Chapter 5

AUTISM SPECTRUM DISORDERS

DEFINITION

The terms *autism spectrum disorders* (ASDs) and *pervasive developmental disorders* (PDDs) encompass autistic disorder, Rett's disorder, childhood disintegrative disorder, Asperger's disorder, and pervasive developmental disorder not otherwise specified (PDD-NOS) (American Psychiatric Association [APA], 2000). Due to overlapping symptoms and few absolute distinctions between autism and the other disorders on the spectrum, classical autism often serves as the prototype for ASD or PDD (Lord & Risi, 2000; Minshew, 1997; Ozonoff & Rogers, 2003). These disorders occur on a continuum of severity and represent a spectrum of disorders (Best, Moffat, Power, Owens, & Johnstone, 2008; Newschaffer et al., 2007; Strock, 2004; Whitman, 2004). Based on this conceptualization of the relation among these five disorders, the term *autism spectrum disorder* (ASD) often is used in place of the term *PDD* in an effort to underscore the presence of a continuum or spectrum. ASDs comprise a group of complex neurobiological disorders that typically lasts throughout a person's lifetime (Billstedt, Gillberg, & Gillberg, 2005; Newschaffer et al., 2007). Although the same psychological processes may occur in all individuals to some extent, the ASDs comprise a behavioral syndrome defined by deficient social interaction, language and communication difficulties, and bizarre restricted or repetitive behavior (motor) patterns (APA, 2000; Klinger & Dawson, 1996; Remschmidt & Kamp-Becker, 2006). These three characteristic domains are sometimes referred to as the autism triad (Parikh, Kolevzon, & Hollander, 2008). Symptoms exhibited by individuals on the spectrum tend to vary in severity and pattern, with some individuals having severe impairment while others having only minor impairment; extent of impairment also may vary across the behavioral triad.

Prevalence and Incidence

ASD cases in the 1960s had an estimated prevalence rate of 4 to 5 per every 10,000 live births; with changes in the diagnostic criteria and increased awareness of ASD over the years, the current incidence rate for the broad spectrum is estimated at 4 to 6 per 1,000 births (Hertz-Picciotto et al., 2006). The prevalence of autistic disorder is estimated at between 10 and 16 per 10,000 (Fombonne, 2005; Tidmarsh & Volkmar, 2003; Volkmar, Lord, Bailey, Schultz, & Klin, 2004). Because of these differences in rates, there is a perception that the incidence of ASDs is on the rise. Others argue that increases in prevalence rates do not necessarily reflect increases in incidence rates

of ASDs but most likely are the result of confounding variables, such as increases in the awareness of ASDs, improvements in early detection and identification of ASDs, increases in service availability for persons with ASDs, and flaws in methodology of some epidemiological studies (Fombonne, 2005). Some methodological problems in these studies consist of population sampling errors and inconsistent diagnostic criteria used for identification.

Prevalence and incidence varies by type of ASD as well. Although it is considered a low-incidence disability (Bryson, 1996; Bryson & Smith, 1998; Ford, Riggs, Nissenbaum, & LaRaia, 1994), autistic disorder historically has been the most prevalent of the ASDs (Klinger & Dawson, 1996), with prevalence rates cited as ranging from 5 to 10 per 10,000 children (APA, 2000; Fombonne, 2003; G. Gillberg, 1993). It has been suggested that the prevalence of Asperger's disorder is much higher than that of autistic disorder, at 36 per 10,000 live births (Ehlers & Gillberg, 1993). Both autistic disorder and Asperger's disorder are three to four times more likely to occur in males than females (APA, 2000; Fombonne, 2003; G. Gillberg, 1993; Hertz-Picciotto et al., 2006; Muhle, Trentacoste, & Rapin, 2004). Data regarding the prevalence of Rett's disorder and childhood disintegrative disorder are lacking, with research often limited to case studies. Rett syndrome occurs predominantly in females, while there is some indication that childhood disintegrative disorder is more common among males (APA, 2000). The prevalence of PDD-NOS diagnoses is unknown as well; however, PDD-NOS is considered to be the most common of the ASD diagnoses in recent years (Constantino & Todd, 2003; Fombonne, Simmons, Ford, Meltzer, & Goodman, 2001), in many cases reflecting the milder end of the spectrum. With a tendency to generalize all the ASDs, including PDD-NOS, under the general term *autism*, particularly in educational settings where the legal, educational label of autism refers to the entire spectrum, accurate determination of the prevalence of the individual ASD may be compromised.

Theoretical Perspectives

Three major theoretical models are proposed to account for ASD. The most discussed over the years has been meta-representational theory or theory of mind (Baron-Cohen, 1988, 1995; Baron-Cohen, Leslie, & Frith, 1985). This perspective conceptualizes ASD as a central disorder of empathy such that individuals on the spectrum are unable to understand mental states of self or others. This disorder is related to their inability to represent (or mentalize) the states or perspectives of others such that they cannot predict behaviors of others (or presuppose how/what others will feel/think); subsequently, pragmatic communication skills are impaired. Theory of mind is believed to consist of more than emotion recognition but also an understanding that other persons may not share the same belief system. Neurological substrates implicated for perspective taking include the temporoparietal junction, superior temporal sulcus, and medial prefrontal cortex (M. F. Mason & Macrae, 2008). It has been suggested that the deficits observed across the spectrum extend beyond what can be explained by theory of mind (Tager-Flusberg, 2007). Debate continues regarding the extent to which theory of mind and the primary deficits in social reasoning are dependent on executive function and language (Apperly, Samson, & Humphreys, 2005; Perner & Lang, 2000).

A second theoretical model, weak central coherence theory (Happé, 1993, 2005), suggests that individuals with ASDs engage in sporadic processing of information (Joseph, 1999), particularly in the establishment of meaningful connections between stimuli

(Joliffe & Baron-Cohen, 1999). The main idea is that individuals with ASD have difficulty switching from details to general concepts (Happé, 2005; Happé, Briskman, & Frith, 2001); this model is based in part on some evidence that individuals with ASDs perform better on specific tasks than on complex, metacognitive or global tasks (Ehlers et al., 1997; Frith, 1989; Frith & Happé, 1994). This finding is also related to why they can retain words in a passage in the absence of understanding (Happé et al., 2001); it may be related to the frequent occurrence of hyperlexia (see Chapter 4) in children with ASDs as well. No particular neurological association is made with this theory other than that the deficit is familial (Happé et al., 2001) and may be related to executive dysfunction (South, Ozonoff, & McMahon, 2007; M. A. Turner, 1997). It has been suggested that this weak central coherence affects social processing and related social-cognitive skills (Burnette et al., 2005; Pellicano, Maybery, & Durkin, 2005). At the same time, others have argued that central coherence can occur on two levels, conceptual and perceptual, and that different individuals with ASDs may have weak central coherence in one, the other, or both (López, Leekam, & Arts, 2008).

ASDs also have been explained from the perspective of executive dysfunction (Ozonoff, Pennington, & Rogers, 1991; Russo et al., 2007). In effect, learning in ASD is characterized by perseveration, poor self-regulation, difficulties adapting to change, reduced forward planning, poor problem solving, and ineffective use of feedback; all of these behaviors are consistent with deficits in executive function. Several studies have provided support for the notion that individuals with ASDs evidence problems with planning, mental flexibility, inhibition, generativity (fluency), and self-monitoring (C. Hughes, 1996, 1998). Further, there is considerable evidence that individuals with ASD have difficulty with cognitive shifts (Minshew, Meyer, & Goldstein, 2002; Ozonoff, 1995). Although it has been hypothesized that there would be an association between the ASD and performance on measures of executive function, such a connection has been only partially supported (Pellicano, 2007; South et al., 2007; Thede & Coolidge, 2007; M. A. Turner, 1997; Yerya, Hepburn, Pennington, & Rogers, 2007). One of the issues in understanding the components of executive function that may be implicated in ASDs is the need for a developmental perspective in the selection of measures and comparison groups as well as in the interpretation of research results (Russo et al., 2007).

ETIOLOGY

With the exception of Rett syndrome, which is directly associated with mutations of the methyl-CpG-binding protein 2 (MeCP2) gene, the etiology of ASDs still remains unknown (Muhle et al., 2004). When autism was first described, attributions were made to a familial/parenting style as a causative factor (Kanner, 1943); at the same time, it was implied that there was a biological basis to autism. Unfortunately, the psychogenic basis of autism gained more attention until others endorsed a more biological-based etiology, changing the focus of research on autism (Rimland, 1964). Several decades past Kanner, much more is known about the etiology. It is now recognized, for example, that there is significant heterogeneity across individuals with autism; severity varies as well. These differences support the notion of disorders on a spectrum. Most recently, it has been suggested that there needs to be consideration of genetic, epigenetic, and environmental influences (Persico & Bourgeron, 2006).

Environmental Influences

It is believed that, in some cases, autism is due to a disruption (e.g., prenatal viral infection, mid-trimester bleeding) of normal brain development. For example, during the 1964 rubella outbreak, 8% to 13% of children born developed autism along with other problems associated with congenital rubella syndrome (Hertz-Picciotto et al., 2006; Muhle et al., 2004). Additional nongenetic causes may include exposure to teratogens (e.g., fetal alcohol syndrome, fetal valproate syndrome; see Chapter 14). Some questions have been raised in relation to thimerosal in vaccines as well as exposure to pollutants and heavy metals (see Chapter 13); the relation between vaccination and autism has not been supported by research (K. Madsen et al., 2002). In general, children with nongenetic forms of ASDs tend to have experienced complications prenatally or perinatally and show a high rate of "soft" neurological signs (Lannetti, Mastrangelo, & Di Netta, 2005). Further, in many instances, ASD co-occurs with mental retardation, epilepsy (Ciaranello & Ciaranello, 1995), chromosomal abnormalities, neurocutaneous disorders, or metabolic disorders (A. Bailey, Phillips, & Rutter, 1996; M. Barton & Volkmar, 1998). In these cases, the same factor that results in the co-occurring disorder may be the cause of the ASD.

Genetic and Epigenetic Influences

Alternatively, various studies (A. Bailey et al., 1995; Pisula, 2003; Rutter, 2005) have highlighted research conducted among families and identical twins that provides confirmation that genetics appear to play an important role in the etiology of ASDs. Estimates are that among monozygotic twins, there is an 82% to 92% concordance rate; among siblings, there is an estimated 2% to 3% risk; heritability estimates are as high as 90% (Folstein & Rosen-Sheidley, 2001; Veenstra-VanderWeele & Cooke, 2004). No single biological or clinical marker for autism has yet been discovered, nor has a single gene been found to be responsible for its expression (Pickett & London, 2005). When etiology is genetic, it is believed that ASD is due to mutations in genes that control brain development. ASD is believed to be polygenetic, with as many as 5 to 20 genes implicated (Folstein & Rosen-Sheidley, 2001; Liu et al., 2001; Muhle et al., 2004); the polygenetic basis of ASD may explain the variations across the ASD. In addition, others have identified gene mutations that form "nonsyndromic" or "syndromic" variants. Finally, some genes have been identified as "vulnerability" genes with potential increased risk, but they are not associated directly with ASD itself (Persico & Bourgeron, 2006). A person has a 10- to 20-fold increase compared to the general population of developing autism if he or she has a sibling with autism, and a number of studies have demonstrated a family history of social and language deficits in persons with autism. In all, a number of proteins involved in neurodevelopment and synaptic function have been identified; to some extent, these have been linked with one of the genetic pathways or gene-environment interactions. In particular, there are X-linked disorders (Rett, fragile X syndrome) where ASD is a secondary manifestation of the primary disorder; while Rett disorder is classified among the ASDs, 20% to 40% of individuals with fragile X also meet criteria for ASD.

The variations in genes and associated proteins further contributes to the heterogeneity of individuals with ASDs (Persico & Bourgeron, 2006). In some cases, it is not solely the genetic makeup that affects the manifestation of ASDs. Further, the phenotypic expression of the disorder varies widely, even within monozygotic twins, suggesting a combination of genetic and environmental factors (Amaral, Schumann, & Nordahl, 2008). Autistic

diathesis theory proposes that genetic predisposition makes the individual vulnerable; it is the interaction of the individual vulnerability with specific psychosocial and environmental stressors that produces the disorder (Persico & Bourgeron, 2006).

Neurological Correlates

Regardless of the theoretical model or etiology, the majority of behaviors associated with ASDs are believed to be a manifestation of physiological dysfunction. Notably, on neurological assessment, gross abnormality in the brain (e.g., tumors) is not generally evident. More recently, with functional magnetic resonance imaging (fMRI), it was found that among higher-functioning individuals with ASDs, there were no differences in the functional organization and activation of brain regions for attention and goal-directed cognitive tasks; however, significant difference in the activation of brain regions was found for social and emotional processing, suggesting that altered organization of a specific neurological network underlies behavioral components in ASDs (D. Kennedy & Courchesne, 2007). In contrast, however, approximately 30% to 47% of children with ASDs exhibit abnormalities on electroencephalography (EEG) (Akshoomoff, Farid, Courchesne, & Haas, 2007; Delacato, Szegda, & Parisi, 1994; L. Y. Tsai, Tsai, & August, 1985). EEG tends to be abnormal in about half the individuals with ASDs with excessive slow-wave activity and decreased alpha activity; absence of abnormality on EEG in conjunction with autism is associated with higher cognitive ability (Coben, Clarke, Hudspeth, & Barry, 2008). Across individuals with ASDs, there is evidence of subclinical epileptiform activity, particularly in the perisylvian regions and the right hemisphere (Muñoz-Yunta et al., 2008). Event-related potentials tend to be abnormal for auditory stimuli to a greater extent than visual stimuli, with abnormal P3b (associated with attention and alertness to environmental stimuli) associated with autism (Courchesne, 1987; Courchesne, Courchesne, Hicks, & Lincoln, 1985). Lateralization of language function is also indicated as notable among children with autism (Kleinhans, Müller, Cohen, & Courchesne, 2008). For example, on letter fluency, the group with autism had significantly greater activation in the right frontal and right superior temporal lobes as compared to controls, suggesting significantly reduced lateralization of activation patterns; the same pattern did not emerge for category fluency. These findings were interpreted to indicate reduced hemispheric differentiation for certain verbal fluency tasks in ASDs (Kleinhans et al., 2008).

Mechanisms believed to be involved include reduced programmed cell death and/or increased cell proliferation, altered cell migration with subsequent abnormalities at the cytoarchitectonic level, abnormal cell differentiation, and altered synaptic function (Bauman & Kemper, 2005; Pickett & London, 2005). At the cortical level, this is evident in increased cell density, smaller cortical columns, and neuronal disorganization (A. Bailey et al., 1998; Casanova, Buxhoeveden, Switala, & Roy, 2002). Across studies and methods, at the structural level, a number of researchers have conducted studies using magnetic resonance imaging (MRI) to advance knowledge of what is known about ASDs (Belmonte et al., 2008; Bloss & Courchesne, 2007; Courchesne, Townsend, & Saitoh, 1994; Hashimoto et al., 1995; Luna et al., 2002; Piven, Bailey, Ranson, & Arndt, 1997; Piven et al., 1992). Relative to brain volume, there are indications of increased brain size and ventricles; this was most evident in males with ASDs (Bigler et al., 2003). More recent research suggests, however, that these differences are not significant when head size is taken into consideration (Bigler et al., 2003; Neeley et al., 2007). Enlarged ventricles are evident in 81% of cases, particularly for the right

ventricle (Delacato et al., 1994). There is also some indication that the splenium of the corpus callosum is significantly smaller in individuals with autism (Hazlett, Poe, Gerig, Smith, & Piven, 2006).

Other areas and structures of the brain have been implicated as well. In particular, the structures of the brain stem that involve gating of sensory input based on the sensorimotor components are believed to be impacted in ASDs (Delacato et al., 1994; Ornitz, Atwell, Kaplan, & Westlake, 1985). In support of this finding, both the midbrain and medulla oblongata are smaller in children with autism (Hashimoto et al., 1993). In other brain regions, the proportion of thalamus to total brain volume is not comparable in individuals with autism (Harden et al., 2007). Still others have suggested involvement of the parietal lobe, with most of the behavioral manifestations a result of spatial neglect (Wainwright & Bryson, 1996). In exploring similarities and differences among children with Attention-Deficit/Hyperactivity Disorder (ADHD) or ASD, it was found that children in both groups demonstrated reduced gray matter volume in the left medial temporal lobe as well as increased gray matter in the left inferior parietal lobe (Brieber et al., 2007). The similarity was proposed to explain the similarity in attention problems exhibited by children in these groups. In contrast, only the ASD group evidenced increased gray matter in the right supramarginal gyrus at the temporoparietal junction. This difference was proposed to be associated with their difficulties in theory of mind and empathy (Brieber et al., 2007). In addition to specific structures, migration anomalies (focal pachygyri) have been found (Bauman & Kemper, 2007; F. Keller & Persico, 2003).

Although there is supporting evidence for involvement of multiple systems, there is no conclusive evidence for any one system; this lack of evidence may support the notion of a developmental disruption with diffuse synergistic effects. Initial overgrowth of white matter in the first 2 years of life, as well as subsequent differences in myelination, has been posited as being significant in explaining the neurobiology of ASDs (Courchesne et al., 2007; J. R. Hughes, 2007). Related to this assertion, it was found that increased white matter volume of the motor cortex for both the right and left hemispheres predicted poorer motor skill (Mostofsky, Burgess, & Larson, 2007). This predictive association was not found for children with other disorders. It was suggested that the implications of the increased white matter in motor areas likely was only one aspect of a global pattern of atypical brain development that related not only to motor dysfunction but also to communication and social functioning in ASDs due to reduced intracortical connectivity (Just, Cherkassky, Keller, Kana, & Minshew, 2007) and associated with the size of the anterior portion of the corpus callosum (R. A. Mason, Williams, Kans, Minshew, & Just, 2008). The lack of seizure behavior in the presence of epileptiform discharges shows that autistic children may have a deficiency of corticocortical fibers that typically spread the discharges through the brain to cause seizure behavior (J. R. Hughes & Melyn, 2005). Other research has examined other areas of brain development in ASDs. Specific areas of the brain implicated include the hippocampus, amygdala, other limbic nuclei, the frontal-striatal system, and the cerebellum (Bachevalier, 1994; Bachevalier & Loveland, 2006; Hazlett et al., 2006; Loveland, Bachevalier, Pearson, & Lane, 2008; Piven, Arndt, Bailey, & Andreasen, 1996; Piven et al., 1992). Additional findings related to specific brain structures and systems are detailed next.

Temporal Lobe and Limbic System

The limbic system hypothesis (Joseph, 1999) attributes social and communication deficits observed in children with autism to medial temporal and limbic structures of the brain. The temporal lobe, particularly language areas, is implicated due to the

communication deficits of individuals with autism. In a single case study of a child with autism, there was partial absence of the left temporal lobe (C. P. White & Rosenbloom, 1992). Similarly, with a case with Asperger's disorder, computed tomography exposed damage to the left temporal lobe (P. B. Jones & Kerwin, 1990). Children with autism had reduced amplitude in temporal areas, particularly the left temporal lobe on EEG (Dawson, Klinger, Panagiotides, Lewy, & Castelloe, 1995). Similarly, single photon emission computed tomography (SPECT) and positron emission tomography (PET) studies indicated reduced cerebral blood flow in the temporal lobes (I. C. Gillberg, Bjure, Uvebrant, Vestergren, & Gillberg, 1993; Zilbovicius et al., 2000). With auditory information, children with autism demonstrated increased slow wave and prolonged N1 peak latency for speech stimuli in the left temporal lobe as compared to children with mental retardation and typically developing children (Narita & Koga, 1987). Taken together, studies consistently indicate some abnormality or difference in temporal lobe functioning.

Within the temporal lobe, the medial temporal lobe (limbic system) and particularly the hippocampus and amygdala are implicated due to similarities between autism and Klüver-Bucy syndrome (DeLong, 1992; Hetzler & Griffin, 1981) as well as the role of the hippocampus in language, construction of meaning, and integration of motivation, experience, memory, and learning. Differences in hippocampal volume and cell number (E. H. Aylward et al., 1999; Courchesne, 1997; Herbert, Ziegler, Deutsch et al., 2003; B. F. Sparks et al., 2002) are believed to be associated with the memory disturbances specific to working memory and more complex tasks, while rote memory and echolalia are intact (Coldren & Halloran, 2003; Luna et al., 2002). In a single case study of a child with autism who had a left temporal tumor involving the hippocampus and the amygdala, some autistic behaviors were found to improve after tumor resection; however, other behaviors persisted (Hoon & Reiss, 1992). Further, hippocampal involvement is indicated in increased cell density, reduced neuronal size, and decreased dendritic branching in CA4 and the subiculum (Minshew & Goldstein, 1993). These differences often are associated with long-term memory deficits; however, not all research indicates long-term memory deficits with autism (Minshew, 1997). Although the hippocampus has been studied extensively in a range of persons with autism disorder, the contribution of the hippocampus to the disorder is yet to be fully understood; however, there are indications of a potential genetic basis for hippocampal abnormalities in autism (D. C. Rojas et al., 2004).

Social behavior is also dependent on the amygdala, orbital frontal cortex, and temporal lobe (Abell et al., 1999; Amaral et al., 2008). Amygdala enlargement is associated with anxiety and difficulties with social and communication skills, the latter of which are diagnostic features of autism (Schumann et al., 2004). The amygdala in boys with autism appears to undergo an abnormal developmental course with a period of enlargement early in life that does not persist through late childhood. The amygdala appears initially to be larger in children with autism but does not undergo the same preadolescent age-related increase in volume that takes place in typically developing boys (Schumann et al., 2004). Qualitative observations in six postmortem cases of autism ages 9 to 29 years indicated that neurons in certain nuclei of the amygdala of autism cases appeared unusually small and more densely packed than in age-matched controls (Kemper & Bauman, 1993). In a comparison of 9 boys with autism and 10 typically developing age-matched male controls, the autism group had significantly fewer neurons in the total amygdala and in the lateral nucleus than the controls (Schumann & Amaral, 2006). These researchers did not find the increased

neuronal density or decreased size of neurons as Kemper and Bauman (1993) had reported. Others have investigated the biochemical abnormalities in the amygdale as potentially contributing to social impairment in autism (Kleinhans et al., 2009).

Both the communication and the social deficits in autism may be related to impaired functioning of the superior temporal sulcus (Amaral et al., 2008; Redcay, 2008; Zilbovicius et al., 2006). As with the hippocampus, there is increased cell density and reduced neuronal size in the amygdale (Bauman, 1991). Further, there is evidence of increased gray matter in the frontal and temporal lobes in young children with ASDs (Carper, Moses, Tigue, & Courchesne, 2002) with associated shifting of the superior temporal sulcus (Levitt et al., 2003). Histological study (autopsy) of six brains of individuals with autism revealed abnormalities in the limbic forebrain (Kemper & Bauman, 1993); histological study also has revealed abnormalities in the hippocampus, entorhinal (olfactory) cortex, septal nuclei, mamillary body, and amygdale (Bauman & Kemper, 1985). Finally, reversed asymmetry of frontal and temporal lobes, as in learning disability, has been found in individuals with ASDs (Hier, LeMay, & Rosenberger, 1979). Related to the communication deficits associated with ASD, there are also indications of malformation and decreased activation of the temporal lobe (Pierce, Muller, Allen, & Courchesne, 2001; Sweeten, Posey, Shekhar, & McDougle, 2002).

Fronto-Striatal Model

Frontal lobe and basal ganglia are also believed to be related to ASDs (Amaral et al., 2008; Hollander et al., 2005; Rinehart, Bradshaw, Brereton, & Tonge, 2002; Rinehart et al., 2006). Rinehart et al. (2002) presented tasks of increasing cognitive complexity to individuals with autism, Asperger's disorder, and normal controls. Across tasks, the Asperger group performed comparably to the controls; however, as the task complexity increased, the autistic group displayed deficits in inhibition. Additional support has been provided by PET studies. For example, individuals with autism evidenced atypical activation of the left anterior cingulate gyrus during language tasks (R.-A. Müller et al., 1999). Another PET study used a continuous performance test (CPT) and found that individuals with autism lacked the normal (i.e., right greater than left) cortical hemispheric asymmetry for attentional tasks (Buchsbaum et al., 1992). Buchsbaum et al. also found decreased relative metabolic rate in the right posterior thalamus and the right putamen. Also using PET, high metabolic rate in the left inferior frontal cortex and an inverse correlation between activation of the medial superior frontal gyral area with performance on CPT was found, as was decreased metabolic rate in the left posterior putamen (B. V. Siegel et al., 1992). Finally, it has been found that children with autism had reduced amplitude in frontal areas, particularly the left frontal area, on EEG (Dawson et al., 1995). Developmental differences emerged such that at 3 to 4 years of age, children with autism evidenced hypoperfusion (decreased blood flow) to the frontal area; however, by age 7, blood flow to the frontal area was normal (Zilbovicius et al., 1995). In addition to the frontal-striatal model, other models have posited dysfunction of the mesolimbic cortex of the temporal and frontal lobes, neostriatum (basal ganglia) and anterior and medial groups of the thalamus (Maurer, 1986). Still another systemic model involves the hippocampus and amygdala as well as the interrelated neurochemical systems (oxytocin and vasopressin, serotonin, and endogenous opiate) and the temporal and parietal association areas; these structures and circuitry interact to produce the deficits associated with autism (Waterhouse et al., 1996).

Notably, individuals with autism exhibited lower glucose metabolic activity in limbic areas as compared to controls (Haznedar et al., 2000). In contrast to normal controls,

on a theory of mind task, individuals with Asperger's disorder activated a completely different area located in the left medial frontal lobe, suggesting that areas of physiological dysfunction determine type and manifestation of ASD (Happé et al., 1996). Neuropsychologically, the anterior cingulate cortex (ACC) is linked to awareness of mental states in self and others (Abell et al., 1999), so associated differences in the ACC would be expected. Finally, related to the motor perseveration, the basal ganglia has been the focus of study, with indications of structural changes (Kates et al., 1998; Sears et al., 1999) and functional impairments (R. A. Müller, Pierce, Ambrose, Allen, & Courchesne, 2001).

Minicolumn Hypothesis

The basic anatomical and physiological unit of the neocortex is the minicolumn; information is transmitted through the core of the minicolumn and is prevented from activating neighboring minicolumns by surrounding inhibitory fibers (Casanova et al., 2006). The minicolumns in the brains of individuals with autism tend to be smaller in size, although there are the same total number of cells per column and more columns; these differences would affect information processing, potentially enhancing the ability to process stimuli that require discrimination, but at the expense of generalizing the relevance of a particular stimulus. This finding could be related to the tendency of individuals with autism to focus on smaller parts of objects rather than the object as a whole and could be a potential explanation for difficulties experienced filtering sensory information (Casanova et al., 2006).

Cerebellum

The cerebellum is implicated functionally in ASDs due to the deficits in integration of attention, movement, and thought processes (Courchesne, 1997; Piven et al., 1992). On autopsy, abnormalities have been found of cerebellar circuits (Kemper & Bauman, 1993), neocerebellar cortex, the roof nuclei of the cerebellum, and inferior olivary nucleus (Bauman & Kemper, 1985). At the cell level, there are findings of decreased Purkinje cells and a modest decrease in granule cells (Bauman, 1991; Courchesne, 1997); there is further indication of an association of specific autistic-like behaviors in association with changes in cerebellar cell level and volume (Pierce & Corchesne, 2001). For example, the cerebellum, particularly the vermis, has been shown to modulate sensory input at the level of the brain stem, thalamus, and cerebral cortex (Amaral et al., 2008). Stimulation of the vermis can cause hypersensitivity to touch and sound. Persons with autism sometimes respond in peculiar ways to sensory stimuli and can be hypersensitive to stimuli (Amaral et al., 2008). The right cerebellum has been shown to work with the left frontal and anterior cingulate areas in word generation tasks (Fiez et al., 1996). The cerebellum is also involved in language function. Lesions of the right cerebellum result in problems in word selection and production. Lesions of the vermis can result in dysarthria and abnormal speech rhythm (Fiez et al., 1996). Finally, these same areas are involved in the shifting of attention; individuals with autism can have difficulty with shifting of attention, and can become fixated with certain stimuli; they may stare into space, avoid eye contact, or look at objects from unusual angles (Amaral, et al., 2008; Fiez et al., 1996).

Studies of individuals with autism suggest that for a majority of cases, there was hypoplasia of vermal areas of cerebellum (Courchesne, 1997); others had hyperplasia of the vermal area (Redcay & Courchesne, 2005). The pons/cerebellum vermian lobules seemed to have developed more rapidly in the group with autism while the posterior fossa

was smaller in children with autism, suggesting early maldevelopment and hypoplasia (Hashimoto et al., 1995). Others have not found any differences in the cerebellar vermal area, pons, or fourth ventricle (Garber & Ritvo, 1992; Holttum, Minshew, Sanders, & Phillips, 1992; Rumsey et al., 1988). The cerebellum has been the target of study in postmortem studies of autism with findings of decreased density of Purkinje cells and 40% less expression of GAD67 mRNA in the cerebellar Purkinje cells of individuals with autism (Yip, Soghomonian, & Blatt, 2007). The postmortem finding of fewer Purkinje cells appears to differ from MRI findings of an enlarged cerebellum in autism; this difference was likely due to the heterogeneous groups and presence of co-occurring disorders across studies (Kern, 2003).

Mirror Neuron System

At the cellular level, mirror neurons have been implicated, particularly with individual response to perceptual events, imitation, empathy, and language learning (Gallese, 2003; Iacoboni & Mazziotta, 2007; Iacoboni et al., 1999; Leslie, Johnson-Frey, & Grafton, 2004; Uddin, Iacoboni, Lange, & Keenan, 2007). Mirror neurons are a group of premotor neurons that provide a simple means for understanding the actions of others (Triesch, Jasso, & Deák, 2007). Although initially identified in studies with monkeys (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996), comparable studies have implicated mirror neurons for the same functions in humans (Decety, Chaminade, Grezes, & Meltzoff, 2002; Decety & Grezes, 1999; Fadiga, Craighero, & Oliver, 2005). Mirror neurons are activated in response to specific actions performed by the individual as well as by similar actions that are observed in others (J. H. G. Williams, Whiten, Suddendorf, & Perrett, 2001a, 2001b); it is the mirror neuron system that allows people to connect an observed action with a corresponding motor representation in their brains (Buccino & Amore, 2008; Iacoboni, 2007). As such, this system would be most consistent with the conceptualization of ASD and deficits related to theory of mind and the inability to presuppose the feelings and actions of others. It would further be consistent with perspectives that social relating and understanding is dependent on the individual's capacity not only to perceive others as similar to self (Meltzoff & Moore, 1995) but also to simulate the behaviors of others in the individual's mental representation of his or her own emotions, cognitions, and movements. There is evidence of the role of mirror neurons and simulation in typically developing individuals; it is believed that this internal simulation and representation overlaps or mediates the imitation of behavior as well as the perception of the behavior (Oberman & Ramachandran, 2007) and understanding of others' intentions (Iacoboni, 2007). It should be noted that support for mirror neurons as explaining intention and attribution is not without controversy (Borg, 2007).

The exact nature and function of the mirror neuron system has not been determined. It has been suggested that damage or developmental failure of these mirror neurons, located in the frontal lobes, may underlie the deficits in empathy and theory of mind in ASDs (Buccino & Amore, 2008; Iacoboni, 2007; Oberman et al., 2005; Oberman & Ramachandran, 2007; Schulte-Rüther, Markowitsch, Fink, & Piefke, 2007; J. H. G. Williams et al., 2001b). In effect, the lack of activation of the mirror neuron system on observing similar movements of others may be related to perspective taking and social cognition (Pfeifer, Iacoboni, Mazziotta, & Dapretto, 2008). Anatomical differences, specifically decreased gray matter in the areas of mirror neuron system, has been found in a group of individuals with high-functioning autism; cortical thinning of the gray matter in this region was associated with symptom severity (Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2006). Brain activity associated with emotional and

facial stimuli in nondiagnosed adults has been identified using fMRI (Schulte-Rüther et al., 2007). Also with fMRI, group comparisons indicated that children with ASDs showed an absence of mirror neuron activity in the inferior frontal gyrus (pars operculis) despite comparable performance on the task (Dapretto et al., 2006). Further, Dapretto and colleagues found that the level of activity at the inferior frontal gyrus was inversely related to symptom severity such that decreased levels of activity were associated with increased severity. Based on PET scans and fMRI, the frontal operculum and the anterior parietal cortex have also been implicated (Decety et al., 1997; Iacoboni et al., 1999), with somatotropic distribution in the premotor and parietal areas similar to that found for monkeys (Buccino et al., 2001). Additionally, the superior temporal sulcus appears to have somatotropic distribution (Pelphrey, Morris, & McCarthy, 2005). Of brain waves, the *mu* wave is associated with execution, imagination, and observation of human action and is believed to be associated with mirror neuron activity. Using EEG and measuring *mu* frequency to self and observed movements, Oberman and colleagues (2001) found that individuals with high-functioning autism did not evidence *mu* suppression to observed hand movements but did evidence the *mu* suppression on self movements, supporting the hypothesis of a dysfunctional mirror neuron system in ASDs. In the insula and anterior cingulate cortex, activation of mirror neurons associated with empathy (i.e., observing facial expressions of disgust or pain) has been observed with fMRI (I. Morrison, Lloyd, DiPellegrino, & Roberts, 2004; T. Singer et al., 2004; Wicker et al., 2003). Mirror neurons are believed to be related not only to empathy and social competence but also to the language difficulties associated with ASDs, particularly the frequency of echolalia, neologisms, and pronoun reversal (Oberman & Ramachandran, 2007).

Neurotransmitters

In addition to specific structures, neurotransmitters implicated include serotonin (B. Devlin et al., 2005), monoamines (Martineau, Barthélémy, Jouve, & Müh, 1992), and opiatergic transmitters (due to high levels of opiate activity in the CSF; C. Gillberg, 1995). Serotonin is considered pivotal to brain development and associated with many of the behavioral characteristics of ASDs (Chugani, 2002); decreased serotonin synthesis has been found in individuals with ASDs, particularly in the left frontal cortex, basal ganglia, and thalamus as well as in the dentate nuclei of the cerebellum (Chugani et al., 1997). Research has yielded some indications of elevated levels of serotonin among individuals with autism (E. H. Cook & Leventhal, 1995; B. Devlin et al., 2005; McBride et al., 1989); levels of serotonin were associated with clinical state, particularly whole-blood 5-hydroxytryptamine (5-HT) levels (Hérault et al., 1996). In an attempt to alter serotonin levels, and presumably address the level of clinical symptoms, use of levodopa (L-dopa) has been studied (Ritvo et al., 1971). Although the L-dopa had the intended effect on the serotonin levels, there were no associated changes in clinical symptoms. In contrast, the use of selective serotonin reuptake inhibitors has been helpful in determining the role of serotonin in autism. For example, positive results have been found with fluoxetine and fluvoxamine (DeLong, 1992; DeLong, Teague, & Kamran, 1998; Ghaziuddin, Tsai, & Ghaziuddin, 1991; McDougle, Price, & Goodman, 1990). DeLong proposed that the serotonergic dysfunction was specific to the left hemisphere in high-functioning autism with bilateral dysfunction in low-functioning autism; Asperger's disorder is hypothesized to reflect serotonergic dysfunction of the right hemisphere only.

Behaviors of self-stimulation and nonresponsiveness to conditioning are indicative of dopamine dysfunction within the mesocortex. Children with autism have been found

to have high levels of D2 receptor binding in the caudate and putamen (Fernell et al., 1997); other studies have indicated differences in D2, D3, and D5 (Martineau, Hérault, & Petit, 1994). In addition, levels of homovanillic acid—a metabolite in the breakdown of dopamine—in the cerebrospinal fluid of children with autism has been found to be much higher than levels in normal children (C. Gillberg & Svennerholm, 1987). Dopamine antagonists (e.g., haloperidol) can be effective in decreasing autistic behaviors in about 50% of cases, further supporting dopaminergic influences.

The neurotransmitter oxytocin is related to social attraction, behavioral response, and memory; as such, oxytocin may be involved in ASDs. Oxytocin is a 9–amino acid peptide that is synthesized in the hypothalamic neurons and transported down axons of the posterior pituitary. Oxytocin levels are important both in the birthing process and in breastfeeding, with oxytocin transmitted from the mother to the infant during feeding. Notably, research suggests that there are low blood plasma levels of oxytocin in individuals with ASDs (Modahl et al., 1998). In addition to serotonin, dopamine, and oxytocin, glutamate receptors also have been implicated in ASDs (Hussman, 2001; Purcell, Jeon, Zimmerman, Blue, & Pevsner, 2001; Serajee, Zhong, Nabi, & Huq, 2003).

COURSE AND PROGNOSIS

Course and prognosis vary based on the type of ASD but consistently revolve around the autistic triad: communication, social interaction, and repetitive/restrictive behavior (Parikh et al., 2008).The various behavioral manifestations that may result in a diagnosis of ASD include cognitive impairment, poor or limited social relationships, underdeveloped or impaired communication skills (verbal and/or nonverbal), and repetitive behaviors, interests, and/or activities (APA, 2000; National Institute of Mental Health, 1999). Each of the disorders in the spectrum includes some combination of these manifestations, with subtle or more obvious differences. From a theoretical perspective, cognitive processes related to dealing with ambiguity, theory of mind, and central coherence continue to be predictive of behaviors associated with ASDs through adolescence and adulthood (Best et al., 2008).

Communicative Impairment

Communication and the ability of the individual to acquire language are key features of ASDs. At the same time, a distinguishing feature between autistic disorder and Asperger's disorder is that individuals with Asperger's disorder exhibit "no clinically significant delays or deviance in language acquisition" (APA, 2000, p. 80); they do, however, often demonstrate difficulty with understanding the emotional content of communication, exhibit problems with pragmatic responses, and evidence difficulty integrating affective and cognitive aspects of a situation or conversation (Blacher, Kraemer, & Schalow, 2003). In fact, several language phenotypes have been identified within the spectrum (Kjelgaard & Tager-Flusberg, 2001), with language abilities in children with autism showing profiles of unevenness such that abilities range from muteness to verbal speech with some residual language deficits (Minshew, 1997). Impairments exist in language comprehension and in receptive and expressive verbal as well as nonverbal communication, especially in the areas of gestures, facial expressions, rhythm and pitch of speech, and eye contact (Minshew, 1997; Whitman, 2004). Pragmatic language deficits are most evident across all

disorders on the spectrum (Bishop & Norbury, 2002) and are most likely to persist across the life span (Rutter, 2001).

Approximately 25% to 50% of the children with autism never develop receptive and expressive language, nor do they compensate through the use of nonverbal communication (Minshew, 1997; Osterling, Dawson, & Munson, 2002). At the same time, however, for children with autism, language development tends to follow a distinctive and abnormal pattern. The verbal language of children with autism may develop in the sequence of

> simple immediate echolalia, complex delayed echolalia, the functional use of echolalia to communicate needs resulting in pronoun reversals (e.g., I for you), original or nonechoed language with grammatical errors or grammatically correct language that is stereotyped, grammatically correct simple sentences, and complex sentences (Minshew, 1997, p. 820)

that is more protracted and not likely to include the same level of abstraction. Similar to children with speech language impairment (SLI), children with ASDs may perform poorly on nonword repetition (Kjelgaard & Tager-Flusberg, 2001). Communication deficits with ASDs differ from those of children with SLI (see Chapter 4) in that both verbal and nonverbal communication is affected (Whitehouse, Barry, & Bishop, 2007). SLI or level of language at age 6 to 8 years was found to account for the greatest variation in outcome in adolescents on the spectrum, with decreased language at age 6 or 8 predictive of outcome in adolescence (T. Bennett et al., 2008). This highlights the importance of language/communication not only during childhood but as individuals on the spectrum enter adulthood.

Out of those children with autism who develop language, 25% of these children maintain a rudimentary stage of verbal and nonverbal language (Minshew, 1997). When communicating with others, children with autism may interrupt others frequently, have difficulty holding an extensive conversation with spontaneous dialogue, and have difficulty understanding satire, jokes, or nonliteral language (Happé, 1993; Whitman, 2004). Pragmatic communication is similarly impaired (Loth, Gómez, & Happé, 2008). Nonverbal communication oftentimes follows a similar sequence as language with (a) initially no eye contact; (b) distant glancing that is constant; (c) the use of the glancing eye in social situations; (d) eye contact that is prolonged in social situations; and (e) engaging in eye contact in social situations that is normal in quantity (Minshew, 1997). Another component to nonverbal communication is facial expression. Facial expressions in children with autism typically are expressionless or consist of a smile that is unvarying (Minshew, 1997).

Social Interaction

Related to their pragmatic communication deficits, individuals with autism may have difficulty with social relations and in making friends; a basic deficit is the lack of orientation toward a social stimulus and associated nonverbal and verbal behaviors (M. J. Weiss & Harris, 2001). When engaging in an activity, individuals with autism do not make attempts to bring others into their activity and do not appear to be aware of the existence of other individuals aside from themselves or one other (Ozonoff & Rogers, 2003). In addition, children with autism have difficulty generalizing their experiences from one situation to the next. While they may know what is expected of them and behave accordingly in one situation, they have difficulty adapting that information to new similar,

situations (Aarons & Gittens, 1999). Components of social cognition that are affected in ASDs include:

- Perspective taking (LeBlanc et al., 2003; Warreyn, Roeyers, Oelbrandt, & De Groote, 2005)
- Sense of agency (David et al., 2008)
- Meaningful imitation (Meltzoff, 2002; Meltzoff & Moore, 1995)
- Joint attention (Baron-Cohen, Baldwin, & Crowson, 1997; Naber et al., 2007; Roos, McDuffie, & Gernsbacher, 2008; Warreyn et al., 2005)
- Mentalizing (Baron-Cohen et al., 1997; David et al., 2008; Sigman, Dijamco, Gratier, & Rozga, 2004)

Across studies, there are indications of deficits in joint attention and imitation (Baron-Cohen et al., 1997; Meltzoff, 2002) as well as face recognition/discrimination despite intact object recognition/discrimination (Klin et al., 1999; B. R. López et al., 2008; Wilson, Pascalis, & Blades, 2007). Even among individuals with average cognitive abilities, or at least average verbal abilities, there are continued deficits in social interactions (Klin et al., 2007). Social deficits are most evident in social situations that are unstructured or ambiguous, where structured routines and patterns do not provide prompts (Loth et al., 2008). It is in these unstructured settings that deficits in theory of mind and the inability to presuppose what is likely to happen and what is expected in terms of behavior become more evident. Similarly, individuals on the spectrum have difficulty predicting the behaviors or motivations of others (Loth et al., 2008).

Early on, the deficits in social behavior are noted in difficulty with early social behaviors, including joint attention, gaze following, pretend play, and imitation (Baron-Cohen, 1995; Charman et al., 1997; Meltzoff, 2002; Rogers, 1999). Facial recognition and emotion recognition strategies are atypical (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Schultz, 2005). Research suggests that individuals with ASDs pay less attention to social cues and are less able to derive social meaning from varying contexts (Klin, Jones, Schultz, Volkmar, & Cohen, 2001a, 2001b). Children with ASDs evidence difficulty with comprehending even the most common of social events (Loveland & Tunali-Kotoski, 2005; Volden & Johnston, 1999). Taken together, it has been suggested that the deficits in theory of mind in conjunction with the social-perceptual style affect the acquisition of common event schemas (Loth et al., 2008). Notably, the social deficits and associated pragmatic skills continue to be evident in adults with high-functioning autism or ASDs, with some indications that the social impairments give rise to pragmatic communication deficits (Colle, Baron-Cohen, Wheelwright, & van der Lely, 2008). Individuals with ASDs continue to demonstrate difficulty in social areas throughout adulthood; the social difficulties may significantly impair not only social functioning but employability (Venter, Lord, & Schopler, 1992).

Restricted or Stereotyped Behaviors

The restriction of ideas and interests that characterizes autism also impedes social relationships. Often, in conversations, children with ASDs will converse in great detail about their topics of interest and may not recognize that they are violating social norms by dominating the conversation with these single topics. Children with ASDs are known to be extremely knowledgeable about specific topics, such as airplanes or cars, and will develop a memory for extensive minute details or facts regarding these restricted topics (Mesibov, Adams, & Klinger, 1997). Related to the restricted interests, individuals with

autism may exhibit splinter skills or circumscribed abilities. These may include the ability to recall entire scripts of films or rapidly decode words in the absence of comprehension (hyperlexia) (Newman et al., 2007). Alternatively, children with ASDs often will become fixated on parts of objects. For example, a child with ASD may only spin the wheels on a car and ignore the real purpose of the car.

The restriction or repetitiveness is not limited to topics of conversation or specific objects. Children with autism tend to engage in behaviors that are atypical, stereotyped, and ritualistic. For example, children with ASDs may engage in a high frequency of self-stimulatory behaviors, such as twirling or rocking their body or objects, or engage in self-injurious behaviors, such as head banging; often these behaviors become evident between 3 and 5 years of age (Rutter, 2001). In addition, they may engage in ritualistic behaviors, such as lining up objects or adhering strictly to a specific and inflexible routine. Interrupting their ritualistic behavior or routine or changing something in their environment can result in emotions of extreme irritation, anxiety, or anger (Loth et al., 2008; Whitman, 2004). Underlying reasons for this behavior are not known; however, dual cognitive deficits—high level of awareness for detail combined with impairments in abilities of abstract reasoning—have been suggested (Minshew, 1997). In regard to what causes stereotyped behaviors, it has been postulated that children with ASD engage in stereotyped behaviors as a way to reduce anxiety or tension or as a means to find stimulation when they are experiencing a low internal state of arousal (Whitman, 2004).

Neuropsychological Profiles

There is continued controversy among those doing research and clinical practice in the PDD area; neuropsychological research suggests differing cognitive profiles for individuals with Asperger's disorder versus autism (Minshew, 1997). It has been argued that Asperger's disorder is most closely associated with the profile of nonverbal learning disability as discussed in Chapter 3; strengths exist in auditory perception, attention and memory, simple motor production, and rote learning while deficits exist in nonverbal areas including problem solving, visual perception and memory, pragmatics, and prosody. Although in preschool, children with autism may show deficits in understanding object permanence and spatial relations (Dawson & Adams, 1984), there is evidence that by adolescence, these children evidence strengths in visual perceptual and visual-spatial areas in conjunction with deficits on tasks requiring verbal skills, simultaneous performance of multiple operations, and complex language and memory skills (Frith & Happé, 1994). Both groups demonstrate deficits in executive functioning; however, the problem exhibited by the group of children with autism was in the inability to shift set (perseveration), indicating limited cognitive flexibility. In constructing potential profiles, it is important to note that only the group of children with autism demonstrates deficits on some theory of mind tasks (Ziatas, Durkin, & Pratt, 2003). In a recent study, it was found that individuals identified with high-functioning autism did not differ from those identified as having Asperger's disorder on more global scales of verbal and nonverbal functioning (Spek, Scholte, & van Berckelaer-Onnes, 2008). The two groups differed, however, on patterns of functioning across subtests such that the high-functioning autism group performed more poorly on the Coding and Processing Speed tasks but better on the Information and Matrix Reasoning tasks (Spek et al., 2008). In a second study with children with high-functioning autism, indications were that they did better on perceptual reasoning and particularly motor-free tasks as well as verbal comprehension tasks as compared to working memory and processing speed (Mayes & Calhoon, 2008). Taken

together with results from other studies, Mayes and Calhoon concluded that the profile on traditional measures of cognition reflected attention, graphomotor, and processing speed weaknesses of children with high-functioning autism while allowing their verbal and nonverbal reasoning to be demonstrated. General deficits associated with ASDs are presented in Table 5.1.

There is some consensus that children with ASDs demonstrate difficulty on various tasks of executive function (B. R. López, Lincoln, Ozonoff, & Lai, 2005; South et al., 2007; Yerys, Hepburn, Pennington, & Rogers, 2007). Examples include increased perseverative errors on the Wisconsin Card Sorting Test as well as decreased efficiency on the Tower of Hanoi (Bennetto, Pennington, & Rogers, 1996; Ozonoff, Pennington, & Rogers, 1991). Similarly, adolescents and adults with ASDs tend to have difficulty with organization and effective strategy use (Minshew & Goldstein, 1993). In a study with adults with ASDs, deficits continued to be evident in areas of working memory and planning (L. Bernard, Muldoon, Hasan, O'Brien, & Steward, 2008). Others evaluated executive function in preschoolers ($n = 18$) with autism in comparison to a control group ($n = 18$); no significant

Table 5.1 Neuropsychological Domains and Specific Deficits with Autism Spectrum Disorders

Domains	Specific Deficits
Cognition	Global decreased functioning with 40% to 60% below the average range
Auditory-linguistic/ Language function	Comprehension (verbal and nonverbal) Expressive (verbal and nonverbal) Prosody Pragmatics
Visual perception/ Constructional praxis	Difficulty when motor components, speed of processing, or memory involved (motor-free visual perception often spared)
Perceptual sensory functioning	Increased sensitivity
Learning and memory	Rote memory usually intact; deficits most evident in working memory
Processing speed	Slow to respond and complete tasks
Executive function	Disinhibition Impaired cognitive flexibility Perseveration
Attention/Concentration	May be hypervigilant and unable to shift attention
Motor function	Perseverative or repetitive behaviors or patterns of behaviors Evidence graphomotor difficulties
Achievement/Academic skills	Hyperlexia
Emotional/Behavioral functioning	Joint attention Imitation Face recognition/memory/discrimination Empathy, mentalizing, perspective taking
Other: Stereotypy	Restricted interests Self-stimulating behavior Self-injurious behaviors

difference in executive function performance was found; however, the children in the autism group exhibited less social interaction (Griffith, Pennington, Wehner, & Rogers, 1999). In a follow-up study of 13 children in the autism group, similar findings were revealed. These results are counter to the executive dysfunction hypothesis of autism based on research with adults. It has been proposed that the executive deficits in autism originate, at least partially, from the inability of individuals with autism to use internal speech to self-regulate behavior and emotions (J. Russell, 1997).This same internal language would be responsible for the deficits in working memory (Joseph, McGrath, & Tager-Flusberg, 2005; J. Russell, 1997).There are some indications of an association between theory of mind and executive function deficits, but research has been equivocal (Bach, Happé, Fleminger, & Powell, 2005; C. Fine, Lumsden, & Blair, 2001; C. Hughes & Graham, 2002). Finally, one study investigated brain activation during a mental rotation task and concluded that there was insufficient activation of the prefrontal cortex in the boys with autism as compared to those in the control group but that parietal activation was similar in the two groups; these findings were seen as supporting a dysfunction in the frontro-striatal networks (Silk et al., 2006).

Prognosis and Associated Features

The level of cognitive functioning of individuals with autism spans a broad range, from profound mental retardation to superior intellect (Pickett & London, 2005). Although individuals with ASD evidence a range of ability levels, a large percentage of those identified with ASD exhibit impaired cognition (E. H. Cook & Leventhal, 1995; DiCicco-Bloom et al., 2006). Additionally, there is a high rate of co-occurrence with epilepsy (see Chapter 10) and attentional disorders, including ADHD (see Chapter 6), as well as other externalizing disorders (E. H. Cook & Leventhal, 1995).

Overlap and similarities in behavioral manifestations also have been noted with Tourette syndrome (see Chapter 7), particularly in relation to echolalia, perseverations, and stereotypic movements (Canitano & Vivanti, 2007; Geurts et al., 2008). Additional associated features include hypersensitivity to sounds, tactile stimulation, or odors. Across studies, there are some indications of difficulty with imitation of motor movements. Motor and movement abnormalities have been identified as early as infancy from home videos in some cases, but this is most noticeable in those children who have developmental delays in addition to autism (Ozonoff et al., 2008). Some of the motor difficulties relate to gait, knee flexion, and posturing (Damasio & Maurer, 1978; Jansiewicz et al., 2006; Minshew, Sung, Jones, & Furman, 2004; Vilensky, Damasio, & Maurer, 1981).

Little research has examined the outcomes of individuals with ASDs, but what research has been done has not been overly optimistic. Some of the early research found that 60% to 75% of those with autism had poor outcomes, as defined by living in institutions and/or not receiving appropriate residential or vocational services (Lotter, 1978). A recent study found that outcome was related to severity of autism (as measured by a rating scale) and cognitive ability at age 11 (Eaves & Ho, 2008). Eaves and Ho found that at age 24, the most common emotional or psychiatric problem was that of "emotional difficulty" (p. 742); additional co-occurring disorders included bipolar disorder, depression, conduct disorder, Tourette syndrome, and anxiety disorder. Of children with ASDs in a population-based cohort, 70% had at least one comorbid diagnosis; 41% had two or more diagnoses in addition to the ASD (Simonoff et al., 2008). The majority continued

to live at home, received government disability, and had a case worker. Families noted unmet needs particularly in the social arena (Eaves & Ho, 2008). Research generally suggests continued difficulties with special obsessions, naiveté, self-centeredness, a tendency to talk incessantly about a topic of interest to them, and low empathy; these difficulties at times contribute to the likelihood of their involvement with the legal system (D. Allen et al., 2008). Furthermore, it is hypothesized that these behaviors make negotiating the legal system more difficult for individuals with Asperger's disorder than for others, thus increasing the likelihood of negative outcome for even a minor offense. In the Allen et al. study, the mean age of first offense was 25.8 years but occurred as early as age 10 or as late as age 61. Self-reported factors that precipitated the offense in at least 50% of cases included social rejection, bullying, sexual rejection, or family conflict. The types of offenses ranged from physical or verbal aggression to other types of offenses (e.g., drugs, traffic offenses).

Assessment Considerations

Assessment of children and adolescents on the autism spectrum requires planning and preparation. Practice parameters for the assessment of ASDs have been offered (Filipek et al., 2000; Klin, Saulnier, Tsatsanis, & Volkmar, 2005; Volkmar et al., 1999). Taken together, the parameters include obtaining sufficient background information related to symptom presentation, history, intensity, and frequency; information from multiple informants related to current (and past) symptom presentation; and direct observation of symptom presentation related to the autism triad (Kanne, Randolph, & Farmer, 2008). Specific measures suggested for these components and specific to ASDs include the Autism Diagnostic Interview—Revised (ADI-R), the Social Communication Questionnaire (SCQ), the Social Responsiveness Scale (SRS), and the Autism Diagnostic Observation System (ADOS) as well as various other rating scales (e.g., Childhood Autism Rating Scale, Gilliam Autism Rating Scale). In addition to assessing the specific symptoms and severity of the ASD, it is also important to obtain information related to cognitive ability, language skills, and adaptive functioning. The choice of the measure to use for determination of cognitive functioning must be based on the language abilities and cooperation level of the individual child; considerations would be similar to those discussed in Chapter 4. In language areas, and particularly with higher functioning or Asperger's disorder, language assessment will need to include measures of pragmatics; the Test of Pragmatic Language may be appropriate in this regard (Kanne et al., 2008). Most important, continuing assessment (progress monitoring) of all domains will be needed over time.

EVIDENCE-BASED INTERVENTIONS

A number of different approaches have been used in the past, and continue to be used, in the treatment of ASDs; the extent to which there is an evidence/research base to support some of these interventions is provided in Table 5.2. Interventions for children with ASDs may focus on specific behaviors or be more comprehensive in scope (J. M. Campbell, Herzinger, & James, 2008). The comprehensive approaches include the use of applied behavior analysis (ABA; Lovaas, 1987), the Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) program of structured teaching (Schopler, 1997), and Learning Experiences . . . an Alternative Program (LEAP) (Kohler, Strain, & Goldstein, 2005). Based on multiple reviews and meta-analyses

Table 5.2 Evidence-Based Status of Interventions for Autism Spectrum Disorders

Interventions	Target Behavior	Status
Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) program	Comprehensive	Promising practice (J. M. Campbell et al., 2008)
Learning Experiences … an Alternative Program (LEAP)	Comprehensive	Promising practice (J. M. Campbell et al., 2008)
University of Colorado Health Science Center (UCHSC) program	Comprehensive	Promising practice (Rogers & DiLalla, 1991; Rogers & Lewis, 1989)
Discrete trial training	Communication and other behaviors	Promising practice (J. M. Campbell et al., 2008; H. Goldstein, 2002)
Adult-directed teaching	Communication	Promising practice (Odom et al., 2003)
Incidental teaching	Communication	Promising practice (H. Goldstein, 2002)
Functional communication training	Communication	Promising practice (H. Goldstein, 2002)
Pivotal response treatment	Range of behaviors	Promising practice (Koegel et al., 2001; Rogers & Vismara, 2008; Shearer & Schreibman, 2005)
Differential reinforcement	Communication; stereotypic behavior	Promising practice (J. M. Campbell, 2003; Odom et al., 2003)
Visual systems and supports (e.g., Picture Exchange Communication System; PECS)	Communication	Emerging to promising practice (Odom et al., 2003)
Facilitated communication	Communication	Ineffective (American Academy of Pediatrics Committee on Children with Disabilities, 1998; Simpson, 2005a; Zimmer & Molloy, 2007)
Social skills training (generic)	Social interaction	Inconclusive (Rao et al., 2008)
Social stories	Social interaction	Promising practice (Ali & Frederickson, 2006; Bellini & Peters, 2008)
Video modeling/Video self-modeling	Social communication skills	Promising practice (Bellini & Akullian, 2007)
Peer-mediated training	Socialization, communication	Promising practice (H. Goldstein et al., 1992; McConnell, 2002; Odom et al., 2003)
Self-monitoring	Social interaction	Emerging (Odom et al., 2003)

(*continued*)

Table 5.2 (*Continued*)

Interventions	Target Behavior	Status
Positive behavior support	Problem behaviors; functional communication	Promising practice (Odom et al., 2003)
Differential reinforcement	Self-injurious behaviors	Inconclusive (Odom et al., 2003)
Verbal and auditory cues, pictorial cues, activity schedules, video priming	Transition between activities	Promising practice (Sterling-Turner & Jordan, 2007)
Inclusive education	Socialization, communication	Inconclusive (Rogers & Vismara, 2008)
Punishment/overcorrection	Self-injurious behaviors	Inconclusive but may be effective when positive approaches are not successful (Matson & LoVullo, 2008)
Secretin	General ASD behaviors	Ineffective with negative effects (Zimmer & Molloy, 2007)
Glutein-free/casein-free diet	General ASD behaviors	Minimal to ineffective with possible adverse effects (Levy & Hyman, 2008)
Small carbohydrate diet	General ASD behaviors	Minimal to ineffective with possible adverse effects (Levy & Hyman, 2008)
DMG, other nutritional supplements	General ASD behaviors	Minimal to ineffective with possible adverse effects (Bolman & Richmond, 1999; Kern et al., 2001)
Auditory integration training	Sensitivity to sound	Inconclusive (American Academy of Pediatrics Committee on Children with Disabilities, 1998)
Sensory integration training, massage therapy	Sensitivity to stimuli	Inconclusive (Zimmer & Molloy, 2007)
Risperdal (Risperidone)	Aggression, irritability, hyperactivity, stereotypy	Positive practice (Chavez et al., 2006; Gleason et al., 2007; McDougall et al., 2005; Parikh et al., 2008)
Revia (Naltrexone)	Aggression and self-injurious behavior	Inconclusive (Parikh et al., 2008)
Haldol (Haloperidol), Anafranil (clomipramine hydrochloride), Depakote (sodium valproate), Lamictal (lamotrigine)	Aggression and self-injurious behavior	Adverse effects (Parikh et al., 2008)
Other medications: Prozac (fluoxetine), Ritalin, Concerta (methylphenidate), Strattera (atomoxetine)	Repetitive behavior, hyperactivity	Inconclusive (Gleason et al., 2007; Posey et al., 2005)

(J. M. Campbell, 2003; J. M. Campbell et al., 2008; Iovannone, Dunlap, Huber, & Kincaid, 2003; Odom et al., 2003; Rao, Beidel, & Murray, 2008; Rogers & Vismara, 2008), a growing body of research provides information on the extent to which there is evidence to support various practices. At the same time, generally there is a lack of sufficient evidence for any of the treatments to meet criteria for "probably efficacious" or "exemplary" based on criteria for empirically supported treatments (J. M. Campbell et al., 2008). A number of approaches and programs, however, have sufficient studies to be considered "promising practices" or "possibly efficacious" (Rogers & Vismara, 2008). Most often, the criterion not met is that of random assignment to condition as typically accomplished with randomized clinical trials. In many cases, the research evidence is further limited by treatment integrity, differences in treatments across studies, child characteristics, generalizability, and follow-up assessment (J. M. Campbell, 2003; Rao et al., 2008). For example, while many studies have been done with ABA or Lovaas-type interventions, there are often variations across studies.

Of the comprehensive interventions with the most support, many programs or approaches draw from ABA. For example, differential reinforcement of appropriate and desired behaviors (Charlop-Christy, Carpenter, Le, LeBlanc, & Keller, 2002; Drasgow, Halle, & Phillips, 2001; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002) and positive behavioral supports have been used to increase communication skills, increase social interactions, and decrease problem behaviors (Keen, Sigafoos, & Woodyatt, 2001). The approach may make use of discrete trial learning based on principles of operant conditioning (Lovaas, 1987), incidental teaching, and functional communication training (H. Goldstein, 2002). Across behavioral approaches, whether positive or aversive, or combination, the behavioral approach has been found to be more effective when the treatment is designed following functional assessment (J. M. Campbell, 2003). Age, treatment intensity, treatment duration, and cognitive level also have been identified as predictors in determining success (Luiselli, Cannon, Ellis, & Sisson, 2000; Rogers, 1998). Across the comprehensive programs, all of which have promising support, common elements incorporate these components. While presenting a problem in comparison and replication across studies, particularly with single-subject design, another common component is that of tailoring the intervention to the specific needs of the individual (J. M. Campbell et al., 2008).

Additional interventions are available with varying levels of support. Various modeling procedures have been used to increase communication and social interaction among children with ASDs, including adult-directed teaching strategies, with the adult providing verbal modeling or prompts (G. Williams, Donley, & Keller, 2000), peer-mediated strategies with peers modeling and providing the prompts (H. Goldstein, Kaczmarck, Pennington, & Shafer, 1992), and the use of video models (Schreibman, Whalen, & Stahmer, 2000). With some children, there is some indication that self-monitoring may be as effective as adult-directed training (Shearer, Kohler, Buchan, & McCullough, 1996). Involvement of various family members in the intervention has been found to increase effectiveness (M. J. Baker, 2000; Dunlap & Fox, 1999; Steibel, 1999). Finally, some studies have attempted to use the child's interests and preferred activities (Koegel, Koegel, & McNerney, 2001), as well as choices, to improve communication and social interaction (C. M. Carter, 2001; Ducharme, Lucas, & Pontes, 1994). Specific accommodations may include providing class notes or outlines, modifying tests to reduce the graphomotor component, allowing additional time for written work, and decreasing written work requirements (Mayes & Calhoon, 2008); the extent to which these accommodations would meet criteria for "evidence based" is unknown. Inclusion often is advocated as an alternative to

self-contained programming, but there is little empirical evidence in this regard, and some argue that the intensity of programming needed for individuals with ASDs is not possible within an inclusive setting (Rogers & Vismara, 2008).

In addition to the traditional or conventional approaches to treatment of ASDs, there are a number of unconventional or alternative treatments (Levy & Hyman, 2003, 2005; Zimmer & Molloy, 2007). Biologic treatments (e.g., secretin, diets) tend to address the belief that gastrointestinal problems are responsible for ASDs. Related to dietary interventions, some have recommended the use of digestive enzymes and probiotics for children with ASDs (Levy & Hyman, 2005). Other supplements, including dimethylglycine (DMG), tryptophan, and tyrosine may be recommended but have minimal to no scientific evidence to support their use and in some cases may have negative side effects (Bolman & Richmond, 1999; Kern et al., 2001; Zimmer & Molloy, 2007). Nonbiologic alternative treatments include auditory integration training, sensory integration training, and massage therapy. Supporters claim that benefits of auditory integration training (AIT) include improved attention, improved auditory processing, decreased irritability, reduced lethargy, improved expressive language, and improved auditory comprehension; however, conclusions were that there was insufficient evidence to support AIT in the treatment of ASDs (American Academy of Pediatrics Committee on Children with Disabilities, 1998). There are few well-designed clinical trials examining sensory integration therapy, massage therapy, movement therapy, or cranio-sacral manipulation for treatment of ASDs (Zimmer & Molloy, 2007). A new approach uses neurofeedback to modulate *mu* rhythms to address the dysfunctional mirror neuron system (Oberman, Ramachandran, & Pineda, 2008); studies are under way to see if this is effective. It should be noted that some of these "therapies" may be dangerous or at least very costly to implement and have no proven or potentially harmful effects (see Table 5.2).

Finally, psychopharmacological interventions have been tried with children and adults on the spectrum. Published studies with young children on the spectrum have focused on risperidone with two randomized clinical trials (Luby et al., 2006; Nagaraj, Singhi, & Malhi, 2006) as well as one open trial (Masi, Cosenza, Mucci, & Brovedani, 2003). Consistently, across studies, there are indications of decreased behaviors, particularly those related to irritability, aggression, and stereotypy (McDougall et al., 2005); at the same time, there is little evidence of effect on other core autistic behaviors (Chavez, Chavez-Brown, & Rey, 2006; Gleason et al., 2007).

CASE STUDY: JOHN—ASPERGER'S DISORDER

The next report is from a hospital-based clinic. Identifying information, such as child and family name, teacher or physician name, and school information, has been altered or fictionalized to protect confidentiality.

Reason for Referral

John is a 12-year-old Caucasian male who was referred for a neuropsychological assessment to determine his current neurocognitive functioning. John's parents reported declines across various areas of functioning including speech/language skills, vision, academic functioning, and social-emotional functioning (i.e., withdrawn, social rejection). Past medical history is significant for a diagnosis of Asperger's disorder; this diagnosis was based on behavioral criteria in areas of pragmatic communication, social

relationships, and stereotypy/restricted behavior by a licensed professional specializing in ASDs; diagnosis was not the purpose of this evaluation. John's parents are searching for the most appropriate and optimal school placement and programming; they have requested this neuropsychological to assist in the intervention planning.

Assessment Procedures

John's parents provided information via questionnaire and interview format. Available medical records and a previous evaluation were reviewed. These assessment measures were utilized during the evaluation:

- Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV)
- Woodcock-Johnson Tests of Achievement, Third Edition—Form A (WJ III Achievement)
- Developmental Test of Visual Motor-Integration, Fifth Edition (DTVMI-V)
- Motor-Free Visual Perception Test, Third Edition (MVPT-3)
- Grooved Pegboard Test
- Rey Complex Figure Test (RCFT)
- Wide Range Assessment of Memory and Learning, Second Edition (WRAML-2)
- Wisconsin Card Sort-64 (WCST-64)
- Behavior Rating Inventory of Executive Function (BRIEF; Parent Form)
- Achenbach Child Behavior Checklist (CBCL; Parent & Teacher Forms)

Background Information

Home

John is an only child and resides with his parents. No recent psychosocial stressors within the home were reported.

Medical

John was born following a full-term pregnancy that was complicated by his mother having the flu during the second trimester. He was delivered vaginally via a lengthy labor (27.5 hours) and weighed 7 pounds 12 ounces at birth. John remained in the hospital for 2 days due to dehydration. John has been a relatively healthy child, with no hospitalizations, surgeries, or long-term medications. Medical history is significant for Asperger's disorder, vision problems (accommodative spasm, very nearsighted), allergies, occasional headaches, and one febrile seizure at 5 years of age. With regard to early development, John's speech, motor, and self-help milestones reportedly were achieved within normal limits. Per parents, family history is significant for bipolar disorder (cousin) and alcohol/substance abuse (aunt, grandparents).

John's parents reported that approximately 10 months ago, he began experiencing declines across various areas of functioning. John reported vision problems, eye pain, headaches, decline in academic functioning, fatigue, and increased social withdrawal. John's parents also reported hair loss on the top/back portion of his head that was suspected to be alopecia or trichotillomania. He is currently prescribed a topical steroid. Magnetic resonance imaging and all blood work performed by the hospital was

reportedly within normal limits. He has a scheduled appointment at the Genetics Clinic next week.

John was diagnosed with Asperger's disorder. He reportedly has difficulties with distinguishing between real and fiction, understanding nonverbal cues, social/peer interactions, some sensory stimuli, unusual types of interests, focused/intense interests, atypical use of objects, and withdrawal when overstimulated. Specific social-emotional concerns included difficulty expressing emotion, naiveté, poor eye contact, preference for solitary play, anxiety, and limited social interaction. John has a long history of language/pragmatics therapy from a local university-based clinic twice a week; despite the interventions, language/pragmatics are reported to be atypical.

Educational

John is currently enrolled in the seventh grade at a local junior high school; no previous grade retentions were reported. Per teacher report, John receives Section 504 accommodations, including preferential seating and study guides. He currently maintains a C–F average across subjects, which is a significant decline compared to his grades in the sixth grade. John's parents reported that he also receives tutoring at school and privately, particularly for math. He is noted to "work better verbally than visually." John's teachers reported that he is a "pleasant young man and respectful," but he has problems with following directions, inconsistent work performance, loses interest easily, appears withdrawn, isolates himself, avoids eye contact, and twirls/pulls out his hair. One teacher also noted John's significant difficulties with sequential math and basic math skills.

Behavioral Observations

John was a quiet boy who presented with an awkward shyness but transitioned well to the testing session. He demonstrated poor eye contact, no spontaneous conversation, and flat affect. Verbal output was characterized by "yes/no" or short answers to questions, and his speech was somewhat muffled. John was appropriate in height and weight compared to same-age peers and was dressed appropriately for weather and setting. He did not wear glasses during the evaluation, and no hearing difficulties were reported or observed. John appeared able to see the test materials presented at a normal distance, and he was able to hear verbal instructions spoken at a normal conversational tone. John appeared to give his best effort on all tasks but was slowed in his mental processing and psychomotor speed. He maintained good attention to tasks; however, he displayed anxiety symptoms including picking at eyebrows and nails. Poor gross motor skills were observed including awkward gait, poor balance, and clumsy walking movements. In terms of upper extremities, he was right-hand dominant, with an immature pencil grip (thumb over two fingers). No tremors or associated movements were observed on motor output tasks. Results from this evaluation should be considered a valid indication of John's current neurocognitive functioning.

Assessment

Intellectual Functions

John's intellectual functioning was assessed using the WISC-IV and was found to be in the low-average to borderline impaired range. Scores were: Full Scale IQ = 79, Verbal Comprehension Index = 87, Perceptual Reasoning Index = 86, Working Memory Index = 91, and Processing Speed Index = 70. John appeared to have great difficulty

with tasks involving mental processing speed, visual scanning, visual-perceptual discrimination, and psychomotor speed; however, his short-term sequential memory and working memory skills were intact (see Table 5.3).

Academic Functioning

John's academic functioning was assessed using selected subtests from the Woodcock-Johnson Tests of Achievement, Third Edition (WJ III): Form A. All scores were in the average to very superior range. Scores were: Letter-Word Identification = 126, Passage Comprehension = 107, Calculation = 105, Applied Problems = 100, Spelling = 138, and Writing Samples = 103. John appeared to have greater ease with more basic tasks and tasks requiring rote memory, such as spelling and reading increasingly difficult words.

Table 5.3 Psychometric Summary for John

	Scaled Score	Standard Score
Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV)		
Full Scale IQ		79
Verbal Comprehension Index		87
Perceptual Reasoning Index		86
Working Memory Index		91
Processing Speed Index		70
Developmental Test of Visual Motor Integration, Fifth Edition (DTVMI-V)		76
Motor-Free Visual Perception Test, Third Edition (MVPT-3)		81
Grooved Pegboard Test		57
Wide Range Assessment of Memory and Learning, Second Edition (WRAML-2)		
General Memory Index Score		76
Verbal Memory Index		97
Visual Memory Index		76
Attention/Concentration Index		73
Story Memory	11	
Design Memory	5	
Verbal Learning	8	
Picture Memory	7	
Finger Windows	1	
Number/Letter	10	
Story Memory Recall	11	
Verbal Learning Recall	7	
Design Recognition	9	
Behavior Rating Inventory of Executive (BRIEF), Parent Form		
Clinical Scales	T- Scores	
Inhibit	45	
Shift	59	
Emotional Control	42	
Initiate	59	

(continued)

Table 5.3 ***(Continued)***

	T-Scores	Standard Score
Working Memory	62	
Plan/Organize	61	
Organization of Materials	52	
Monitor	60	
Indices		
Behavioral Regulation Index	48	
Metacognition Index	61	
General Executive Composite	57	
Woodcock-Johnson Tests of Achievement, Third Edition (WJ III)		
Letter-Word Identification		126
Calculation		105
Spelling		138
Passage Comprehension		107
Applied Problems		100
Writing Samples		103

Visual-Perceptual and Visual-Motor Functions

Visual-motor integration and visual-motor output skills were assessed using the Developmental Test of Visual-Motor Integration (VMI). John demonstrated a right-handed immature pencil grip (thumb over two fingers) and completed only 20 out of 30 simple figure designs. He obtained a Standard Score of 76 (5th percentile), suggesting borderline impaired visual-constructional abilities. Figures were distorted for age, but no directional confusion was noted.

With regard to visual-perceptual skills, John was administered the Motor-Free Visual Perception Test, Third Edition (MVPT-3). On this task, he obtained a Standard Score of 81 (10th percentile), which fell within the low-average range. In examining his profile, he had particular difficulty with items involving visual discrimination, spatial orientation, visual closure, and embedded figure/figure ground tasks. In combination, these scores indicated significant problems in the areas of visual-perceptual and visual-constructional skills. These problems are negatively affecting his academic functioning, particularly in math and written output.

John demonstrated significant difficulty on the copy performance portion of the Rey Complex Figure Test. He scored in the $\leqslant$ 1st percentile (raw score = 28) compared to others his same age. He was unorganized in his copy approach, and the design was significantly distorted. Problems with this task are likely related to poor visual-perceptual and visual-constructional skills as well as poor motor planning and organization.

Psychomotor speed and fine motor coordination were measured using the Grooved Pegboard Test. John demonstrated significant psychomotor slowing across hands bilaterally, with an appropriate dominant hand advantage. He had particular difficulty with his left hand (Scaled Score = 57; 2 dropped pegs), including motor slowing and poor fine motor coordination.

Memory Functions

John was administered the Wide Range Assessment of Memory and Learning, Second Edition (WRAML-2) as a measure of general memory processing skills. John's General Memory Index Score was in the borderline impaired range of functioning; however, there was a significant difference between his verbal and visual memory scores as well as within verbal memory areas. John did much better on recall of verbal information that is meaningful and semantically related (i.e., story recall); he had more difficulty on recall of unconnected words (i.e., list learning). In visual areas, John had particular difficulty with encoding, transfer, and retrieval of visual information, which is consistent with his measured difficulties with visual-perceptual stimuli, as noted. John also demonstrated difficulty with short-term sequential visual memory tasks, which lowered his overall Attention/Concentration Index score. These memory problems are adversely impacting academic performance and support the idea that he tends to learn better verbally. John's verbal memory strength should be used in teaching him; however, he would benefit from multiple modes of input, including verbal, visual, and tactile, in his learning. He also will benefit from repetition in his learning and cues/prompting to aid in memory retrieval processes.

Executive Functions

The results of the Behavior Rating Inventory of Executive Function (BRIEF)—Parent Form are presented in Table 5.3. This form was completed by John's mother to assess current executive skills functioning. Overall, John's profile fell within the average range, with no significant areas of weakness.

John also was administered the Wisconsin Card Sort-64 (WCST-64) as an objective measure of executive functioning. His problem-solving and mental flexibility skills fell in the low-average to impaired range. John had 31 total errors, 28 perseverative responses, 2 completed categories, and 0 failures to maintain set. John was able to perform basic problem solving when given verbal feedback on his performance; however, he began to guess when categorization of set became more difficult. He had specific difficulties with mental set shifting and perseveration.

Social-Emotional and Behavioral Functioning

Behavior and social-emotional functioning was measured using the Achenbach Child Behavior Checklist (CBCL)—Parent & Teacher Forms. John's mother reported problems with depression, somatic complaints, social interactions, and attention problems. On the same scale, John's teacher reported the same areas of problems as well as behaviors consistent with anxiety and thought problems.

Summary

- John has a previous diagnosis of Asperger's disorder with reported general decline across areas of functioning beginning 10 months ago. He is currently enrolled in the seventh grade and receives Section 504 modifications and tutoring for math.
- Intellectual skills were found to be in the low-average to borderline impaired range, with particular difficulty with tasks involving mental processing speed, visual scanning, visual-perceptual discrimination, and psychomotor speed.

- Academic abilities were in the average to superior range. No learning disabilities were indicated. He performed better on basic and rote memory tasks.
- Significant difficulties were noted with visual-perceptual and visual-constructional skills as well as motor planning and organization.
- John exhibited slowed mental processing speed, especially with visual-perceptual tasks. Psychomotor speed was slowed across hands, with greater difficulty with his left hand (nondominant).
- Significant problems with visual memory processes, retrieval functions, and higher level memory organization were identified. In addition, John evidenced difficulties with problem-solving skills and mental flexibility (perseveration and set shifting).
- Per parent and teacher report, John has continued difficulties with poor motivation and limited social interaction as well as problems with attention and anxiety. Behavior observations were consistent with flat affect, poor eye contact, limited conversation, and limited social interaction.

Diagnostic Impressions

- Results from the current neuropsychological evaluation indicated significant difficulties with visual-perceptual and visual-constructional skills as well as visual memory functions (encoding and retrieval). These problems are consistent with his reported areas of academic underachievement, especially involving math and written output. John also demonstrated significant slowing with mental processing speed and psychomotor output, more with his left hand. This pattern of problems suggests difficulties with right temporal and right frontal lobe functioning.
- Difficulties with inattention, problem solving, set shifting, and mental flexibility also indicate problems with prefrontal lobe functioning. This pattern of problems likely will adversely impact his math abilities, written output, inconsistencies in classroom performance, ability to complete multistep directions, and planning and organizational skills.
- John's profile is consistent with a diagnosis of Asperger's disorder. He also demonstrates a pattern of symptoms similar to that of a person with nonverbal learning disorder (NVLD). It should be noted that NVLD and Asperger's disorder have similar patterns of symptoms and are often difficult to differentiate.

Recommendations

- John's parents were provided with a detailed packet on Asperger's disorder at today's evaluation.
- John's parents are encouraged to share this report with his school and consider the need for placement as a child with a disability under the Individuals with Disabilities Education Improvement Act (Autism Spectrum Disorder or Part B; Other Health Impaired; e.g., special education and related services). John's diagnosis of Asperger's disorder should qualify him for these services; however, determination of an educational disability is made by the student's educational committee. If these services are not available, John should continue to receive services under Section 504 of the Rehabilitation Act of 1973 (e.g., modification plan designed, implemented, and evaluated in the regular classroom). In any case, John requires

additional classroom modifications and possible resource classes for math if he is to achieve at his potential.

These are suggested recommendations for the home and school:

- John's difficulties with constructional tasks and motor planning skills likely will affect his efficacy on writing tasks. He should be allowed extra time to complete writing tasks and to utilize printing if this is a more effective means for written communication. Alternatives to conventional writing also may need to be considered, such as a laptop computer, word processor, and/or tape recorder. A tape recorder will be particularly effective since it will allow John to dictate initial drafts of writing assignments, eliminating any significant motor output requirements. For essay-type tests, he may benefit from the option of dictating his response or from oral testing.
- It is suggested that his school provide John with all of his textbooks as audio recordings. This will give him the opportunity to gain access to information without relying strictly on his reading abilities. It also will allow him to utilize his strengths with verbal memory.
- Due to John's significant difficulty with visual-perceptual and visual-constructional tasks, these modifications should be considered:
  - Relaxed grading for handwriting.
  - Relax time limits for written material.
  - Pair visual material with an auditory presentation of material.
- John should not be required to complete lengthy copying tasks. He would benefit from copies of the lecture notes, slide presentation, and so on prior to the lecture.
- John may benefit from the option of dictating his response or from oral testing.
- Allow the use of computers or typewriters for written assignments.
- These classroom modifications should be considered to help with attention and concentration problems:
  - John should be given preferential seating in his school classes. He should be seated close to the teacher in order to minimize distractions, and away from windows, doors, and pencil sharpeners in order to minimize distractibility.
  - The teacher should provide necessary prompts and cues (preferably unnoticeable to other children).
  - Larger tasks should be broken into smaller, more manageable tasks, such as presenting John with only one worksheet at a time. Also, parts of an assigned worksheet page can be covered up (hidden) to reduce distraction or stress.
  - Teachers should try to keep instructions and directions concise and simple as possible.
  - John should be allowed to take breaks when possible.
  - Multiple modalities should be used when presenting directions, explanations, and instructional content (e.g., auditory, visual, tactile, etc.), especially visual aids (e.g., schedule of events, written instructions on board).
  - Teachers should provide John with ample time (preferably one week) and specific/detailed study guides to help with exam/project preparation.
  - Due to John's visual-perceptual processing and slowed mental processing speed, he would benefit from modified assignments (e.g., reduced length or number of

problems) and increased time limits on tests and assignments. Another option would be a modified grading system in which John is graded based on completed work if an appropriate amount of work is attempted. This will also help to reduce John's test and performance anxiety.

- John appears to benefit from cuing and structure in order to facilitate retrieval of information. Given this finding, it is suggested that teachers give him multiple-choice or matching format tests whenever possible. Word banks also would be beneficial in cuing recall of information.
- John would benefit from a structured environment and as much one-on-one teaching as possible. He also would benefit from a visual schedule attached to his desk to help with changes in schedule and self-monitoring. A male "buddy" also may help John with increasing social skills and transitioning between classes.
- John is quite perseverative in his response style; this interferes with his skills at shifting effectively and efficiently within or between tasks. Teachers need to monitor his performance on in-class worksheets as he will require extra time and direct cues to facilitate subtle shift (e.g., changing from addition to subtraction on a math worksheet). John also will require a brief break or extra warm-up time when expected to change from one task to another.
- Due to John's problems with visual-perceptual processing, it will be extremely difficult for him to complete "bubble answers" on most standardized test forms. He should be allowed to write his answers, dictate into a voice recorder, or dictate the answers to someone who can complete the form.
- John is encouraged to engage in activities involving visual-perceptual skills (e.g., putting puzzles together or models).
- It is suggested that John use a daily assignment/homework notebook. He will need direct teacher assistance as he adjusts to using this organizational/memory tool. Teachers will need to provide him with cues as to what needs to be logged into the notebook. A lead teacher then will need to review the notebook at the end of each school day and provide direct cues as to what materials are needed for that evening's homework. John's mother should maintain close contact and monitoring with the school, including signing off on the notebook each night, to ensure success with this tool.

These recommendations are to be considered for working memory problems:

- John should be taught strategies to help him better retain basic concepts, including making meaningful/applied connections of instructional material as well as the use of mnemonic devices or associative cues to assist with his memory.
- Repeated drill and practice of basic skills presented through multiple formats will increase the likelihood of retention. Software programs may provide this drill in a more gamelike format.
- John should create environmental cues to aid with memory, such as a schedule of daily events on his desk, to-do lists, and the like.

John's current social skills should continue to be fostered at home, through therapy, and at school through the use of modeling emotions and social stories portraying appropriate pictures and labels of emotions. The next social stories books and authors are suggested:

- *Comic Strip Conversations: Colorful Illustrated Interactions with Students with Autism and Related Disorders* by Carol Gray
- *The Original Social Story Book* and *The New Social Story Book* by Carol Gray
- Encourage John's participation in activities in and outside of school to maximize his opportunities for socialization with his same-age peers.
- John should have a follow-up neuropsychological evaluation in two years to continue to map his neurocognitive development.

Further Discussion of Case Study

John's history and progress are consistent with the pattern often evident with youth with Asperger's disorder. He demonstrates the decreased nonverbal/visual spatial abilities as well as impaired executive function. Notably, John had difficulty with the embedded figures task; this is often an area of strength for youth with Asperger's disorder, but not in this case. As often occurs with ASDs, individual differences preclude the assumption of a specific pattern of strengths and weaknesses. The extensive list of recommendations addresses all aspects of impairment noted; multiple suggestions are offered to allow flexibility by the service providers in choosing interventions and prioritizing target behaviors. Because John's behaviors did not emerge as being particularly problematic, there is less reliance on Applied Behavior Analysis (ABA) methods, but a structured setting with consistent expectations continues to be recommended.

CONCLUDING COMMENTS

In the popular press as well as in the professional community, there is increased concern for the numbers of children being identified with ASDs as well as potentially negative or limited outcomes for these children as they grow into adulthood. It has been suggested that ASDs are the most severely debilitating of the neurocognitive disorders (Pelios & Lund, 2005); only mental retardation is considered to occur at the same frequency (Newschaffer et al., 2007). A number of theories have been proposed and with advances in neuroscience, more is known about ASDs now than previously. At the same time, much still is unknown about the highly heterogeneous group of individuals who fall somewhere on the spectrum; no specific genotype or endophenotype has been identified (Newschaffer et al., 2007).

One of the major points of consensus is the need for early identification and early intervention if potential success and positive outcomes are to be maximized. The broad range of deficits that can be associated with ASDs and the variations in manifestation across the behavioral triad of communication, social interaction, and stereotypy/restricted range make it virtually impossible to develop a phenotype for the ASDs. Assessment and subsequent intervention need to be determined on an individual basis (Myles, Grossman, Aspy, Henry, & Coffin, 2007). As with all neurocognitive disabilities, there is a need for further research relative to scientifically based and effective practices (Simpson, 2005a,b). At the same time that there is increased concern with the evidentiary base to choosing interventions, attention also is being given to social validation and the extent to which various stakeholders support the use of various interventions (Callahan, Henson, & Cowan, 2008).