

## HIGH-FUNCTIONAL AUTISM: AN OVERVIEW OF CHARACTERISTICS AND RELATED ISSUES

**Ann X. Huang**

**and**

**John J. Wheeler**

*Tennessee Technological University*

*Individuals with high-functioning autism are characterized by almost normal language ability and intelligence as well as social, pragmatic impairments. Before the 1980s, limited research was focused on this disorder. This paper reviews previous research on this underserved population with a hope that we are able to gain some insights from existing literature and seek directions for future research. The definition and diagnostic criteria for high-functioning autism are addressed first, and then followed by an overview of the characteristics of these individuals and its relationship with Aspergers syndrome. Finally, research on the social/emotional well being of individuals with this disorder will be introduced as will research on theory of mind and other related research in the fields of neuroscience and cognitive science.*

Since Kanner first published his groundbreaking study on autism in 1943, countless researchers have focused their research interest on this disorder. According to the Diagnostic and Statistical Manual of Mental Disorder (DSM-IV, 1994), individuals with autism are characterized by impairments in normal social interaction and/or communication, and by repetitive behavior and/or interest. This pervasive developmental disability usually occurs before the age of three and may last for a lifetime. Although research in the past few decades has led to great progress in this field, its causes are still unknown.

Since the 1970s, a lot of researchers have been working hard to advance people's understanding of individuals with this disorder as well as to develop behavioral and educational interventions to improve their social communication abilities and daily functioning skills. However, most existing studies are focused on young children or elementary students with moderate to severe autism (especially in recent years, society has begun to realize the essential importance of early identification and early intervention for conditions such as autism), comparatively, individuals with high-functioning autism (HFA) are underserved. To better serve this disadvantaged group, more exploration and greater public awareness need to occur.

According to Kanner (1943), individuals with autism can be defined as high functioning if they have almost normal language ability and intelligence. As mentioned previously, HFA received comparatively little attention of researchers until recently in the United States. Several researchers began studying individuals with HFA in the late 1980s (e.g., Levy, 1986; Tsai & Scott-Miller, 1988). They found that these individuals have very different

characteristics, strengths and needs from those with moderate to severe autism (Levy, 1986; Tsai, 1992).

This article is an overview of existing literature on high functioning autism, concerning its definition and diagnostic criteria, characteristics (strengths and needs), its relationship with Asperger syndrome, its related emotional problems, and explanation of theory of mind, as well as other related research in the fields of neuroscience and cognitive science. Such an overview is essential in the hope that we are able to gain some insights from existing research and seek directions for future research.

#### *Definition and Diagnostic Criteria*

Within existing literature, researchers proposed several similar definitions for high-functioning autism. Researchers from Yale University defined high-functioning autism as individuals with autism whose full-scale IQ is greater than 70, without significant language and intellectual delays (Rubin & Lennon, 2004). Attwood (2003) reported the term high-functioning autism was initially used to describe individuals who demonstrated typical symptoms of autism when they were young children, but as they grow older, they gradually showed greater degree of cognition, social and adaptive behavior skills with good long-term clinical outcomes compared to other children diagnosed with autism. Based on previous research and the ICD-10<sup>th</sup> (International Classification of Disease, 10<sup>th</sup> revision) system, Tsai (1992) proposed a specific definition for high-functioning autism as follows:

*High functioning autism is a subtype of pervasive developmental disorders. It is defined by the presence of slightly abnormal and/or mildly impaired development in the areas of social interaction and communication, as well as by the presence of restricted, repetitive behavior. The characteristic type of abnormal functioning is manifested before the age of 3 years. There is some difficulty in domestic, school, occupational, or social functioning, but there are some meaningful interpersonal relationships (p. 36).*

Although many researchers believed it is necessary to further sub-classify autism (e.g., Tsai, 1992), it is frustrated to know that even today, no standardized or official diagnostic criteria are available for HFA, despite the fact that some researchers (i.e., Tsai & Scott-Miller, 1988) have already called for clearer diagnostic criteria for this population since almost twenty years ago. Among the existing literature, Tsai (1992) proposed the following diagnostic criteria according to the ICD-10<sup>th</sup>:

- A. Criteria A, B, C, and D as described in the proposed ICD-10 definition and diagnostic criteria of childhood autism (see early section).*
- B. Nonverbal IQ of 70 or above on an individually administered standardized test.*
- C. Language comprehension, as assessed on a standardized test, that fall no lower than one standard deviation below the mean for children younger than the age of 8, or two standard deviations for children age 8 or older.*
- D. Expressive language skills, as assessed on a standardized test, that falls no lower than one standard deviation below the mean for children younger than the age of 8, or two standard deviations for children age 8 or older.*
- E. Social functioning, as assessed on a standardized test that falls no lower than one standard deviation below the mean for children younger than the age of 8, or two standard deviations for children age 8 or older.*
- F. The clinical picture is not attributable to the other varieties of pervasive developmental disorders; specific developmental disorder of receptive language with secondary socio-emotional problems; reactive*

*attachment disorder or disinhibited attachment disorder; Asperger's syndrome; obsessive-compulsive disorders; Tourette syndrome, or schizophrenia of unusually early onset (p. 36).*

#### *Characteristics of Individuals with HFA: Cognitive Profiles*

Overall, individuals with HFA display many different characteristics from other members of the autistic population. Based on findings from previous neuropsychological studies, this session introduces the cognitive profiles of individuals with HFA in the following areas: (1) intelligence, strengths and needs; (2) attention, language and social communication skills; and (3) exceptional strengths, academic ability and learning style; as well as (4) executive functioning. A better understanding of this population is essential and can help us design more appropriate and effective educational interventions for these individuals.

#### *Intelligence, Strengths & Needs*

Although individuals with HFA have almost normal intellectual and language development, researchers have found cognitive development is uneven within this group (Lincoln, Courchesne, Kilman, Elmasian, & Allen, 1988; Rubin & Lennon, 2004), which was consistent with the findings of previous studies. Research showed that "IQ test profiles vary with developmental level" among individuals with HFA (Rumsey, 1992, p. 44). For example, those who with lower Full Scale IQs (below 85) showed better performance scores than verbal scores, while those with higher Full Scale IQs demonstrated almost no discrepancies in verbal scores (Szatmari, Tuff, Finlayson, & Bartolucci, 1990). Some researchers believed, for individuals with HFA, it is the social-affective impairments that are the basic concern, but not cognitive deficits (Fein, Pennington, Markowitz, Braverman, & Waterhouse, 1986). Conversely, other researchers argued that cognitive deficits are the basis on which social impairments rest (Rutter, 1987). Based on previous studies, researcher summarized the relative strengths and challenges of this population as follows:

#### *Relative strengths:*

*Visual discrimination; Visual spatial processing; Capacity to focus or sustain attention for static visual information; Ability to immediately recall information of a rote nature; Recall of discrete information versus more complex or conceptual information; Associative learning (e.g., stimulus-response learning, paired learning); Procedural learning (e.g., calculations, reproduction of music, and drawings)*

#### *Relative challenges:*

*Expressive and receptive language; Disengaging and/or shifting attention; Shifting attention between response modalities (e.g., between auditory to visual); Making rapid changes to task expectations; Recalling information in the absence of contextual or semantic cues; Organizing information; Recalling aspects of a learning episode that are not explicitly targeted; Coping with new information due to cognitive inflexibility, incomplete understanding of implicit concepts, or problems in strategy generation (Tsatsanis, 2004, p. 262).*

#### *Attention, Language, & Social Communication Skill*

Limited research has been done to measure attention in individuals with HFA. According to previous studies on individuals with classic autism, these individuals tend to show rare narrow attention and inability to shift attention flexibly (Rumsey, 1992). Recent research indicated that most members of this group face challenges in two major areas: joint attention and symbol use (National Research Council [NRC], 2001; Prizant, Wetherby, Rubin, & Laurent, 2003; Prizant, Wetherby, & Rydell, 2000; Rubin & Lennon, 2004). Rubin and Lennon (2004) believe these two areas play essential role in social learning: they have tremendous influence on the development of social communication skills in individuals with HFA. They have identified common social communication challenges in this group in these two areas:

#### *Capacity for joint attention:*

**Comment:** Not sure that 'and' is the correct conjunction here: the connection between the two parts of the sentence is not clear. You need to say why a better understanding of this population is essential. I suspect you mean it is essential *because* 'it can help us design more appropriate... education interventions'. If this is not your intended meaning, you need to restructure the sentence.

**Comment:** Should reference these previous studies.

**Comment:** Should you be using the past tense here, or is the debate ongoing, in which case the present tense would be more appropriate.

**Comment:** Not quite clear on your meaning here. Do you mean these individuals rarely show narrow attention?

**Comment:** Again, be careful with tense. As this was published in 2004, it is basically contemporary, so the present tense is better. Present perfect is also fine: "Rubin and Lennon have argued..."

**Comment:** Use of 'they' is a bit clumsy here, because you have used it to refer to something else in the previous sentence. You could name the authors, or use the title of their work: "In *Challenges...*, Rubin and Lennon identified..."

- a. Determining the attentional focus, perspectives, and intentions of others.
- b. Perceiving emotional states and considering plausible causal factors.
- c. Initiating and maintaining conversational exchanges that are sensitive to the social context, the interests of others, and the previous knowledge of those involved.
- d. Recognizing and repairing breakdowns in communicative exchanges on the basis of misinterpretations or the emotional reactions of others.

*Capacity for symbol use:*

- a. Understanding and using more sophisticated language as a means to clarify intentions.
- b. Understanding and using nonverbal cues (e.g., gestures, facial expression, body proximity, and intonation) as a means to clarify intentions such as emotion, humor, sarcasm, and non-literal meanings.
- c. Understanding and adhering to social conventions and cultural norms for initiating, exchanging turns, and terminating interactions.
- d. Using language as a tool for guiding behavior, collaborating with others, and emotional regulation (Rubin & Lennon, 2004, p. 273).

Language delay in early childhood is evident in individuals with HFA (Rubin & Lennon, 2004). Such individuals can read at early childhood and may have relatively sophisticated vocabularies (Fullerton, 1996). However, they cannot use language to communicate with people around them effectively because of pragmatic deficits: they tend to engage in nonreciprocal and preservative speech and language, with *flat intonation*, and *without following the flow, give-and-take, or focus of conversation* (Rumsey, 1992, p. 50). Language problems, such as self-talking, word or phrase repetition, nonsense speech, and failure to comprehend words in different contexts (literalness), as well as inflexibility, can be found in individuals with HFA (Dewey & Everward, 1974; Rumsey, 1992).

Researchers have found that time and experience can improve receptive and expressive language in some individuals with HFA (Cantwell & Baker, 1989; Lord & Paul, 1997; Paul & Cohen, 1984). However for some people with this disorder, echolalia language may last into adolescence or even adulthood, especially when communicating with unfamiliar people (Rydell & Prizant, 1995). This is consistent with a recent study on sentence comprehension in HFA, which suggested that *different degrees of information integration and synchronization in language processing* can be found in individuals with HFA (Just, Cherkassky, Keller, & Minshew, 2004, p. 1811).

It is evident that individuals with autism show both verbal and nonverbal communication deficits (Rumsey, Andreasen, & Rapoport, 1986). Researchers found individuals with HFA demonstrate fewer nonverbal communication skills such as facial expression or gestures, compared to their typical peers (Rubin & Lennon, 2004). They are also unable to comprehend complex social interaction, or to understand other people's emotional states through reading their facial expressions and body language (Rubin & Lennon, 2004). They are insensitive to social and emotional cues, with limited awareness of what causes these emotional states (Klin, Jones, Schultz, & Volkmar, 2003). Some researchers have suggested that it is these deficits in the use of pragmatic language that result in the social learning disabilities in individuals with HFA (Landa, 2000). Other researchers also believe that their inappropriate social behavior may stem from their poor social comprehension (Rubin & Lennon, 2004). In the eyes of typically developing people, this population lacks empathy, is unable to appreciate humor, and may appear eccentric or aloof (Rumsey, 1992).

Exceptional Strengths, Academic Ability & Learning Style

Despite their vulnerabilities in social communication, individuals with HFA actually *demonstrate relative strengths in visual-spatial perception and visual memory* (Rubin & Lennon, 2004, p. 280). According to Tsatsanis (2004), individuals with this disorder usually *acquire new information through rote memory, classical conditioning (stimulus-response learning), and mechanical/procedural learning* (p. 263). Previous studies have also suggested that many individuals with HFA have unusual visual memory (or rote memory) and can learn detailed, concrete things very well (Fullerton, 1996; Rumsey, 1992), even though they may not be able to comprehend (Fullerton, 1996). Previous research indicated individuals with HFA have difficulty retrieving information effectively rather than encoding information (Bennetto et al., 1996).

**Comment:** Unusually good?

**Comment:** Comprehend what? You should be more specific here. Are they unable to comprehend the concepts behind the details that they can memorize?

Besides their relative strengths in visual-spatial perception and visual memory, some individuals with HFA also excel in some specific areas, such as calculating and solving math problems, artistic giftedness (e.g., drawing & music), and supersensory perception (e.g., the ability to complete puzzles or form boards unusually quickly) (Tsai, 1992). Rumsey and Hamburger (1990) found many individuals with HFA demonstrate sound ability in the areas of reading, spelling and calculating. However, compared with their dyslexic peers, their abilities to comprehend and to use semantic context are poor (Frith & Snowing, 1983).

#### *Executive Function*

Executive dysfunction in individuals with autism and Asperger syndrome has been documented in the existing literature for more than two decades (Bennetto, Pennington, & Rogers, 1996; McEvoy, Rogers, & Pennington, 1993; Ozonoff & McEvoy, 1994; Ozonoff, Pennington, & Rogers, 1991; Rumsey, 1985). Executive function (EF) includes such abilities as planning, organization, flexibility, and self-regulation (Stuss & Benson, 1986), which are essential elements for *everyday functioning and school success* (Ozonoff, 1998, p. 263). Research suggested executive dysfunction is resulted from the frontal lobe damage (Ozonoff, 1998; Stuss & Benson, 1986). The Wisconsin Card Sorting Test (WCST) is the most popular task used to measure EF in individuals with autism. Other measures include Trail Making Test and Tower of Hanoi. Previous research showed individuals with HFA perform worse on the above tests than their normally developing controls (Rumsey, 1985), or control groups with other disabilities such as severe dyslexia (Rumsey & Hamburger, 1988), learning disabilities (Borys, Spitz, & Dorans, 1982) and other executive function disorders (Szatmari et al., 1990).

#### *High-Functioning Autism & Asperger Syndrome Controversy in Diagnosis*

Although individuals with HFA and individuals with Asperger syndrome (AS) have many characteristics in common, such as normal IQ, relatively unimpaired language ability and adaptive behavior skills, studies from various disciplines have indicated that researchers have not been able to reach a consensus that HFA and AS are the same thing with different names (Rubin & Lennon, 2004). It is interesting to note that, although no standardized and/or official diagnostic criteria are available for HFA, the American Psychiatric Association did propose diagnostic criteria for AS in the Diagnostic and statistical manual of mental disorder (DSM-IV, 4<sup>th</sup>, 1994).

According to Gillberg (1998),

*The most controversial issues in the diagnosis of AS versus HFA appear to be whether or not: (a) motor skills should be regarded as a differentiating feature; (b) AS or HFA could be associated with cognitive disability; (c) language is impaired in HFA but spared or even hyper-functioning in AS; (d) a diagnosis of HFA and of AS can be made in the same individual at different stages of development; and (e) HFA and AS refer to the same or distinct groups of individuals (p. 201).*

#### *Distinct Intellectual Profiles*

As mentioned earlier, although individuals with HFA and individuals with AS share some similarities, research has suggested that individuals with HFA possess distinct intellectual profiles from individuals with AS (e.g., Rubin & Lennon, 2004; Tsatsanis, 2004). Overall, researchers reported that individuals with AS tend to have higher IQs than individuals with HFA (Ehlers et al., 1996). Studies revealed individuals with HFA usually perform better at non-verbal tasks, so they have higher scores on performance IQ (PIQ) than verbal IQ (VIQ) on standardized tests; in contrast, people with AS are characterized by a high VIQ and a relatively low PIQ (Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995; Rubin & Lennon, 2004; Tsatsanis, 2004). Tsatsanis (2004) summarized the relative strengths and challenges of individuals with AS as follows (the similar profiles of individuals with HFA can be found in the previous section):

*Relative Strengths:*

*Expressive and receptive language; verbal problem-solving skills (lexical knowledge and vocabulary, verbal expressiveness and verbal memory); ability to shift conceptual set when aided by verbal modality.*

*Relative Challenges:*

*Visual spatial processing, particularly with more complex visual information (e.g., nonverbal social cues); visual working memory; visual motor integration; inconsistent attentional focus, particularly to visual information; difficulty forming visual mental representations to guide behavior; challenges in dealing with new information because of nonverbal deficits, and difficulties with using language to support organization (p. 266).*

*Other Related Issues*

Concerning early language development, comparative studies have reported that individuals with AS have fewer language problems than individuals with HFA (Gillberg, 1998). Theory of mind deficits are very commonplace in individuals with HFA (Baron-Cohen et al., 1985); however only very young children with AS may have the same problem (Frith, 1991, Happé, 1994), while older children and adolescents with AS usually perform better in theory of mind tasks (Prior et al., 1990; Happé, et al., 1996). Although many researchers agreed that both HFA and AS are a result of brain dysfunction (Frith, 1991), researchers (e.g., Gillberg, 1998) found *the rate of brain dysfunction appears to be lower in AS than in HFA* (p. 203). Findings from genetic studies have revealed that AS is *a predominantly genetic disorder* while HFA is *either a genetic disorder with a different inheritance pattern or more often caused by brain damage* (Gillberg, 1998, p. 204).

According to studies in HFA, individuals with higher intelligence have better outcomes; while research based on outcomes for individuals with AS have been limited, so no related finding has been released so far (Gillberg, 1998). However, researchers (i.e., Wing 1981a; Wolff & McGuire, 1995) did find that individuals with AS tend to have a high suicide rate. Recently, several Canadian researchers (i.e., Starr, Szatmari, Bryson, & Zwaigenbaum, 2003) examined the stability and change over time (two years) by using ADI-R (Autism Diagnostic Interview-Revised, Lord, Rutter, & Le Couteur, 1994) ratings in two subgroups of PDD children: HFA and AS. They found significant differences between the two groups: the group with AS showed fewer and/or less severe symptoms in all three domains (communication, social interaction, and repetitive and stereotyped behavior) than the HFA group over time. Both groups experienced improvement in communication and social interaction over time, but not in repetitive and stereotyped behavior, which the researchers believed is not caused by IQ. These findings are not consistent with those of Piven et al. (1996), who found improvements in all three areas over time, especially in communication and social interaction.

**Comment:** Outcomes in what? Specific tests, or education in general?

**Comment:** In this case, and the one below, 'e.g.' ('for example') might be a better option than 'i.e.' ('that is').

Over the past three decades, scientists and researchers from multiple disciplines have been working hard to explore the relationship between HFA and AS. However, due to the

limitations of our current knowledge and the development of clinical technologies, no clear-cut consensus has been reached to date. It seems it is reasonable to predict that this debate will continue for some time to come.

#### *Emotional Problems in Individuals with HFA*

Many researchers believe that social skill deficits contribute to the development of emotional problems in individuals with autism (Attwood, 1998; Gillot, Furniss, & Walter, 2001). According to Attwood (1998), anxiety is a common emotional problem in this population. Gillott et al. (2001) also reported that children with HFA have significant higher scores on anxiety measurement than typically developing peers, or peers with other learning disorders. Similarly, Kim et al. (2000) conducted a survey to examine the prevalence of emotional problems among children with autism, and found 13.6% of 59 participants with either HFA or AS have scores more than two standardized deviations above the mean on a parent-report measure of generalized anxiety, and on internalized factors such as generalized anxiety, separation anxiety, and depression.

#### *Social Skill Deficits & Anxiety*

As mentioned earlier, research indicates that there is a link between social skill deficits and social anxiety in individuals with autism. Researchers believe that individuals who have experienced, for example, negative peer interactions and/or peer rejection resulting from social skill deficits, are more likely to develop social anxiety than their peers (Ginsburg, La Greca, & Silverman, 1998; La Greca & Lopez, 1998). Tantam (2000) also found that social functioning deficits have a tremendous negative impact on the individuals' social interaction with people around them. This also hinders the establishment of lasting and meaningful friendships with peers, which may result in rejection and isolation, as well as the later development of anxiety and depression.

Another recent study by Bellini (2004) explored the relationship between social skill deficits and social anxiety. Forty-one adolescents and their families participating in this study were asked to complete several measure instruments, including the Social Skills Rating System (or SSRS; Gresham & Elliot, 1990), the Multidimensional Anxiety Scale for Children (MASC; March, 1999), the Social Anxiety Scale for Adolescents (or SAS-A; La Greca, 1999), and the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992). Results indicated there is a low negative correlation between social skill deficits and social anxiety in adolescents with high-functioning autism. These findings support previous studies.

**Comment:** Give examples of previous studies?

#### *HFA & Other Emotional Problems*

In addition, researchers discovered individuals with autism are more likely to experience loneliness caused by poor social interactions with typical peers (e.g., Asher, Parkhurst, Hymel, & Williams, 1990; Bauminger, Shulman, & Agam, 2003). Bauminger et al. (2003) examined social interaction with peers, and understanding and feelings of loneliness in 18 children with HFA and 17 typically developing children matched for IQ, chronological age, gender, and maternal education. Through analyzing the data from onsite observations, results indicated that there is a link between loneliness and poor social interaction, and that children with HFA experience higher-level loneliness than their typically developing peers. Many researchers believed their poor social interaction is the result of social-affective impairments, which can be explained using theory of mind.

**Comment:** In addition to what? Other social problems suffered by individuals with autism?

#### *HFA & Theory of Mind*

In the 1980s, Baron-Cohen started his studies of theory of mind (ToM) in individuals with Autism Spectrum Disorders (ASD) and found that children with autism have problems understanding other minds. Since then, numerous studies have supported the belief that theory of mind deficit is a very common phenomenon in children with autism (For a review, see

Baron-Cohen, 2000). Most studies of theory of mind focus on individuals with HFA (here the term individuals with HFA refers to people with autism who *are verbal and do not have mental retardation, or major impairing associated behavioral symptoms*, (Baron-Cohen, 2000, p. ix), or autistic individuals with mind mental retardation and comparative lower adaptive skills (Baron-Cohen, Tager-Flusberg, & Cohen, 2000).

As summarized by Baron-Cohen (2000), previous studies from different angles revealed that mind blindness, also referred to as theory of mind deficit, is evident in children with autism. For example, Baron-Cohen (1989a) discovered children with autism have significant impairment in comprehending ontological differences between mental and physical entities and events. Flavell and his colleagues (1986) reported that children with autism are not able to distinguish between appearance and reality. Several studies have revealed that children with autism have difficulty inferring the mental states of others: they tend to simply describe their own perspectives rather than considering how different people might perceive or think about the world (Baron-Cohen et al., 1985, 1986; Leekam & Perner, 1991; Perner et al., 1989; Reed & Peterson, 1990; Swettenham, 1996; Swettenham et al., 1996). Other researchers found that young children with autism also have problems in interpreting simpler mental states, such as others' intentions, comparing to children with other developmental delays (Carpenter, Pennington, & Rogers, 2001). Pratt and Bryant (1990) proved that it is hard for children with autism to understand the *seeing leads to knowing* principles. Results from tests of recognizing mental-state words showed that, compared to their normal peers, children with autism have more difficulty in making correct judgments (Baron-Cohen et al., 1994).

With regard to the spontaneous speech of children with autism, researchers found that members of this group employ fewer words to describe mental states than their typically developing peers (Baron-Cohen et al., 1986; Tager-Flusberg, 1992); this may reveal that children with autism have *delays or deficits in comprehension of mental-state concepts* (Baron-Cohen, 2000, p. 8). Several studies have demonstrated that children with autism perform less often in pretend play (Baron-Cohen, 1987; Lewis & Boucher, 1988) probably because of a lack of imagination (Leslie, 1987) or executive dysfunction (Russell, 1997), or both (Baron-Cohen, 2000). Results from tests of emotional causation showed that compared to children with other developmental delays, children with autism have difficulty understanding complex causes of emotion (Baron-Cohen, 1991; Baron-Cohen, et al., 1993a). Children with autism also have difficulties inferring others' thoughts and desires from gaze-direction (Baron-Cohen et al., 1995; Leekam et al., 1997).

Furthermore, several studies demonstrated children with autism have difficulty in understanding both when they are being deceived by others, and in trying to deceive others (Baron-Cohen, 1992; Sodian & Frith, 1992; Yirmiya et al., 1996). Results from several more advanced tests in figurative language and in intention to joke on children with HFA revealed that this population fails to understand metaphor, sarcasm and irony; nor are they able to understand jokes (Happé, 1994; Baron-Cohen, 1997). A similar study by Emerich et al. (2003) investigated the ability to comprehend humorous materials including cartoons and jokes in adolescents with HFA or AS. Results revealed that, compared with the control group consisting of typically developing peers, the performance of adolescents with HFA or AS was significantly poorer. Researchers also found children with autism have deficits in pragmatics, such as using context and staying on topic (Baron-Cohen et al., 1999; Surian, Baron-Cohen, & Van der Lely, 1996). In addition, other researchers have reported that imagination impairments are evidenced in children with autism (Craig, 1997; Craig & Baron-Cohen, 1999).

#### *Other Related Studies on HFA*

##### *Recent Studies on HFA from Neuroscience*

Piggot et al. (2004) recently conducted a study that focused on the emotional attribution in high-functioning individuals with ASD. The study aimed to determine *whether expertise in*

*the attribution from basic facial expressions in high-functioning individuals with ASD is supported by the amygdala, fusiform, and prefrontal regions of interest (ROI) and is comparable to that of typically developing individuals* (p. 473). Fourteen individuals (male) with HFA and 10 typically developing adolescents participated in the study. Researchers first acquired functional magnetic resonance imaging scans from all participants when they were doing emotion match (EM) (perceptual), emotion label (EL) (linguistic), and control tasks. Then researchers measured such parameters as accuracy, response time, and average activation for each ROI. Results showed there was no significant difference in accuracy, response time, or ROI activation between groups concerning EL tasks. However, with respect to EM tasks, although accuracy was the same for both groups, the ASD group needed longer response time and had lower average fusiform activation than the control group.

This study concluded the above hypothesis was supported in the perceptual task but not in the linguistic task. Thus, expertise in emotional attribution from basic facial expressions is task-independent in the high-functioning ASD group, and should not be generalized across emotional attribution task in this population. The researchers believe that the reduced fusiform activation is connected with the diagnosis of ASD.

Another study by Wang et al. (2004) aimed to examine the neural basis of impairments in interpreting facial emotions in children and adolescents with ASD. Functional magnetic resonance imaging scans were acquired from 12 persons with ASD and 12 typically developing individuals when they were matching faces by emotion and assigning a label to facial expressions. Results showed both groups demonstrated similar networks during the process, for example, analogous activity in the fusiform gyrus (FG) and prefrontal cortex. However, the ASD group showed significantly less activity than the control group in the FG but greater activity in the precuneus when matching facial expressions, as revealed by the between-group analyses in regions of interest (ROI). Researchers found no difference at both behavioral and neural level between these two groups when labeling facial expressions. Furthermore, moderate activity in the amygdala was noticed in the control group but not in the ASD group. The study concluded that, to some degree, people with ASD employ different neural networks when they are processing facial emotions. Individuals with HFA may perform better in recognizing basic emotions, but still demonstrate differences when processing facial expressions.

**Comment:** Differences to what?  
Typical children, or those with ASD?

#### Recent Studies on Cognitive Science

A study by Toichi & Kamio (2001) suggested it is possible that *semantic processing in individuals with HFA might be qualitatively different from that in controls* (p. 483). They later conducted another study (Toichi & Kamio, 2003) to examine the nature of verbal long-term memory (LTM) in individuals with HFA. Results indicated that the nature of verbal LTM in individuals with autism is different from that of typically developing people. The study suggested *elaboration in verbal encoding in individuals with autism may be different from ordinary semantic or associative elaboration in non-autistic individuals* (p. 160). However, other researchers (i.e., Beversdorf et al., 1998, 2000; Fein et al., 1996) reported that adults (rather than children) with HFA have unimpaired LTM, even when using semantically related materials. With regard to cognitive styles, a study by Teunisse et al., (2001) addressed two important cognitive domains – central coherence and cognitive shifting – in individuals with HFA. Researchers found that *weak central coherence and poor cognitive shifting are significantly more common in individuals with HFA than in normative control subjects* (p. 55).

#### Summary

Autism is a complex mysterious developmental disorder. Although great progress has been achieved in the past decades, our current knowledge about HFA is still far from sufficient. Further research in this area is in urgent need. Advancing understanding in this area is essential for the development of effective individualized educational interventions to better

serve those who not only suffer from their own disabilities but also from other people's misunderstanding, as well as to enhance quality of life of people with this disorder.

Future research should pay more attention to early identification of HFA in very young children. Adolescents and young adults with HFA also deserve more attention of researchers, so do other practical issues such as transition and job training. Studies focused on long-term outcome of individuals with this disorder need further exploration. No doubt, continuing our journal of developing effective and efficient educational programs or interventions for children with HFA still ranks the most important thing.

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