Chapter 11
Autistic Spectrum Disorders

Research in Autistic Spectrum Disorders (ASD) has greatly increased within the past decade. DSM IV TR (APA, 2000) has grouped autism, Rett's disorder, Asperger's Disorder (AS), and childhood disintegrative disorder under the umbrella term, Pervasive Developmental Disorder (PDD). PDD-NOS (not otherwise specified) is a term and diagnosis with no specific criteria which is often used when a child does not meet full criteria for either diagnosis and is generally used when the child shows some, but not all of the symptoms of either AS or autism.

The main hallmark of these disorders is a severe impairment across situations in social interaction skills as well as significant problems with communication or stereotyped behaviors, interests, and activities. PDD may also be seen with medical and chromosomal abnormalities and has been particularly associated with tuberous sclerosis. Common comorbid diagnoses with ASD are seizures (Volkmar, Klin, & Pauls, 1998), Tourette's syndrome (Baron-Cohen, Scahill, Izaguirre, Hornsey, & Robertson, 1999), ADHD (Ghaziuddin, 2002), anxiety, and mood disorders (Kim, Szatmari, Bryson, Streiner, & Wilson, 2000). Case histories suggest that some children with autism spectrum disorders (ASD) were socially unresponsive from early infancy (Dahlgren, Ehlers, Hagberg, & Gillberg, 2000) while others report the onset of symptoms sometime after the second year of life (Volkmar, Lord, Bailey, Schultz, & Klin, 2004).

Social interaction difficulties such as poor eye contact and difficulty understanding nonverbal communication and social reciprocity are the hallmarks for the diagnosis of autistic spectrum disorder (Semrud-Clikeman, 2007). Delays are often found in spoken and receptive language, pragmatic language, the presence of stereotyped and echolalic speech. A narrow pattern of interests and behavior is frequently present, coupled with repetitive behaviors and preoccupation with objects and items.

Incidence and Prevalence

The overall prevalence of the Autistic Spectrum Disorders (ASD) is approximately 26.1 per 10,000 (Fombonne, 2001) with estimates of prevalence for ASD of 12.7 cases per 10,000 (Fombonne, 2003b). The incidence of ASD appears to be increasing due, in part, to improved diagnostic measures and the tendency for children with autism to be eligible for more services through the public schools than those with mental retardation. It is not uncommon for neuropsychologists, school psychologists and clinical psychologists to be pressured into making a diagnosis of autism to receive these additional services. Children with autism are generally identified earlier compared to diagnoses of PDD or AS, approximately by the age of 30.0 months of age, compared to 37.2 for PDD-NOS and AS.

Epidemiological data reports indicate that the incidence of AS is approximately 8.4 per 10,000 children (Chakrabarti & Fombonne, 2001), while Rett's disorder and Childhood Disintegrative Disorder have lower rates (<1 per 10,000 and 1 per 50,000, respectively). The prevalence of PDD-NOS is more problematic to estimate due to the difficulty

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with the diagnostic criteria. It has been estimated from an epidemiological stay at 36.1 cases per 10,000 (Chakrabarti & Fombonne, 2001).

Racial and ethnic differences have not been substantiated for the diagnosis of ASD or between social class and ASD (Dyches, Wilder, & Obiakor, 2001; Fombonne, 2003a). More males are identified with autism than girls with the ratios approaching 2:1 (Fombonne, 2003b). There appears to be a difference based on cognitive ability with average or higher ability being related to a higher incidence of ASD in males. When the ability level is in the mentally handicapped range, the ratios approach each other (Volkmar et al., 2004). It has been suggested that boys may be at higher risk for autism while girls require more neurological compromise for autism to be confirmed.

Neuropsychological Aspects of ASD

Asperger Disorder and High Functioning Autism

A more recent conceptualization of autism is that impairments in social reciprocity, communication, and stereotyped behaviors lie on a severity continuum ranging from severely autistic to those individuals classified as high functioning (HFA) (Barrett, Prior, & Manjiviona, 2004; Prior & Ozonoff, 1998). Children with ASD have difficulties with planning, cognitive flexibility, working memory, and verbal fluency, with few differences between HFA and AS found on these measures (Klin, Saulnier, Tsatsanis, & Volkmar, 2005; Klin, Sparrow, Cicchetti, & Rourke, 1995; Miller & Ozonoff, 2000; Ozonoff & Griffith, 2000; Verte et al., 2006).

Presently, the differentiation between AS and children who are classified with HFA is not clear given the overlap in the areas of social reciprocity, communication, and perspective taking found in both disorders (Gillberg, 1999; Macintosh & Dissanayake, 2004). Some neuropsychological differences have been identified between HFA and AS. Strengths on visual-spatial tasks and perceptual reasoning have been found in HFA with weaknesses in obtaining knowledge that requires inferential thinking (Ehlers et al., 1997). In contrast, the children with AS exhibit the opposite pattern. Further analysis found that these differences were due to higher overall cognitive ability and language skills in the children with AS compared to those with HFA.

Others have found that children with HFA show a higher performance IQ than verbal IQ, with the opposite present for children with AS (Klin et al., 1995). This finding continues to be of interest, but has not been replicated with larger groups of children. Similarly, executive function and social-cognitive abilities were not found to discriminate between HFA and AS (Manjiviona & Prior, 1999; Miller & Ozonoff, 2000). Some behavioral differences do appear to be present. Children with AS have fewer stereotyped behaviors, but more abnormal preoccupations than children with HFA (Kugler, 1998; McLaughlin-Cheng, 1998). Others have suggested that HFA and AS are part of the same disorder, but may differ in severity.

Social Understanding

Children with ASD generally have difficulty with social reciprocity, likely related to challenges in social information processing. The encoding of these social-emotional cues includes processing of nonverbal cues such as facial expressions, gestures, and voice intonation. Nonverbal, novel stimuli are generally processed in the right hemisphere in typically developing children and in adults, while the lexical aspects of language are processed in the left hemisphere. Children with ASD frequently utilize language to process social information and, thus, may use left hemispheric pathways more than children without ASD. Such processing generally requires longer latencies and is not as efficient.

Ashwin, Wheelwright, and Baron-Cohen (2006) studied latency to Stroop-like pictures of emotional faces in adults with AS and controls. Findings indicated that response latencies to angry faces were the longest, followed by response to neutral faces, and fastest for looking at an object (a chair). The control group showed the longest latency for the angry faces while the AS group showed no difference between angry and neutral faces. As predicted, the controls

showed more attention to faces that could be considered threatening while the ASD group showed longer latencies to all faces versus the object. These differences may be related to difficulties in encoding any face in participants with ASD, and suggest a threat vulnerability to facial expressions of any type (Schultz, Gauthier et al., 2000).

Ashwin, Wheelwright et al. (2006) suggest that any face may produce anxiety for participants with ASD and that these participants are actually biased toward attempting to decode facial expressions. Thus, it may be that these latency differences are due to perceptual decoding difficulties as well as an innate problem for understanding facial expressions. Williams, Goldstein, and Minshew (2005) studied adults with HFA on measures of auditory and visual memory. Compared to the control sample, deficits were found for memory of faces and the social scenes compared to the controls. These findings implicate difficulty in the area of recalling faces and social scenes that may interfere with social performance in more naturalistic settings.

Children with ASD may have difficulty understanding emotions from standardized facial expressions such as anger, fear, happiness, and sadness when matched to same-aged peers (Castelli, 2005b). Some have hypothesized that these differences are due partially to difficulties with social interaction in children with ASD while others suggest that a visual perceptual deficit contributes to this problem (Behrman, Thomas, & Humphreys, 2006). For some children simple identification may be related to low ability. When children with ASD are matched to peers at the same developmental language level, these differences disappear (Ozonoff, Pennington, & Rogers, 1990), except for young children (Klin et al., 1999).

Castelli (2005) studied children with HFA and found they were as able as control children to identify static pictures of complex and simple emotions. This study differs from other studies because it included only HFA and AS children rather than the full range of abilities that was utilized in earlier studies. It is possible that children with HFA and AS have developed compensatory techniques to identify emotions based on intensive intervention generally provided in early and middle childhood.

Support for this hypothesis comes from an event-related potential study evaluating face processing in children aged 3–4 years prior to having experienced significant amounts of intervention pointed toward emotional identification. In that study slower brain responses to faces and higher activation to objects were found for children with ASD, compared to children who were typically developing and those who were developmentally delayed but not autistic (Webb, Dawson, Bernier, & Panagiotides, 2006). There was a preference for objects over faces implicating both perceptual differences and, possibly, motivation to process social interactions. For this reason it is important to control for ability level as well as age level when studying the ability of a child with ASD to recognize facial expression from pictures.

It has also been hypothesized that children with ASD may prefer fragmented and detail-oriented processing of visual material which interferes with processing of the whole picture; this is also referred to as weak central coherence (Happe & Frith, 2006). Thus, the difficulty present in emotion identification in faces may be due to problems with paying attention to the whole rather than the parts (Mann & Walker, 2003). In support of this hypothesis Baron-Cohen, Wheelwright, and Jolliffe (1997) found that adults with ASD have a problem recognizing feelings when shown the eye region, as compared to the whole face, as well as in understanding more complex emotions such as interest or surprise. These complex emotions require more processing as well as perspective taking as they are related to a metacognitive understanding of why the person may feel what he/she is feeling compared to simple identification ("she's happy"). It may be that the child with ASD is centered on details rather than the whole.

Similarly, Grossman, Klin, Carter, and Volkmar (2000) found that when the label conflicted with the pictured emotion, children with ASD used the verbal label rather than the nonverbal information to define the emotion depicted. Again, the emphasis was on details rather than generalizing or understanding the whole of the nonverbal information presented. Castelli (2005) suggests that these difficulties may be related to executive functioning deficits as well as in perspective taking.

Thus, these studies are of interest to understand facial recognition, but do not provide information about how the child performs in a more naturalistic setting which is, by definition, more fluid and dynamic. While there may not be consistent

difficulties for children with ASD in facial identification in a controlled clinical environment, these difficulties are likely to present when the child is faced with a threatening experience or when the facial expressions change quickly as happens in everyday social interactions.

Rett's Disorder/Childhood Disintegrative Disorder

Rett's disorder and childhood disintegrative disorder are included under the PDD umbrella. Rett's disorder is a neurodegenerative disorder and seems out of place in the ASD category. Some have suggested that it is grouped within ASD as a place marker (Volkmar et al., 2004). Rett's disorder is found only in girls and is usually not identified until the child is at least five-months-old (frequently later), but generally before the age of three (Swaiman & Dyken, 1999). Initially the child appears to have difficult with hand control and becomes less interested in observing or interacting with others. Neurological examinations, with MRI confirmation, generally find that the head stops growing due to a lack of brain growth. The child appears to lose language and show significant cognitive decline (Ozonoff & Rogers, 2003). With age the child begins to wring his/her hands, and to clap or rub his/her hands together. In addition, the cognitive decline continues. It is believed that Rett's syndrome is a mutation of the X chromosome (Kerr, 2002).

Childhood Disintegrative Disorder

Childhood disintegrative disorder (CDD) is a rare condition. The child shows a pattern of regression after normal development. It is present in both genders, but more commonly seen in males. In this disorder the regression occurs without warning, is quite severe, and can occur anywhere between the ages of two and 10. Prior to this time the child's development appears normal. The child's ability and adaptive behaviors decrease significantly and communication and social interaction become nonexistent. This process lasts approximately 1–2 months with the child becoming very agitated and difficult to control. After this period the child appears to have severe autism and mental retardation. Unfortunately, there is little improvement with treatment and the condition is irreversible. The cause of this disorder is not presently clear, but it is believed to be genetic (Ozonoff & Rogers, 2003).

Pervasive Developmental Disorders-Not Otherwise Specified (PDD-NOS)

PDD-NOS is very difficult to reliably diagnose and is frequently a fallback diagnosis when the criteria for AS or autism is not met. For the most part, a diagnosis of PDD-NOS indicates that two of the three symptom clusters that identify children with ASD or AS have been met (Ozonoff & Rogers, 2003). These clusters are the social responsiveness cluster, communication skill difficulty, and stereotyped or repetitive behaviors. The diagnosis of PDD-NOS requires that the child have difficulty with social reciprocity and either social communication problems or stereotyped/repetitive behaviors. The incidence of mental retardation is much lower than in autism and is generally around 7.3 percent of the PDD-NOS population (Chakrabarti & Fombonne, 2001). Most children with a diagnosis of PDD-NOS show some autistic-like symptoms, but do not qualify for a diagnosis of autism, or have a language delay and so do not qualify for a diagnosis of AS.

The DSM IV field trials found that the diagnosis of PDD-NOS is one of the more unreliable diagnostic categories (Volkmar et al., 1994). In the field trials one-third of the children diagnosed with PDD-NOS met criteria for autism, while another one-third did not qualify for any diagnosis in the autistic spectrum. The children who did not qualify were generally found to have language and learning problems or had significant symptoms of ADHD.

Developmental Course of Autistic Spectrum Disorders

For most children with ASD onset occurs prior to age three, particularly for those children with a

more severe presentation of the disorder. As discussed earlier a sizable majority does not show the disorder until after the age of two, particularly when diagnosed with AS or PDD-NOS. Retrospectively the children who are diagnosed later are reported to show irregularities and delays in development from infancy until diagnosis. Generally these problems are related to difficulty with nonverbal communication, inappropriate responses to facial expressions, and a lack of social responsiveness to caretakers. Approximately one-third of children with autism show regression of skills between the ages of 1–2 years, and some have hypothesized that this regression is due to infections and immunological factors (Hornig & Lipkin, 2001) or to genetic influences (Lainhart et al., 2002).

Qualitative differences are present in the expression of some symptoms at different ages. Stereotyped and repetitive behaviors are most commonly seen in preschool and either improve or significantly decline in elementary school (Semrud-Clikeman, 2007). For children receiving early intervention, it is estimated that 50 percent approach normal functioning by adolescence (McEachin, Smith, & Lovass, 1993). Although improvement is noted, most of these adolescents continue to have difficulty with social interaction and few are able to establish an independent lifestyle in adulthood (Howlin, 2000). The most predictive variable for a positive outcome is the level of intelligence present by the age of five (Howlin, 2000).

Prenatal and Postnatal Factors

An increase in the incidence of prenatal and perinatal complications in autistic individuals compared to normal children has been found (Meyer et al., 2008). Some of the more frequent complications are meconium in the amniotic fluid, bleeding during pregnancy, and use of doctor-prescribed hormones (National Institute of Mental Health, 2006). In a study of mice and their offspring, Meyer et al. (2008) found that prenatal events predispose the child to autism or schizophrenia more so than postnatal events.

Seven studies that met stringent criteria for selection were reviewed to evaluate prenatal and perinatal risk factors for autism (Kolevzon, Gross, & Reichenberg, 2008). Selected studies needed to have a well-defined sample standardized and data collected during and after pregnancy, a group of comparison subjects who also experienced obstetric complications without resulting autism, and a standardized report of the findings to allow comparisons across studies. Characteristics that were selected were those associated with a 50 percent increase or larger in risk. Factors that emerged for parental characteristics included advanced maternal age, advanced paternal age, and maternal birthplace. Of the seven studies, three showed maternal age to be a significant predictor for autism when confounding variables were covaried. Paternal age has also been identified as a risk factor with a twofold risk found for each 10-year increase in paternal age (Reichenberg et al., 2006).

Other factor that emerged included birth weight and prematurity as well as hypoxia at birth. Low birth weight (defined as less than 2,500 g) was not associated with an increased risk of autism. Four studies reported prematurity with a birth at less than 35 weeks to be at higher risk for autism in two studies. Apgar scores below seven were also associated with autism in all four studies that examined this variable. The authors concluded that hypoxia-related complications appeared to increase the risk of autism. They also concluded that low birth weight and prematurity were not strongly tied to a heightened risk for autism and that further study is needed to more carefully examine these issues (Kolevzon et al., 2008).

Autism and Vaccines

An additional issue that has arisen in the past decade is the relationship between autism and vaccines that contain thimerosal. The media has reported a possible link between autism and these vaccines. The empirical support for such a link is tenuous at best. Thimerosol was removed from vaccines, except for trace amounts, by 2001. The Immunization Safety Review Committee of the Institute of Medicine from the National Academies reviewed the data about thimerosal and autism and did not find a causal relationship (Immunization Safety Review Committee: Board on Health Promotion and Disease Prevention, 2004). Studies that have

evaluated the incidence of autism since thimerosal's removal from the vaccines have not found a drop in the incidence of the disorder (Fombonne, 2008; Schechter & Grether, 2008).

Studies that evaluated early thimerosal exposure and neuropsychological functioning in mid-childhood have been conducted in children without autism (Thompson, Price, Goodson, & Shay, 2007). One-thousand-forty-seven children were enrolled in the study and administered several neuropsychological measures. The study did not find a causal association between early exposure to thimerosal and neuropsychological deficits. Thus, the findings, taken as a whole, do not support a link between thimerosal and autism.

Genetics

The heritability of autism is supported by two important findings: (1) the rate of autism in siblings of autistic individuals is approximately 50 times that of the general population (Bailey, Pelferman, & Heavey, 1998), and (2) there is a high concordance rate of autism in monozygotic twins compared to dyzygotic twins (Ozonoff & Rogers, 2003). Recent advances in genetic analysis have found that autism recurs in families at an approximate rate of 3–6 percent, which is higher than the rate found in the general population (Bailey, Le Couteur, & Gottesman, 1995). Twin studies have found that monozygotic twins have a concordance rate for a diagnosis of autism of 60 percent, while the rate was 5 percent for dyzygotic pairs (Bailey et al., 1995). When all types of PDD were included the concordance rate increased to 90 percent for monozygotic pairs, yielding a heritability estimate greater than 0.90 (LeCouteur et al., 1996). In studies that have evaluated familial risk factors in autism, these families have a higher rate of psychiatric and developmental illnesses compared to the general population. In addition, these families also show a higher incidence of medical disorders leading one to suggest that the genetic structures in these families leaves the members vulnerable to many types of disorders (Brimacombe, Ming, & Parikh, 2007)

Ozonoff and Rogers (2003) further point out that autism frequently co-occurs with other chromosomal abnormalities including tuberous sclerosis, fragile X syndrome and in deletion syndromes including chromosomes 7, 15, and 18 (Semrud-Clikeman & Schaefer, 2000). Fragile X syndrome is a commonly inherited cause of mental retardation that is transmitted by the mother's contribution to the sex chromosomes. Approximately 2–8 percent of boys with autism and Fragile X syndrome are also mentally retarded (Reiss & Hall, 2007; Wassnik, Piven, & Vieland, 2001).

Tuberous Sclerosis (TS) is a genetic disorder where tubers or lesions are present throughout the body, particularly in the brain. Approximately 2–4 percent of children with autism have TS (Hansen & Hagerman, 2003). Although the majority of children with TS are not diagnosed with autism, approximately 43–61 percent show autistic symptoms with a higher than expected percentage showing brain lesions in the temporal lobe, an area of the brain particularly involved in language and emotion recognition (Gillberg & Billstedt, 2000). A possible link between ASD and TS was evaluated in a PET study. Patients with TS, both with and without autism, showed a higher metabolic rate in areas of the brain associated with impaired social interactions, language problems, and stereotyped behaviors (Asano, Chugani, & Muzik, 2001). These are the areas that are specifically problematic for children with ASD.

Neurological Features

Neurodevelopmental anomalies have been identified in children with autism, particularly in the frontal lobes with neural circuits differing as well as frontal lobe enlargement and atypical patterns of brain connectivity (Courchesne, Carper, & Akshoomoff, 2003; Courchesne & Pierce, 2005; Hill, 2004; Murphy et al., 2002). Although the exact etiology of autism is still unknown, results from electrophysiological and dichotic listening techniques suggest that autistic children may not show the expected pattern of hemispheric specialization. Research has documented that normally the two hemispheres are functionally and structurally asymmetric at birth (Gazzaniga, Ivry, & Mangun, 2002). Autistic children do not show such hemispheric specialization and may show less functional

asymmetry as evidenced by dichotic listening techniques as well as through electroencephalograms (Coben, Clarke, Hudspeth, & Barry, 2008).

Data from electrophysiological studies indicate that children with autism tended to either have dominant right-hemisphere response to linguistic stimuli with impairment in the left hemisphere or did not show a dominant language hemisphere (Tanguay, 2000). When EEG recordings are made during completion of cognitive tasks, a reversed pattern of brain activity during language tasks and use of the right hand (normally left-hemispheric-mediated tasks) has been found (Dawson, Finley, Phillips, & Galpert, 1986). Moreover, children with autism have been found to show differences when told not to attend to stimuli compared to typically developing children. These differences indicate that children with autism may process auditory signals (i.e., words and sounds) differently than those without autism and that this difference leads to difficulty in processing of information (Dunn, Gomes, & Gravel, 2008).

As you will recall from Chapter 3, the P300 component has been associated with the detection of novel and unpredictable stimuli. In individuals with autism this component has an extended latency; that is, it occurs later than expected and the amplitude (degree of response) is smaller (Dawson et al., 1986). Additional work in this area has led researchers to hypothesize that the foregoing results may be due to the possibility that autistic children react to novel stimuli as aversive and/or as overstimulating (Dawson et al., 2005). Moreover, there is emerging evidence that autistic individuals may be chronically over-aroused (Wolf, Fein, & Akshoomoff, 2007).

It may well be that the connectivity of the brain in children with autism interferes with the crucial aspects of language processing that are so important for social interactions. Differences in the ability to process emotional and non-emotional words as well as possible perceptual difficulty likely interfere with the autistic child's ability to understand the social and general world. Atypical patterns of brain connectivity have indicated an underconnectivity for both inter- and intrahemispheric neuronal signals (Rippon, Brock, Brown, & Boucher, 2007). This underconnectivity has been associated with problems with social cognition (Barnea-Gorly et al., 2004), frontal lobe connectivity (Belmonte et al., 2004), and facial processing (Dawson & Webb, 2005).

Neuroimaging

Neuroimaging techniques have made it possible to view the developing brain while the child completes various tasks. Thus, the ability to compare brain activity among groups as well as for different tasks allows us to understand some of the differences that are present that may account for problems in reasoning, social interaction, and with executive functioning. One of the more common techniques used to study children and adolescents with autistic spectrum disorders is functional magnetic resonance imaging (fMRI).

Because the behaviors associated with autism vary from social reciprocity/understanding to language, to stereotyped and repetitive behaviors, it is likely that many brain systems are involved and will vary depending on the severity of the autistic symptoms as well as the level of cognitive involvement. Children with autism tend to have larger heads than the general population (Aylward, Minshew, Field, Sparks, & Singh, 2002). Brains of autistic toddlers have measured 10 percent larger than same-aged peers; the largeness of the head decreases with age, but continues to be larger than matched aged peers throughout life (Courchesne et al., 2003). Interestingly, there is no difference in head size at birth (Lainhart, 1997) and the brain growth that later occurs may be due to early overgrowth of neurons, glial cells, and a lack of synaptic pruning (Courchesne & Pierce, 2005). Findings have suggested that this increased brain size indicates that the extra tissue is not well utilized or organized, thus resulting in poorer skill development (Aylward et al., 2002). Specific findings indicate an increase in gray matter volume, particularly in the temporal lobes (Herbert et al., 2002; Rojas et al., 2004). Autopsy studies have found that the cellular columns that make up the frontal and temporal gray matter areas were disrupted, possibly resulting in an inability to inhibit neuronal activity in these areas and, thus, produce cognitive dysfunction and possibly

behavioral overflow (Casanova, Buxhoeven, & Brown, 2002; Casanova, Buxhoeven, Switala, & Roy, 2002).

Using structural MRI analyses, Courchesne et al. (2001) found smaller measures of white matter compared to gray matter in toddlers and adolescents. Other studies of adults with autism have found reduced measures of the corpus callosum (Hardan, Minshew, & Keshavan, 2000), a structure that connects the two hemispheres, as well as difficulties with interregional integration. Some have suggested that the larger brain, higher white matter volume, and disrupted gray matter cellular columns may contribute to an autistic person's difficulty in integrating information and generalizing this information to new situations (Schultz, Romanski, & Tsatsanis, 2000). These difficulties may interfere with the person's ability to put information together into an understandable whole—or interfere with establishing central coherence—a theory discussed in an earlier chapter.

Schultz et al. (2003) suggested that the social brain incorporates frontal, limbic, and temporal connectivity and that these regions are integral to socialization. In children with ASD, findings have included hypoactivation in the areas of the superior temporal gyrus (STG), the fusiform face gyrus of the temporal lobe (FG), and regions of the temporal and occipital lobes. These areas are the hypothesized regions for social understanding and comprehension. Schultz et al. (2003) suggest that this hypoactivation is not causative of autism, but rather may be an outcome of autism–less practice may mean less growth in this region.

The amygdala has also been implicated in autism (Adolphs, 2001; Baron-Cohen et al., 2000; Sparks et al., 2002). Patients with damage to the amygdala experience difficulties with some aspects of social impairment including lack of emotional response and problems in recognizing fearful stimuli (Zirlinger & Anderson, 2003). Postmortem analysis of autistic brains have found increased neuronal density in the amygdala in people with autism (Kemper & Bauman, 1993). When the amygdala has been ablated in rhesus monkeys and neonatal rats, social behaviors are poorly developed, particularly if the damage occurred before birth (Baron-Cohen et al., 2000; Wolterink et al., 2001). The amygdala has extensive connections to the cortex, the striatum, and the hippocampus (Amaral, Price, Pitkanan, & Carmichael, 1992). This connectivity may influence perception as well as perspective taking abilities. If there is a reduction in the functional connectivity for social processing, then there should be differences in these regions on fMRI as well as on Diffusion Tensor Imaging (DTI), a procedure that examines white matter tracts.

MRI Findings in ASD

Structural imaging in ASD has found a variety of cerebral anomalies. Some findings indicate differences in the corpus callosum, particularly in thinning and in the midsagittal area and in white matter density in persons with ASD (Chung, Dalton, Alexander, & Davidson, 2004; Hardan et al., 2000; Vidal et al., 2006). These differences have been linked to difficulties with language processing and in working memory (Just, Cherkassky, Keller, & Minshew, 2004). Structural imaging findings have found increased brain size in children with ASD, specifically enlargement in the regions of the parietal, temporal, and occipital lobes (Courchesne et al., 2003; Piven, Arndt, Bailey, & Andreasen, 1996). The enlargement is due to greater volumes of white matter, but not gray (Filipek, 1999). For adolescents and adults with autism, increased brain size was not found, but increased head circumference was identified (Aylward et al., 2002).

Findings have also implicated the caudate in children with ASD. Sears et al. (1999) found increased volume bilaterally in the caudate of adolescents and young adults with HFA. Caudate enlargement was proportional to the increased total brain volumes also identified. To determine whether these findings were specific to the sample studied, the results were replicated with a different sample of participants with ASD. Previous studies have found that the caudate volume in typically developing children decreases at puberty (Giedd, 2004). For the Sears et al. (1999) study this decrease did not occur.

In typically developing adults, right-sided activation has been found for the FG, the STG, and the amygdala when viewing social faces (Schultz et al., 2003) and social interaction (Semrud-Clikeman,

Fine, & Zhu, submitted). These findings seem to corroborate the hypothesis that the right hemisphere is more heavily involved in social processing than the left (Winner, Brownell, Happe, Blum, & Pincus, 1998). Studies of adults with HFA or AS have found differences in these regions using structural and functional imaging that found less activation or smaller volumes (Abell et al., 1999; Baron-Cohen, Ring et al., 1999).

Some studies have found underactivation in the prefrontal areas in participants with ASD (Schultz et al., 2000) with higher activation in controls particularly in the left prefrontal regions. Significant metabolic reduction has been found in the anterior cingulate gyrus, an area important for error monitoring, and in the frontostriatal networks involved in visuospatial processing (Ohnishi et al., 2000; Silk et al., 2006). The amygdala and striatal regions have been implicated in processing of emotional facial expressions (Canli, Sivers, Whitfield, Gotlib, & Gabrieli, 2002; Killgore & Yurgelun-Todd, 2005; Yang et al., 2002).

Studies involving the amygdala have found that patients with bilateral lesions show difficulty in judging emotional facial expressions (Bechara, Damasio, & Damasio, 2003). Faces that were negative in nature were found to produce slower activation than those which were neutral in controls (Monk et al., 2003; Simpson, Öngür, Akbudak, Conturo, & Ollinger, 2000). Positive stimuli increased activity in the amygdala with happy expressions, resulting in faster response times (Canli et al., 2002; Pessoa, Kastner, & Ungerleider, 2002; Somerville, Kim, Johnstone, Alexander, & Whalen, 2004). Hare, Tottenham, Davidson, Glover, and Casey (2005) found longer latencies for negative facial expressions in activation of the amygdala in normal adult controls, while activation of the caudate was present when the participant was avoiding positive information.

These findings are important because they point to the neural networks that underlie the processing of positive and negative emotions. It is crucial to determine how emotional cues may influence behavior that interferes with this processing which is frequently seen in children and adults with ASD. Similarly, Ashwin, Baron-Cohen, Wheelwright, O'Riordan, and Bullmore (2006) studied the amygdala in adults with HFA and AS using fMRI when viewing fearful (high and low fear) and neutral faces. Findings indicated that the control sample showed more activation in the left amygdala and left orbitofrontal regions compared to the HFA/AS group when viewing the fearful faces. In contrast, the HFA/AS group showed more activation in the anterior cingulate and the superior temporal cortex when viewing all of the faces.

Specific areas implicated in ASD using fMRI include the superior temporal gyrus (STG) (Allison, Puce, & McCarthy, 2000; Baron-Cohen, Ring et al., 1999) and the amygdala (Amaral et al., 1992; Carmichael & Price, 1995). When a child with ASD is asked to view faces, functional imaging has found less activation in the right fusiform face gyrus (FG) (Critchley et al., 2000; Dierks, Bolte, Hubl, Lanfermann, & Poustka, 2004; Pierce, Muller, Ambrose, Allen, & Courchesne, 2001). The fusiform face gyrus appears to be selectively engaged when the person views faces. Children with ASD appear to pay less attention to the face and may not activate this region in the same manner as typically developing children (Schultz et al., 2003).

Differences in activation have not been found solely for viewing of faces. Just et al. (2004) found more cortical activation in children with HFA when processing verbal material compared to a control group. This finding may indicate that more brain resources are needed to process verbal information in children with ASD. This inefficiency may slow down their processing and take resources away from understanding the intent of the speaker's prosody or interpreting facial expressions. Kana, Keller, Cherkassky, Minshew, and Just (2006) found that children with HFA show poorly synchronized neural connectivity when asked to process material using their imagination. Moreover, children with ASD were also found to use parietal and occipital regions associated with imagery for tasks that had low imagery as well as high imagery requirements. Controls only utilized these regions for the high imagery tasks.

The difference in activation that ASD participants have when viewing faces is important for our understanding of ASD. Animal studies have found that the temporal cortex responds to the perceptual aspects of social stimuli (Hasselmo, Rolls, & Baylis, 1989; Perrett & Mistlin, 1990). Human studies have also found a relationship between the perception of eyes and mouths in the superior temporal cortex

(Adolphs, 2001; Haxby, Hoffman, & Gobbini, 2000). The superior temporal lobe is thought to be involved in perceiving social stimuli with the connections to the amygdala and frontal lobes to interpret these stimuli. Findings from participants with ASD have repeatedly shown that these areas are important for the processing of facial expressions. An area of the temporal lobe that is important for recognizing faces has been studied in children with autism. This area is underactive in people with autism, and the degree of underactivation is highly correlated with the degree of social impairment (Schultz et al., 2001). Additionally, this area of the temporal lobe has also been implicated in successfully solving Theory of Mind tasks, skills that are also impaired in people with autism (Castelli, 2005a; Martin & Weisberg, 2003).

Few studies have used DTI in children with ASD. Alexander et al. (2007) used DTI with children with ASD and found reduced volumes in the corpus callosum and reduced fractional anisotropy (FA) of the genu, splenium, and total corpus callosum in children with ASD. Medication status and the presence of comorbid diagnoses were not found to have an effect on the DTI measures. In a similar vein to these findings, Boger-Megiddo et al. (2006) scanned young children with ASD and found that the corpus callosum area was disproportionately small compared to total brain volume for these children, compared to typically developing children. Children with a more severe form of ASD showed the smallest corpus callosal area. Future research needs to utilize quantitative imaging to more fully capture the relation between the corpus callosum connectivity and ASD. Taken together these findings suggest that children with ASD may be inefficient in their use of neural networks and that their networks show poor connectivity compared to same-aged peers.

The amygdala, anterior cingulate, and hippocampus have also been studied in children with ASD. These two structures are part of the limbic system of the brain—or the emotional part of the brain. The amygdala is important in emotional arousal as well as processing social information. The hippocampus allows for the short-term and eventual long-term storage of information while the anterior cingulate works as a type of central executive directing attention where it is most required. Abnormalities have been found in these parts of the brain during autopsy with reduced size and fewer connections present (Kemper & Bauman, 1993). These abnormalities may contribute to the behavioral difficulties seen in people with autism in social reciprocity and social awareness. Further study is needed in these areas. Some have suggested that the amygdala may be important for mediating physiological arousal and, if it is not as active, the person may not be as motivated to participate in social activities (Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Klin & Volkmar, 2003).

Areas of the frontal lobes have also been studied in patients with autism. Both the frontal lobes and the superior area of the temporal lobes are important for understanding and perceiving social interactions as well as interpreting facial expressions. The frontal lobes have been particularly implicated in the ability to take another's perspective, or in social cognition. These areas are intimately connected to the limbic system as well as the temporal lobe areas discussed earlier in this section. Studies of brain metabolism have found reduced activity in these regions of the brain in autistic patients, particularly when individuals are asked to perform tasks that tap social cognition and perception (Castelli et al., 2002; Ehlers et al., 1997; Haznedar et al., 2000).

The neuroimaging findings are intriguing and suggest that there are significant differences structurally as well as in neural connectivity of cognitive systems. These differences likely result in neuropsychological challenges for these children as well as for the neuropsychologist. The following section discusses the neuropsychological factors involved in autism.

Neuropsychological Aspects in Diagnosis

The cognitive ability of children within the ASD umbrella varies widely, ranging from significant mental retardation to giftedness. There is no pattern of strengths and abilities within the cognitive measures, although some have found a pattern of performance IQ being stronger than verbal IQ (Akshoomoff, 2005). Some have suggested that children with autism show a VIQ $<$ PIQ profile, and

children with AS show the opposite pattern (Klin et al., 1995), while others have not replicated this finding. Instead, children with AS have higher verbal scores compared to those with HFA, but not performance ability (Ghaziuddin & Mountain-Kimchi, 2004). Ability is generally found to be higher in HFA children with some suggesting the neuropsychological differences between AS and HFA are due to ability and not true neuropsychological variation (Miller & Ozonoff, 2000).

A comprehensive neuropsychological evaluation of a child suspected of having an ASD needs to include a measure of communication ability including both receptive and expressive language skills (Kjelgaard & Tager-Flusberg, 2001). Consistent with the discussion presented in earlier sections, children with autism also have difficulty with executive functioning, particularly in cognitive flexibility and working memory (Lord et al., 2006). The difficulties in executive functioning have been equivocal with some studies which have identified problems in these areas (Kleinhans, Akshoomoff, & Delis, 2005; Ozonoff & Jensen, 1999), while others have not (Griffith, Pennington, Wehner, & Rogers, 1999; Liss et al., 2001). Further evaluation of the differences among these studies is that some were with young children who may not evidence executive functioning deficits on standardized measures until a later age (Semrud-Clikeman & Schaefer, 2000), while others did not match the groups on ability (Wolf et al., 2007). These areas require additional study with groups matched by ability as well as evaluating the effect of age on the performance of the child on standardized measures of executive functioning. It is certainly appropriate for an evaluation to include measures of executive functioning as well as problem solving skills. These skills have been tied to the ability to adapt to changing environments; an area of difficulty for many children with ASD.

As discussed earlier in this chapter, many children with ASD have difficulty discerning the whole from the parts. Tests such as block design or copying of figures (VMI, Rey-Osterreith Complex figure) may be particularly difficult for them. It is important to evaluate these skills for the individual. Memory skills is another area that requires evaluation in children with ASD. Verbal memory and spatial memory skills have been reported as an area of difficulty (Lord et al., 2006; Luna et al., 2002; Toichi & Kamio, 1998) while visual memory skills for designs have been relatively intact. Working memory skills may also be an area of weakness for children with ASD and appear to be very dependent on the context and nature of the skills required (Ozonoff & Strayer, 2001).

Attention is a variable area in the population of children with ASD. Few studies have evaluated the co-occurrence of ADHD and ASD partly due to the exclusion of ADHD in the diagnostic criteria for AS. However, Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin (1998) found a high co-occurrence of ADHD in a sample of children with AS followed by a higher than expected incidence of depression. A significant number of attentional symptoms were found in approximately 33 percent–50 percent of the ASD population in this study. In contrast, the co-occurrence of ASD and hyperactivity/impulsivity symptoms is less (approximately 7–10%). Other studies have found that children diagnosed with HFA and AS appear to share similar attentional difficulties with ADHD children (Ehlers et al., 1997; Nyden, Gillberg, Hjelmquist, & Heiman, 1999).

Leyfer et al. (2006) examined 109 children with autism for comorbid diagnoses. Phobias were the most common co-occurring disorder, followed by obsessive- compulsive disorder and ADHD. Of the 109 children in the sample, 20 percent qualified for a diagnosis of ADHD: predominately inattentive (ADHD:PI). When cases that were one symptom short of diagnosis were included, the rate increased to 55 percent. It is not clear from this study how many of the children with co-occurring ASD and ADHD also had other diagnoses. Studies have found that 40 percent of children aged 3–5, and 50 percent of those aged 6–12 referred to a clinic with ASD showed some form of ADHD (Gadow, DeVincent, & Pomeroy, 2006; Gadow, DeVincent, Pomeroy, & Azizian, 2005). Findings also indicated that these rates of ADHD in children with ASD were similar to children without ASD who were also referred for a clinical evaluation.

One of the concerns about the comorbidity of ADHD and ASD is whether the attentional and hyperactive/impulsive symptoms are part of the ASD diagnosis or are reflective of the ASD diagnosis. Gadow et al. (2006) sought to study DSM IV

psychiatric symptoms in children with ASD who referred to a clinic using parent and teacher rating scales. Findings indicated that 20 percent of the younger children qualified for a diagnosis of ADHD:PI, and 12 percent for ADHD:C along with a diagnosis of ASD. For the older group 36 percent qualified for a diagnosis of ADHD:PI and 20 percent for ADHD:C, as well as a diagnosis of ASD. Importantly, there were no differences in severity between the groups of children with ASD and those with a sole diagnosis of ADHD, suggesting that the expression of significant attentional difficulties is similar in the two populations. Gadow et al. (2006) conclude that DSM IV should be considered a blueprint for diagnosing ADHD in this population and not as a firm standard given the dearth of studies with this population. In addition, these findings also lend support to the hypothesis that ADHD co-occurs with ASD and is not just part of the ASD diagnosis. The existing studies used parent and teacher rating scales to determine the existence of ADHD.

Given the hypothesis that children with ASD may have attentional differences, it is important to rule out significant attentional problems for these children. ADHD may interact with ASD and stretch the already depleted attentional resources to the limit. These children's ability to understand social interactions may be further compounded by difficulties with response inhibition as well as with impulse control. These concerns about the comorbidity of ASD and ADHD raise the question about previously equivocal findings of executive functioning in children with ASD. It may be that attentional issues were not controlled in these studies, thus confounding the findings.

As discussed in Chapter 6, many of the neuropsychological measures for memory, attention, and language are presented and are appropriate for use with children with ASD depending on the child's ability level and age. The following section discusses particular instruments that have been developed for children with autism. Most of these measures are parent interview and behavior rating scales. The findings discussed above indicate that there is no current "pattern" of functioning for a child with ASD and, thus, a comprehensive evaluation needs to include measures from the various domains as well as the interviews discussed below.

Diagnostic Instruments

Diagnosing ASD has been somewhat problematic, but the advent of fairly well-standardized measures has improved our ability to reliably diagnose children with ASD. Three diagnostic instruments are considered to be reliable for diagnosis (Wolf et al., 2007): the Childhood Autism Rating Scale (CARS) (Schopler & Reichler, 2004), Autism Diagnostic Observation System (ADOS) (Lord, Rutter, DiLavore, & Risi, 1999), and Autism Diagnostic Interview-Revised (ADI-R) (Rutter, Le Couteur, & Lord, 2003).

Although many children with autism have been diagnosed with mental retardation, there are more children now diagnosed in the average to above average range with autism partly due to improved diagnostic skills as well as in our understanding of the disorder's scope (Volkmar et al., 2004). Previously these children were not diagnosed because they were able to adapt somewhat to the situation at hand or their parents had arranged for early and intense interventions. During the past several years, studies have found that less than half of children with autism now qualify for an additional diagnosis of mental retardation when adequately evaluated (Chakrabarti & Fombonne, 2001, 2005; Howlin, 2000; Tsatsania, 2003).

Psychopharmacological Treatment

Psychopharmacological treatment for ASD has increased by approximately 50 percent in the past 15 years (Aman, Lam, & Van Bourgondein, 2005). Antidepressant medication is the most commonly prescribed medication in children with ASD, followed by psychostimulants and antihypertensive drugs (Aman et al., 2005). Medication to reduce anxiety and compulsive behaviors includes anticonvulsants, stimulants, neuroleptics, fluoxetine and clomipramine, fenfluramine, and most recently opiate antagonists (Wilens, 2004). These medications may assist with obsessions and compulsions as well as anxiety and irritability. Fenfluramine, a serotonin reducer, has had a good effects on early autistic symptoms, but this response diminishes with time and an increasing the dosage has been only

moderately helpful (Erickson, Stigler, Posey, & McDougle, 2007). Another type of psychopharmacological intervention is the use of opiate receptor antagonists such as naloxone or naltreione. Opiate receptor antagonists do not allow the postsynaptic receptors to absorb the brain endorphins. Beginning evidence shows that low doses of this agent have reduced many maladaptive behaviors including self-injurious behavior (Benjamin, Seek, Tresise, Price, & Gagnon, 1995), while high doses improve the child's ability to relate to others (Feldman, Kolman, & Gonzaga, 1999).

Atypical antipsychotics have also been studied in children with ASD. These medications, such as haloperidol, have been found to improve symptoms in ASD as well as attentional difficulties, but have also increased dyskinesias and so are used sparingly due to this serious side effect (Barnard, Young, Pearson, Geddes, & O'Brien, 2002; Remington, Sloman, Konstantareas, Parker, & Gow, 2001). Risperidone has also been utilized for children with ASD to control difficult behavior. While the medication has been very helpful in reducing behavioral difficulties in children with ASD (Hanft & Hendren, 2004), side effects such as decreased appetite, weight gain, fatigue, and drooling may counterindicate the use of this medication (Findling et al., 2004; Stigler, Posey, & McDougle, 2004).

Attentional problems are also seen frequently with autistic spectrum disorders.While not diagnosed in the presence of such a disorder, the difficulty they cause for the child is often treated through medication. Approximately 60 percent of children with ASD exhibit attentional problems, and 40 percent of these also have hyperactivity (Hazell, 2007). Improvement in activity level and attention has been found for a majority of children with ASD with attention/hyperactivity symptoms following administration of methylphenidate (Handen, Johnson, & Lubetsky, 2000; Research Units on Pediatric Psychopharmacology Autistic Disorder Network, 2005), but not for dexamphetamine (Handen et al., 2000).

Behavioral Treatments

The treatment options available for autistic children has grown, but no one solution has been found to be appropriate for all children with autism. Areas that require intervention include the domains of language, attention, social cognitive, cognition, learning, and adaptive behavior. These areas require multifaceted treatment that includes working with families, schools, and individuals in order to improve functioning as well as develop skills (Iovannone, Dunlap, Huber, & Kincaid, 2003). There has been an explosion in literature in the area of autism and many of the clinicians and researchers suggest that, based on the literature, no single approach is appropriate for all children with autism. Therefore, programs needs to be tailored to the individual child's needs (National Research Council, 2001). It has been strongly suggested that a combination of approaches be used to support the child's acquisition of basic skills and allow the child to develop more complex social skills and social reciprocity (Volkmar et al., 2004).

Behavioral treatment has by far the most support for interventions for children with autism, although improvement has not been as good as previously was predicted from initial studies (Mudford, Martin, Eikeseth, & Bibby, 2001; Smith, Buch, & Gamby, 2000; Smith, Groen, & Wynn, 2000). Although behavioral treatment improved targeted behaviors, the children required continual support to maintain these gains and cognitive skills did not improve (Bibby, Eikeseth, Martin, Mudford, & Reeves, 2001). Parent satisfaction has been generally good with applied behavior analysis techniques as well as other behavioral treatments, and the maintenance and increase in gains have not been significant when the children are followed 2–3 years later (Volkmar et al., 2004).

One important finding is that to be successful, the child needs to be motivated to participate in the program and that the program needs to be tailored to the specific family's needs (Lord & McGee, 2001; Moes, 1998). Teaching individual skills such as joint attention and social communication skills has led to improved social skills (Drew et al., 2002; Whalen & Schreibman, 2002). However, these skills are often not generalized to the natural setting without directly teaching those skills in that setting (Hwang & Hughes, 2000; Strain & Hoyson, 2000).

A review of 10 studies on the efficacy of communication intervention found that teaching social communication was most successful when it was

directly related to everyday situations and possible communications to which the child would be exposed (Delprato, 2001). When the communication skills are tied to an interest of the child's (i.e., weather, dinosaurs), language skills improvement is dramatic and appears to be present in long-lasting follow-up evaluations (Siller & Sigman, 2002).

Similar to the findings for language, Gutstein & Whitney (2002) suggest that interventions need to include specific occasions for the child to learn social skills that are apart from the traditionally scripted approaches most commonly seen with social skills programs. Tasks that directly teach appropriate social interaction as well as perspective taking, and are guided by adults, have been most appropriate. These authors suggest that the initial interventions need to be ritualistic and predictable with inconsistency and novelty kept to a minimum. As the child learns these skills, more complexity and novelty is introduced, assisting the child with generalization. The intervention needs to be in a quiet and distraction-free environment where the child feels safe. It is important to restrict the sensory input so that the child does not become overwhelmed. Actions, emotions, intonations, and gestures need to be overdone and amplified so that the child learns what is important. Emotions and environmental input that are subtle may be too difficult for the child to process and will most likely be ignored. Finally the adult coaches need to move the child to a peer coach as readiness is perceived. Using these techniques can assist the child in developing the abilities that are needed, but more importantly to generalize the skills to the more dynamic nature seen in most social exchanges.

Due to the difficult nature of intervention studies, most empirical evidence comes from case studies or small groups. Further study is needed to determine the parameters for the success of many of these interventions, and to move much of the work into public schools. Corbett (2003) has developed a video modeling intervention based on Bandura's social learning theory. Video modeling emphasizes the ability to learn new behaviors by observing a model engaging in a behavior the child would like to emulate. Video modeling involves the child watching a videotape of a desirable model producing a behavior. The behavior is then imitated and practiced with a therapist. The behaviors are repeated and reinforced over time.

Corbett (2003) studied the efficacy of video modeling on social skill acquisition using a single case study design. The child was eight-years, three-months-old and was diagnosed with autism. His IQ was measured at 60 with adaptive behavior being significantly lower at 37. The child watched the videotape showing expressions denoting happy, sad, angry, or afraid. The videotape was shown for 10–15 minutes daily for two weeks. The child quickly mastered identification of the happy face with improvement seen in the other categories over the treatment duration. Certainly this study shows promise and replication, and follow-up of the length of these gains is needed.

Social stories have also been used fairly successfully with ASD children. This method describes a social situation to the child and explains what the child should do and what the appropriate feelings should be. The child is asked for his or her interpretation. Gray & Garand (1993) use four types of sentences for the social stories. The descriptive sentence describes where the situation is occurring and who the main character is. The perspective sentences describe the reactions of others and the feelings that the characters have. The directive sentences provide information about what the child is expected to do or say. Finally, the control sentence is generally written by the child to solve the situation. Most stories have 0–1 control and/or directive sentences for every 2–5 descriptive and perspective sentences. For those children who cannot read the stories can be read to them and discussed as the therapist reads the story.

An example of a social story would be the following:

> John rides the school bus to school every day (descriptive). He sits in the front seat next to the bus driver (descriptive). The ride takes about 20 minutes to get to John's school (descriptive). He knows that he can ask the bus driver for help if he needs it (perspective). John also knows that he can't always have the same seat on the bus if someone gets on before him (perspective). He can ask the other child if he can sit on the seat (descriptive). He is afraid to ask the child to move over (perspective). John asks the child and sits next to her (perspective). Buses have large seats (control). His mother will be proud that he solved his problem (perspective).

Social stories can help the child solve a current problem or resolve an issue that is troublesome to him/her. They can also be tailored to fit the child's

particular interests to keep the story relevant to him/her. As with other interventions, this appears promising, but empirical support has not been developed at this time.

Conclusion

The etiology, effective psychopharmacological treatments, and productive educational interventions for autism are currently being developed and researched. Much is unknown about this disorder, but gains are being made in our understanding. It is likely that a transactional approach, utilizing neurological and neuropsychological knowledge of this disorder in conjunction with work in the child's two major environments, namely home and school, will be most effective. Evidence of an exquisite sensitivity to environmental stimulation has led to a new understanding of the autistic child's behavior and language skills. Effective pharmacological treatment continues to elude practitioners, and additional work is needed in that regard. Researchers are beginning to develop programs across the life span for individuals with autism, and promising vocationally based programs have been started for adolescents and adults.

The following case study is an example of a complex scenario that is often referred to a neuropsychologist. The school has repeatedly attempted an evaluation, but the school personnel do not have the requisite knowledge to structure an evaluation. This case was selected to illustrate the difficulties that may be present when evaluating a significantly compromised child, and the need to pursue serial evaluations in order to obtain the most comprehensive and useful assessment of the child's abilities.

A Child with Severe Expressive Aphasia and Motor Apraxia with Pervasive Developmental Delay

This case illustrates the complexity of diagnosing children with severe expressive aphasia with motor apraxia and pervasive developmental delays at an early age. It demonstrates the need for collaboration between neuropsychologists and public school staff so that neuropsychological findings can be integrated into the classroom. Initial contact with the child came at the family's request to verify previous evaluations and diagnoses conducted at a different clinic. A comprehensive neuropsychological evaluation was conducted to determine the child's neuropsychological, academic, cognitive and social-emotional functioning, and to develop an appropriate intervention program. Serial evaluation results were presented at the school's multidisciplinary team meetings.

Teddy

First and Second Evaluations

Information gathered from the first (age 5 1/2 years) and second (age 7 1/2 years) evaluations was based on observational methods because Teddy was unable to respond adequately to verbal or nonverbal test items. A number of methods were attempted during the first and second evaluations, including items from the Stanford-Binet, the NEPSY II, the Wechsler Scales, the Reitan-Indiana Battery, the French Pictorial Test of Intelligence, and the Leiter International Scales. Severe motor apraxia affected his ability to complete nonverbal measures, and his severe expressive language deficits interfered with verbal measures. On several subtests of the Leiter Scales, however, Teddy showed near average abilities at the age of five and one-half years.

Teddy was enrolled in a preschool program for children with significant developmental delays. He was transferred to a regular elementary school in first grade and received special education services. Speech-language, occupational, and physical therapy were the major interventions in the special education program at the public school. Although he was taught sign language, which he readily picked up, articulating vowels and consonant-vowel combinations was the major focus of speech therapy over a four-year period.

At the time of the last evaluation, the therapy goal was to attain expressive language to the five-year-level. After four years of speech therapy, Teddy had not reached his milestone. Teddy was mainstreamed for part of the day for socialization, but received services for learning disabilities

55 percent to 60 percent of the day, 12 percent to 15 percent of which were for speech. Although he learned to read, Teddy appeared hyperlexic as his rate and speed of reading outpaced his reading comprehension skills.

Despite two years of extensive physical therapy and a full-time aide who helped Teddy trace, cut paper, and draw lines and letters, he was unable to print his name, cut with scissors, or draw simple figures. While he did not approach age-appropriate levels for fine motor skills, Teddy did learn to use a computer and was able to type (one-two finger technique) on the keyboard. Gross motor skills were also delayed, but were not as significantly affected.

Attempts to increase his socialization skills showed some progress in that Teddy became more responsive to others. Although he was encouraged to use a combination of speech and sign language for communication, Teddy remained isolated despite attempts to increase socialization with normal and handicapped peers.

Recommendations at the end of the second evaluation urged the school to make a transition into computer technology so that Teddy could make better progress with communication and academic skills.

Third Evaluation

The third evaluation was conducted when Teddy was 9 years –3 months of age, and in the third grade. This was the first evaluation where Teddy was able to complete subtests on standardized assessment measures. During individual testing sessions, Teddy was able to work for periods up to about 45 minutes long. Teddy's attention span was best when activities required reading or when pictures were used to elicit a response. Teddy was able to indicate when he did not know an answer, and occasionally it appeared that he simply said he didn't know when the answer required a complex verbal response. His expressive language was difficult to understand, and Teddy became frustrated when the examiner could not understand what he was saying. He always repeated his answer, but as the session progressed this was obviously frustrating for him. When speaking, Teddy tried hard to enunciate individual letter sounds, especially the T and C sounds. On numerous occasions, he used the proper speech inflection and rhythm, but it was difficult to determine if his verbal responses were correct. Because of severe limitations in responding, formal evaluations may underestimate Teddy's actual level of academic and cognitive development. Portions of the Tests of Cognitive Ability from the Woodcock-Johnson Psychoeducational Test Battery (WJIII) were administered in an attempt to determine Teddy's cognitive potential. The following scores were taken from age-based norms and must be analyzed with caution because of Teddy's severe expressive language delays secondary to motor apraxia.

Measure	Standard score	Percentile
Memory for Names	109	73
Memory for Names (delayed)	105	63
Memory for Words	89	17
Picture vocabulary	86	16
Visual Closure	79	8

Teddy's most outstanding strengths were revealed on tests of associational learning and long-term retrieval. Specifically, Teddy was able to learn associations between unfamiliar auditory and visual stimuli, and scores on the subtest reached the average to high average range of ability. He was able to remember these auditory-visual associations after a four-day delay, and his scores fell within the average range compared to same-age peers. Further, his associational learning was much better when pictures were used instead of more abstract visual stimuli, like rebus figures.

On another measure of short-term memory, Teddy scored within the average range of ability as he was able to recall a series of unrelated words in the proper order. Teddy also showed at least average potential on a task measuring comprehension-knowledge or crystallized intelligence (standard score = 86). When asked to name familiar and unfamiliar pictured objects Teddy identified "waterfall," "grasshopper," "magnet," and "theater." While Teddy scored within the average range on this subtest, several of his verbal responses were unintelligible. Thus, his academic potential may be higher than can be measured at this time.

Teddy had more difficulty on tasks that required visual processing when objects were distorted or superimposed on other patterns. He also had

trouble on a test where he had to remember a series of objects when similar or "distractor" pictures were included (standard score = 73). While this test is a measure of visual processing, Teddy often did not study the pictures for the full five-second interval before the distractors were presented, so his lack of interest in or attention to this task reduced his score. Subtest scores on the Stanford Binet Intelligence Scale-Fifth Edition revealed similar patterns as did the WJ III Cognitive subtests. Teddy scored above age level on terms where short-term memory for objects was required, and had difficulty on items requiring complex verbal or motor responses.

Educational Implications

Academically, Teddy appears to show improvement in the areas of reading recognition and comprehension. On standardized measures, Teddy identified words such as *special, straight*, *powder*, and *couple*. While he was able to read sentences, he made errors when responding to questions. For example, he clapped five times instead of two and identified his "eyebrow" instead of his elbow. At other times it was impossible to understand his verbal responses; as a result, Teddy's reading comprehension may be slightly higher than reported. He also showed slightly higher comprehension scores on the Woodcock Reading Mastery Test than on the K-ABC II test. According to his teacher, Teddy is reading and understanding vocabulary slightly above grade level and is reading from a fourth-grade book at school.

Test	Standard score	Percentile
WJ III		
Letter-Word ID	93	18
Reading Comprehension	79	8
Mathematics Calculation	60	1
Mathematics Reasoning	Unable to complete	

Teddy's math skills are less well developed than his reading abilities. While math skills are emerging, this area is a weakness for Teddy (below the 1.0 grade level). Teddy was able to identify numbers and to determine if there were "just as many" puppets and people in different pictures. However, he could not complete simple addition or subtraction, and he was unable to identify the "third" position in a line. Visual-perceptual deficits appear to be having an impact on his ability to develop math skills.

Spelling skills were not formerly measured because severe apraxia interferes with Teddy's printing skills. However, Teddy can spell some words with his Touch Talker that he is unable to write. For example he was able to type the words *to* and *be*. At this point he spontaneously remarked, "To be or not to be. Shakespeare." He obviously associated this phrase with something he had learned at home, and he was able to further associate it in the testing session. Severe motor apraxia severely limits Teddy's written expressive skills, and he remains virtually a non-writer because of his motor limitations.

Classroom Observations

Because standardized assessment tools may be underestimating Teddy's academic progress, a school-based observation was conducted. Teddy seemed aware of the routine and reacted appropriately to directions for small group activities. In large open classroom settings, Teddy was less adaptable, showing more distractibility and off-task behaviors. He was unable to complete worksheets without the help of a teacher's aide, who helped Teddy print the answers on his paper. When working in pairs, Teddy attempted to answer the questions his partner read aloud to him and was more successful when questions were not too complex. Teddy was able to answer 21 percent (3 out of 14) of the questions read to him and guessed at others. He was unable to print any answers on his worksheet, although his aide traced all the answers with him. In less structured story time, Teddy sat on the floor with the rest of his class and showed appropriate behaviors.

Generally, Teddy's behaviors were not distinguishable from those of his peers during story time. He did, however, move close to his teacher and sit up on his knees to see the pictures of the book better. When his classmates signaled for him to sit down, he complied. On several occasions Teddy rested his elbows on his teacher's lap, and

he seemed comfortable to be close to her during story time. He smiled spontaneously, and he seemed very attentive throughout this session, which was 25 minutes long.

In speech therapy Teddy was careful when articulating and appeared highly motivated and spontaneous in his interaction with the speech therapist. His articulation of individual sounds was clear, distinct, and at a more normal pace. He played the message on the Touch Talker, and he seemed genuinely spontaneous and interested in interacting. Teddy was able to introduce the neuropsychologist to his teacher when prompted. He practiced muscle control in front of the mirror, and he used the proper hand and finger cues to remind himself where his tongue belonged when reproducing individual sounds. His speech production of individual sounds was about 80 percent intelligible, while his production of c-v-c combinations and words were about 25 percent to 30 percent intelligible. He produced the K sound at the beginning and end of words, he read out of a "book" he created about Mickey Mouse, and he played a Mickey Mouse game.

Teddy showed some signs of anxiety during the speech therapy session that was not present at any other time during the day. Teddy repeatedly stomped his feet, clapped his hands, and laughed out loud. He would stop for a short time when his teacher told him to, but he would continue to act out when frustrated. Despite these problems, Teddy was more intelligible, happy, interactive, and spontaneous during speech therapy then at any other time during the day.

Teddy showed appropriate lunchtime behaviors. He turned in his lunch ticket by himself, carried his tray with some assistance from his aide, ate quietly, and cleaned up by himself. He used his utensils correctly and opened his milk carton on his own. He sat next to his homeroom "buddy" and smiled, but did not communicate further with him. During recess another child gave Teddy a "high five" and he responded appropriately. Other than this 5- or 10-second interchange, Teddy did not interact with anyone else. When left by himself, he walked up and down a square of asphalt. His aide told him to play on the equipment, and he methodically walked over to each piece and climbed up a ladder and over two arches. Before climbing over the ladder, Teddy walked around a square area for seven minutes waiting for two children to leave. Once they left, he climbed the ladder once and then left.

Although he went through the motions of play, Teddy did not appear enthusiastic or involved. In the afternoon sessions, Teddy worked on a worksheet counting the number of units of 10 and units of one. He was able to count the units by himself, but his aide had to trace the numbers on the worksheet with him. When he played a game of Addition Bingo, the aide helped him count problems like $7 + 3$, $1 + 1$, $3 + 0$, $4 + 5$, $3 + 4$, $2 + 3$, and $5 + 1$. Teddy was not independent on any of these problems, but he was able to count out loud when the aide pointed to the edge of each number. No other concrete objects were used during this lesson.

In language arts, Teddy did one computer reading lesson in which he had to read a short passage and answer questions. He was able to turn the computer on, type his first and last name, and select the correct sequence to start the lesson. His accuracy rate was about 75 percent for the comprehension questions following a story about dinosaurs.

In a small group reading lesson with his LD teacher and one other student, Teddy read and answered questions in a fourth-grade book. His intelligibility continues to be a problem, but his teacher appears to understand his responses. His inflections and rhythm follow the sentence structure, which suggests that he is processing written material. He was able to answer questions showing that he understood the difference between fiction and nonfiction, and he was able to answer questions such as “Which animal is extinct?”, “Why was the place terrible?”, and “Where did the bugs go?” His teacher also reported that his recognition vocabulary is at the level of the fourth-grade reading book, and his comprehension skills are improving.

Developmental Progress

There have been remarkable gains in several areas since Teddy’s initial evaluation. First, the most apparent developmental progress is in the area of behavior and classroom adjustment. Teddy seems to be very much aware of classroom expectations,

although he is not always able to respond to everything requested of him, especially writing on worksheets. He is able to walk to his different classes without getting lost, make transitions with relative ease, and sit in his seat and attend to lessons for longer periods of time.

Second, Teddy appears to initiate interactions with teachers and several peers at a rate higher than previously observed. Although Teddy is still isolated because of his communication difficulties, he spontaneously interacts and seeks to communicate more often. Third, Teddy seems more tuned into and aware of his surroundings. He responds more appropriately to the directions of his teachers and he redirects quickly when reminded. Fourth, Teddy spends less time daydreaming and staring off. Although he still has a tendency to watch others, he is more attentive to his lessons and to his teachers. Fifth, Teddy has made remarkable academic gains, especially in reading and in reading comprehension. Math continues to be a weakness.

Sixth, Teddy's expressive skills are improving. His sound repertoire is larger than before and his intelligibility is much better. Teddy is also using speech to communicate. Seventh, Teddy has learned to use the Touch Talker to communicate. This involves sequential associative learning whereby icons and words or sentences are combined to communicate. Finally, Teddy shows more independence for everyday activities, such as going to the bathroom and eating lunch. Gains are apparent in speech production and Teddy is communicating with a higher frequency than previously noted. His articulation has improved, although he still has a tendency to speak quickly, which reduces his intelligibility.

Teddy also appears more mature, and his classroom behaviors are more age- appropriate. Although he still is not fully integrated into his surroundings because of his developmental problems, Teddy responds more appropriately to classroom rules, is more attentive, and is more independent for everyday self-help skills at school. Although Teddy remains isolated from his peers, he is more spontaneous than ever and he initiates interactions more frequently. He spontaneously interacts with his teachers more often, and he smiles and laughs appropriately. Although he remains delayed in overall social interaction skills, his progress over the last year has been substantial.

Specific Recommendations

1. The school staff was encouraged to focus on functional communication skills with an integrated speech-language program rather than primarily a therapy-articulation focus.
2. Augmented speech technology should be incorporated throughout Teddy's academic lessons. At this time, the Touch Talker is used as a secondary rather than primary method for inputting and outputting communication. This should be reversed.
3. The educational environment and expectations should be modified to include computer technology for written and reading lessons. Computer technologies are only intermittently used at present. Again, this should be shifted, with the majority of assignments produced on the computer. Efforts to encourage Teddy in social interactions with peers were recommended. Social skills training may be initiated to teach appropriate communication and joining-in skills. Teddy should be reinforced for social interactions and should be assigned a "buddy" for portions of the day during recess or lunchtime. Other cooperative learning experiences should also be incorporated into daily lessons. Socialization should be closely monitored and reassessed periodically to determine whether goals and recommendations are realistic.

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