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AUTISM AND MISDIAGNOSIS: IS EARLY
DETECTION ALWAYS ACCURATE?

by Melissa Hosier

A Thesis

Submitted in partial fulfillment of the requirements of the
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of
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at
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Advisor

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ABSTRACT

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AUTISM AND MISDIAGNOSIS: IS EARLY DETECTION ALWAYS ACCURATE?

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Master of Arts in Applied Psychology and Mental Health Counseling

Autism is a brain-based disorder that involves disrupted social interactions and communication development along with stereotyped patterns of behaviors and interests. Early detection and intervention is crucial for children diagnosed with autism. While current trends in research and detection are leaning toward earlier diagnosis of the disorder, limited research exists to support that earlier diagnoses are accurate. The present study utilized archival research and interviews to examine the accuracy of early diagnosis in children identified as autistic using DSM-IV criteria, standard screening and diagnostic tools and genetic testing. Results indicated that genetic testing was the most reliable tool for accurately diagnosing autism. Earlier diagnosis of autism spectrum disorders has significant implications for primary healthcare providers and diagnostic and therapeutic service.

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CHAPTER I

Introduction

Autism is a brain-based disorder that involves disrupted social interactions and communication development along with the presence of stereotyped patterns of behaviors and interests. (Landa & Mayer, 2006) Children with autism often have poor personal attachment behaviors and may instead demonstrate preferences for particular objects. (Goin & Myers, 2004) The presence of social skill dysfunction is one of the most prominent indicators of the disorder, as children with autism often fail to establish relationships with others or engage in joint-attention behaviors. (Goin & Myers, 2004) Additionally, children with autism tend to perform stereotyped and repetitive behaviors and may be resistant to changes in routine or patterns. Communication delays, both verbal and nonverbal are often present and some children never develop language skills. (Shore & Rastelli, 2006) Children may also present with cognitive impairments with as many as 75-80% of children also meeting criteria for mental retardation. (Goin & Myers, 2004) It has been proposed that children with autism lack a function called the “theory of mind”, or the ability to imagine situations from other perspectives, and that other peoples’ experiences are different from their own. (Shore & Rastelli, 2006). Additionally, children with autism tend to focus on “dissociated fragments” rather than integrated “wholes”, leading to an overly concrete view of the world. (Goin & Myers, 2004)

The number of children diagnosed with Autism has been rising steadily since it was first diagnosed in the 1940s. At that time the rate was considered to be between 1 and 4 out of

The number of children diagnosed with Autism has been rising steadily since it was first diagnosed in the 1940s. At that time the rate was considered to be between 1 and 4 out of 10,000 people. (Shore & Rastelli, 2006) In the most recent governmental study on the rate of autism in 2003, the Centers for Disease Control and Prevention (CDC) found the rate of autism spectrum disorders was 3.4 per 1,000 for children 3-10 years of age. (NIMH, 2007) The recent increase in the number of cases in the United States is likely due to improved diagnosis and changes in diagnostic criteria as well as increasing media attention and public awareness. (Mayoclinic.com) The disorder occurs three to four times more often in boys than in girls. The severity of symptoms varies for each child, and although prognoses are diverse, autism is viewed as a chronic disability that results in lifelong impairment for most individuals. (Erba, 2000)

In order for a clinical diagnosis of autism to be made, the symptoms in social and communication impairment, as well as the stereotyped behaviors, must be present before the age of 3. (Trillingsgaard, Ulsted Sorensen, Němec, & Jorgensen, 2005) Many parents of children later diagnosed with autism reported concerns about their child's atypical development during infancy, however, most children are not diagnosed until after 3 as it is often difficult to distinguish autism from other developmental disorders at that age. (Azar, 1998) Research suggests that earlier detection and intervention leads to more positive outcomes for children diagnosed with autism. Developmental researchers have noted there are critical periods of child development after which certain systems such as language, vision and motor skills become less malleable. (Azar, 1998) In recent years there has been a push for better screening and surveillance tools and diagnostic instruments to identify

autism before the age of two. However, it is often difficult to make the diagnosis in younger children, as several of the main symptoms of the disorder involve behaviors that don't fully develop in children until later in childhood. (Selfe, 2002) In other words, children should be given the opportunity to "show us reasonably reliably, what they can do in terms of language, social skills, motor function and visual perceptual functioning" before a diagnosis can be given. (Selfe, 2002) However, affected infants and toddlers who are not diagnosed until the age of three are missing out on crucial intervention options. According to Rogers (1998) children receiving therapeutic interventions earlier, demonstrate more significant improvements in functioning than older children receiving the same interventions. In sum, earlier diagnoses appears limited by our knowledge of the early development in those infants later diagnosed with the disorder and our reliance on the symptoms identified in conventional classification systems, such as the DSM-IV-TR. (Baranek, 1999) "Professionals are often reluctant to diagnose autism prior to the age that a child would typically develop representational capacities and prior to expectations for production of consistent social initiatives such as sharing, offering comfort and initiating joint attention." (Baranek, 1999)

To further complicate the issue of making a diagnosis, the course of autistic symptomatology changes considerably with age, and symptoms observed during infancy may not appear at all like the manifestation of the disorder as the child grows older. (Selfe, 2002) Research suggests that autistic symptoms are easier to recognize as they intensify or become more pervasive with age. As a result, parents' awareness of the symptoms also increases. (Baranek, 1999)

Additionally, there are several other childhood disorders that may resemble autism, including Childhood Disintegrative Disorder and Attention Deficit/Hyperactivity Disorder (ADHD), Obsessive Compulsive Disorder, Bipolar Disorder, Oppositional Defiant Disorder. This is particularly the case with ADHD as many of the behavioral symptoms of the disorders overlap. (Shore & Rastelli, 2006) A child may indeed present with these disorders, however autism should be considered the primary problem. (Shore & Rastelli, 2006) There are also several syndromes that may resemble autism. While these syndromes do not fall under the autism spectrum disorders, they may occur comorbidly with the disorder, or be mistaken independently as autism. They include Tourette's syndrome, Fragile X syndrome, William's Syndrome, Down's Syndrome, Cornelia DeLange Syndrome and Landau-Kleffner Syndrome. (Shore & Rastelli, 2006)

There is no disputing the importance of early detection in children suspected to have autism. (Rogers, 1998) Not only will these children have immediate access to early intervention services, which may greatly improve their overall outcome, but also this is also particularly important to the parents of an autistic child. In terms of future family planning, families often plan to have their children 2-3 years apart. Landa and Mayer (2006) report autism has a heritability estimate of over 90% and subsequently born siblings have between 4.5-10% chance of developing the disorder. Additionally, it is important for parents to have accurate information about their child's diagnosis so that they can learn how to best manage the symptoms and seek the most appropriate care. (Goin & Myers, 2004)

While current trends in literature continue to reinforce the need for earlier assessment based on the efficacy of early intervention, it is also plausible that earlier diagnosis could lead to increased misdiagnosis. Furthermore, the claims of an autism “cure” based on effects of an early intervention program could very well be based on the fact that some children were originally misdiagnosed. The purpose of this study is to examine the accuracy of early diagnosis in children identified as being autistic at age three years old or younger. Implications for such a study may include the need for revision to the current diagnostic criteria for autism to reflect a more accurate depiction of the course of the disorder in infants and young childhood. Additionally, it may demonstrate the need for more specific and sensitive assessment and diagnostic measures for autism in infancy and young childhood.

While a number of studies and retrospective analyses presently exist that lend evidence to the existence of autistic symptoms in infants and young toddlers and convey the need for better screening and diagnostic tools, limited research exists that examines the rate of misdiagnosis of autism. Current limitations to the present study include its small sample size, as well as the assumption that parents are accurate in their reporting of their child’s symptoms. Improvements noted through early intervention services may be seen as sufficient evidence for parents to make their own determination that their child no longer meets the criteria for autism, hence altering the actual reports of misdiagnosis. Additionally, the present study is limited by the diagnostic criteria itself, whose very qualifications tend to be most reliable in children closer to the age of three, making a valid diagnosis under that age questionable and controversial.

CHAPTER II

Autism: Birth to Age 3

The following was taken from the DSM IV-TR Diagnostic Criteria for Autistic Disorder 299.00

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3):

Qualitative impairment in social interaction, as manifested by at least two of the following:

- (a) 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
- (b) failure to develop peer relationships appropriate to developmental level
- (c) 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)
- (d) lack of social or emotional reciprocity

Qualitative impairments in communication as manifested by at least one of the following:

- (a) 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)
- (b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others
- (c) stereotyped and repetitive use of language or idiosyncratic language
- (d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level

Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:

- (a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
- (b) apparently inflexible adherence to specific, nonfunctional routines or rituals
- (c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or
- (d) persistent preoccupation with parts of objects twisting, or complex whole-body movements)

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

While several theories have been posited to explain what causes autism, no one really knows for sure. (Plauch & Johnson, 2007) Most experts agree that autism is probably caused by a combination of genetic and environmental factors. (Plauch & Johnson, 2007) Genetically, research has shown that autism clusters in families. According to the Centers for Disease Control and Prevention: (2003)

- Studies have shown that among identical twins, if one child has autism, then the other will be affected about 75% of the time.
- In non-identical twins, if one child has autism, then the other has it about 3% of the time.
- Also, parents who have a child with an ASD have a 2%–8% chance of having a second child who is also affected
- Autism also tends to occur more frequently among individuals with inherited medical conditions such as Fragile X syndrome and tuberous sclerosis.

Researchers have also identified differences in the shape and structure of the brains of children with autism, specifically in the frontal lobe region. Specifically, researchers have found that children with autism, ages 12 or younger, had a larger overall brain size but significantly smaller parietal lobes, which are responsible for movement, orientation, recognition and perception of stimuli. (Volkmar, et al, 2000)

Other theories include the brain-gut connection, which suggests individuals with autism can't process and eliminate heavy metals such as aluminum, lead, mercury from their systems. The inability to excrete these metals than leads to "heavy metal poisoning" which in turn produces symptoms of autism. (Shore & Rastelli, 2006)

Testosterone has also been identified as a potential cause of autism, and appears easily supported by statistics that boys outnumber girls in cases of autism. Simon Baron-Cohen (2002) has proposed a theory that suggests that autism is a function of right-brain dominance, seen commonly in males. He further hypothesizes that too much testosterone in utero leads to the development of autistic symptoms.

Researchers estimate that 30-70% of autistic children present with some form of immune system abnormalities. (Shore & Rastelli, 2006) It has been theorized that natural stress hormones produced by the mother, viral exposure or trauma such as chemical exposure during pregnancy may increase the risk of autism. Additionally, it has been shown that many autistic individuals have family members with autoimmune diseases such as diabetes. (Shore & Rastelli, 2006)

Perhaps one of the most controversial theories of autism stems from early childhood vaccinations. Some people believe autism is caused by vaccines, particularly the measles-mumps-rubella vaccine (MMR). (Taylor, Miller, Farrington, Petropoulos, Favot-Mayaud, Li, & Waight,) Additionally, vaccines containing thimerosal, a preservative that contains small amounts of mercury have also been linked to autism. (Taylor, et al, 1999) This theory in particular has been used as an attempt to explain the regressive form of autism.

It centers on the idea that around the ages of 18-24 months, children receive the majority of vaccinations and it is this same time that children with regressive autism begin to show symptoms. While this theory may show a correlation between autism and vaccinations, it does not show causation. In response to this growing theory, the National Academies' Institute of Medicine in Washington D.C. issued a statement that "it has found no conclusive evidence to implicate thimerosal in vaccines." (as cited in Shore & Rastelli, 2006)

Several large-scale studies have also found no evidence to support this theory. In 2000, The American Academy of Pediatrics (AAP), held a conference to address the proposed link between the MMR vaccine and autism. Upon review the AAP issued a statement in Pediatrics that they did not find sufficient evidence to support this theory. The same year, the Institute of Medicine (IOM) also conducted in own investigation and concluded there was insufficient evidence to support an association between autism and the MMR vaccine. (Halsey and Hymen, 2001)

In 1999, Taylor and colleagues also conducted a study to investigate the suggested link between autism and the MMR vaccine. This study looked at all the known cases of autism in children living in certain districts of London who were born in 1979, or later. Researchers then matched the autism patients with an independent registry of vaccinations. The results showed that: 1) the number of autism cases had increased steadily since 1979, however there was no drastic increase in the number of cases of autism after medical professionals began using the MMR vaccine in 1988. 2) Children showed symptoms of autism and were diagnosed with autism at the same ages, regardless

of the age at which they received the vaccination 3) By age two, vaccination coverage among children with autism was nearly the same as vaccination coverage for children the same age who did not have autism throughout the region. This data suggests if the MMR vaccine and autism were in fact associated, then a greater number of children who had been vaccinated would have in that region would have had autism 4) Additionally, they found that the first signs of autistic behavior or first diagnosis of autism was not more likely to occur in time periods following the MMR vaccine than in other time periods. (Taylor, et al, 1999)

While current theories about the cause or causes of autism vary, most experts agree that the best way to counter the affects of autism is through early intervention services. (Rogers, 1998) Researchers have determined the optimal age for the onset of early intervention is less than four years old. However, most children are not diagnosed until 3-4 years old despite parental concerns as early as two years prior to the diagnosis. This delay in diagnosis prevents children from receiving the full benefits of an early intervention program. (Rogers, 1998)

Speech problem and language delays are often the first concerns reported by parents of autistic children, followed by difficulties with social development, sleep problems, rituals, stereotypies, motor delay, emotional problems and lack of imaginative play. (Gray & Tonge, 2001) The diagnostic criteria for autism including some social and communicative development take time to materialize and may be difficult to observe in infants and preschool ages children. (Gray & Tonge, 2001) For instance, a follow up study found that a number of behaviors which differentiated children with autism from

children with speech and language delays without autism were not as prevalent in children with autism at the age of 3 than at the age of 2. (Lord, 1995) Despite the difficulties of diagnosing autism in preschool children, recent studies suggest that a diagnosis of autism in children less than 3 years old remains stable. (Gray & Tonge, 2001)

Additionally, “it has been shown that the symptoms of autism can be reliably assessed by 18 months of age” (Dietz, Swinkles, van Daalen, van Engeland, Buitellar, 2006) That being said, it is important that clinicians have a clear picture of the features of autism in children under three years old. If the presenting symptoms in infants and preschool children differ from those identified in the DMS-IV-TR criteria then what could clinicians expect to see in an infant identified as being at risk for autism?

To date, the most valuable data researchers have comes from retrospective studies and home movies of children later identified as having autism. (Werner, Dawson, Osterling & Dinno, 2000) Retrospective analysis of home movies of infants later diagnosed with autism can be considered a valid and reliable tool to identity early symptoms and the trajectory of the disorder. (Werner, Dawson, Osterling & Dinno, 2000) Specifically, they allow researchers to obtain data and information that is not influenced by parents’ recall or time passed and they also give researchers the opportunity to observe the specific course of the disorder over time. In general some of the identified impairments observed have included a) failure to respond to their name; b) a lack of solo babbling and lack of babbling in response to the speech of others; c) difficulty tracking an object moving across the field of vision; difficulty making eye contact; d) Failure to smile in response to

the smiles of others) lack of appropriate facial expression, f) difficulty changing focus from one object to another, g) failure to point at objects in the distance to share his/her interest with others, (joint attention behaviors) h) hypotonia and poor attention. In the second year of life additional observed behaviors were noted. These include: a) ignoring people, b) preference to be alone, c) lack of eye contact, d) lack of emotional expressions, e) lack of appropriate gestures. (Charman and Baird, 2002)

Losche (1990) was the first researcher to study the development of infants later diagnosed with autism using home video analysis. He identified striking differences in sensorimotor development, joint social activities and symbolic play. A few years later Adrien (1993), also using video analysis, found abnormalities in social attention interaction, communication, emotion and more behavior in children with autism. Furthermore, Adrien also found that children with autism demonstrated a lack of social smiling, eye contact and appropriate facial expressions when compared with those children without autism. (Clifford, Young & Williamson, 2007)

Osterling and Dawson (1994) conducted a study in which they observed home videotapes of children at their first birthday parties. By using these particular tapes they were able to ensure that all children involved in the study were in fact in the same age. The results revealed differences between 11 typically developing infants and 11 infants with autistic spectrum disorder. The particular areas of interest included social, joint attention and autistic like symptoms. Specific behaviors such as pointing, showing and failing to orient to name correctly classified 91% of the participants.

Baraneck (1999) also conducted a study using home videotapes in which he viewed infants ages 9-12 months. These children were described as children with autism, children with mental retardations and typically developing children. It was found that children with autism had poor visual attention, required more prompts to respond to their name, used their mouths more to process objects and tended to show more aversion to social touch than children in the other two groups. (Baraneck, 1999)

In 2000, Werner, Dawson, Osterling and Dinno expanded on Osterling and Dawson's original study and added 8 additional infants to the study to enlarge the sample of the original study. They predicted that impairments in social attention and affective responsiveness would be observable before the age of 1 as these are two behaviors that typically developing infants exhibit. They hypothesized that 8-10 month old infants (later diagnosed with autism spectrum disorder) would spend significantly less time looking at others, orienting to their name, using combined eye contact and smiling and vocalize in a communicative manner. Additionally, they also sought to examine whether infants with autism spectrum disorder exhibited more nonfunctional repetitive behaviors than those typically developing infants. (Werner Dawson, Osterling and Dinno, 2000)

Results of the Werner et al, (2000) study suggested that differences between infants with early onset autism spectrum disorder and typically developing infants could be detected at 8-10 months of age. The strongest indicator of the autism spectrum disorder in these infants was that they were much less likely than typically developing infants to orient to their name.

In their previous study, Dawson and Osterling (1994) also found that at age 1 this behavior distinguished children with autism spectrum disorders from typically developing infants. This was also consistent with finding from Barenecks (1999) study of 9-12 month old infants who reported children with later diagnosed with autism spectrum disorders required more prompts to respond to their names than typically developing infants.

Similar results were also found in a study by Dawson, Meltzoff, Osterling, Rinaldi and Brown (1998), which took place in a controlled experimental setting. Their study compared children with Down syndrome, children with autism and typically developing children and found that children with autism spectrum disorders failed to orient to their names and other social stimuli. In a study conducted in 2002, Osterling et al, found that 12-month old infants with autism could be distinguished from other infants who were mentally retarded or typically developing by their lack of social gazing and orientation to their names.

Landa and Mayer (2006) conducted a prospective longitudinal study of general development in infants with autism from 6 to 24 months of age using the Mullen Scales of Early Learning (MSEL). A total of 87 infants were tested at ages 6, 14 and 24 months. Infants came from both high (siblings of children with autism) and low risk (no family history of autism) groups. Additionally, based on the results of language test scores, Autism Diagnostic Observation Schedule and clinical judgment, the groups were further categorized at 24 months as being: unaffected, autism spectrum disorder (ASD) or language delayed. (LD) Results indicated there were no statistically significant group

differences at the age of 6 months, however, at 14 months, the ASD group performed significantly worse on than the unaffected group on all scales of measurement. And at 24 months, the ASD group performed significantly worse than the unaffected group in all domains and the LD group in gross motor, fine motor and receptive language. (Landa & Mayer, 2006)

In their study among infants aged 12-30 months, Mars, Mauk and Dowrick (1998) identified joint attention deficits as the strongest early predictor of pervasive developmental disorders. Additionally, a study by Barneck (1999) found that pointing and showing behaviors were rarely seen and, additionally, following another's gaze was absent in children with autism in the first 18 months of life. Clifford Young and Williamson (2007) conducted a study, which compared infants with autism to infants who had developmental or language delay and typically developing infants. Results showed that the best discriminating items between the autism and developmental delay group centered on peer interest, gaze aversion, anticipatory postures and proto-declarative showing. Furthermore, it was concluded that peer interest, positive effect, eye contact quality and lack of response to name discriminated 79% of the infants who were later diagnosed with autism from the infants in the other developmental categories. Clifford Young and Williamson (2007) did acknowledge a low rate of misclassification in their study, however they reported the errors only occurred in discriminations between developmentally delayed and typically developing infants.

While the results of several home videotape studies show promise in the identification of infants with autism, it should be noted that while differences were observed, the diagnosis is not always correct. In the discussion sections of the study by Werner, Dawson, Osterling and Dinno (2000), they acknowledged that the developmental pediatrician who rated the videotapes in their study tended to overdiagnose autism in the 8-10 month old infants. Furthermore, they suggest that at very young ages clinicians will need to use more precise diagnostic tools to accurately diagnose autism in infants rather than relying on clinical impressions alone. (Dawson, et al, 2000) Additionally, parent report data also suggest, that not all children with autism are symptomatic at such young ages.

For a subgroup of children, parents report that their child had normal or near-normal development for their first 15 to 24 months and then experienced a regression in their communication skills and/or social skills. Maestro, Muratori, Cesari Pecini, Apicella, & Stern, D, 2006) Estimates of the prevalence of this "regressive" pattern range from 20% to 47% among children with autism. (Maestro, et al, 2006)

CHAPTER III

Assessment and Diagnostic Measures

No medical tests presently exist to identify biological markers for autism and screening tools must rely on behaviors alone to identify those children at risk. (Werner, Dawson, Osterling, Dinno, 2000) While many parents report having concerns about their children as early as 12-18 months, autism often remains unrecognized and undiagnosed until or after late preschool age due to the lack of appropriate screening and diagnostic tools. (Rogers, 1998) In a Report of the Quality Standards Subcommittee of the American Academy of Neurology and the Child Neurology Society (Volkmar, Prizant, Rapin, Rogers, Stone, Teplin, Tuchman, Gordon, Gravel, Johnson, Kallen, Levy, Minshew, Ozonoff, Filipek, Accardo, Ashwal, Baranek, Cook & Dawson, 2000), the following was reported about the experience of parents of autistic children in their plight for answers regarding developmental concerns:

It has been estimated that fewer than 10% of children were diagnosed at initial presentation; another 10% were either told to return if their worries persisted, or that their child would simply “grow out of it.” The rest were referred to another professional, at a mean age of 40 months. At this time only 40% were given a formal diagnosis. 25% were told not to worry and 25% were referred to a third or fourth professional for another opinion. Almost 25% of parents reported that they had to

exert considerable pressure to obtain the referrals or pay out of pocket. Over 30% of parents referred to subsequent professionals reported that no help was offered and only about 10% reported that a professional explained their child's problems. (p. 469)

As discussed in the above chapters, a growing body of research has emphasized the importance of early detection and intervention for improving long-term outcome for children with autism. In an effort to identify children at risk, several screening and diagnostic approaches have been utilized.

Screening

The use of screening questionnaires by primary care physicians and early childhood professionals currently offers the best method for the early identification of children with autism. (Gray & Tonge, 2004) A dual-level approach to the assessment and diagnosis in at risk children had been proposed, with level 1 requiring the routine screening of preschool children for developmental disorders by primary care providers. (Gray & Tonge, 2004)

In the Report of the Quality Standards Subcommittee of the American Academy of Neurology and the Child Neurology Society, (Volkmar, et al, 2000) the following guidelines were recommended for level 1 screening:

Level one evidence-based recommendations.

Clinical practice recommendations.

1. Developmental surveillance should be performed at all well-child visits from infancy through school-age, and at any age thereafter if concerns are raised about social acceptance, learning, or behavior.
2. Recommended developmental screening tools include the Ages and Stages Questionnaire, the BRIGANCEt Screens, the Child Development Inventories, and the Parents' Evaluations of Developmental Status.
3. Because of the lack of sensitivity and specificity, the Denver-II (DDST-II) and the Revised Denver Pre-Screening Developmental Questionnaire (R-DPDQ) are not recommended for appropriate primary-care developmental surveillance.
4. Further developmental evaluation is required whenever a child fails to meet any of the following milestones: babbling by 12 months; gesturing (e.g., pointing, waving bye-bye) by 12 months; single words by 16 months; two-word spontaneous (not just echolalic) phrases by 24 months; loss of any language or social skills at any age.
5. Siblings of children with autism should be carefully monitored for acquisition of social, communication and play skills, and the occurrence of maladaptive behaviors. Screening should be performed not only for autism-related symptoms but also for language delays, learning difficulties, social problems, and anxiety or depressive symptoms.
6. Screening specifically for autism should be performed on all children failing routine developmental surveillance procedures using one of the validated instruments—the CHAT or the Autism Screening Questionnaire.
7. Laboratory investigations recommended for any child with developmental delay and/or autism include audiologic assessment and lead screening. Early referral for a formal

audiologic assessment should include behavioral audiometric measures, assessment of middle ear function, and electrophysiologic procedures using experienced pediatric audiologists with current audiologic testing methods and technologies. Lead screening should be performed in any child with developmental delay and pica. Additional periodic screening should be considered if the pica persists

Current existing instruments that have been assessed for their screening capacity and ability to differentiate autism from other childhood disorders include: the Checklist for Autism in Toddlers (CHAT), the Social Communication Questionnaire (SCQ), the Screening Tool for Autism in Two-year olds (STAT), the Modified Checklist for Autism in Toddlers (M-CHAT), The Developmental Behaviour Checklist (DBC-P), the Autism Behavior Checklist (ABC). (Gray and Tonge, 2000) More recently developed screening tools include the First Year Inventory (FYI) and the Early Screening of Autistic Traits Questionnaire (ESAT)

CHAT

The Checklist for Autism in Toddlers (CHAT) is a screening tool that is intended for use in the general population at 18 months of age. (Dumont-Mathieu & Fein, 2005) The tool is designed to be used by general practitioners or health care providers at a child's 18-month check up. (Gray & Tonge, 2004) It consists of nine parent report items and five observation items. (Baron Cohen et al., 2000) When all fourteen items are looked at as a whole, five of these items have been found to be key indicators if possible autism based on the Diagnostic and Statistical Manual (DSM-IV-TR) criteria for autistic disorder. (Dumont-Mathieu & Fein, 2005)

Specifically, behaviors such as gaze monitoring, proto-declarative pointing, and pretend play were implicated as key indicators. Baron-Cohen et al., (1996) found at 18 months of age if toddlers demonstrated difficulties specifically with gaze monitoring, proto-declarative pointing, and pretend play, there was an 83.3 % chance they would subsequently be diagnosed with autism via a diagnostic evaluation.

In 2001 Scambler, Rogers and Wehner investigated the efficacy of the CHAT in a group of children ages 2-3 years old with a diagnosis of autism or other developmental disorders. When compared with rigorously established clinical diagnosis, the CHAT demonstrated both high sensitivity (65%) and high specificity (100%) for autism. This finding showed similar results to a 2000 study by Baird et al., in regards to the high specificity, however in regards to sensitivity, the numbers were significantly higher in Scambler, Rogers and Wehner's (2001) study at 65% compared to 20-38% in Bairds (2000) study just a year before.

SCQ

The Social Communication Questionnaire (formerly known as the autism screening questionnaire) is a selection of 40 questions that are to be answered by the child's primary caregiver. (Allen, Silove, Williams & Hutchins, 2006) It is a screening tool for children at risk of developmental problems that provides an operational diagnosis, which is based on behavioral item scores in three areas of functioning, including reciprocal social interactions, language and communication and repetitive and stereotyped patterns of behavior. (Allen, Silove, Williams & Hutchins, 2006)

In 1999 Berument, Rutter, Lord, Pickles and Bailey conducted a study to determine the validity of the SCQ using individuals between the ages of 4 and 18, whose parents were already aware of the diagnosis. They concluded the sensitivity for differentiating pervasive developmental disorders from autism was 85%, specificity was 67%, positive predictive value was 93% and negative predictive value was 55%. (Berument, et al, 1999)

STAT

The Screening Tool for Autism in Two-year olds (STAT) consists of 12 items that assess imitation, play, and communication. It is an interactional assessment of children aged 24-35 months, takes approximately 20 minutes to complete and is administered by a trained clinician. (Gray & Tonge, 2004) The STAT was designed as a second-stage screening tool to differentiate children with autism from those with other developmental disabilities. (Klinger, 2000) The scale consists of 12 play, motor imitation and joint attention items that measure different aspects of play interaction. Each item is scored as pass or fail and the number of passes is summed to obtain a domain score. If a child fails two tasks in any one domain, then they fail that domain. Failing two of three of the scale's domains results in a classification of high-risk for ASD. (Klinger, 2000) The scale was applied to a sample of 33 children (26 boys and 7 girls) between 24 and 35 months of age. (Klinger, 2000) Twelve children had a diagnosis of autism, 21 had a non-autistic developmental disorder. There was 83% sensitivity and 86% specificity. (Gray & Tonge, 2000)

M-CHAT

The Modified Checklist for Autism in Toddlers (M-CHAT) is a modified version of the CHAT and consists of 23 yes or no items to be completed by parents. It retains the original 9 CHAT items in addition to 14 more items. (Robins, 2001)

The M-CHAT has been used to screen 1122 children at their 18-month well-baby checkup and a high-risk sample of 171 children currently receiving early intervention services. (Robins, 2001) Six of the 23 items were found to best differentiate children with autism from non-autistic children, with sensitivity of .87, specificity of .99, positive predictive power of .80 and a negative predictive power of .99. (Robins, 2001) It has been concluded that the M-CHAT is an accurate method of detection, correctly classifying 33 of 38 children with autism/PPD and 1188 of 1196 children who did not have ASD/PDD. It has been reported that the items with the best predictive ability were joint attention, social relatedness, and communication. (Robins, 2001)

DBC-P

The Developmental Behaviour Checklist (DBC-P) is a 96-item parent or caregiver completed checklist designed to measure behavioral and emotional disturbance in children and adolescents with intellectual disability. (Einfeld and Tonge, 1995) It takes approximately 10-25 minutes to complete and is completed by the primary caregiver. (Although there is also a teacher version, DBC-T, which has 94 items and is completed

by a teacher who has known the individual for at least 2 months.)(Einfeld and Tonge, 1995) The DBC-P has been evaluated in terms of its ability to discriminate between children and adolescents with autism and those with intellectual disability without autism. (Gray and Tonge, 2004) Researchers have identified twenty-nine items on the DBC-P that best discriminate between children with autism and those with intellectual disability without autism. It has been described a sensitive screening tool for detecting autism in intellectually disabled children and adolescents with sensitivity of .86 and specificity of .69. (Gray and Tonge, 2004)

ABC

The Autism Behavior Checklist (ABC) is a tool designed to screen children ages 18 to 35 months and measures 57 behaviors on five dimensions including: sensory, relating, body and object use, language, and social skills. (Wadden, Bryson & Rodger, 1991) Each item on the checklist holds a different weight. Individuals with knowledge about the child's behavior including parents or teachers, may complete the checklist of behaviors. Krug *et al.* (1980) conducted a study in which 1049 raters, blinded to the purpose of the checklist, rated children previously diagnosed with autism, mental retardation, emotional disturbance, who were deaf-blind, or typically developing. Using the weighted behavior checklist, those individuals who previously were diagnosed with autism had a total mean score of 78, whereas all other diagnostic groups had total mean scores less than 45. The tool has a reported inter-rater reliability of 0.95 and test-retest reliability of 0.87. (Krug, et al, 1980)

FYI

The First Year Inventory (FYI) is a recently developed parent questionnaire designed to assess behaviors in 12-month-old infants that suggest risk for an eventual autism diagnosis. (Watson, Baranek, Crais, Reznick, Dykstra and Perryman, 2007) The FYI is based on a list of characteristics reported to distinguish infants and toddlers eventually diagnosed with autism spectrum disorders, focusing on characteristics that would be identifiable in 12-month old infants.

The questionnaire includes reported unusual behavior, the absence of typical behaviors and typical behaviors occurring only with extensive parental report. (Watson et al) A study by Watson et al (2007) examined the construct validity of the FYI by comparing retrospective responses of parents of preschool children with either: autism spectrum disorders, other developmental disabilities and typical development. Results indicated that children with autism spectrum disorders rated at significantly higher risk on the FYI than children with developmental disabilities or typical development. (Watson, et al, 2007)

ESAT

The Early Screening of Autistic Traits Questionnaire (ESAT) is also a recently developed general population screening instrument for children ages 14-24 months. (Pinto-Martin, & Levy, 2004) After a review of the literature of early symptoms of autism reported in retrospective studies, prospective studies, and family home movies, Dietz, Swinkles, van Daaler, van Engeland and Buitellar (2006) selected 19 potential

screening items that formed the preliminary version of the Early Screening of Autistic Traits (ESAT). This version of the ESAT included the three key items of the CHAT (Baron-Cohen et al., 1992, 1996) and in addition, covered the domains of pretend play, joint attention, interest in others, eye contact, verbal and nonverbal communication, stereotypes, preoccupations, reaction to sensory stimuli, emotional reaction, and social interaction. (Dietz, et al, 2006)

Children who respond positively to three or more items on the ESAT are considered to have screened positive for autism spectrum disorder. (Dietz, et al, 2006) In a recent study by Dietz, et al, (2006) data was collected retrospectively from parents who had a child diagnosed with autism spectrum disorders to develop an instrument that showed a higher than 90% sensitivity for autism spectrum disorders. The test also had a high specificity to differentiate normal from abnormal development but was less specific in distinguishing between autism spectrum disorders and other types of abnormal development.

In the Report of the Quality Standards Subcommittee of the American Academy of Neurology and the Child Neurology Society, (Volkmar, et al, 2000) the following guidelines were recommended for Level 2 screening:

Level Two: Evidence-Based Recommendations for Diagnosis and Evaluation for Autism

Clinical Practice Recommendations:

1. Genetic testing in children with autism, specifically high resolution chromosome studies (karyotype) and DNA analysis for Fragile X, should be performed in the presence of mental retardation (or if mental retardation cannot be excluded), if

there is a family history of Fragile X or undiagnosed mental retardation, or if dysmorphic features are present. However, there is little likelihood of positive karyotype or Fragile X testing in the presence of high-functioning autism.

2. Selective metabolic testing should be initiated by the presence of suggestive clinical and physical findings such as the following: if lethargy, cyclic vomiting, or early seizures are evident; the presence of dysmorphic or coarse features; evidence of mental retardation or if mental retardation cannot be ruled out; or if occurrence or adequacy of newborn screening for a birth is questionable.
3. There is inadequate evidence at the present time to recommend an electroencephalogram study in all individuals with autism. Indications for an adequate sleep-deprived electroencephalogram with appropriate sampling of slow wave sleep include clinical seizures or suspicion of subclinical seizures, and a history of regression (clinically significant loss of social and communicative function) at any age, but especially in toddlers and preschoolers.
4. Recording of event-related potentials and magnetoencephalography are research tools at the present time, without evidence of routine clinical utility.
5. There is no clinical evidence to support the role of routine clinical neuroimaging in the diagnostic evaluation of autism, even in the presence of megalencephaly.
6. There is inadequate supporting evidence for hair analysis, celiac antibodies, allergy testing (particularly food allergies for gluten, casein, *Candida*, and other molds), immunologic or neurochemical abnormalities, micronutrients such as vitamin levels, intestinal permeability studies, stool analysis, urinary peptides,

mitochondrial disorders (including lactate and pyruvate), thyroid function tests, or erythrocyte glutathione peroxidase studies.

Diagnostic Tools

Four commonly used diagnostic tools for children suspected of having ASD are described below, including The Autism Diagnostic Observation Schedule (ADOS) The Autism Diagnostic Interview-Revised (ADI-R), The Childhood Autism Rating Scale (CARS) and The Gilliam Autism Rating Scale (GARS).

ADOS

The Autism Diagnostic Observation Schedule (ADOS) a semi-structured assessment of communication, social interaction and play or imaginative use of materials for individuals suspected of having autism or other pervasive developmental disorders. (Ozonoff, Goodlin-Jones & Solomon, 2005) The ADOS assesses current behavior in children including social play and communication through a series of "planned social occasions" that allow the children to respond to social cues. (Pinto-Martin & Levy, 2004) The ADOS includes four modules. Each module is designed to address the child at the appropriate developmental stage and language level. (Ozonoff, Goodlin-Jones & Solomon, 2005) Play is assessed using an algorithm based on the Diagnostic and Statistical Manual of Mental Disorders IV and International Classification of Diseases of the World Health Organization-10 criteria for impaired social interaction and communication skills for the diagnosis of autism and pervasive developmental disorders. (Ozonoff, Goodlin-Jones & Solomon, 2005)

It has a reported sensitivity of 95% and specificity of 92% for differentiating autism and PDD-NOS from those outside the autism spectrum based on samples of 45 to 59 subjects. (Pinto-Martin & Levy, 2004)

ADI-R

The Autism Diagnostic Interview-Revised is a structured clinician based parent report interview for parents of children 3 to 4 years of age. (Pinto-Martin & Levy, 2004) It is used to assess children and with a mental age greater than 18 months, and has a sensitivity of 96% and a specificity of 92%. (Pinto-Martin & Levy, 2004) During the interview parents or caregivers are asked about their child's current and past behavior, with particular attention to preschool behavior. The instrument focuses on behavior in three main areas: qualities of reciprocal social interaction; communication and language; and restricted and repetitive, stereotyped interests and behaviors. (Tomanik, Pearson, Loveland, Lane & Shaw, 2007) In order to receive an autism diagnosis a child must meet the cutoff score in each of the three domains according to the scoring algorithm and have evidenced a developmental abnormality prior to 36 months of age. (Tomanik, et al, 2007)

CARS

The Childhood Autism Rating Scale (CARS) is the most widely used behavioral rating system. (Kabot, Masi & Segal, 2003) It includes 15 scales measuring domains such as resistance to environmental change and verbal and nonverbal communication. (Ventola, et al, 2006)

Each scale is scored on a seven-point Likert scale, ranging from normal to severely abnormal based on observations of behavior in the home, clinic, or school.

(Pinto-Martin & Levy, 2004) The total CARS score has a possible range from 15 to 60.

(Ventola, et al, 2006) An independent investigation of the CARS found an inter-rater reliability of 0.71. (Garfin, 1988) The scale was also found to have an internal

consistency of 0.94, although the sample on which this statistic is based was not

disclosed. (Garfin, 1988) The CARS has been criticized for no longer being reflective of the current diagnostic criteria as it was first published in 1980 before the revisions took

place. (Perry, Condillac, Freeman, Dunn-Geier & Belair, 2005)

GARS

The Gilliam Autism Rating Scale (GARS) is a more recently developed behaviour rating scale designed to measure the severity and probability of autism. This instrument was also developed to discriminate individuals with autism from other developmental disabilities.

(Gilliam, 1995) The GARS was designed for use by teachers, parents, and clinicians and

helps to identify and diagnose autism in individuals' ages 3-22. A total of 56 items are grouped into 4 subtests that examine stereotyped behaviors, communication, social

interaction, and developmental disturbances for parents to contribute data about their child's development during the first 3 years of life. The entire scale can be completed in

approximately 5-10 minutes. (Gilliam, 1995)

Few studies exist on the validity of the GARS. Results of a study by South et al, 2003 indicated that the GARS consistently underestimated the likelihood that the children in the

sample would be diagnosed with autism. The average GARS summary score, known as the Autism Quotient, for the sample was 90.10 (SD=13.92), 10 points below the reference group mean of 100.

This difference between the sample group and the reference group reached statistical significance. This result indicates that a substantial majority of the sample with a clear diagnosis of autism had a low probability of autism being evident on the GARS. If viewed as a diagnostic measure, results of the current sample indicated a poor diagnostic sensitivity of .48 (South et al, 2003).

Despite continuing advances in the development of screening tools and diagnostic instruments, autism still remains undiagnosed in a large majority of children until 3 or 4 years of age.

Genetic Testing

An estimated 10 to 15 percent of individuals with autistic disorder have an identifiable genetic condition, however in most cases there is no underlying specific cause. (Rutter, Bailey, Bolton & Le Conteur, 1994) There are several genetic syndromes that may cause autism, including Fragile-X, tuberous sclerosis, Rett syndrome, Prader-Willi syndrome, Angelman syndrome, well as a variety of chromosomal abnormalities. (Rutter et al, 1994) A geneticist can determine whether the autism is caused by a genetic disorder, or has no known genetic cause.

Fragile X Syndrome

Research studies have shown there is a known association between autism and Fragile X syndrome. (Cohen, Sudhalter, Pfadt, Jenkins, Brown & Vietze, 1991) Fragile X syndrome is a genetic condition transmitted via the X chromosome that causes mild to moderate mental retardation. (Cohen, et al 1991) Fragile X syndrome affects 1:4,000 to 1:6,000 males (Turner, Webb, Wake, Robinson, 1996). The prevalence of Fragile X syndrome in females is approximately one-half the prevalence in males. (Turner et al 1996) Approximately 2-3 percent of individuals with autism have Fragile X syndrome (Fombonne, Du Mazaubrun, Cans & Grandjean, 1997).

Tuberous Sclerosis Complex

It is estimated that as many as 14 percent of individuals with autism and seizures have tuberous sclerosis complex (TSC) (Gillberg 1991). Symptoms of TSC may include seizures, mental retardation, and abnormalities of the skin and brain. (Gillberg 1991) There are two different genes that are known to cause tuberous sclerosis complex, one on chromosome 9 (TSC1) and the other on chromosome 16 (TSC2). Genetic testing can confirm this diagnosis. (Ritvo, 1990).

Rett Syndrome

Rett syndrome is caused by a mutation in the MECP2 gene on the X chromosome. (ghf.com) The disorder primarily affects females and is characterized by a regression in language and motor skills, microcephaly, reduced muscle tone and stereotypical hand

movements such as wringing or waving. (Shore & Rastelli, 2006) An estimated seventy to 80 percent of girls given a diagnosis of Rett syndrome have the MECP2 genetic mutation. (ghf.com)

Prader-Willi Syndrome

Prader-Willi syndrome is characterized by hypotonia, initial feeding difficulties followed by hyperphagia, excessive weight gain, mental retardation, language, motor and developmental delays, hypogonadism and short stature. Many of these behavioral features overlap with features of autism. Prader-Willi syndrome is caused by the loss of active genes in a specific region of chromosome 15. (ghf.com)

Angelman syndrome

Angelman syndrome is characterized by severe mental retardation, ataxia, microcephaly, seizures, ataxia, inappropriate laughter and a happy demeanor. (ghf.com) Angelman syndrome is caused by loss of the maternally inherited UBE3A gene in the Prader-Willi/Angelman syndrome region on chromosome 15. (ghf.com)

While many of the symptoms of Angelman syndrome overlap those of autism, individuals with Angelman syndrome can be distinguished from those with autism by their sociability and affectionateness.

Chromosome Abnormalities

Chromosomal abnormalities have been reported in individuals with autism. As can be seen from the literature noted above, most often these abnormalities are believed to center

around chromosome 15. “In fact, idic (15) is the most frequently identified chromosome problem in individuals with autism.” (ghf.com)

CHAPTER IV

Present Study

Methods

Participants consisted of children diagnosed with autism before the age of 3 who were receiving early intervention services between 2005 and 2007 through the Rowan Early Intervention Program. Archival research and interviews with the treating therapist were used to obtain data. A total of 32 children were utilized for the study with a mean age of 24.968 months at diagnosis and a mean current age of 45.406 months. The final sample consisted of 27 boys and 5 girls. All 32 children were given the initial autism diagnosis by either a pediatric specialist (N=23) or family doctor (N=9) based on clinical opinion. A licensed psychologist through the early intervention program also assessed the same children using DSM-IV-TR criteria upon entry to the program. (mean age of 24.968 months). 8 of the 32 children in the sample were genetically tested for the disorder. Genetic testing discriminated those children with autism from those children with other developmental disorders. Variables of concern included the child's age of diagnosis, current age, how they were diagnosed and if genetic testing was performed. Additionally, of concern was whether the children in the study still held an autism diagnosis at their current age and if they still met the DSM-IV criteria for the diagnosis.

Results

Using a nonparametric correlation coefficient, Gamma, there was a significant relationship between autism diagnosis and genetic consultation. ($-.800$), $p = .014$. As can be seen in Table 1, there is a significant negative correlation between autism diagnosis and genetic consultation. 8 of the 32 children in the sample had genetic testing. Of those 8 children, 2 maintained the autism diagnosis following testing and 6 were given alternate diagnoses. (Angelmans Syndrome (1), XYY Syndrome (2), Rett Syndrome (1), Chromosome 11 (1), Fragile X (1)).

However, in Figure 2, we see that based on DSM-IV criteria alone, only 40.6 met the DSM-IV criteria for the diagnosis and 59.4 did not using the same sample. All 32 children initially met criteria for the diagnosis; however only genetic testing was able to discriminate between a formal autism diagnosis and other developmental disorders.

Discussion

Significant progress has been made in the past decade to assist with earlier identification of children with autism. With the current screening and diagnostic tools available today experts are able to diagnose autism in children as young as 2 years old. However as can be seen by the current study, the diagnosis may be less accurate and stable in children this young. The particular pattern of symptoms that presents in a 2-year-old with autism may differ from that seen in a 4 or 5-year-old child.

In particular, overt repetitive and stereotyped behaviors may be less notable in a 2-year old. However, when seen alongside the social and communicative impairments they are highly indicative of autism.

Results of the present study found that genetic consultation provided the most accurate and stable diagnosis of autism. Once children had genetic testing they tended to get another diagnosis than autism. As seen in the present study, a greater number of children who did not have genetic testing remained diagnosed as autistic.

Furthermore, the use of genetic testing in the sample used was able to discriminate children with autism from those with Rett's, Anglemans, and Fragile X syndromes, whose symptoms often mimic those of autism. Furthermore, it is recommended that the use of standardized assessment instruments and DSM-IV diagnostic criteria alone need to be employed with caution as findings also suggested many of the children who in fact were autistic, did not meet criteria. Although responsible practitioners are hesitant to place an autistic label on suspected children, many doctors today are inclined to give the diagnosis to children who show signs of a developmental disorder in order to ensure accessibility to crucial early intervention services.

It remains clear that earlier diagnosis and earlier accessibility to therapeutic interventions leads to significant improvements in functioning. However, given the variation that is seen in the presentation of suspected children over time, and the variation in children's response to different interventions there continue to be limits to the certainty with which an accurate diagnosis can be made under the age of 3 years old.

Table 1. Number of Children Still Labeled Autistic After Genetic Consultation

<i>Still Autistic</i>	<i>Yes</i>	<i>No</i>	<i>Total</i>
Yes	2	18	20
No	6	6	12
Total	8	24	32

Figure 1. Number of Children Still Labeled Autistic After Genetic Consultation

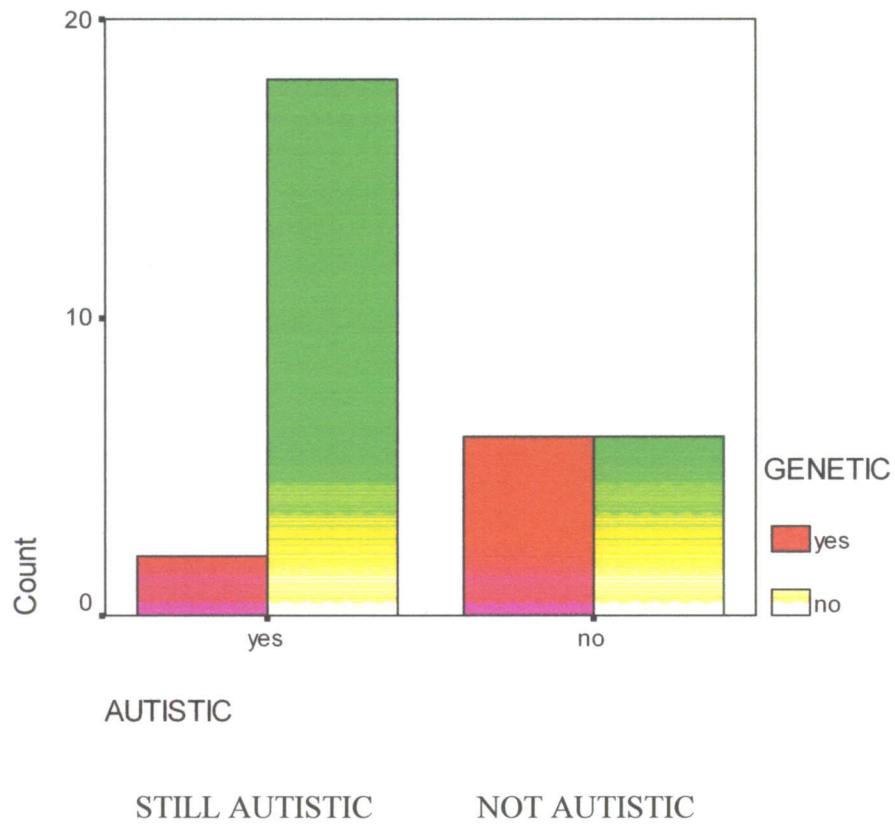
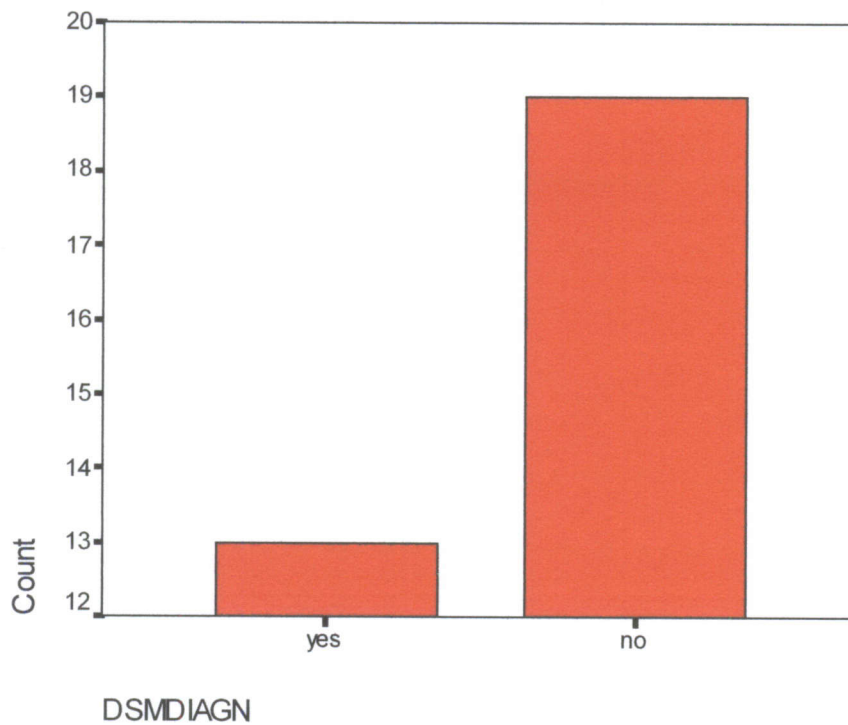


Table 2. Number of Children Who Still Met the DSM-IV Criteria

	<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>	<i>Cumulative Percent</i>
Yes	13	40.6	40.6	40.6
No	19	59.4	59.4	100.0
Total	32	100.0	100.0	

Figure 2. Number of Children Who Still Met the DSM-IV Criteria



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