a keyboard	-0.1	-0.3	0.3	0.0	-0.3	0.2	-0.2	0.1	0.0	-0.7	0.2
Instant message or chat online	-0.5	-0.6	-0.4	-0.6	-0.3	-0.7	-0.5	-0.6	0.0	-0.7	-0.3
Navigate websites	0.1	0.0	0.3	0.1	0.0	0.0	0.2	0.2	0.0	0.3	0.0
Understand web content	-0.2	-0.4	0.1	-0.1	-0.7	-0.2	-0.2	-0.2	0.0	0.3	0.0
Understand privacy or safety concerns online	-0.7	-1.0	-0.3	-0.7	-1.0	-1.0	-0.6	-0.7	0.0	-0.7	-0.8
Understand the difference between ads and content	-0.5	-0.7	-0.1	-0.4	-1.0	-0.3	-0.5	-0.4	0.0	-0.3	-0.3
Create content for the web (like videos, blog post, photos)	-0.4	-0.5	-0.1	-0.3	-0.7	-0.5	-0.3	-0.4	0.0	-0.7	-0.2
Find and watch videos	0.3	0.4	0.1	0.4	0.0	0.2	0.4	0.4	0.0	0.7	0.3
Find and listen to music	-0.1	0.0	-0.1	-0.1	0.0	0.2	-0.2	0.0	0.0	0.3	0.0

34. How safe is the Internet, in general, for your child?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Very safe	11%	17%	0%	13%	0%	33%	0%	13%	0%	67%	0%
Safe	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Not safe or unsafe	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unsafe	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Very unsafe	11%	17%	0%	13%	0%	17%	8%	6%	0%	33%	0%
No response	79%	67%	100%	75%	100%	50%	92%	81%	33%	0%	43%

36. How easy is the Internet to use, in general, for your child?

	All	Child's Age		Gender		Com. Score		Soc. Score		F. Cog. Score	
		6-11 (n=12)	12+ (n=7)	M (n=16)	F (n=3)	Low (n=6)	High (n=13)	Low (n=16)	High (n=3)	Low (n=3)	High (n=14)
Very easy to use	42%	42%	43%	44%	33%	33%	46%	38%	33%	67%	21%
Easy to use	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Not easy to use or difficult to use	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Difficult to use	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Very difficult to use	5%	8%	0%	6%	0%	17%	0%	6%	0%	0%	0%
No response	79%	67%	100%	75%	100%	50%	92%	81%	33%	0%	43%

APPENDIX C. SURVEY QUESTIONS

The purpose of this study is to determine what effects various personality traits have on scanning and evaluating web content. This is the first part of the study where we get details on your personal style and preference for various activities or thought processes.

This survey is made up of about 79 questions, and will take about 10-15 minutes to complete. Your participation is completely voluntary, and all of the data you share will be completely anonymous. If you wish to stop your participation at any time, simply close your browser window. We will delete all incomplete results.

GENERAL BACKGROUND

1. Age

- 17 or younger
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25 or older

2. Gender

- Male
- Female

3. Native Language

- English
- Other (Specify:)

4. What is your major area of study? (Pick the closest category or specify in other.)

- Arts or Design
- Music
- English or Communication
- Foreign Language
- Science / Math
- Engineering
- Social Studies / Social Sciences
- Education
- Medicine / Veterinary Science
- Business
- Other (please specify)

5. On average, how much time do you spend online every day?

- 0 hours
- 0-1 hour
- 1-3 hours
- 3-10 hours
- 10+ hours

6. What types of sites do you frequently visit? (Check all that apply.)

- Social networking sites (like Facebook, Twitter)
- Search engines (like Google, Yahoo!)
- Video sites (like YouTube, Hulu)
- Music sites (like LiveFM, Spotify)
- Shopping sites (like Amazon, eBay)
- Blogging/Journaling sites (like LiveJournal, WordPress)
- Forums/Chatrooms
- News sites (like CNN, New York Times)
- Humor sites (like ComedyCentral, Cracked)
- Game sites (like AddictingGames, Club Penguin)
- Dating sites (like Match, eHarmony)
- Sports sites (like ESPN, Yahoo! Sports)
- Email (like GMail, Hotmail)
- Other _____

7. How familiar are you with the following sites?

- Amazon very familiar slightly familiar slightly unfamiliar very unfamiliar
- Bing Maps very familiar slightly familiar slightly unfamiliar very unfamiliar
- eHarmony very familiar slightly familiar slightly unfamiliar very unfamiliar
- Etsy very familiar slightly familiar slightly unfamiliar very unfamiliar
- ESPN very familiar slightly familiar slightly unfamiliar very unfamiliar
- Facebook very familiar slightly familiar slightly unfamiliar very unfamiliar

- Flickr	very familiar slightly familiar slightly unfamiliar very unfamiliar
- Google	very familiar slightly familiar slightly unfamiliar very unfamiliar
- Hulu	very familiar slightly familiar slightly unfamiliar very unfamiliar
- MSP Metro Transit	very familiar slightly familiar slightly unfamiliar very unfamiliar
- Munchin with Munchkin	very familiar slightly familiar slightly unfamiliar very unfamiliar
- NBC News	very familiar slightly familiar slightly unfamiliar very unfamiliar
- Twitter	very familiar slightly familiar slightly unfamiliar very unfamiliar
- Wikipedia	very familiar slightly familiar slightly unfamiliar very unfamiliar
- Yahoo Mail	very familiar slightly familiar slightly unfamiliar very unfamiliar
- YouTube	very familiar slightly familiar slightly unfamiliar very unfamiliar

PERSONALITY TRAITS

The aim of these questions is to determine your personal style or preferences for various tasks or activities. There are no right or wrong answers, we ask that you try to be as honest and accurate as possible.

1.	I prefer to do things with others rather than on my own.	definitely agree	slightly agree	slightly disagree	definitely disagree
2.	I prefer to do things the same way over and over again.	definitely agree	slightly agree	slightly disagree	definitely disagree
3.	If I try to imagine something, I find it very easy to create a picture in my mind.	definitely agree	slightly agree	slightly disagree	definitely disagree
4.	I frequently get so strongly absorbed in one thing that I lose sight of other things.	definitely agree	slightly agree	slightly disagree	definitely disagree
5.	I often notice small sounds when others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
6.	I usually notice car number plates or similar strings of information.	definitely agree	slightly agree	slightly disagree	definitely disagree
7.	Other people frequently tell me that what I've said is impolite, even though I think it is polite.	definitely agree	slightly agree	slightly disagree	definitely disagree

8.	When I'm reading a story, I can easily imagine what the characters might look like.	definitely agree	slightly agree	slightly disagree	definitely disagree
9.	I am fascinated by dates.	definitely agree	slightly agree	slightly disagree	definitely disagree
10.	In a social group, I can easily keep track of several different people's conversations.	definitely agree	slightly agree	slightly disagree	definitely disagree
11.	I find social situations easy.	definitely agree	slightly agree	slightly disagree	definitely disagree
12.	I tend to notice details that others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
13.	I would rather go to a library than a party.	definitely agree	slightly agree	slightly disagree	definitely disagree
14.	I find making up stories easy.	definitely agree	slightly agree	slightly disagree	definitely disagree
15.	I find myself drawn more strongly to people than to things.	definitely agree	slightly agree	slightly disagree	definitely disagree
16.	I tend to have very strong interests which I get upset about if I can't pursue.	definitely agree	slightly agree	slightly disagree	definitely disagree
17.	I enjoy social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
18.	When I talk, it isn't always easy for others to get a word in edgeways.	definitely agree	slightly agree	slightly disagree	definitely disagree
19.	I am fascinated by numbers.	definitely agree	slightly agree	slightly disagree	definitely disagree
20.	When I'm reading a story, I find it difficult to work out the characters' intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
21.	I don't particularly enjoy reading fiction.	definitely agree	slightly agree	slightly disagree	definitely disagree
22.	I find it hard to make new friends.	definitely agree	slightly agree	slightly disagree	definitely disagree
23.	I notice patterns in things all the time.	definitely agree	slightly agree	slightly disagree	definitely disagree
24.	I would rather go to the theatre than a museum.	definitely agree	slightly agree	slightly disagree	definitely disagree

25.	It does not upset me if my daily routine is disturbed.	definitely agree	slightly agree	slightly disagree	definitely disagree
26.	I frequently find that I don't know how to keep a conversation going.	definitely agree	slightly agree	slightly disagree	definitely disagree
27.	I find it easy to "read between the lines" when someone is talking to me.	definitely agree	slightly agree	slightly disagree	definitely disagree
28.	I usually concentrate more on the whole picture, rather than the small details.	definitely agree	slightly agree	slightly disagree	definitely disagree
29.	I am not very good at remembering phone numbers.	definitely agree	slightly agree	slightly disagree	definitely disagree
30.	I don't usually notice small changes in a situation, or a person's appearance.	definitely agree	slightly agree	slightly disagree	definitely disagree
31.	I know how to tell if someone listening to me is getting bored.	definitely agree	slightly agree	slightly disagree	definitely disagree
32.	I find it easy to do more than one thing at once.	definitely agree	slightly agree	slightly disagree	definitely disagree
33.	When I talk on the phone, I'm not sure when it's my turn to speak.	definitely agree	slightly agree	slightly disagree	definitely disagree
34.	I enjoy doing things spontaneously.	definitely agree	slightly agree	slightly disagree	definitely disagree
35.	I am often the last to understand the point of a joke.	definitely agree	slightly agree	slightly disagree	definitely disagree
36.	I find it easy to work out what someone is thinking or feeling just by looking at their face.	definitely agree	slightly agree	slightly disagree	definitely disagree
37.	If there is an interruption, I can switch back to what I was doing very quickly.	definitely agree	slightly agree	slightly disagree	definitely disagree
38.	I am good at social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
39.	People often tell me that I keep going on and on about the same thing.	definitely agree	slightly agree	slightly disagree	definitely disagree
40.	When I was young, I used to enjoy playing games involving pretending with other children.	definitely agree	slightly agree	slightly disagree	definitely disagree
41.	I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	definitely agree	slightly agree	slightly disagree	definitely disagree

42.	I find it difficult to imagine what it would be like to be someone else.	definitely agree	slightly agree	slightly disagree	definitely disagree
43.	I like to plan any activities I participate in carefully.	definitely agree	slightly agree	slightly disagree	definitely disagree
44.	I enjoy social occasions.	definitely agree	slightly agree	slightly disagree	definitely disagree
45.	I find it difficult to work out people's intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
46.	New situations make me anxious.	definitely agree	slightly agree	slightly disagree	definitely disagree
47.	I enjoy meeting new people.	definitely agree	slightly agree	slightly disagree	definitely disagree
48.	I am a good diplomat.	definitely agree	slightly agree	slightly disagree	definitely disagree
49.	I am not very good at remembering people's date of birth.	definitely agree	slightly agree	slightly disagree	definitely disagree
50.	I find it very easy to play games with children that involve pretending.	definitely agree	slightly agree	slightly disagree	definitely disagree
51	I enjoy doing work that requires the use of words.	definitely agree	slightly agree	slightly disagree	definitely disagree
52	There are some special times in my life that I like to relive by mentally "picturing" just how everything looked.	definitely agree	slightly agree	slightly disagree	definitely disagree
53	I can never seem to find the right word when I need it.	definitely agree	slightly agree	slightly disagree	definitely disagree
54	I do a lot of reading.	definitely agree	slightly agree	slightly disagree	definitely disagree
55	When I am trying to learn something new, I'd rather watch a demonstration than read how to do it.	definitely agree	slightly agree	slightly disagree	definitely disagree
56	I think I often use words in the wrong way.	definitely agree	slightly agree	slightly disagree	definitely disagree
57	I enjoy learning new words.	definitely agree	slightly agree	slightly disagree	definitely disagree
58	I like to picture how I could fix up my apartment or a room if I could buy anything I want.	definitely agree	slightly agree	slightly disagree	definitely disagree

59	I often make written notes to myself.	definitely agree	slightly agree	slightly disagree	definitely disagree
60	I like to daydream	definitely agree	slightly agree	slightly disagree	definitely disagree
61	I generally prefer to use a diagram rather than a written set of instructions.	definitely agree	slightly agree	slightly disagree	definitely disagree
62	I like to "doodle."	definitely agree	slightly agree	slightly disagree	definitely disagree
63	I find it helps to think in terms of mental pictures when doing many things.	definitely agree	slightly agree	slightly disagree	definitely disagree
64	After I meet someone for the first time, I can usually remember what they look like, but not much about them.	definitely agree	slightly agree	slightly disagree	definitely disagree
65	I like to think of synonyms for words.	definitely agree	slightly agree	slightly disagree	definitely disagree
66	When I have forgotten something I frequently try to form a mental "picture" to remember it.	definitely agree	slightly agree	slightly disagree	definitely disagree
67	I like learning new words.	definitely agree	slightly agree	slightly disagree	definitely disagree
68	I prefer to read instructions about how to do something rather than have someone show me.	definitely agree	slightly agree	slightly disagree	definitely disagree
69	I prefer activities that don't require a lot of reading.	definitely agree	slightly agree	slightly disagree	definitely disagree
70	I seldom daydream.	definitely agree	slightly agree	slightly disagree	definitely disagree
71	I spend very little time attempting to increase my vocabulary.	definitely agree	slightly agree	slightly disagree	definitely disagree
72	My thinking often consists of mental "pictures" or images.	definitely agree	slightly agree	slightly disagree	definitely disagree

APPENDIX D. INFORMED CONSENT

INFORMED CONSENT DOCUMENT

Title of Study: The Effect of Cognitive Traits on Web Content Evaluation

Investigators: Hannah Deering, Debra Satterfield, Sunghyun Kang

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to determine what effects various cognitive traits have on the scanning and evaluation of web site content. You are invited to participate in this study because you are an Iowa State University student with basic experiences using the Internet & computers. You should not participate if you are not between 18-24 years of age.

DESCRIPTION OF PROCEDURES

If you agree to participate, you will be asked to complete both parts of this study.

Part 1: Online Survey You will be asked to complete a survey that will rank the strengths of various personality traits by indicating how much you agree or disagree with various statements (for example, "I enjoy meeting new people."). A selection of volunteers who take the survey will be randomly selected to participate in the lab portion of the study.

This survey will take between 10-15 minutes to complete.

Phase 2: Lab Study If you are selected to participate in the lab study, we will arrange for a time to come in that works for your schedule. We will introduce the study process, and ask you to sign this consent document.

You will then be seated at a computer and we will calibrate the eye tracking system. You will be asked a series of questions associated with specific web pages. These questions relate to the purpose, content and reliability of the page. As you find the answer to the questions, you will be asked to verbalize your thought process. Between web pages, you will also be asked to find specific elements amongst a group.

Once you have finished the questions, there will be a short open interview to ask any follow up questions about the study.

Your voice, eye movements, and screen (including mouse movements) will be recorded for later analysis. The lab study will take about 1 hour to complete.

RISKS

There are no foreseeable risks from participating in this study. The websites used in this study are very commonly visited and present no disturbing or mature material.

The eye tracking device being used is non-invasive. It uses near infrared illumination to create reflection patterns on the cornea and pupil of the eye and two sensors are used to capture the images of the eyes and the reflection patterns. The near infrared light is used at a very low intensity and the eye-tracking technology is safe on the eyes. There is no documentation of it causing any harm. You may experience mild discomfort keeping relatively still while completing this study in front of the eye tracker. If you need a break at any time, feel free to ask.

BENEFITS

If you decide to participate in this study there will be no direct benefit to you. It is hoped that the information gained in this study will benefit society by improving the usability of website design and content creation.

COSTS AND COMPENSATION

You will not have any costs from participating in this study. If you decide not to continue during the survey, you will not receive any compensation. If you are selected for the lab portion of the study, you will be given $10 at the beginning of our time in the lab. If you decide not to continue your participation during the lab study, you will be able to keep the money as a token of our thanks. If you are enrolled in MKT 340 & MIS 330 you will also receive 1 credit for your participation in this study.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled. You can skip any questions that you do not wish to answer.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies, auditing departments of Iowa State University, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken: All data will be coded to prevent identification of individual participants. Data will be kept, password protected, on the investigator's computer, and will only be transmitted via secure storage devices. Voice recordings will be transcribed, as necessary, and destroyed within one year. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study.

- For further information about the study contact Hannah Deering (612-207-0700, hjhunt@iastate.edu) or Sunghyun Kang (515-294-1669, shrkang@iastate.edu).
- If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, Iowa State University, Ames, Iowa 50011.

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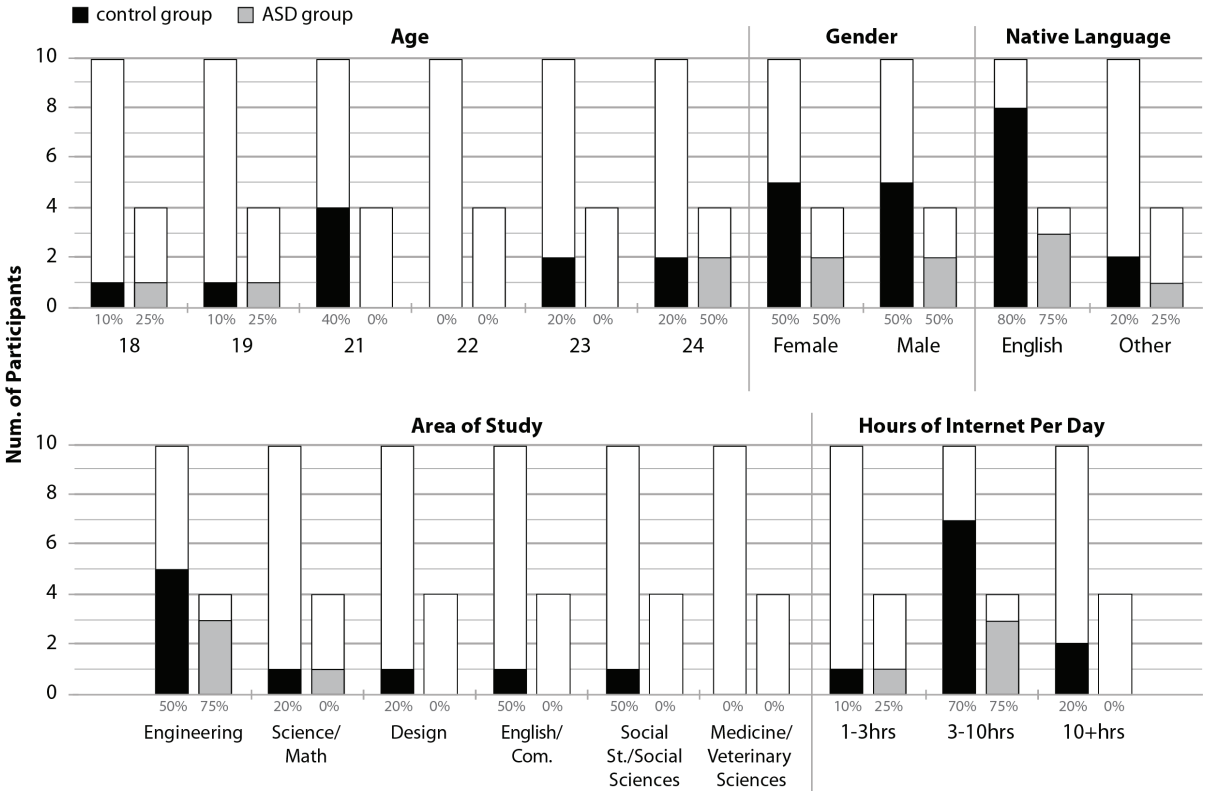
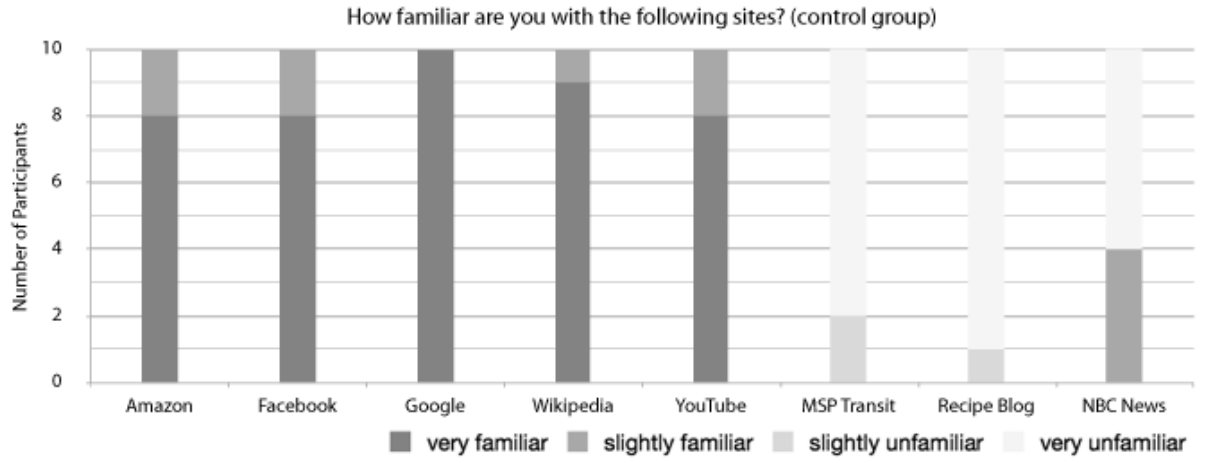
PARTICIPANT SIGNATURE

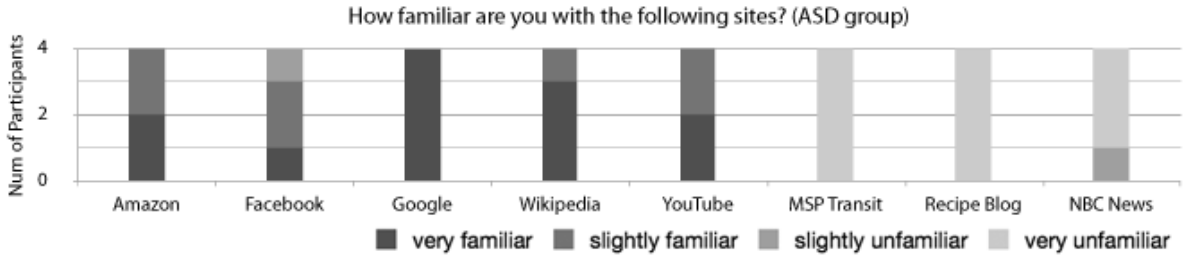
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document, and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study. Remember to print a copy of this document for your own records.

Participant's Name (printed)	Participant's Signature	Date

APPENDIX E. STUDY DEMOGRAPHICS







APPENDIX F. LAB STUDY STIMULI

content category

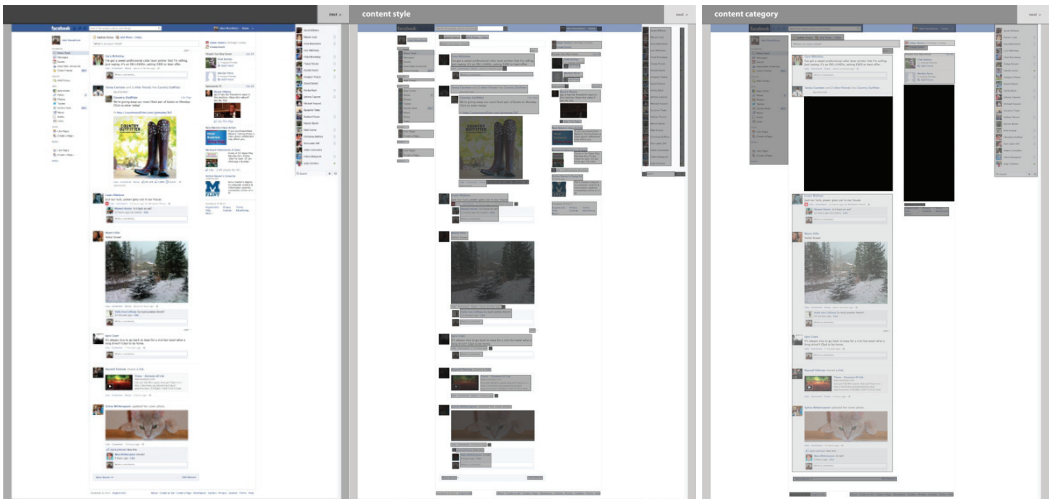
- Advertising & Sponsorship
- Self Promotional
- Site Identity & Welcome
- Navigation
- Site Content
- User-Created Content

content style

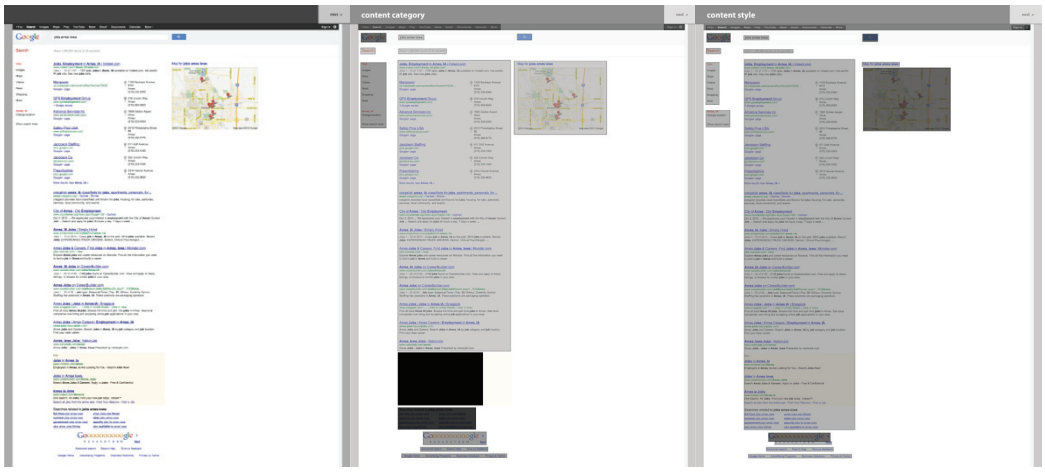
- Visual
- Verbal
- Personal

1. Amazon AOI

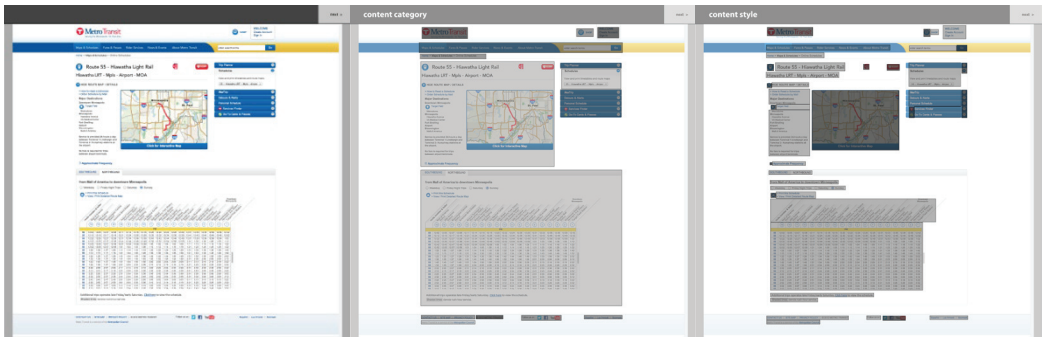
2. Facebook AOI



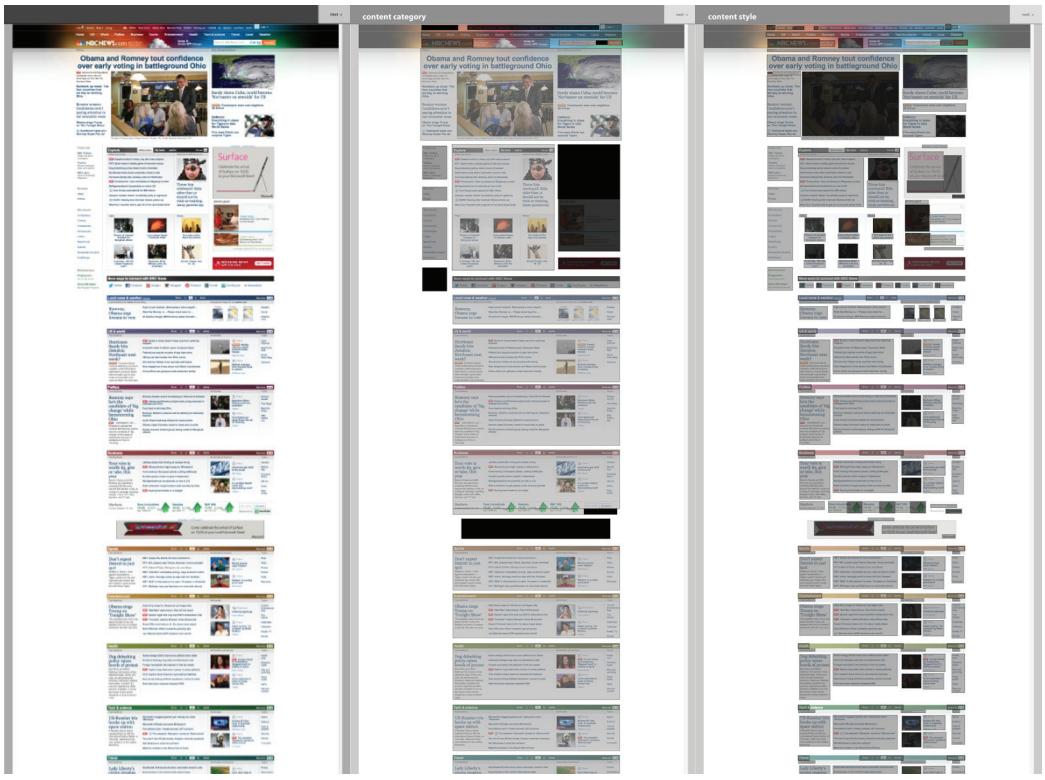
3. Google AOI



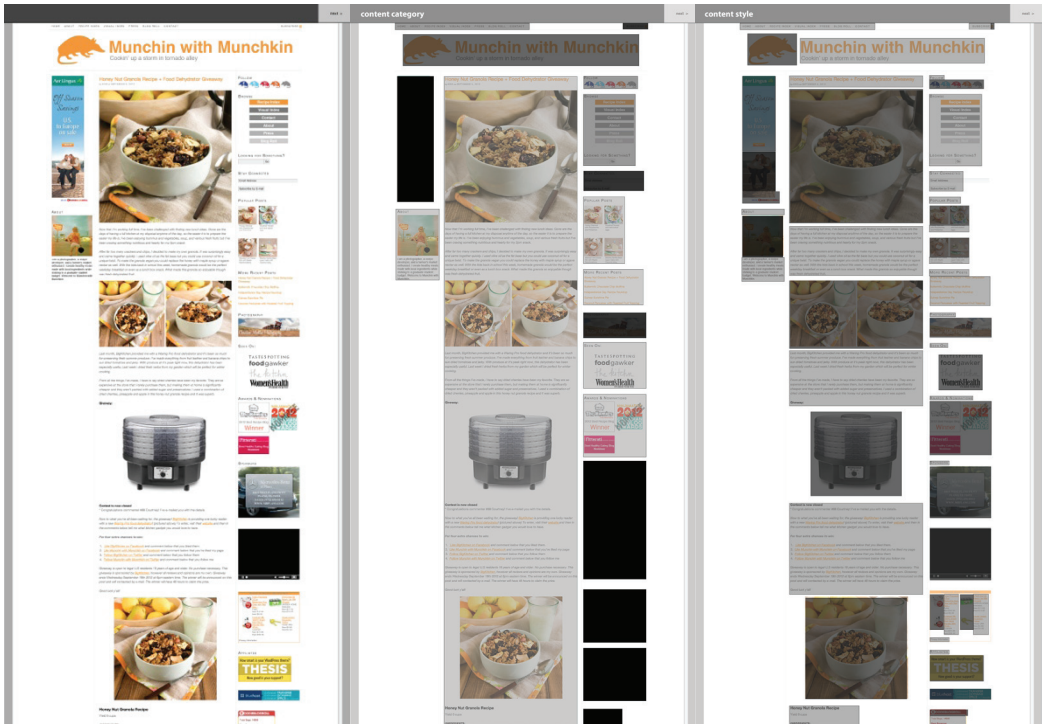
4. MetroTransit AOI



5. NBC News AOI

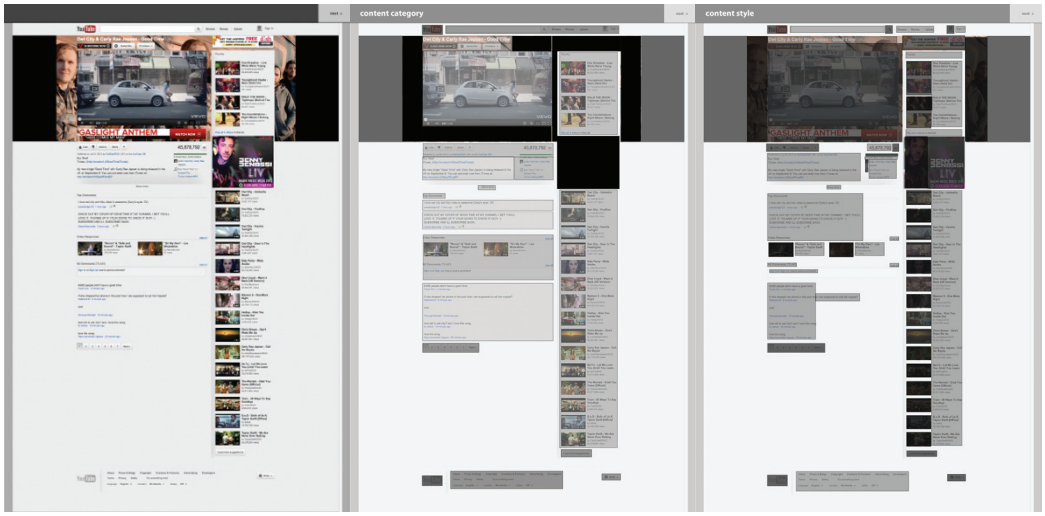


6. Recipe AOI



7. Wikipedia AOI

8. YouTube AOI



APPENDIX G. STUDY RESULTS

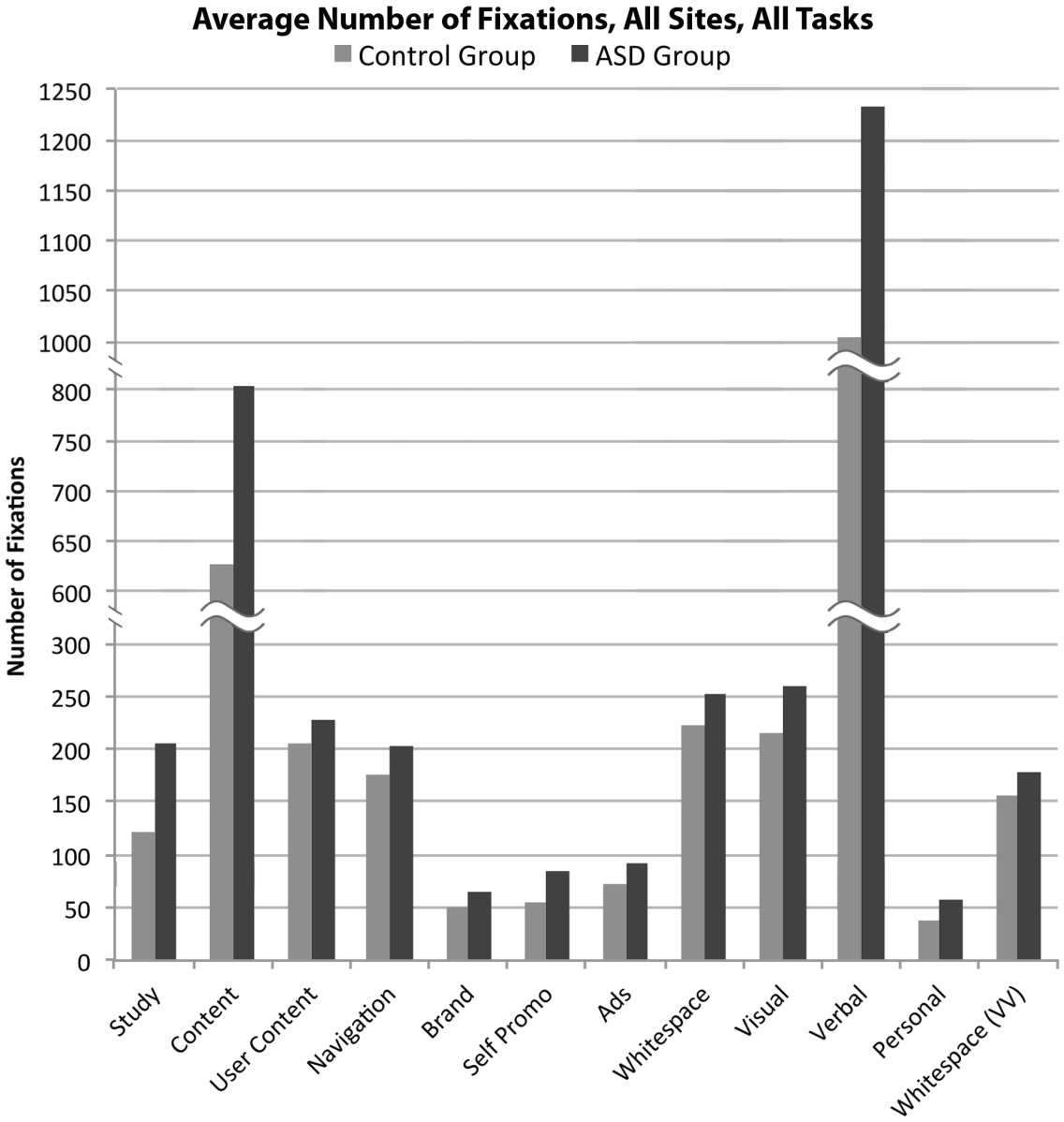
1. Survey Score Statistical Analysis (SAS)

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
gender	15	0.53333	0.51640	8.00000	0	1.00000
lang	15	0.20000	0.41404	3.00000	0	1.00000
AQ	15	23.66667	10.34178	355.00000	8.00000	41.00000
AS	15	6.00000	2.77746	90.00000	0	10.00000
SS	15	4.33333	3.01583	65.00000	0	9.00000
AD	15	5.86667	1.72654	88.00000	2.00000	8.00000
C	15	4.53333	3.20416	68.00000	0	10.00000
I	15	2.93333	2.21897	44.00000	0	8.00000
SOP	15	57.73333	8.52280	866.00000	42.00000	72.00000

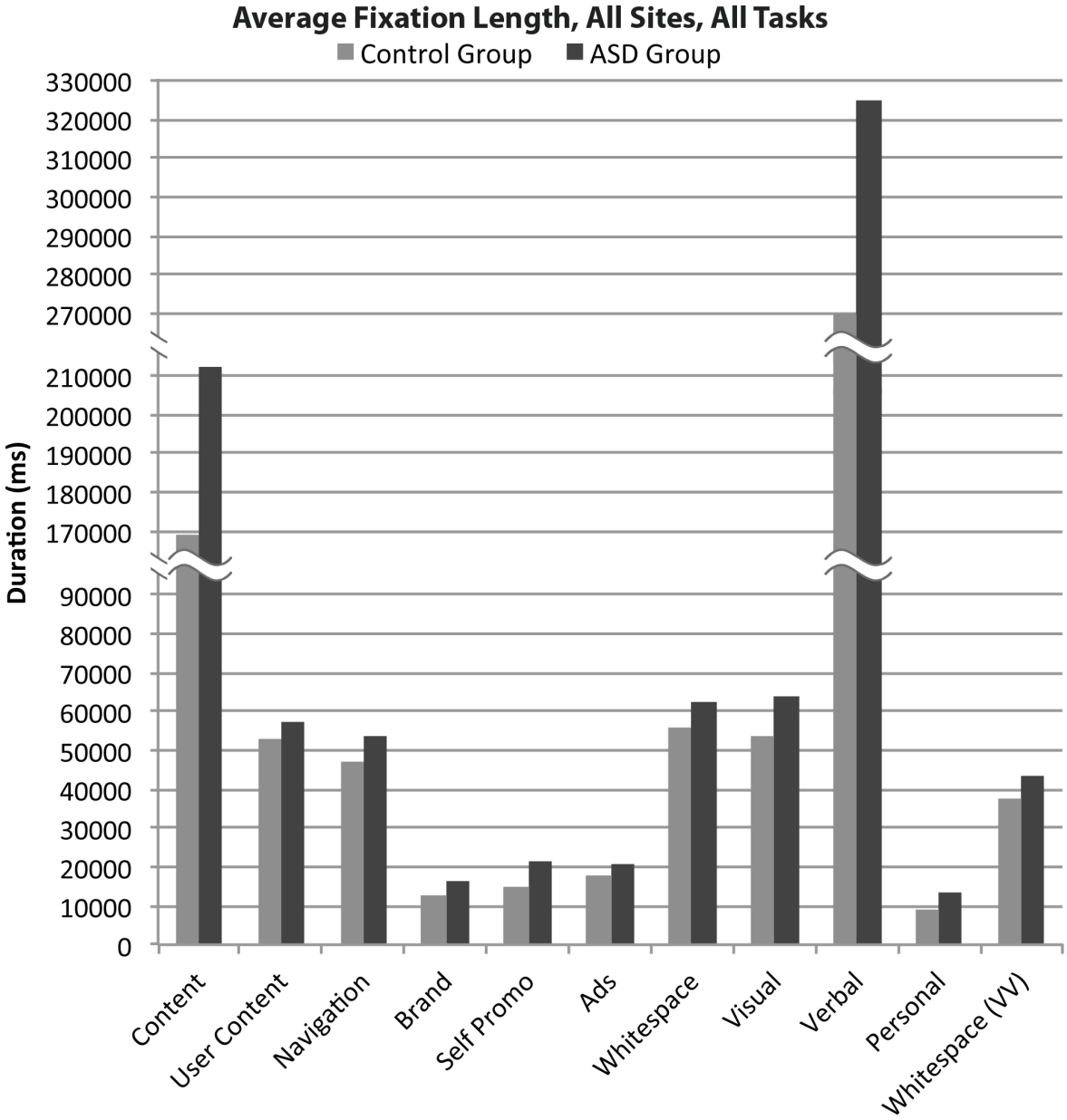
Pearson Correlation Coefficients, N = 15 Prob > |r| under H0: Rho=0									
	gender	lang	AQ	AS	SS	AD	C	I	SOP
gender	1.00000	0.13363	-0.03121	0.14940	0.15288	-0.31512	0.03166	-0.34077	0.44036
		0.6349	0.9121	0.5951	0.5865	0.2526	0.9108	0.2139	0.1004
lang	0.13363	1.00000	-0.03336	-0.06211	0.05720	-0.15987	-0.03230	0.01555	0.17813
	0.6349		0.9060	0.8259	0.8395	0.5693	0.9090	0.9561	0.5253
AQ	-0.03121	-0.03336	1.00000	0.85544	0.92447	0.34536	0.96067	0.67751	0.29714
	0.9121	0.9060		<.0001	<.0001	0.2074	<.0001	0.0055	0.2821
AS	0.14940	-0.06211	0.85544	1.00000	0.76747	0.25322	0.78657	0.35928	0.40434
	0.5951	0.8259	<.0001		0.0008	0.3625	0.0005	0.1884	0.1350
SS	0.15288	0.05720	0.92447	0.76747	1.00000	0.09145	0.91905	0.59061	0.37887
	0.5865	0.8395	<.0001	0.0008		0.7458	<.0001	0.0204	0.1637
AD	-0.31512	-0.15987	0.34536	0.25322	0.09145	1.00000	0.24618	0.03480	-0.01230
	0.2526	0.5693	0.2074	0.3625	0.7458		0.3764	0.9020	0.9653
C	0.03166	-0.03230	0.96067	0.78657	0.91905	0.24618	1.00000	0.60814	0.18083
	0.9108	0.9090	<.0001	0.0005	<.0001	0.3764		0.0162	0.5190
I	-0.34077	0.01555	0.67751	0.35928	0.59061	0.03480	0.60814	1.00000	0.11230
	0.2139	0.9561	0.0055	0.1884	0.0204	0.9020	0.0162		0.6903
SOP	0.44036	0.17813	0.29714	0.40434	0.37887	-0.01230	0.18083	0.11230	1.00000
	0.1004	0.5253	0.2821	0.1350	0.1637	0.9653	0.5190	0.6903	

Pearson Correlation Statistics (Fisher's z Transformation)									
Variable	With Variable	N	Sample Correlation	Fisher's z	Bias Adjustment	Correlation Estimate	95% Confidence Limits		p Value for H0:Rho=0
gender	lang	15	0.13363	0.13443	0.00477	0.12894	-0.410432	0.601475	0.6414
gender	AQ	15	-0.03121	-0.03122	-0.00111	-0.03009	-0.534123	0.489718	0.9139
gender	AS	15	0.14940	0.15053	0.00534	0.14418	-0.397434	0.611296	0.6021
gender	SS	15	0.15288	0.15409	0.00546	0.14755	-0.394537	0.613443	0.5935
gender	AD	15	-0.31512	-0.32622	-0.01125	-0.30494	-0.706797	0.245700	0.2585
gender	C	15	0.03166	0.03167	0.00113	0.03053	-0.489388	0.534433	0.9126
gender	I	15	-0.34077	-0.35496	-0.01217	-0.32997	-0.720452	0.219377	0.2188
gender	SOP	15	0.44036	0.47268	0.01573	0.42760	-0.108414	0.770982	0.1015
lang	AQ	15	-0.03336	-0.03338	-0.00119	-0.03217	-0.535608	0.488135	0.9080
lang	AS	15	-0.06211	-0.06219	-0.00222	-0.05990	-0.555131	0.466680	0.8294
lang	SS	15	0.05720	0.05727	0.00204	0.05517	-0.470389	0.551835	0.8428
lang	AD	15	-0.15987	-0.16126	-0.00571	-0.15430	-0.617738	0.388682	0.5764
lang	C	15	-0.03230	-0.03232	-0.00115	-0.03115	-0.534879	0.488913	0.9109
lang	I	15	0.01555	0.01555	0.0005553	0.01499	-0.501118	0.523238	0.9570
lang	SOP	15	0.17813	0.18005	0.00636	0.17196	-0.373175	0.628830	0.5328
AQ	AS	15	0.85544	1.27607	0.03055	0.84702	0.591344	0.947965	<.0001
AQ	SS	15	0.92447	1.61893	0.03302	0.91952	0.769917	0.973316	<.0001
AQ	AD	15	0.34536	0.36017	0.01233	0.33446	-0.214569	0.722870	0.2122
AQ	C	15	0.96067	1.95447	0.03431	0.95793	0.875080	0.986235	<.0001
AQ	I	15	0.67751	0.82450	0.02420	0.66421	0.230307	0.877800	0.0043
AQ	SOP	15	0.29714	0.30638	0.01061	0.28744	-0.263645	0.697063	0.2885
AS	SS	15	0.76747	1.01413	0.02741	0.75596	0.397716	0.914200	0.0004
AS	AD	15	0.25322	0.25885	0.00904	0.24474	-0.305874	0.672667	0.3699
AS	C	15	0.78657	1.06236	0.02809	0.77562	0.436969	0.921678	0.0002
AS	I	15	0.35928	0.37606	0.01283	0.34806	-0.199838	0.730138	0.1927
AS	SOP	15	0.40434	0.42883	0.01444	0.39219	-0.150261	0.753143	0.1374
SS	AD	15	0.09145	0.09171	0.00327	0.08821	-0.444119	0.574514	0.7507
SS	C	15	0.91905	1.58286	0.03282	0.91379	0.754897	0.971359	<.0001
SS	I	15	0.59061	0.67860	0.02109	0.57670	0.091461	0.840626	0.0187
SS	SOP	15	0.37887	0.39873	0.01353	0.36722	-0.178652	0.740234	0.1672
AD	C	15	0.24618	0.25134	0.00879	0.23790	-0.312435	0.668676	0.3839
AD	I	15	0.03480	0.03482	0.00124	0.03356	-0.487076	0.536599	0.9040
AD	SOP	15	-0.01230	-0.01230	-0.0004392	-0.01186	-0.520956	0.503463	0.9660
C	I	15	0.60814	0.70596	0.02172	0.59427	0.117896	0.848293	0.0145
C	SOP	15	0.18083	0.18284	0.00646	0.17457	-0.370855	0.630456	0.5265
I	SOP	15	0.11230	0.11278	0.00401	0.10834	-0.427658	0.587971	0.6960

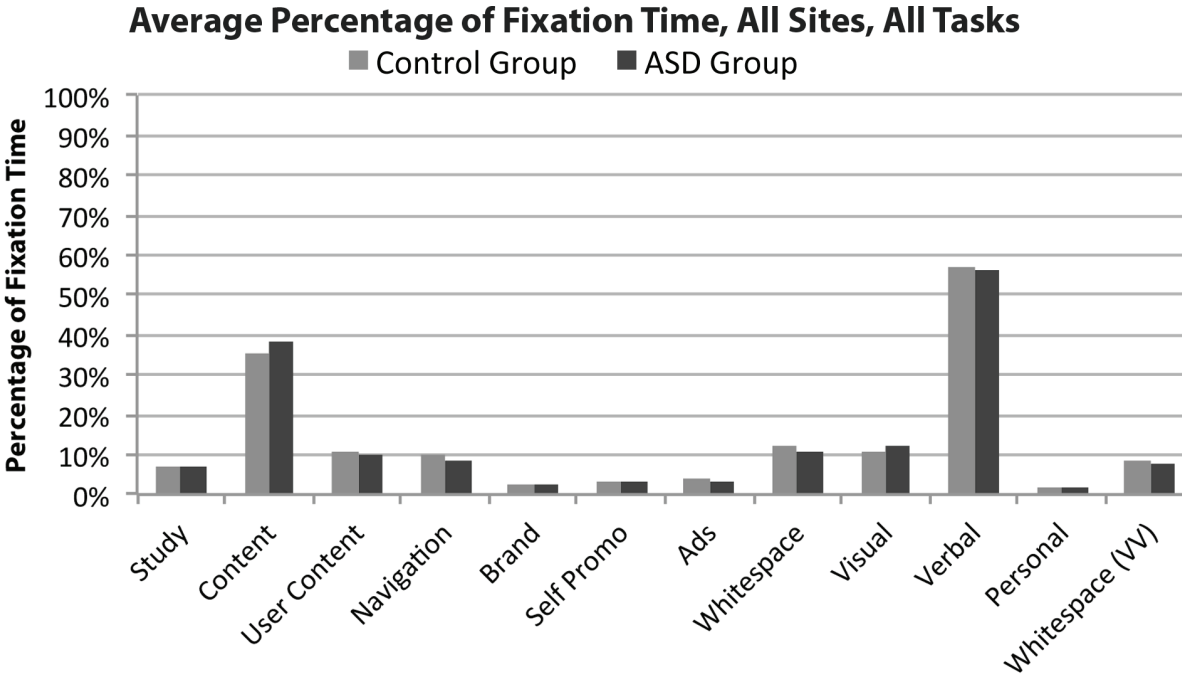
2. Mean AOI Hits



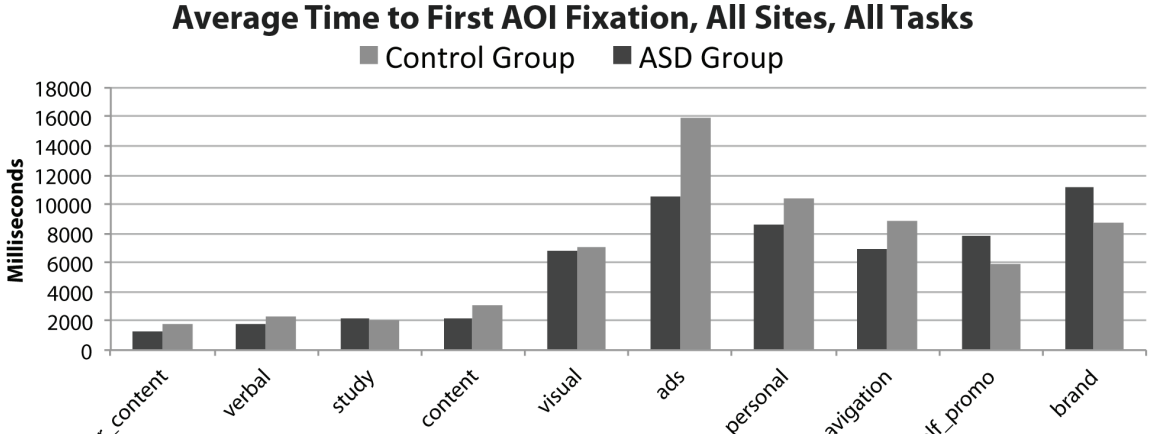
3. **Mean AOI Duration**



4. **Mean AOI Percentage**



5. **Time to First Fixation**



6. Time on Task