INTERNATIONAL REVIEW OF RESEARCH IN MENTAL RETARDATION

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CHAPTER ONE

THEORY AND RESEARCH ON AUTISM: DO WE
NEED A NEW APPROACH TO THINKING
ABOUT AND STUDYING THIS DISORDER?

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Abstract

Most theories of autism have tended to be static and unidimensional, often focusing on one process that is purported to be defective, while ignoring other potentially important emergent processes. In this chapter, a comprehensive and developmental theory of autism is proposed, describing the interrelationship between symptoms/processes diagnostically associated with autism and other features that commonly co-occur with this disorder. Past research relating to specific symptoms associated with autism is then described, with a special emphasis placed on examining how these symptoms may influence one another. Finally, future research directions along with research methodologies that can be pursued to advance our understanding of autism are suggested.

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International Review of Research in Mental Retardation, Volume 35 © 2008 Elsevier Inc.
ISSN 0074-7750, DOI: 10.1016/S0074-7750(07)35001-5 All rights reserved.
employed to evaluate the structure of complex systems and how they change over time are discussed.

1. INTRODUCTION

Autism is a developmental disorder that is characterized by social interaction and language/communication deficiencies as well as by the presence of stereotyped and restricted behavior patterns. Within the DSM-IV classification system, Autistic disorder is one of several disorders within a larger category of pervasive developmental disorders (PDD), which also includes Rett’s disorder, Childhood Disintegrative Disorder, Asperger’s Syndrome (AS), and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). All of these latter disorders share core characteristics in common with Autistic Disorder and are sometimes given the label nonautistic PDDs (American Psychiatric Association, 2000).

Autism is often referred to as a spectrum disorder because of the marked individual differences that exist among persons diagnosed as autistic. This variation is reflected in many domains, including social, language/communication, and cognitive functioning. For example, many individuals with autism are characterized as having mental retardation; however, some function in the average and above average range of intelligence. Individuals who meet the criteria of mental retardation are estimated to be around 75% (American Psychiatric Association, 2000). This figure may be inflated, however, because individuals with autism are at a disadvantage in IQ testing situations because of their social and communication impairments.

Autism is commonly acknowledged to have a genetic basis. Evidence for this assertion comes from various types of research, including twin, family, and genetic linkage studies (Rutter, 2005; Whitman, 2004, pp. 119-122). However, the pattern of inheritance and the factors affecting genetic expression appear to be complicated. Genetic linkage studies suggest that a number of genes, perhaps from 15 to 20, are needed to produce the characteristics associated with autism. Research also has suggested that what is inherited is a genetic susceptibility, with extrinsic agents, such as an infection or toxin, possibly serving as a trigger for vulnerable individuals. The complexity of autism at the genetic level is mirrored at both a structural and a neurochemical level, with numerous parts of the brain and a variety of neurotransmitters and neurohormones being proposed as playing a role in this disorder (Whitman, 2004, pp. 124-132). Despite its biological roots, autism appears to be a plastic disorder, capable of being influenced by early intervention programs.

Although genetic and biological markers are being sought, the diagnosis of autism is currently based on the examination of behavioral signs.
Historically, autism was not diagnosed until age three or later; however, recent research indicates that screening for autism and earlier diagnosis, during the second and even first year of life, is possible (Coonrod & Stone, 2005). Estimates of the incidence of autism have varied considerably over time, ranging from 2 to 72 children per 10,000 births (Fombonne, 2005). Recent estimates have suggested that the incidence of autism is increasing and that it may occur in 1 out of every 150 births. Some researchers have maintained that this apparent increase is an artifact, related to the emergence of clearer diagnostic criteria, better assessment instruments, and greater professional and parent awareness. Other individuals have asserted, however, that the increase is real and related to factors such as immunization procedures and increases in environmental toxins in the earth, air, and water (Whitman, 2004, pp. 43–45).

From a demographic perspective, it is known that autism occurs more frequently in males than females, with a ratio of somewhere between 3:1 and 4:1; however, autism in females is generally associated with greater developmental delays than in males. Furthermore, research suggests no difference in incidence in autism across social classes; however, it may be diagnosed more frequently in higher socioeconomic status individuals because parents are more proactive in seeking out services for their children when developmental problems occur (Fombonne, 2005).

At present, there is no known medical cure for autism. However, there is evidence that some medications may be used to control specific autistic or comorbid symptoms. Moreover, research has repeatedly shown the importance of early educational interventions that are individualized and intensive in nature. A range of studies have suggested that, when begun early, such interventions can have a dramatic effect on the trajectory of this disorder, with individuals occasionally achieving developmental levels approximating those of neurotypical individuals (Whitman, 2004, pp. 176–232).

In this chapter, we will describe current theory and research focusing on symptoms/processes diagnostically associated with autism and other features that commonly co-occur with this disorder. These symptoms/processes include arousal/emotion, sensory, motor, cognitive, social, language/communication, and restricted, repetitive, and stereotyped behaviors. Although a variety of theories have been proposed to explain autism, these theories have tended to be static and unidimensional, often focusing on one process that is purported to be defective, while ignoring other potentially important emergent processes. In contrast, in this chapter, a comprehensive and developmental theory of autism is proposed, describing different ways that the various characteristics of autism may be dynamically interrelated. After presenting this theory, past research and theory relating to specific symptoms associated with autism are described, with a special emphasis placed on examining how these symptoms may influence one another. At the end of the chapter, we discuss future research directions along with research
methodologies that can be employed to evaluate the structure of complex systems and how they change over time.

2. **Toward a Developmental Theory of Autism**

Despite the increasing theoretical and empirical attention being given to the study of autism, there remains a considerable difference of opinion about how this disorder develops. Theory formulation is particularly difficult because of the number and heterogeneous nature of the symptoms associated with autism. Both theory and research have typically focused on only one or two of the characteristics of autism, most commonly a particular cognitive, or social process. At present, however, it is not clear which symptoms of autism are primary, that is, critical components of a process leading to other symptoms. In this section, a broader and more dynamic theoretical perspective regarding its origins is presented that considers not only symptoms diagnostically associated with autism but also other characteristics commonly connected to this disorder.

We believe that a comprehensive theory of autism should

- Describe the processes underlying both its initial emergence and later development.
- Account for the considerable individual differences in persons labeled autistic. Ideally, a comprehensive theory should provide insights not only into the reasons for differences in individuals diagnosed with autistic disorder but also differences between individuals with this diagnosis and other individuals on the autism spectrum, including AS and PDD-NOS. From a theoretical perspective, it is reasonable to assume that different causal pathways may be needed to explain these individual differences.
- View autism as emerging through an interaction of a variety of individual processes, with the pattern of relations between and among these processes likely changing over time. To study these changing patterns, longitudinal designs need to be employed. As Smith and Thelen (1993) have pointed out, emergent behaviors show patterns over time that are not contained in any of their components when evaluated in a cross-sectional fashion.
- Make sense at both a biological and a psycho-behavioral level. It is assumed at one level that autism is a genetic disorder that affects development and functioning at an anatomical and neurophysiological level, and, in turn, behavior. Conversely, biological development is affected by behavior development and both types of development are influenced by environmental factors. Biological and/or environmental stressors may change the microstructure of the brain, resulting in impaired sensitivity and a cascade of events that lead to a cycle of increasing impairments at both a biological and a behavioral level.
Constructing a theory that incorporates the aforementioned characteristics is a demanding task. The theory, presented in Fig. 1.1, represents one approximation of how it might be constructed. This theory postulates that a number of factors need to be considered in order to understand the development of autism in its diverse manifestations. Three of the constructs in the theory relate to symptoms/processes referred to in the DSM-IV (American Psychiatric Association, 2000) definition of autism—social interaction deficiencies, communication/language deficiencies, and repetitive, restricted, and stereotyped responses. Four other constructs in the theory consist of symptoms/processes—arousal/emotion, sensory, motor, and cognitive—that are not a formal part of this definition.

The self-regulatory construct in Fig. 1.1 refers to the processes employed by individuals with autism to cope with their environment. The stereotyped, restrictive, and repetitive behaviors displayed by individuals with autism are reflective of a poorly developed self-regulatory system that evolves because more sophisticated forms of self-regulation are not learned. The six processes, depicted to the left of the self-regulatory construct in Fig. 1.1, are hypothesized to influence the development of the self-regulatory system, which in turn influences in a reciprocal fashion the development of these other processes. More specifically, as Whitman (2004) has suggested, their unique self-regulatory style is shaped by their cognitive, language, and social deficiencies as well as their emotional, sensory, and motor problems.

Effective self-regulation requires an optimal level of arousal, with both hyperarousal and hypoarousal associated with diminished functioning. The sensory system is critical for self-regulation because it provides information to the individuals about the environment and their behavior. The motor

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**Figure 1.1** A developmental theory of autism: The role of arousal/activation, sensory, motor, cognitive, language/communication, and social interaction processes in the emergence of self-regulation.
system enables individuals to engage in rudimentary self-regulation acts when distressed, such as sucking and cuddling, as well as provides a structural foundation for the development of more complex, cognitive, linguistic, and social forms of self-regulation. The cognitive, language, and social interaction systems provide individuals the advanced tools (e.g., executive functioning, self-instruction, and information-seeking) that they need to strategically guide their behavior. Because each of these systems is frequently compromised in children with autism, an immature self-regulatory system emerges. This immature self-regulatory system is not only influenced by the emotional, sensorimotor, cognitive, language, and social processes but in turn also influences these processes, with self-regulation deficiencies resulting in problems and deficiencies in motor planning, rule-governed behavior, problem solving, self-monitoring, following social protocols and emotion management.

All of the theoretical constructs in Fig. 1.1 can be considered, either directly or indirectly, as “causes” that exert influence across time on the other constructs; thus, constituting a complex chain of “causality” that results in the emergence of the symptoms of autism. The theory assumes that the characteristics referred to in the seven constructs change over time and, thus, the system as a whole is in a constant state of reorganization. Moreover, all of the constructs can be considered at either a psychobehavioral or a neurobiological level. The theory, therefore, can be considered, at least implicitly, as psychobiological in nature.

Although all of the processes referred to in the theory described in Fig. 1.1 exert influence, either directly or indirectly, on the other processes, the three processes on the left side of Fig. 1.1 (arousal/activation/emotion, sensory, and motor processes) mature earlier developmentally than the other processes (cognition, language/communication, and social interaction) and for that reason may play a particularly critical role during the initial stages of emergence of autism. For example, children with autism appear to be especially vulnerable to stress because their early environment is chaotic and challenging. If early stress is not managed, the development of their sensory and motor as well as their cognitive, language, and social interaction systems is likely placed at risk for delays. Such delays in turn make it difficult for individuals with autism to develop more mature forms of regulating their emotions and behaviors and to engage in independent, intentional, and goal-directed action (Ruble, 2001). Similarly, the theory also suggests that individuals who have early motor or sensory problems may have a different trajectory of cognitive, language, and social development than individuals without these early problems (see Fig. 1.1). Thus, the theory allows for the possibility that these early occurring processes may play a major role in the development of different symptom patterns for some children on the autism spectrum, with the role of these early emerging processes diminishing as the cognitive and communication systems mature.
The theory presented in Fig. 1.1 is likely to be refined and perhaps even radically modified by future research. A major advantage of this theory is, however, that it does not exclude potentially important processes and interactions among the processes that may be important for understanding how autism unfolds. In Section 3, research and theory examining each of the characteristics/constructs outlined in this theory and their possible interrelationships are described.

3. Characteristics Associated with Autism

Whereas researchers have actively studied the social, cognitive, and language/communication features associated with autism, less attention has been given to the investigation of other processes, specifically affective, sensory, and motor, that may play a dynamic role in the early development of this disorder. For this reason, these latter processes are discussed first in this section. After examining each of the aforementioned features of autism, self-regulation processes in children with autism will be described along with their connections to stereotyped and restrictive behavior patterns. We begin by examining arousal/activation and emotion processes in autism.

3.1. Arousal/activation and emotion processes

There has been considerable discussion about the emotional life of individuals with autism; however, much of the literature in this area is descriptive in nature. A number of clinical studies have indicated that children and adults on the autism spectrum are at great risk for mood and anxiety disorders (Bradley, Summers, Wood, & Bryson, 2004; Ghaziuddin, Ghaziuddin, & Greden, 2002; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Muffs, Steeneman, Merckelbach, Holdrinet, & Meesters, 1998). For example, Muffs et al. (1998) found in their study that 84% of individuals with a PDD met the full criteria for an anxiety disorder. Other research has pointed to the problems individuals with autism have in emotion expression, emotion recognition, and emotion interpretation (Hobson, 2005). Although there is evidence that older children and adults with autism may be at greater risk for certain types of emotional problems, little is known about early affective processes in young children with autism or how they influence development in other domains.

In order to function effectively, a calm-alert state is necessary. Paris (2000) suggested that children with autism demonstrate levels of arousal that tend to the extremes, either lower than desirable or so high that decompensation results. Reviewing evidence from experimental studies
on children with autism, Toichi and Kamio (2003) pointed out that there is support for both a hypoarousal and a hyperarousal hypothesis, either of which they speculate could result from an impairment in the reticular activating system. Hypoarousal is frequently connected with lethargy, indifference, and sleep, whereas hyperarousal is associated with intense, often uncomfortable feelings, avoidance, or immobility (Dunn, 1997).

Related research examining temperament in children with autism has found that they show greater variability in affect regulation, less effective affect-regulation strategies, poorer inhibitory control, and difficulties in being soothed (Konstantareas & Stewart, 2006). They have also been reported to be less adaptable and require more intense stimulation from the environment in order to respond (Hepburn & Stone, 2006). Research by Shalom et al. (2006) suggests that children with autism are not impaired in their emotional response at a physiological level but rather in the manner in which they interpret, express, and react to the emotions they are experiencing at a physiological level.

Problems in the arousal/activation and affect-regulation system have been theorized to have a major influence on both the early and the later development of the sensory, motor, cognitive, language, social, and self-regulatory systems. At a sensory level, children with autism who are experiencing a high state of arousal might be expected to show a pattern of hypersensitivity, particularly in environments that are changing, novel, and/or more intense. In contrast to more typically developing children, they would be expected to show slower habituation responses to sensory input. Conversely, problems of hyposensitivity and the absence of an orienting response toward stimulus inputs, such as pain, hot, and/or cold, could be explained by a state of low arousal (Whitman, 2004, pp. 61–63).

Paris (2000) suggested that a state of hyperarousal could also explain many of the motor symptoms associated with autism, including muscular tension and problems related to the development of gross and fine motor skills, coordination, balance, and motor planning. Hyperarousal would also be expected to be associated with hyperactivity, behavioral disorganization, and avoidance. In contrast, low arousal would be compatible with a state of low muscle tone, lethargy, and inactivity.

Cognitively, individuals with autism in a state of hyperarousal would likely be distractible and impulsive, as a result of problems in attentional focusing, attention-span, changing attentional focus, and information processing as well as in short-term and long-term memory (Dawson & Levy, 1989). As a consequence, learning would be slower and more complex cognitive and metacognitive processes, such as abstract thinking, problem solving, executive functioning, social comprehension, self-monitoring, and self-understanding, would show particularly adverse effects. Although the process would be somewhat different, low arousal would likely lead to a similar pattern of problems due to inattention rather than distractibility.

Increasingly, arousal science perspective as in Wolfe (2004). Gardner's infant, maladaptive a organization in perinatal aroused infants to prefer that, under conditions permanently establishes brain, thus having a d preference for noncor similarity to the attenti children with autism w.
Increasingly, arousal and cognition are viewed from a cognitive neuroscience perspective as intricately bound developmental processes (Bell & Wolfe, 2004). Gardner and Karmel (1983) suggested that during early infancy, maladaptive arousal patterns may alter central nervous system organization in permanent ways. In discussing research that showed highly aroused infants to prefer less complex and informative stimuli, they pointed out that, under conditions of prolonged stress, such preferences may be permanently established as functional and structural connections in the brain, thus having a detrimental effect on cognitive development. This preference for noncomplexity displayed by distressed infants bears close similarity to the attention fixations and stereotyped routines engaged in by children with autism who are under stress.

In an intriguing proposal, Baron-Cohen, Ring et al. (2000) suggested that autism may be caused by a defect in the amygdala. The amygdala, which is interconnected with many regions of the brain, including the limbic system and the neocortex, receives many types of sensory input and plays a critical role in attentional behavior, threat detection, fear, and flight or flight responses. Baron-Cohen, Ring et al. (2000) presented evidence indicating that amygdala activity is abnormal in people with autism and may be related to their deficits in social intelligence. Moreover, a variety of studies, both human and animal, have suggested that a pathological amygdala contributes to abnormal fears and anxiety and may be related to social-cognitive deficits, including problems in facial identity and interpreting facial expressions (Amaral, Bauman, & Schumann, 2003; Schultz, 2005), as well as higher levels of repetitive/restricted behaviors (Dziobek, Fleck, Rogers, Wolf, & Convit, 2006).

Schultze (2005) pointed out that early problems involving the amygdala have a cascading effect on the development of cortical areas that mediate social perception and the acquisition of social knowledge. Ledoux (1998) suggested that information about external stimuli reaches the amygdala by two pathways, directly from the sensory thalamus (the low road) and also from the sensory thalamus to the sensory cortex to the amygdala (the high road). What Ledoux’s characterization perhaps implies, but does not include, is a feedback loopback from amygdala to the sensory cortex (Ledoux, 1998). If the amygdala is defective in individuals with autism, as Brothers (1990) and Baron-Cohen, Ring et al. (2000) indicated, it is likely that all these pathways will not function normally.

Teichner (2002) suggested that early stress and dysfunctions in the limbic system can lead to abnormalities in the left hemisphere, and reduced integration between right- and left-hemisphere processes and possibly a shift from left- to right-dominated states, resulting in problems in emotion perceptions. Although Teichner’s research focused on individuals with a history of abuse, it is plausible to assume that similar effects might be produced by other types of trauma, including the early social and physical
stressors that lead children with autism, who are already biologically compromised, to display intense fear reactions, social avoidance, and social withdrawal.

Because the limbic system is implicated in emotional functioning and influences the functions of the hypothalamus and the pituitary gland, a variety of research has examined hormones associated with these organs. Research with typically developing children has indicated that hypothalamic-pituitary-adrenal (HPA) reactivity to stress is adaptive in this population. For example, Blair, Granger, and Razza (2005) found a positive relation between HPA reactivity and measures of executive function and self-regulation. In a study by Curin, Terzić, Petović, Zekan, Terzić, and Šušnjara (2003), children with autism were found to have significantly lower serum concentrations of cortisol and higher concentrations of adrenocorticotropic hormone compared to control age- and sex-matched subjects, thus indicating a possible dysfunction in the HPA axis in individuals with autism, which might in turn lead to a disruption at a cortical level and cognitive problems.

The relationship between arousal and emotion processes in individuals with autism and performance in perceptual and cognitive task situations is just beginning to be examined. For example, Schwartz et al. (2005) found that error rate on a speeded reaction task requiring subjects to make a discrimination was directly related to self-reported anxiety in high-functioning individuals with autism. In an intriguing study by Toichi and Kamio (2003), autonomic responses to mental tasks requiring attention were examined in adolescents with autism and age- and ability-matched controls. Autonomic function was evaluated using an index of heart rate variability. Whereas the control group showed a significant decrease in parasympathetic function during mental tasks, the group with autism showed no significant change, suggesting perhaps that they were not orienting toward the task. In contrast, some individuals with autism appeared more emotionally aroused in a resting condition than in the mental task condition, possibly indicating that the lack of structure or the complexity and unpredictability of this condition was more stressful for them.

Arousal/activation and emotion processes may also play a critical role in the development of the language/communication system in individuals with autism. Language development is likely influenced through the impact that hyperarousal and hypoarousal have on language acquisition and communication processes, such as those which are a part of the cognitive (e.g., attention and monitoring) and motor (speech) systems. Bloom (1993) linked affective expression with the development of language. She pointed out that emotional expression competes with language learning for an infant's attention, and suggested that a neutral emotional state allows infants to use their limited cognitive resources for early language learning.

Her research indicates that neutral emotional states are associated with multiword speech, e.g., (Bloom & Capatide, 1993) while intense and unregulated early delays in language development are associated with hyperarousal. Paris (2005) conducted a study with autism results are consistent with the hypothesis that autism is a disorder of attention and a dysfunction in joint attention recognition, and it is a possible reason why individuals with autism have a higher degree of anxiety.

Further insight into the role of emotion and language development is provided by a study by J. (2005), which showed that children with autism have a higher degree of anxiety. Physiological responses to faces, reduced anxiety for faces, and increased inhibition of processing. In turn, they tend to use less joint attention making, and less social interaction. Results of a correlational analysis between autistic and non-autistic control participants indicate that higher levels of anxiety are associated with joint attention making, and less social interaction.
Her research indicated that one-year-old infants who spent more time in neutral emotional states achieve language milestones, such as first words and multiword speech, earlier than infants who are more emotionally expressive (Bloom & Capafides, 1987). If infants with autism are experiencing more intense and unregulated emotions, this could explain at least in part their early delays in language development.

Social development is also likely affected by states of hyperarousal and hypoarousal. Paris (2000) suggested that because the level of arousal of individuals with autism is less than optimal, their ability to learn and perform in social situations will be adversely affected. This impact on social learning and performance is likely mediated in part through the attentional problems that result from overarousal and/or underarousal, with inattention or selective attention leading to problems in encoding, processing, and recalling social information. Children who are extremely anxious are less likely to be aware of their social environment, less strategic in their social decision-making, and less able to carry through an orderly plan of social action. Results of a correlational study by Bellini (2004) indicated that adolescents diagnosed with autism, AS, and PDD-NOS were more likely to report higher levels of anxiety than would be expected in a general population; in turn higher anxiety was associated with lower social assertion.

Further insight into how emotional arousal might affect social functioning is provided by research examining face processing in children with autism. A variety of studies indicate that individuals with autism demonstrate marked abnormalities, compared to non-autism spectrum disorder (non-ASD) controls, in the processing of faces, including reduced attention to faces, reduced attention to eyes, increased focus on mouths, poor memory for faces, and impaired recognition of familiar faces. More generally, they tend to use a feature-based rather than a configural approach to processing. In turn, this mode of facial processing has been purported to be associated with a variety of social and communication problems, including joint attention deficiencies, reduced social imitation, poor emotion recognition, and lower social-referencing (Sasson, 2006). The amygdala hypothesis of autism proposed by Baron-Cohen, Ring et al. (2000) suggests a relation between threat detection and social functioning as well as a possible reason why facial processing in individuals is impaired. Indirect support for this hypothesis is provided by recent research.

In a study by Joseph, Ehrman, McNally, Keehn, and Tager-Flusberg (2005), two groups of children (with and without autism) viewed faces on a computer. Children were asked to look at the faces and remember them. Physiological reactivity to the faces was measured, using skin conductance as a measure of autonomic arousal. Children with autism performed as well as control participants when face recognition depended on differences in the mouth region, but not when face recognition depended on differences in
the eye region. Children with autism exhibited increased arousal to faces with eyes fixed in a direct gaze (in contrast to eyes gaze-averted to one side); in turn, arousal was inversely related to their face-recognition accuracy. In contrast, there was no association between face-recognition performance and autonomic reactivity in the control group. Thus, it appeared that faces with eyes focused directly increased arousal in children with autism which in turn inhibited face recognition. Similarly, Kyliläinen and Hietanen (2006) found that physiological arousal responses to straight gaze responses were stronger than responses to averted gaze in children with autism. In a related study of individuals with autism, Dalton et al. (2005) found that variation in gaze fixation was strongly and positively associated with amygdala activation, again suggesting that gaze fixation is associated with heightened emotional arousal in autism.

In summary, the majority of the research on affective processes in individuals on the autism spectrum has been directed to the study of emotional problems occurring in later childhood and adulthood. Considerably less is known about the affective states of young children with autism or how emotional reactivity and arousal affect functioning in other domains during this period. Research with younger age groups could prove to be extremely important because of the possibility that arousal processes may play a formative role in the psychological, behavioral, and neurological development of children with autism.

3.2. Sensory processing

Although formal definitions of autism do not include sensory processing problems as a key defining characteristic of this disorder, the presence of sensory disturbances in children with autism has been widely acknowledged (Baranek, Parham, & Bodfish, 2005). Individuals with autism appear to experience the sensory world at the extremes, showing either hypersensitivity or hyposensitivity. Sensory problems have often been reported in terms of a specific modality; however, problems in one sensory modality may influence functioning in other sensory modalities, thus creating sensory integration problems (Anzalone & Williamson, 2000). Other sensory problems associated with autism include sensory distortions, sensory overload, and synesthesia. (Baranek et al., 2005; Harrison & Hare, 2004).

Gillberg and Coleman (1992) suggested that abnormal sensory responses to stimuli may constitute the most characteristic symptom of autism not currently contained in the diagnostic criteria for this disorder. O’Neill and Jones (1997), reviewing evidence from clinical and empirical studies, indicated that unusual sensory responses are present in the majority of children with autism during early development and are linked to other aspects of autistic behavior. Existing research has also indicated that sensory symptoms are not unique features of autism but are also associated with other clinical diagnoses (Baranek et al., Wehner, 2003).

Baranek et al. (2005) suggested that sensory features exist at a young age, but often decrease as the child grows older. However, some children with autism continue to exhibit unusual sensory responses throughout childhood. Disorganization might arise from an inability to focus on incoming stimuli, and/or a failure to attend to stimuli. These problems are associated with difficulties in everyday functioning and may elicit a fight or flight response. Dunn (1984) has suggested that hyperreactivity results in a heightened emotional response, whereas hyposensitivity results in behavioral lethargy and withdrawal.

The influence of sensory processing has been studied extensively in processing tactile input (e.g., impaired grasping, hand control), motor control (e.g., oral motor control, articulation problems), and auditory processing (e.g., speech). Children with autism are less reactive than typically developing children, but more reactive than children with other clinical diagnoses.
Baranek et al. (2005) summarized evidence suggesting that unusual sensory features exist at a young age in children with autism, including during infancy, but often decrease over time. Given the fact that sensory symptoms appear to occur early, an argument can be made that sensory symptoms may play an important role in the early stages of development of autism. Support for this position is provided by Rogers et al. (2003) who found that sensory symptoms were significantly related to overall adaptive behavior. Little is known, however, about the etiology and development of sensory problems in children with autism or their possible relationships to the sequelae and symptoms associated with autism. Despite the fact that little research has investigated these questions, there has been considerable theoretical speculation about interprocess relationships.

Ornitz (1983) suggested that the behavior of children with autism becomes disorganized because of their inability to modulate sensory input. Disorganization might occur for a variety of reasons, including an inability to focus on incoming stimuli, a failure to filter out irrelevant aspects of the stimuli, and/or a failure to process completely information contained in the stimuli. These problems may in turn produce disruptions at an emotional level that further inhibit effective sensory processing, and even perhaps elicit a fight or flight response, thus preventing coordinated and strategic action. Dunn (1997) pointed out that for some children hypersensitivity results in a high level of arousal and activity; for other children, however, hypersensitivity results in sensory overload and an ensuing behavioral lethargy and flatness of affect.

The influence of sensory problems on the motor system may also be far-reaching and profound. For example, Paris (2000) suggested that problems in processing tactile information can result in impairments in gross motor control (e.g., impaired balance reactions, postural insecurity, and motor clumsiness), hand control (e.g., impairments in grasp and manipulation skills), oral motor control (e.g., decreased isolated tongue movements and articulation problems), physical problems, such as shortening of the hand, as well as general disruptions in motor development (e.g., feeding, walking, and speech). Research by Gepner and Mestre (2002) indicated that children with autism are less reactive posturally to visually perceived environmental motion than typically developing children, and that hyporeactivity to such visual input is associated with motor impairments. This type of relation between the visual and motor sensory system may account for the delays some children with autism experience in achieving major motor milestones, as well as motor problems such as rigid gait and writing problems.

Sensory problems also seem to influence cognitive, language, and social development. Cognitively, hypersensitive children often appear distractible or narrowly focused on one aspect of their environment. In contrast,
hyposensitivity, which can be viewed as an attempt on the part of children to deal with the problem of overstimulation by shutting out a physical and social world that is too intense and chaotic, has been associated with low levels of attention to incoming stimuli. Huebner (2001) suggested that sensory problems adversely affect social and language development through their impact on arousal, motor, and cognitive learning processes.

Available information indicates that the sensory problems of children with autism may be secondary to their problems in other areas, such as in the arousal/activation or self-regulatory systems, rather than due to basic defects in the sensory system. In particular, there is no compelling evidence that their sensory problems are related to problems in the peripheral sensory structures; however, there are reports in the literature of children with autism having different types of visual and hearing difficulties (Baranek et al., 2005; Carmody, Kaplan, & Gaydos, 2001; Klin, 1993; Rosenhall, Nordin, Sandstrom, Ahlsen, & Gilberg, 1999).

### 3.3. Motor characteristics

Motor problems have been mentioned as one of the key characteristics of individuals with AS. For example, Gillberg (1989) found that 83% of the individuals with this disorder have relatively poor motor skills; in particular, he noted that they were generally clumsy and had an awkward way of walking that has been described as rapid and arrhythmic. Other motor problems that have been noted include: difficulties in throwing and catching a ball, problems with balance, and a lack of manual dexterity (e.g., difficulties in tying shoelaces, and handwriting) (Attwood, 1998).

Whereas motor problems are viewed as an important feature of AS, children with autism have sometimes been portrayed as displaying normal motor development and even possessing special competencies in this domain. However, a variety of research challenges this perspective and suggests that children with autism may have at least as high of incidence of motor problems as children with AS (Jansiewicz et al., 2006; Manjiviona & Prior, 1995; Rinehardt, Bradshaw, Brereton, & Tonge, 2001).

In a review of research, Smith (2004) evaluated the claim that motor problems are characteristics of specific subgroups within the autism spectrum. Examining motor skills in individuals with high-functioning autism (HFA) and AS, she concluded that an AS-HFA distinction does not hold up in the motor domain. It is still possible that motor abilities may vary across other portions of the autism spectrum, for example, between individuals with HFA and lower functioning autism. Support for such a relationship is provided by Baranek et al. (2005) who summarized evidence suggesting that individuals who are more cognitively advantaged are more motorically competent than less cognitively advantaged individuals.

Although motor pr problems with ASDs, they are closely related to a variety of other developmental delays, including attention deficit disorders, and increasing evidence suggests that there is a distinctively associated with mental retardation. From a developmental perspective, these problems are often displayed early in life and may serve as an adaptive mechanism for disordered motor development. The availability of nonverbal and nonverbal communication is crucial for the development of social and language skills. In contrast, involuntary movements may serve as an adaptive mechanism in the motor domain, particularly in cases of mental retardation. Research suggests that children with autism may have at least as high of incidence of motor problems as children with AS (Jansiewicz et al., 2006; Manjiviona & Prior, 1995; Rinehardt, Bradshaw, Brereton, & Tonge, 2001).
Although motor problems frequently have been observed in populations with ASDs, they are certainly not unique to these disorders. Children with a variety of other developmental disorders, such as mental retardation and attention deficit disorder, also exhibit an array of motor symptoms. There is, however, increasing evidence that there may be specific motor difficulties distinctively associated with autism, including imitation deficits (Baranek et al., 2005; Williams, Whiten, & Singh, 2004). Imitation deficits and their relationship to other processes will be discussed at length in Section 3.5.3.

From a developmental perspective, parents, clinicians, and researchers have noted that infants and toddlers, later diagnosed with autism, often display early problems in self-feeding, dressing, and general manual dexterity, as well as delays in meeting the major motor milestones (Teitelbaum, Teitelbaum, Nye, Iwama, & Mauer, 1998). Results of a study by Baranek (1999) are intriguing in that they suggest that motor as well as sensory problems are present in children with autism when they are 9–12 months old, and that these symptoms might be used, in conjunction with social deficiencies, to distinguish children with autism from typically developing children.

Motor symptoms can be conceptualized as falling into two categories, voluntary and involuntary. Voluntary motor behaviors involve a cognitive component (praxis) that involves understanding/visualizing what needs to be done, planning to execute, and then actually executing an action. In contrast, involuntary motor behaviors are nonintentional, but nevertheless may serve an adaptive function. Although little is known about the developmental course of involuntary movement problems in children with ASD, there is evidence that they are negatively related to IQ and comorbid with mental retardation (Baranek et al., 2005).

Reviewing research on voluntary movements, Baranek et al. (2005) suggested that children with autism have particular problems on nonrepetitive gross and fine motor tasks that involve complex and novel features. They indicated, however, little is known about the specific processes that influence these types of performance. It is not clear whether the early occurring motor problems that are associated with autism are a function of defects in the motor system, the arousal/activation system, the sensory system, or a combination of these and other defects. For example, it is possible that during infancy early stress and associated sensory problems lead to disorganized motor behavior. In turn, the motor problems may restrict the availability of motor coping resources available for dealing with stress, which then further exacerbates the infant’s emotional and sensory problems (Als, 1982).

Although the relations among motor functioning and cognitive functioning, speech acquisition, socioemotional development as well as stereotyped behavior have been of interest to autism researchers, the importance of these relations is only beginning to be appreciated (Baranek et al., 2005).
Motor development has been proposed as playing a critical early role in the development of the cognitive system (Piaget, 1970). From a sensory and cognitive perspective, a more motorically advanced child not only comes into contact with more of the environment but is also able to explore more fully and competently that environment through active manipulation. Children’s perception of the world changes dramatically as locomotion increases (Smith & Thelen, 1993). The motor system also likely plays a critical role in social development, through its influence on the acquisition of motorically based communication skills and social behaviors. Delays in the motor arena not only hamper social interaction but also mark children as different, sometimes stigmatizing them.

Most of the aforementioned relationships between motor development and functioning in other domains have not yet been systematically examined in populations with autism. Some research has suggested that motor dysfunction in autism is related to motor-planning problems including dyspraxia (Rinchardt et al., 2001). Motor planning is a process which requires conscious attention and effort (Paris, 2000). Dyspraxia, a common problem in children with autism, refers to difficulties in formulating a goal, figuring out how to accomplish a goal, and executing an action, steps that obviously have a strong cognitive as well as a motor component. Children with dyspraxia find it difficult to learn new tasks (Huebner, 2001).

3.4. Cognitive characteristics

The range of cognitive deficiencies that have been associated with autism is considerable. For example, theory and research have suggested that individuals with autism display deficits in attention, executive functioning, and theory of mind processes. In this section, these processes are discussed along with how they are related to each other and functioning in other domains.

3.4.1. Attention and information-processing difficulties

It is quite common for persons with autism to have attention difficulties, with estimates of this type of problem being as high as 64% (Tsai, 1998). Deficiencies in attention have been linked to later language problems and language competence (Im-Belter, Johnson, & Pascual-Leone, 2006), difficulties in understanding the state of mind of other people, thus in turn possibly explaining why individuals with autism have difficulties in social as well as educational situations (Phillips, Baron-Cohen, & Rutter, 1992; Uvland & Smith, 1996).

Speculations regarding the precise nature of the attention problems of children with autism suggest a range of potential deficits, including an inability to orient to a stimulus, to sustain attention to a stimulus, and to shift attention from one stimulus to another. Research has suggested, however, that many of the aforementioned attention characteristics are not necessarily reflective of autism can and do attend (Adams, & Klinger, 1997). Stimulus overselectivity in limited subset of stimuli toward overselectivity may in inappropriate behavior in.

The challenge faced by that produce attentional problems as responsible. One explanation evolve as a way of resolving these that are overdemanding, attention characteristics, look at objects using peripersonal attention with other people, explanation for the attention they have difficulty perceiving “complicated” stimulus paths to stimuli that are simpler in have also suggested that they may improve attention to direct their actions, pa information that must be in.

Frith and Happé (1994) have abnormality in information processing or what they refer to as weak central co aspects of a task or an environment rather than on the task/environmental details of the task into a for this theoretical position research has emphasized the processing complex material performance.

For example, Gross (2007 information processing and autism made fewer global reemotions than children wid esting, given a finding by Ba they found that positive mood and inversely related to a low stimuli in the Gross study el autism, leading them to pro A study by Hill, Berthoz, an
not necessarily reflective of a basic underlying defect and that children with autism can and do attend appropriately in certain situations (Mesibov, Adams, & Klinger, 1997). Nevertheless, persons with ASDs often display stimulus overselectivity in which behavior/attention is controlled by a limited subset of stimuli within a complex stimulus array. This tendency toward overselectivity may inhibit learning in academic situations and result in inappropriate behavior in social situations.

The challenge faced by researchers is to understand the circumstances that produce attentional problems and what underlying mechanisms may be responsible. One explanation is that their unique attentional style may evolve as a way of regulating unpleasant emotions and dealing with situations that are overdemanding (Reed & Gibson, 2005). From this perspective, attention characteristics, such as eye-gaze avoidance, a tendency to look at objects using peripheral perception, and “unwillingness” to share attention with other people, can be viewed as coping mechanisms. Another explanation for the attentional problems of individuals with autism is that they have difficulty perceptually integrating or deriving meaning from “complicated” stimulus patterns; instead they restrict their focus and attend to stimuli that are simpler in nature (Mesibov et al., 1997). Some researchers have also suggested that children with autism have a problem using cues to direct their actions, particularly if the cues contain complex social information that must be interpreted (Leekam & Moore, 2001).

Frith and Happé (1994) hypothesized that persons with autism display an abnormality in information processing, more specifically a failure of holistic processing or what they referred to as “weak central coherence.” Individuals with weak central coherence tend to concentrate on one or a few aspects of a task or an environment, that is they process at a local level, rather than on the task/environment as a whole and fail to integrate the local details of the task into a global percept. Although research support for this theoretical position has been mixed (Jordan, 1999), a variety of research has emphasized the difficulties that individuals with autism have in processing complex material and how these difficulties influence social performance.

For example, Gross (2005) found a significant relation between global information processing and recognition of human emotions. Children with autism made fewer global responses and more errors in recognizing human emotions than children without autism. The results of this study are interesting, given a finding by Basso, Scheff, Ris, and Dember (1996), in which they found that positive mood was directly associated with global processing and inversely related to a local bias. It may be that the emotionally laden stimuli in the Gross study elicited a state of high arousal in the subjects with autism, leading them to process information at a local level (Gross, 2005). A study by Hill, Berthoz, and Frith (2004) suggests that individuals on the
autism spectrum also have more difficulty processing their own emotions. Moreover, Burnette et al. (2005) found relations between weak central coherence and theory of mind measures. The attention and information-processing style of individuals with autism could also explain some of their executive functioning deficiencies.

3.4.2. Executive function deficiency
A variety of research conducted on children with autism has suggested that they display an executive dysfunction (e.g., Halvorsen, Rasmussen, & Henderson, 2005; Goldberg et al., 2005). Russell (1997) referred to executive functioning as “a set of mental processes necessary for the control of action” (p. 258). Executive functioning involves processes such as planning, searching, strategy selection, impulse control, and attention-shifting, as well as working memory and monitoring, all processes that facilitate flexibility of thought and action. These processes are more conscious in nature, guided by knowledge, goals, ideas, plans, and scripts (Jordan, 1999).

Research has suggested that children with autism have a variety of problems because of a deficit in their executive control system. For example, Jarrold (1997) indicated that children with autism have problems with pretend play because of an executive dysfunction. Relatedly, Turner (1997) hypothesized that they engage in repetitive behaviors in play situations because they are unable to generate alternative ways of acting. Landa and Goldberg (2005) also suggested that executive functioning influences social functioning and language development, including the formulation and implementation of plans in social situations, shifting social behavior in response to changing contextual demands, and holding social information in mind during dynamic social exchanges. Empirical support for these hypothesized relations is weak to nonexistent, although little research has been focused in this direction (Joseph, McGrath, & Tager-Husberg, 2005; Landa & Goldberg, 2005). Similarly, the relation between executive functioning and the least studied autistic characteristics, restricted and repetitive symptoms, has been underinvestigated. However, Lopez, Lincoln, Ozonoff, and Lai (2005) found that three executive processes—cognitive flexibility, working memory, and response inhibition—were significantly related to this symptom category.

Ozonoff, South, and Provencal (2005) indicated that executive dysfunction may be secondary to and influenced by earlier emerging core symptoms, including lack of social awareness, imitation problems, and failure to use language to control thoughts and behavior. Russell (1997) speculated that the development of awareness in children with autism may be disrupted because of action-monitoring deficiencies, and that as a consequence they have problems such as developing a sense of agency or intentionality, obtaining knowledge regarding their own actions, imitating the actions of others, and regulating their actions through inner speech.

3.4.3. Social cognition
The area of social cognition processes are related to how persons come to understand the minds of others (e.g., beliefs and knowledge) (Baron-Cohen, Tager-Flusberg, & Wheelwright, 2005). Baron-Cohen et al. (2005) proposed that individuals with autism spectrum disorder have a mindblindness, or difficulty recognizing, understanding, and empathizing with others, as well as difficulty understanding how their own mental states are dynamically interrelated to the mental states of self and others. Whereas individuals with autism spectrum disorder have a difficulty with theory of mind, they are dynamically interrelated to the mental states of self and others.

Some researchers have suggested that children with autism have a mindblindness because of a deficit in their executive control system. For example, Jarrold (1997) indicated that children with autism have problems with pretend play because of an executive dysfunction. Relatedly, Turner (1997) hypothesized that they engage in repetitive behaviors in play situations because they are unable to generate alternative ways of acting. Landa and Goldberg (2005) also suggested that executive functioning influences social functioning and language development, including the formulation and implementation of plans in social situations, shifting social behavior in response to changing contextual demands, and holding social information in mind during dynamic social exchanges. Empirical support for these hypothesized relations is weak to nonexistent, although little research has been focused in this direction (Joseph, McGrath, & Tager-Husberg, 2005; Landa & Goldberg, 2005). Similarly, the relation between executive functioning and the least studied autistic characteristics, restricted and repetitive symptoms, has been underinvestigated. However, Lopez, Lincoln, Ozonoff, and Lai (2005) found that three executive processes—cognitive flexibility, working memory, and response inhibition—were significantly related to this symptom category.

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3.5. Social interaction
From a diagnostic perspective, autism is characterized by deficits in social interaction. Deficits in social interaction are often seen as the primary feature of autism, and are the hallmark of Autism Spectrum Disorder. People with autism may have difficulty understanding and responding to social cues, and may have difficulty engaging in social interactions. This can make it difficult for them to form relationships and to understand the social world around them.
3.4.3. Social cognition, theory of mind, and empathy

The area of social cognition involves the study of how a person’s thought processes are related to their social context. Research in this area has focused on how persons come to understand both their own thought processes as well as the thought processes of other people. Some researchers have proposed that individuals with autism have a primary deficit in understanding the minds of other people (mind-blindness) and how mental states (e.g., beliefs and knowledge) influence behavior in social situations (Baron-Cohen, Tager-Flusberg, & Cohen, 2000).

Baron-Cohen et al. (2005) hypothesized that mind-blindness and empathy are dynamically interrelated. Empathizing involves understanding the mental states of self and others and their relationships to behavior and emotions. Whereas individuals with autism often have difficulty expressing empathy, Baron-Cohen et al. (2005) suggested that they may have intact and even superior systematizing skills that allow them to understand, manipulate, and make predictions about the physical/nonsocial world. They also pointed out that a strong drive to systematize in individuals on the autism spectrum may be responsible for their repetitive, obsessional, and narrowly focused interests, as well as their special abilities, and in combination with their poor empathizing skills explain the mechanical ways they socially interact with others.

Some researchers have suggested that children with autism do not understand others’ minds because they do not know that they themselves have a mind, or if they do possess this general knowledge, they do not understand or appreciate the contents of their own mind; that is, they have a metacognitive deficit. Other theories and research have indicated a relation between theory of mind deficiencies and weak central coherence (Burnette et al., 2005). Russell (1997) hypothesized that executive-processing dysfunctions lead to theory of mind problems, although empirical support for this relation is mixed (Landa & Goldberg, 2005; Russell, Saltmarsh, & Hill, 1999). Still other theories focus on social processes to explain theory of mind problems. Peterson (2005) suggested that children with autism may be deprived of critical social experiences (e.g., play and conversation with others) that provide a forum for learning about the mental states of other people.

3.5. Social interaction deficiencies

From a diagnostic perspective, social deficits are considered a core characteristic of autism. Deficiencies in the social development of children with autism are not always easy to detect during infancy; however, they become increasingly apparent during the second year of life. Although children with autism often become attached to their parents, use gestures to make requests, and show turn-taking skills during play, they typically display
limitations in these as well as other areas of social interaction, especially in situations requiring joint attention, social initiation, and dynamic social reciprocity. For example, children with autism manifest a variety of difficulties in social situations, such as using adults as a social reference to interpret ambiguous social contacts, following social protocols, engaging in social play with peers, and developing friendships. Wing and Gould (1979) suggested that the social interaction styles of individuals with ASDs can be grouped into three types: (1) aloof, (2) passive, and (3) active, but odd. Like individuals with autistic disorder, individuals with AS show impaired social behavior despite their more normal language and intellectual development (Gillberg & Gillberg, 1989).

As indicated earlier, many theoretical perspectives have emphasized the major influence that the cognitive system and deficits in this system have on the social development of individuals with autism. A different perspective, referred to as enactive mind, shifts the focus from “disembodied cognition” to the interaction of the mind with the social environment and how experience changes the mind (Klin, Jones, Schultz, & Volkmar, 2005). Klin et al. (2005) pointed out that the affective and motivational predispositions that are brought by children with autism into social situations and that shape the social mind/brain are different from those of typically developing children.

Similarly, Hobson (1993, 2005) has viewed the difficulties that children with autism display in peer and adult interactions—including those relating to social gesturing, sharing experiences, joint attention, affect coordination, emotion perception and expression, imitation, attachment behavior, and self-development—as evidence of their broader difficulty in intersubjective engagement. As a consequence of this intersubjective difficulty, children with autism are constrained in their ability to acquire knowledge about other people’s mental and emotional states, their own selves, language, and communication.

3.5.1. Play

Research examining the social difficulties of children with autism has often used play as a forum. Play with others provides a social vehicle for exploration and learning and for the development of social, language/communicative, and cognitive skills. It is well established that children with autism are impaired in their play skills. Their play not only appears to be delayed but is also different in its level of complexity, frequency, social orientation, functionality, and symbolic nature (Rogers, Cook, & Mcryl, 2005). For example, children with autism have been found to be less socially engaged than typically developing children, as well as children with other developmental delays, because they less frequently initiate or accept requests for play (Rogers et al., 2005; Sigman & Ruskin, 1999).
Functional play skills, along with responsiveness to bids for attention and imitation of requesting behaviors, have been found to be early childhood predictors of gains in language skills in adolescents with autism (Sigman & McGovern, 2005). Conversely, it seems likely that a child's language skills also affect their play skills. Lewis (2003), however, has suggested that although there is general support for a play–language correlation in typically developing children, the nature of this relation in children with autism is likely more complex, specifically because children with autism show play deficits when compared to children who have a similar language ability, but do not have autism. The results of a study by Blanc, Adrien, Roux, and Barthélémy (2005) pointed out that both level of play and communication skills in children with autism are associated with their ability to self-regulate. The findings of Blanc et al. (2005) are consistent with the suggestion of Russell (1997) that the language of children with autism does not regulate as effectively their social behavior as that of typically developing children.

The social–cognitive perspective and research just described suggests that children with autism develop differently because of the predispositions they bring into social situations and that in turn their interactions in these social situations shape both their social–cognitive and language development. Two of these predispositions, joint attention and imitation, are briefly discussed here.

3.5.2. Joint attention
Joint attention involves both responding to the bids for attention by others and soliciting the attention of others. Mundy and Burnette (2005) propose that these skills are impaired in infants with autism and inhibit proper attention deployment, social information processing, and social learning, thus isolating them from the typical pattern of social exchange, resulting not only in social impairment but also in neurobehavioral disorganization and neurodevelopmental pathology.

Sigman and Ruskin (1999) found that children with autism have a deficit in joint attention compared to children with Down syndrome. Moreover, joint attention skills in this study predicted both concurrent language abilities and long-term gains in expressive language. Similarly, Bono, Daley, and Sigman (2004) found that better joint attention skills were associated with greater language development. Most interestingly, they also found that a relationship between amount of intervention and language development was conditional, depending upon the children's ability to respond to the bids for joint attention from others as well as their initial language skills. Relatedly, Whalen, Schreiber, and Ingersoll (2006) found that teaching joint attention skills to children with autism was related to improvement in social initiations, positive affect, imitation, play, and spontaneous speech.
3.5.3. Imitation

Like joint attention, imitation appears to be a key process that shapes learning during infancy and early childhood, influencing early motor development, play, social interaction, communication skills, and knowledge acquisition as well as socioemotional understanding. The difficulties children as well as adults with autism have in imitating the actions of others is well documented. Furthermore, imitation defects seem to be universal in this population. Although individuals with autism appear to manifest a general imitative deficit, their ability to imitate simple actions on objects seems less impaired than their imitation of body movements, such as oral-facial movements. Relatedly, imitation of body movements having social significance and/or involving sequential action is more difficult for them (Rogers et al., 2005).

Although imitation deficits are not unique to autism, given they also occur in individuals with a range of other developmental delays, this deficit seems to be greater in individuals with autism (Rogers, Bennett, McEvoy, & Pennington, 1996). In a meta-analysis of action imitation research in individuals with ASD, Williams et al. (2004) concluded that children with ASD show a marked and highly significant delay in normal imitative development, but not an absolute deficit.

Several different processes have been suggested to produce this imitation deficit, including representational and executive functioning deficits, motivational problems, sensory integration and motor problems, social interaction deficits, low verbal ability, dysphasic and action representation disorders, and deficits in self-other mapping (Rogers et al., 2005). At present, little is known about how imitation defects are related to delays in motor, social, cognitive, and language development or whether imitation in individuals with ASD is not only delayed but also develops in a deviant fashion. Intervention research has, however, established that imitative skills can be learned and generalized to novel environments. Moreover, an increase in reciprocal imitation skills in young children with autism has been associated with increases in social communicative behaviors, including language, pretend play, and joint attention (Ingersoll & Schreibman, 2006). In addition, imitation, along with joint attention and toy play, have been found to be early predictors of communication development in this age group (Toth, Munson, Meltzoff, & Dawson, 2006).

From a biological perspective, considerable attention has been given to mirror neurons and the role they play in imitation. Mirror neurons have been thought to be involved in both the perception and the comprehension of motor actions. Because deficits in each of these processes occur in individuals with ASD, there has been speculation that the mirror neuron system is dysfunctional in this population. Past research has indicated that when typically developing humans, as well as monkeys, watch an action performed by another, neurons fire in the prefrontal cortex. A representation of an object action, thus providing a higher-order process. From an early age (Galaburda & Goldman, 1998; Rizzolatti, Fogas actions can be related to the understanding and production of actions.

Although there is an action neuron system in infancy, beginning to be conducted on the brain, a neural system involves methodology. However, many with ASD showed a discrepancy between their own hand and the hand of another signiﬁcant interaction is maintained. Although there is a neural system in individuals with ASD, beginning to be conducted on the brain, a neural system involves methodology. However, many with ASD showed a discrepancy between their own hand and the hand of another significant interaction is maintained. Although there is a neural system in individuals with ASD, beginning to be conducted on the brain, a neural system involves methodology. However, many with ASD showed a discrepancy between their own hand and the hand of another significant interaction is maintained.
performed by another that is also in their own motor repertoire, mirror neurons fire in the prefrontal cortex. There is speculation that this pattern of firing of the mirror neurons means that they play a role in linking the visual representation of an observed action to the motor representation of that action, thus providing a foundation for the development of both lower- and higher-order processes, such as imitation, language, empathy, and theory of mind (Gallese & Goldman, 1998; Oberman et al., 2005; Rizzolatti & Arbib, 1998; Rizzolatti, Fogassi, & Gallese, 2002). Once another individual's actions can be related to one's own actions, then it is a short step to being able to understand and predict another's actions. Although there is an emerging interest in the functioning of the mirror neuron system in individuals with ASD, research in this area is only beginning to be conducted. One major tool for evaluating the mirror neuron system involves monitoring mu-neuron suppression. Using this methodology, Oberman et al. (2005) investigated whether individuals with ASD showed a dysfunction in the mirror neuron system when compared with age- and gender-matched control subjects. Whereas control subjects manifested significant mu-neuron suppression both while moving their own hand and observing hand movements, the ASD group showed significant mu-neuron suppression only to self-performed movements. The authors suggested that their results support the hypothesis that high-functioning individuals with ASD have a dysfunctional mirror system, specifically because they do not appear to recognize the similarity between actions performed by others and their own actions. The developmental implications of this finding for areas such as language have not yet been empirically explored.

3.6. Communication and language
Communication and language deficiencies are also a core diagnostic characteristic of autism. As Tager-Flusberg, Paul, and Lord (2005) have pointed out, there is considerable variation in the timing and patterns of language acquisition in children with autism. Estimates suggest that around 50% of them do not acquire speech as a primary mode of communication (Prizant, 1996). Early speech characteristics include echolalia, pronoun reversal, and peculiar word use. Once children with autism acquire speech, they manifest a variety of problems relating to articulation, syntax, morphology, prosody, and pragmatics. As a consequence, they have difficulty engaging in dynamic discourse with others and comprehending the intricacies of social communications. They also frequently display peculiar paralinguistic features relating to vocal quality, intonation, and stress patterns (Paul & Sutherland, 2005). Many of the aforementioned characteristics are also displayed by children with AS (Attwood, 1998; Gillberg & Gillberg, 1989).
The fact that children with autism have communication deficiencies is not surprising given their problems in preverbal communication (e.g., limited use of social gestures) and deficiencies in maintaining eye contact, social referencing, and imitation. Several core problems have been proposed as being responsible for the communicative deficits of children with autism including a failure to attend to speech, joint attention deficiencies, symbol use limitations, and emotion-regulation problems (Marans, Rubin, & Laurent, 2005; Paul & Sutherland, 2005; Tager-Flusberg et al., 2005; Wetherby & Prizant, 2005).

From a cognitive perspective, Tager-Flusberg (1996) hypothesized that children with autism seldom use language to share or seek information from others because they fail to understand that other people’s viewpoints are not the same as theirs; that is, they do not have a theory of mind. In contrast, Russell (1997) suggests that children with autism have difficulty both retaining and utilizing information to guide their social behavior because of an inability to use inner speech, a process that has been conceptualized as having its roots in social interaction. Some theorists emphasize that inner speech or self-verbalization is part of a developmental process in which the interpersonal nature of thought is transferred into an intrapersonal process, that is internalized (Lucia, 1961; Vygotsky, 1978). Because of the problems children with autism have in their interpersonal relationships, it seems likely that this internalization process will not proceed in a typical fashion and that the language and cognitive processes that assist them in self-regulating their behavior will not develop normally.

A more recent theory of language acquisition, espoused by Bloom and Tinker (2001), views the child as an active agent in her/his language development. Although their theory of language acquisition was not developed to explain language development in children with delays, their theory implies that to understand the language acquisition process in children with autism, the unusual cognitive, emotional, and social characteristics of this population would all need to be considered.

In contrast to this perspective, Prizant (1996) pointed out that there is increasing evidence that speech problems in individuals with autism may be caused by factors other than or in addition to their social-cognitive impairments. More specifically, he suggested that their general motor difficulties, including oral motor impairments and motor-planning problems, may be responsible for their speech and communication delays. Similarly, Murray-Slutsky (2000) indicated that effective speech and communication require that a child registers sensory information, formulates an idea, plans and sequences thoughts, and then speaks. She pointed out that this is the same process that occurs in motor planning and executing total body activities and hypothesized that motor planning and language share overlapping neural structures.

Research examining communication deficiencies and ited. Hale and Tager-Flusberg between discourse deficien measured by the Autism (2005) examined and ratings of social autisms. Prosody refers to of a speech signal such as study of young children were associated with social problems (Farrant, Fluc.t.

3.7. Repetitive, restricted

A self-regulator

In addition to the soci associated with autism, ther iistics, consisting of repetitive behaviors. Turner (this symptom category level behaviors in which behavior and repetitive complex responses (e.g., interests, and insistence tive behaviors also occur disorders such as ment. Research in the area of classes of repetitive beh. (Turner, 1999). It is cle: relatively high frequency.

South, Ozonoff, and repetitive behavior category and circumscribed inter than in typically develop also displayed a higher (object use and rigid to Symons, Parker, and Lore mental retardation had si stereotypy, and self-inju Most importantly, repeti:
Research examining the connections between language and communication deficiencies and other autistic symptomatology has been quite limited. Hale and Tager-Flusberg (2005) investigated and found a relationship between discourse deficits, specifically utterances that do not relate to a prior speaker’s utterance, and a broader range of autistic symptoms as measured by the Autism Diagnostic Observation Schedule. Paul et al. (2005) examined and found a connection between prosodic performance and ratings of social and communicative competence in individuals with autism. Prosody refers to those aspects of speech that modulate the meaning of a speech signal such as intonation, rate, pitch, rhythm, and timing. In a study of young children with language impairments, these impairments were associated with theory of both mind and visual perspective taking problems (Farrant, Fletcher, & Maybery, 2006).

3.7. Repetitive, restricted, and stereotyped behavior: A self-regulatory perspective

In addition to the social and communication/language deficiencies associated with autism, there is an intriguing third set of diagnostic characteristics, consisting of repetitive, restricted, and stereotyped interests, activities, and behaviors. Turner (1999) suggested that the broad range of behaviors in this symptom category can be subdivided into two subcategories: lower-level behaviors in which there is repetition of movement (e.g., stereotyped behavior and repetitive manipulation of object) and higher-level, more complex responses (e.g., object attachments, repetitive language, narrow interests, and insistence on maintaining sameness). Stereotyped and repetitive behaviors also occur in typically developing children as well as in other disorders such as mental retardation and obsessive compulsive disorder. Research in the area of autism has focused on whether there are certain classes of repetitive behavior that are unique to autism (Bodfish, Symons, Parker, & Lewis, 2000) as well as the relationship of repetitive behaviors to age and IQ. The answers to these questions are inconclusive and complex (Turner, 1999). It is clear, however, that individuals with autism display a relatively high frequency of repetitive and stereotyped behaviors.

South, Ozonoff, and McMahon (2005) found that the incidence of four repetitive behavior categories (object use, motor movements, rigid routines, and circumscribed interests) was more pronounced in persons with ASD than in typically developing individuals. Individuals with autistic disorder also displayed a higher incidence of certain types of repetitive behaviors (object use and rigid routines) than those with AS. Relatedly, Bodfish, Symons, Parker, and Lewis (2000) found that subjects with autism and mental retardation had significantly higher severity ratings for compulsions, stereotypy, and self-injury than individuals with only mental retardation. Most importantly, repetitive behavior severity predicted severity of autism.
in this study. This latter finding raises interesting questions about the inhibitory role that repetitive behaviors play in the cognitive and social development of children with autism.

There has also been considerable speculation about the origins of repetitive behavior that focus variously on operant learning, drive-reduction, sensory reinforcement, cognitive, and homeostatic explanations. In particular, there has been speculation about the role of arousal in repetitive and stereotyped behavior as well as other unusual responses in children with autism.

3.7.1. The role of arousal
One thing that differentiates children with autism from typically developing children is their difficulty, when they become upset, in regaining a sense of calmness, alertness, and focused attention. When children with autism are put in novel and complex situations, they often appear confused, helpless, and distractible; act in an impulsive and seemingly mindless fashion; and perseverate using ineffective strategies (Adrien et al., 1995).

Many of the unusual behaviors that children with autism display in new and challenging situations, such as stereotypy as well as hyperactivity, inattention, gaze aversion, restricted attentional focus, withdrawal, social aloofness, and physical escape, can be viewed as functional in the sense that they serve to reduce unpleasant states of high arousal (Dunn, 1997). A related explanation for such behaviors suggests that there is an optimal level of stimulation necessary for adaptive human functioning. In order to maintain homeostasis, individuals self-activate or seek stimulation when their level of arousal is low or conversely act to decrease stimulation when their overall level of arousal is high. From this perspective, behaviors such as stereotypy can be viewed as serving either a self-stimulatory function, directed at increasing stimulation, or a filtering mechanism, directed at reducing external stimulation. In explaining stereotyped behaviors, both the tension-reduction and homeostatic hypotheses suggest that although the external environment plays a role, the critical factor is not what is happening in the environment per se. Instead, it is what impact the environment has on the state of arousal/activation within the individual, with levels of arousal/activation mediating the effects that the external environment has on behavior.

3.7.2. The role of self-regulation
The aforementioned perspective suggests that the defect that produces stereotyped and repetitive behaviors in individuals with autism is a dysfunctional arousal/activation system. This hypothesis is generally consistent with the amygdala theory of autism discussed in an earlier section. In contrast, another hypothesis invokes a concept of an immature self-regulatory system to explain autistic behaviors, including stereotypy and repetitive behavior.
Self-regulation is considered to be an essential skill that lays a foundation for a child’s development. Self-regulation develops during early infancy, progressing from primitive attentional and motor responses that regulate arousal and sensory input, and gradually evolving into more complex capacities that direct cognitive activity and social interaction (Whitman, 2004). Although children come equipped with a few innate responses for controlling arousal, the development of self-regulation occurs in conjunction with and is closely related to a child’s overall development. Structurally, self-regulation is commonly conceptualized as involving cognitive as well as language and motor components. More specifically, self-regulation involves skills such as attention deployment, inhibitory processes, problem-solving skills, and more generally, executive functioning skills. Regulatory skills improve dramatically as language becomes more advanced. Self-regulation allows an individual to direct and share attention, process and store information in memory, retrieve information, and use it to guide responding. Brain development, particularly in the frontal lobes, support the child’s cognitive growth of processes, such as attention, working memory, metacognition, and executive functioning (Bronson, 2000).

Until recently, little research has been directed at studying the self-regulatory system of children with autism. Research by Gomez and Baird (2005) suggested that children with autism display difficulties in self-regulation during infancy; specifically, they were reported as having more self-regulatory problems at one year than children without disabilities, at a level that was consistent with a diagnosis of regulatory disorder. In a study of older children, at 8 and 10 years, Bieberich and Morgan (2004) found children with autism to have more self-regulation problems than children with Down syndrome. More specifically, children with autism showed greater deficits in measures of attention, flexibility, engagement, and goal directedness during play activity.

Although the infant-caregiver relationship is critical for the development of self-regulation in children without disabilities, this process in children with autism appears to be heavily influenced by their pattern of motor, cognitive, social, and language deficiencies and prolonged periods of distress. For example, Russell (1997) suggests that children with autism have difficulty using language/inner speech to direct their actions. Individuals with autism have also been characterized as not understanding their own capabilities and how they can be utilized in action situations (Whitman, 1990). As a consequence, they often perseverate in using ineffective strategies, thus appearing inflexible. Moreover, they do not appear to self-monitor or self-evaluate their actions; and even when they are successful, they do not seem to understand the reasons for their success or experience a sense of self-accomplishment (Millward, Powell, Messer, & Jordan, 2000).

If autism is viewed as a self-regulatory disorder, children with autism can be paradoxically characterized as both undercontrolling and overcontrolling.
in their self-regulatory style when confronted with emotional and cognitive challenges. They are undercontrolled because they often do not develop more complex forms of self-regulation, such as executive control processes (e.g., planning and monitoring), or sometimes even simpler forms of self-regulation, such as soliciting social support. Children with autism share a number of other characteristics in common with undercontrolled children who are often described as impulsive and distractible, seek immediate gratification, and are easily influenced by shifting environmental contingencies (Kremen & Block, 1998). Conversely, they appear overcontrolled in that they use the primitive self-regulatory techniques they possess to restrict and compulsively order their environment. Children with autism share several other features in common with overcontrolled children. They are often described as obsessive, perseverative, uncomfortable with ambiguities, reactive to novel situations, temperamentally wary, difficult to soothe, and socially withdrawn (Kremen & Block, 1998; Rubin, Coplan, Fox, & Calkins, 1995).

4. Future Research Directions

Both the theory described earlier (see Fig. 1.1) and the research summarized in previous sections suggest the need for a more multivariate perspective for understanding the development of autism. This perspective includes not only characteristics/processes directly associated with the diagnosis of autism (social, language/communication, stereotyped, repetitive, and restricted behaviors) but also other commonly occurring characteristics/processes. Moreover, this perspective emphasizes the need to examine how the relations among these characteristics/processes change over time and combine to create a unique self-regulatory system.

Past research examining the characteristics associated with autism has most often fallen into one of three categories: descriptive, comparative, and process-oriented. Descriptive research has focused on examining the frequency with which a specific characteristic or characteristics occur in populations with autism (Muris et al., 1998). Comparative research has examined the relative frequency of these characteristics in populations with autism and other populations without autism, for example, individuals with mental retardation, other developmental disabilities, and/or without any delays (Kim et al., 2000). Often the question posed in such research is whether characteristics associated with autism are unique to this disorder or different in their configuration from those that occur in other populations.

A third category of research has examined the concurrent linkages between one or more processes/characteristics associated with autism. Frequently, this type of research has been directed at exploring intradomain questions. An example within the cognitive domain is whether weak central coherence is related to attentional tendencies. Research has examined the influence of attention over time on the development of autistic symptoms.

In contrast, research dynamics across time. A speculative perspective exists concerning how these relationships change over time and combine to create a unique self-regulatory system. A variety of research efforts are needed in this area, and by the developmental perspective addressed within this framework, we believe the endeavor should be focused on understanding how the influences of different domains change over time and combine to create a unique self-regulatory system.

Developmental process trajectories of different domains, such as language, social skills, and social expectations, are complex and change over time. A critical question is whether characteristics associated with autism are unique to this disorder or different in their configuration from those that occur in other populations.

A related but more complex question is how the relative influence of different domains changes over time. For example, how do the influences of attention, emotion, and social expectations change over time and combine to create a unique self-regulatory system? Critical periods of influence:

- Motor development: Does the child develop rapidly or at a slower pace? How do these influences change over time?
- Sensory development: Does the child become hypersensitive over time?
- Language development: How do the influences change over time and how are they influenced by the child's environment?
- Critical periods of influence: What are the critical periods of influence?

A related but more complex question is whether the influences change over time and combine to create a unique self-regulatory system.
coherence is related to emotion recognition (Gross, 2005). Much less frequently, research has addressed interdomain questions such as how joint attention influences language processes (Sigman & Ruskin, 1999). Relatedly, other studies have examined how physical or social environmental factors affect these various developmental processes (e.g., Reed & Gibson, 2005).

In contrast, research has seldom examined intraprocess and interprocess dynamics across time. As pointed out in previous sections, considerable speculation exists concerning how autism unfolds, how specific processes change over time, and how functioning/symptomatology in one domain influences subsequent functioning in other domains. By studying these relationships across time, more precise information about the development of autism can be obtained.

A variety of research questions, suggested both by the previous literature review and by the developmental theory presented in Fig. 1.1, can be addressed within this framework. We describe five categories of questions below that we believe are salient and feasible at this stage of the research endeavor.

**Developmental process trajectories:** At a descriptive level, the developmental trajectories of different processes (arousal/emotion, sensory, motor, cognitive, language, and social interaction) can be examined. For example, within the sensory realm what is the trajectory of individuals who are hypersensitive early in life? Does this hypersensitivity reduce over time and if so how rapidly? How variable are these trajectories across individuals with autism? Within the motor realm, it appears that some individuals with autism show early motor delays and these delays continue over time whereas other individuals seem to function well motorically during early development but manifest increasing problems over time.

**Developmental process interrelationships:** How do different domains of development interrelate? For example, how are individuals' trajectories of hypersensitivity over time related to their trajectories of motor development or how are individuals' motor development trajectories related to their language development trajectories?

A related but more complex question can also be examined. What is the relative influence of different domains of development on a particular process? For example, what is the relative influence of the trajectories of arousal/emotion, sensory, motor, cognitive, language, and social processes over time on the development of and changes in stereotyped, repetitive, and restrictive behaviors?

**Critical periods of influence:** Are there critical time periods in which a particular process or processes have greater influence on the development of autistic symptomatology? For example, it may be that early delays in motor development are associated with greater subsequent autistic
symptomatology than later delays in motor development. Examining the antecedents relating to the emergence of symptoms associated with autism, as well as symptom severity, may provide critical insights into not only the early but also the later development of autism; for example, why some children with autism develop significant language delays while others do not or what the developmental consequences are for children with autism who have an early history of regression.

In discussing the developmental model in Fig. 1.1, we suggested that the influences of three early emerging processes (emotional arousal, motor, and sensory) may diminish over time in their influence on cognitive, language, and social processes. In contrast, these latter processes may increase over time in their influence on the early emerging processes, as well as on each other, and more generally on the development of various autistic symptoms. For example, it might be hypothesized that early gross motor functioning will have greater influence, compared to later developing fine motor functioning, on cognitive language and social development; in contrast, development in these latter three areas will have greater influence on the development of fine motor skills than gross motor skills.

Mediational and moderational relationships: Mediational as well as moderational questions can also be addressed within a longitudinal framework. For example, does cognitive and/or language/communication competency mediate a relationship between emotional reactivity and stereotypy or does language/communication and/or cognitive competency serve to moderate, as either a risk or a protective factor, a relation between motor development and stereotypy?

Autism subtypes and their etiology: At a complex multivariate level, questions can be asked concerning whether there are different subtypes of autism. For example, it may be that some individuals fall into a cluster without sensory or motor symptoms, whereas other individuals are in a cluster with these symptoms. Is membership in these clusters stable over time? How is early group membership related to later autistic symptomatology and overall development?

Finally, questions can be asked about whether there are uniform or different pathways involved in the development of different autism subtypes/clusters as well as about whether similar autism outcomes are sometimes produced through different pathways (See Fig. 1.1).

Previous and current research in the area of autism has utilized cross-sectional designs. However, in order to study the types of process connections just outlined in individuals with autism, longitudinal designs must be employed. Although studies using cross-sectional designs can be conducted more quickly, inferences about causality are quite limited. In contrast, longitudinal designs: (1) intraindividual as interrelation between (3) the causes of differentiation and magnitude of process variables, (5) maximum influence, forships between processes as used. Fortunately, a using longitudinal des and dynamical systems that they utilize advo Farris, & Maxwell, 20

It should be noted that designs place considerate intensive or adequate number of established and/or actigraphic areas is requin to confront investigators (e.g., cognitive, motor development). Another challenge well as cross-sectional information on the stressors, and parenti precise statements abs longitudinal research it will provide into the difficulties that must b

5. Final Thoughts

Because the de explicitly include a se words regarding its that autism is caused by of children with autism with their occupations, there is no empirical their children’s autism
longitudinal designs allow for the examination of a variety of relations: (1) intraindividual as well as interindividual patterns of changes, (2) the interrelation between the trajectories of different developmental processes, (3) the causes of different patterns of intraindividual change, (4) the direction and magnitude of causal connections between and among different process variables, (5) critical periods when specific processes exert their maximum influence, and (6) factors that may mediate or moderate relationships between processes. To examine patterns of change and relations between processes across time, appropriate statistical techniques must be used. Fortunately, a variety of techniques are available to autism researchers using longitudinal designs, including latent growth curve, autoregressive, and dynamical systems approaches. A major advantage of these approaches is that they utilize advanced techniques for handling missing data (Carothers, Farris, & Maxwell, 2007; McCartney, Burchinal, & Bub, 2006).

It should be noted that when employed, multivariate longitudinal designs place considerable demands on researchers because they are measurement intensive and require larger sample sizes. In order to obtain an adequate number of subjects, large autism research registries have to be established and/or active collaboration among researchers in different geographic areas is required. Moreover, a variety of measurement challenges confront investigators evaluating psychological and behavioral processes (e.g., cognitive, motor, and language) that undergo rapid change over time. Another challenge confronting researchers who use longitudinal as well as cross-sectional designs is to obtain more complete developmental information on the subjects (e.g., medical history, major environmental stressors, and parenting history) so as to allow them to make more precise statements about the generalizability of their findings. Although longitudinal research is more demanding, it seems likely that the insights it will provide into the development of autism will more than justify the difficulties that must be confronted.

5. Final Thoughts

Because the developmental theory described previously does not explicitly include a social environmental construct (see Fig. 1.1), a few words regarding its role are in order. Historically, it was proposed that autism is caused by poor parenting. Kanner (1943) described the parents of children with autism as often appearing cold and aloof, more preoccupied with their occupational and personal pursuits than their children. Currently, there is no empirical evidence to suggest that parents are responsible for their children’s autism, and considerable evidence to the contrary; rather
research strongly indicates that autism is a genetically based disorder. Nevertheless, there is growing evidence that environment may play a critical role in how this disorder emerges. This interplay between genes and environments and their influence on brain and behavior has long fascinated researchers.

As Moffitt, Caspi, and Rutter (2006) pointed out, psychologists have come to appreciate the multiplicity of ways genetic and environmental risk factors interact. For example, early experience can alter gene expression, which in turn influences behavior development. Alternatively, a person’s genotype can make a person vulnerable to insults from certain types of environments. Relatedly, genetically determined characteristics can limit the ways a person responds to an environment. Although it is clear on the one hand that genes can ultimately influence an organism’s adaptation to the environment, it is also clear that biological development is influenced by an individual’s behavior and adaptation to the environment. At present behavioral researchers are only beginning to understand the multiplicity of ways that environments can place individuals who are already at risk for genetic reasons, like children with autism, at further increased risk for developmental delays or conversely, how such environments can protect and facilitate development in such at-risk populations.

The results of various investigations have emphasized the dramatic inhibitory effects that environmental restriction/deprivation can have on early brain and behavior development and conversely how environmental enrichment can greatly facilitate such development. For example, Lewis (2004) summarized research that points out how environmental complexity prevents the development of stereotyped behavior as well as alters neuronal metabolic activity. Moreover, Dong and Greenough (2004) described the impact that environmental factors can have on brain plasticity, at both the neuronal and the nonneuronal level, along with an emerging body of research suggesting how the structural and functional plasticity of neurons in developmental disorders, including autism, may be impacted by environmental and experiential factors.

Although considerable research is needed to clarify the types of environmental factors that enhance or inhibit plasticity at the neurological level in individuals with autism and how these neurological changes mediate change at the behavioral level, existing research has suggested a range of prenatal and postnatal environmental factors that may be related to autism and autistic characteristics. For example, greater prenatal stress during the 21- to 32-week gestation period has been reported by mothers of children with autism in comparison to mothers of children with Down syndrome and mothers of children without a neurodevelopmental diagnosis (Beversdorf et al., 2005). In another study pointing to the importance of prenatal factors, twin status was associated with subthreshold autistic symptomatology in males. Other research has suggested the influence of social environmental factors on et al., 2005) and the abili (Parker, Nelson, & The B 2005).

In addition to investigating factors, attention also needs to be paid to environments that children changing these environmental opment. The environments through their restrictive b put in place by parents w: social skills, they are of: provide a forum for learning.

Even though autism has many environmental triggers, it is clear that environments can either enhance or diminish social competence in children with autism, like children with autism, at further increased risk for developmental delays or conversely, how such environments can protect and facilitate development in such at-risk populations.

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In addition to investigating the influence of these types of environmental factors, attention also needs to be given to evaluating the impact of the environments that children with autism create for themselves as well as how changing these environments through early interventions influences development. The environments that children with autism create in their homes through their restrictive behaviors are typically quite different from those put in place by parents with professional assistance. Because children lack social skills, they are often deprived of critical social experiences that provide a forum for learning adaptive behavior (Peterson, 2005).

Even though autism has genetic origins, perhaps with some early biological triggers, it is not unreasonable to assume that parents of children with autism, like parents of all children, exert considerable influence on the general development of their children. As autism emerges, parents are confronted with children whose characteristics are peculiar and perplexing. At least initially, they have little insight into why their children act as they do and what they as parents should do to help their children. For example, they may be bewildered by their children who are hypersensitive, motorically challenged, fearful, socially avoidant, linguistically and cognitively delayed, and prone to engage in unusual stereotyped and ritualistic behaviors. Moreover, because the social signaling system of children with autism is compromised, parents have difficulty responding to the needs of their children. The children are not able to elicit the instrumental and emotional supports from their parents (and teachers) that they need to develop normally. Parents experience increasing stress, and not infrequently a sense of helplessness, as their children manifest increasing delays and self-regulation problems. Although any parent would find the symptoms of autism challenging, the parents of children with autism may possibly find their behaviors more challenging because they share for genetic/familial reasons certain characteristics in common. Nevertheless, evidence is accumulating which indicates that this parental and child trajectory can be at least partially ameliorated through intervention programs.

Although more and better research needs to be conducted, both anecdotal report and research have suggested that intervention programs can have positive, and sometimes dramatic, effects on children with autism, particularly if they are intensive, begun early, and are multidimensional in nature (Whitman, 2004). The theory, presented in Fig. 1.1, not only describes the processes that appear to be involved in the development of autism but also provides a general blueprint for designing multidimensional interventions to alter the trajectory of this disorder.
ACKNOWLEDGMENTS

This study of this chapter was supported in part by grants from NICHD (HD-007184 and HD-26456).

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