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Variability in Language and Reading in High-Functioning Autism

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1. Introduction

Autism is a complex developmental disorder characterized by a triad of core deficits in verbal communication, reciprocal social interaction, and cognitive flexibility reflected in restrictive and repetitive patterns of behavior and poor symbolic play. Poor verbal communication is a defining feature of ASD, but a high degree of variability exists in the clinical manifestation of the disorder, especially within the communication and language domains. Some children with autism never develop functional speech or language and remain nonverbal; others use well-developed speech (Tager-Flusberg, Paul, & Lord, 2005; Kjelgaard & Tager-Flusberg, 2001; Wilkinson, 1998). A significant developmental milestone in children diagnosed with autism in the preschool years is whether the child acquires useful speech and language skills by the age of 5 years, a developmental marker shown to be an indicator of a better prognosis for long-term outcome and is characteristic of those who are *higher-functioning* (Howlin, 2002).

Although the classifications systems and the diagnostic categories applied to the differential diagnosis of Autism Spectrum Disorders (ASD) are well recognized, verbal children with autism are often referred to as *high-functioning autism* (HFA), a term not included in the classification of autism spectrum disorders in the DSM-IV. Rather, HFA is a clinical description used for children who meet three criteria: a) a clinical history and behavioral manifestation of the diagnostic criteria for a diagnosis of autism (DSM-IV, APA, 1994; ICD-10, WHO, 1992), including a history of delay in acquiring speech and language, difficulty in reciprocal social interaction, and odd or repetitive behaviors, b) have functional verbal behavior, and c) an IQ criterion, absent mental retardation. Individuals with autism are considered as high-functioning if the IQ is above 70, the psychometric point of demarcation for mental retardation. Currently there is little consensus in the literature concerning which domain of intellectual functioning to use for the application of the IQ criterion in defining HFA for research purposes. For example, should the Full Scale IQ composite score be used, or would either the Verbal or Nonverbal Performance score suffice? This is a situation that may contribute to difficulty in comparing results among different studies focusing on children with HFA. Recent research suggests that there may be subgroups of children with HFA based on differing cognitive profiles. For example, children showing a profile of a higher Verbal IQ than Nonverbal IQ score higher on a measure of adaptive communication skills , have fewer social symptoms, and demonstrate better overall functioning than children showing the reverse cognitive profile (e.g. NVIQ > VIQ) (Black, Wallace, Sokoloff & Kentworthy, 2009). Yet, when the IQ criterion is investigated across studies on children or adults with HFA, differing IQ criterion are noted. Some investigators set the cognitive criterion for HFA to be a Full Scale IQ $\geq$ 70 (Asarnow, Tanguay, Bott, Freeman, 1987; Mayes & Calhoun, 2008; Minshew, Goldstein & Siegel, 1995), or a Full Scale IQ $\geq$ 80 (Landa & Goldberg, 2005). Other researchers have chosen to use only the Verbal IQ score (Losh & Capps, 2003) or the Nonverbal IQ ($\geq$ 70) (Freeman, Lucas, Forness, Ritvo, 1985; Smith Gabig, 2008; 2010) as the cognitive criterion. Still, others do not rely on an IQ criterion, rather they use a measure of receptive vocabulary > 70 as an index of overall verbal ability and verbal intelligence (Emerich, Creaghead, Grether, Murray, and Grasha, 2003), or a combination of an expressive vocabulary standard score > 70, and educational placement in the general education classroom, as the criteria for classification as *high-functioning* (Jones & Schwartz, 2009).

The term HFA is used to characterize children with autism who are verbal and have higher intellectual functioning, yet no single language profile has been identified in the group. Some of the children show normal language function and others range from mild language impairment to significant language impairment independent of intellectual functioning. However, deficits in the pragmatic use of language are a defining feature (Kjelgaard & Tager-Flusberg, 2001; Tager-Flusberg, Paul, & Lord, 2005). Children with autism will demonstrate impairments in pragmatic aspects of language use even if other aspects of language, such as morphosyntactic or lexical-semantic ability, are well developed (Stone & Caro-Martinez, 1990; Tager-Flusberg, 2003). Deficits in the pragmatic function of language are so pervasive in the clinical population of autism that it distinguishes between children with autism from other developmental language delays (Rice, Warren, & Betz, 2005; Wilkinson, 1998).

Beyond anticipated impairments in the pragmatic aspect of language functioning, investigators of language profiles of subgroups of children with ASD focus on patterns of performance in the areas of syntax and semantics that may distinguish groups of children with autism. There is accumulating evidence that some children with HFA present with deficits in syntax, similar to children with Specific Language Impairment (SLI). For example, Kjelgaard & Tager-Flusberg, (2001) found significant language and communication differences in the verbal behavior of HFA children with some of the children scoring in the normal range and others, in the profoundly language impaired range, even in the presence of a Full Scale IQ > 85. High-functioning individuals with autism are often referred to having *fluent autism.* The spontaneous speech and language characteristics reported include fluent narrative speech, frequently with grammatically correct sentences, the use of repetitive topics reflecting a narrow range of interests, odd phrasing and word choices, and abnormalities in prosody (Rice et al., 2005).

Currently, two theoretical perspectives on the nature and cause of language impairment in individuals with HFA appear in the literature. One perspective is that the abnormalities in communication and language functioning can be explained by the presence or absence of syntactic deficits; those with impairments in syntax are more likely to also demonstrate additional language difficulty in other linguistic domains, principally semantics (Condouris, Meyer, & Tager-Flusberg , 2003; Kjelgaard & Tager-Flusberg, 2001). The other perspective is that the language and communication characteristics seen in HFA are consistent with a generalized deficit in complex information processing abilities that preserve basic speech and language functioning, yet impact higher level propositional language (Minshew & Goldstein, 1998; Minshew, Goldstein, & Siegel, 1995; Minshew, Goldstein, Taylor & Siegel, 1994). These separate viewpoints have generated research investigating the nature of and causal linkages to the profile of language variability and impairment of individuals with HFA, each with compelling findings to support the separate theoretical framework (Condouris, Meyer, & Tager-Flusberg, 2003; Landa and Goldberg, 2005; McGregor, Berns, Owen, Michels, Duff, Bahnsen & Lloyd, 2011; Minshew, Goldstein, & Siegel, 1995; Minshew, Goldstein, Taylor & Siegel, 1994) .

In addition to variability in oral language functioning, significant variation is also seen in reading ability in verbal children with HFA . Some individuals with HFA present with excellent phonetic decoding ability yet poor comprehension, while others struggle with phonetic decoding of unfamiliar words , perhaps contributing to difficulties with reading comprehension (Nation, Clarke, Wright & Williams, 2006). Variability in the comprehension and use of spoken language and reading has compelling implications for the academic success of school-age children with HFA. Children with HFA are often included within the regular classroom to facilitate access to the general education curriculum and to gain social interaction with peers. High-Functioning children with autism are faced with increasingly more complex discourse processing demands as each grade progresses (Cazden, 1988). The language of the curriculum often is complex and abstractly removed from the language used in social control and interaction placing additional cognitive -linguistic demands on the child with HFA in the classroom (Loveland & Tunali-Kotoski, 2005).

The purpose of this chapter is: 1) to review the research on HFA from the two theoretical perspectives on the nature of and possible causal explanations to language impairment and variability in *fluent autism* and , 2) to examine the current research on literacy in school-age children and adolescents who meet the clinical and psychometric profile of HFA. A third goal is examine the association between oral language and literacy in children and adolescents with HFA in order to better understand the language functioning in HFA across these domains, and to gain insight into why many children with HFA demonstrate reading comprehension difficulty . It is important to consider both the oral language and literacy ability in individuals with HFA for two reasons. First, by definition, children with HFA have a history of speech and language delay and impaired communication seen in the preschool years. Even if the child has achieved well developed verbal ability by 5- years of age, deficits in oral language ability initially seen in the preschool years may contribute to uneven performance in later academic functioning, such as reading ability, reported in children with HFA. Second, there is a strong relationship between oral language competence and reading in typically developing and in non-autistic language-impaired populations. Aspects of oral language ability, including, phonology, syntax, narrative ability, metalinguistic awareness, and vocabulary have been shown to be critical predictors of reading acquisition and literacy achievement (Catts, Fey, Zhang, & Tomblin, 1999; Nation, Clarke, Marshall & Durand, 2004; Roth, Speece, Cooper, De La Paz, 1996; Snyder & Downey, 1991). Therefore, it is seems likely that children with HFA will demonstrate significant variability in literacy as well as reported variability in oral language and communication.

In order to meet the objective of this review, literature was reviewed that examined either oral language or literacy functioning in school-age children or adolescents with HFA. Studies were included if the participants met the specific inclusionary criteria of a diagnosis of autism and an IQ criterion > 70 (either Full-Scale, Verbal, or Performance IQ) , or if high-functioning autism could be extrapolated from psychometric data reported for any group of children with ASD included in a study on language or literacy functioning. Careful attention was paid to studies on spoken or written language ability in children with autism that included direct assessment using standardized tests assessing aspects of receptive and expressive language particularly in the lexical/semantic and syntactic domains of language. This decision is in keeping with the recently proposed and recommended assessment framework for younger children with ASD by experts on language disorders in autism convened by the National Institute on Deafness and Other Communication Disorders (NIDCD) (Tager-Flusberg, Rogers, Cooper, Landa, Lord, Paul, et al., 2009). Likewise, studies on literacy functioning and achievement in children with HFA were carefully screened for an emphasis on critical aspects of reading competency identified by the Report of the National Reading Panel (NIH, 2000), including phonological awareness, word reading accuracy, and reading comprehension.

2. Language abilities of children with high-functioning autism: Lexical–semantic and morphosyntactic abilities

There is a general consensus in the literature on language profiles of verbal children with autism that aspects of language form, including phonology and basic grammar and sentence structure syntax, are often areas of relative strength, followed by lexical- semantic abilities reflected in receptive and expressive single-word vocabulary measures of language content. Higher order morphosyntactic skill, narrative discourse, and pragmatic competence are more profoundly impaired (Rice, Warren, & Betz, 2005; Tager-Flusberg, 1999; 1981). Speech articulation is essentially spared (Kjelgaard & Tager-Flusberg, 2001; Tager-Flusberg, 2003) with the exception of prosody, phrasing, and consonant distortions on later acquired phonemes (Shriberg et al., 2001). There is recent compelling evidence that many verbal, high-functioning children with *fluent autism* also have significant deficits in complex morphosyntactic ability as well as higher level lexical semantic processing, and that the relative strengths or weaknesses in these language domains contribute to each other, effecting overall language competence (Condouris, Meyer, & Tager-Flusberg, 2003; Kjelgaard & Tager-Flusberg, 2001).

Kjelgaard & Tager-Flusberg, (2001) identified a subgroup (N = 44) of children as high-functioning autism in their study of a larger heterogeneous group of 89 children, between the ages of 4-14 years (M = 7.4). The diagnosis of autism was validated using the *Autism Diagnostic Interview-Revised* (Lord, Rutter, & LeCouteur, 1994) and the *Autistic Diagnostic Observation Schedule-Generic* (Lord, Risi, et al., 2000). The majority of the children in the sample were school-age into young adolescence (M (*age*) = 7.4 ; range 4-14 years). Intelligence was assessed using the *Differential Abilities Scale* (Eliott, 1983). All the children were given a battery of standardized tests including the *Goldman-Fristoe Test of Articulation* (GFTA), (Goldman & Fristoe, 1986), the *Clinical Evaluation of Language Fundamentals* (CELF-III, Semel, Wiig & Secord, 1995), or, depending on the age, the *Clinical Evaluation of Language Fundamentals* – Preschool (CELF-P; Wiig & Semel, 1992), the *Peabody Picture Vocabulary Test*-III (PPVT) (Dunn & Dunn, 1997), the *Expressive Vocabulary Test* (EVT) (Williams, 1997). Overall, the children scored highest in the areas of speech articulation, receptive vocabulary, and expressive vocabulary , indicating that these speech-language areas are not as impaired for the ASD group. Speech articulation and single-word vocabulary ability are considered by some researchers as basic mechanical aspects of language functioning, and not reflective of higher –language processing (McGregor, Berns, Owen, Michaels, duff, Bahnsen & Lloyd, 2011). Amend: (McGregor, Berns, Owen, Michaels, Duff, Bahnsen & Lloyd, 2011). Only 49 % (N= 44) of the children were able to complete the CELF, a standardized language measure considered to assess more complex aspects of lexical-semantic and morphosyntactic processing and production. For example, one of the core measures of language content on the CELF for children 5-12 years is a task that requires the child to follow increasingly more complex directions requiring logical operations. Older children (e.g. 9-12 years) complete a task that measures the ability to understand and explain the relationships between words based on semantic class or word meaning, and analyze or define words. Similarly, the syntactic domain is measured by tasks of sentence imitation and sentence formulation that taps the ability to formulate grammatically and semantically complete sentences.

The cognitive profile of children completing the CELF indicated significantly higher Full-Scale IQ scores (M = 85, D= 17.3) than for the children who could not complete the CELF (M= 50; SD 16.8). This pattern of higher FS IQ scores for the CELF completers also held for the standard scores on the two vocabulary measures, the PPVT, measuring receptive vocabulary, and the EVT, measuring expressive vocabulary, with higher performance in these as well. Based on the Full Score IQ in the average range (M = 85) and the cognitive-linguistic ability to complete the CELF, Kjelgaard & Tager-Flusberg, (2001) considered this group of ASD children to be the *high-functioning* children with autism.

Kjelgaard & Tager-Flusberg, (2001) examined the performance by the children with HFA on the CELF and noted that the composite score for Expressive Language was better than the Receptive Language Composite Score, suggesting that the fluent speech and language observed in many children with HFA may mask difficulty in understanding and processing more complex aspects of language. Kjelgaard & Tager-Flusberg, (2001) also divided the HFA group into three subgroups by overall standard score performance on the CELF: *normal* language learners with an overall language quotient in the normal range (SS $\geq$ 85), *borderline* language learners (SS = 70-84), and *impaired* language learners (SS < 70). The group identified as *normal* language learners (SS = $\geq$ 85) scored within the average range on all speech and language areas measured, including receptive vocabulary (PPVT), expressive vocabulary (EVT), speech articulation (GFTA), and higher-order semantic and morphosyntactic abilities measured by the CELF. In addition, the normal language group demonstrated average ability to repeat novel phonological sequences as measured by the Nonword Repetition Test (NWRT). These normal language learners also had the highest Full Scale IQ as a group (FSIQ Mean = 93; SD = 16.52) 85). The group identified as *borderline* in language learning (SS = 70-84) had deficits in all aspects of language including receptive and expressive vocabulary, higher order semantic and morphosyntactic measures , and below average performance in phonological working memory, measured by the NWRT. However, speech articulation ability was within the average range of performance for age for the borderline language group. The Full Scale IQ for the *borderline* language learning group was in the low end of the normal range (FSIQ Mean = 85; SD = 13.86). Finally, the group identified as most language impaired (SS < 70) showed significant language deficits across lexical-semantic and morphosyntactic domains with accompanying deficits in NWRT. This group also had the lowest IQ (FSIQ = 58; SD = 18.76).

According to the IQ criterion for a diagnosis of HFA, this final language impaired group cannot be considered as HFA since their FSIQ mean is < 70; although some of the children in this impaired group may have had a FSIQ of 70 or greater, given the standard deviation. If we exclude the most impaired language group because of the IQ criterion, we are left with two subgroups of children with *fluent autism* who meet the IQ criterion for HFA, *normal* language learners, and *borderline* language learners. Therefore, two subgroups of HFA children can be identified via the IQ criterion in this study: a group that has a higher IQ and normal language learning, and a group with borderline language and low average IQ (M = 85). The *borderline* language group with low average FSIQ (M = 85; SD = 13.86) may also contain some children who score well within the average range for IQ (>90). The *borderline* language group of children with HFA displayed language impairments in both lexical-semantic and morphosyntactic domains, despite the appearance of fluent verbal ability and the ability to attend to a complete standardized measures of language functioning.

2.1 Differences in standardized testing versus spontaneous language function

In a follow-up study of the identified cohort group of 44 high-functioning children from the original Kjelgaard and Tager-Flusberg (2001) study , Condouris, Meyer, & Tager-Flusberg (2003) further investigated the lexical-semantic and grammatical domains of language functioning using both standardized measures and spontaneous language sampling . The 44 children with ASD in this study were the group initially described by Kjelgaard and Tager-Flusberg (2001) as the children with ASD who were able to complete the language testing. Recall that, as a group, the 44 children ranged in age from 4-to-14 years (M = 7;3), with IQ functioning above 80, although a wide range in scores was noted for both cognitive domains (VIQ: *M* = 84, range = 53-133; NVIQ: *M* = 90, range = 49-153). The purpose of the Condouris, et al. (2003) study was to compare the use of standardized measures of language with spontaneous language measures, since both types of assessment practices are widely used with children with developmental language delay. Higher level lexical-semantic and morphosyntactic knowledge was assessed using either the CELF-P for children younger than 6 years, or the CELF-III for children age 6 years and above. Natural language samples were also included in order to compare the results from the use of standardized measures of language function with spontaneous speech measures. Spontaneous language sampling was measured for MLU and number of differing word roots used (NDWR). Both spontaneous language measures (MLU and NDWR) demonstrated significantly below average performance for age, with children scoring 2 *SDs* below the reference database. Partial correlations, controlling for the effects of age and Nonverbal IQ, between standardized measures of lexical-semantic processing and morphosyntactic ability with natural spontaneous language measures of MLU and NDWR revealed that all correlations were positive, indicating that the majority of the verbal children with HFA have broad language deficits affecting lexical-semantic processing and morpho-syntactic ability, and that these two domains of language interact and predict language function.

2.2 Interaction between syntactic impairment and lexical-semantic functioning

Following the proposed linkages and associations between lexical-semantic processing and morphosyntactic processing, McGregor, Berns, Owen, Michels, Duff, Bahnsen & Lloyd (2011) sought to move beyond the descriptions of strengths and weaknesses in lexical-semantic and morphosyntactic domains and explore the interactive relationship between syntactic competence and breadth and depth of the semantic lexicon in two groups of children with HFA, one with syntactic deficits, and one group of HFA children without syntactic deficits (McGregor, Berns, Owen, Michels, Duff, Bahnsen & Lloyd, 2011). The study also included a group of non-autistic children with developmental language impairment (e.g. *specific language impairment,* SLI) in order to explore the overlap of language functioning in the two phenotypes. There were two control groups; one an age-matched , typically developing group (AM), and a younger syntactic-matched group (SM). All the children were between 9-to-14 yeas old and all had a Nonverbal IQ > 85, based on the matrices subtest of the *Kaufman Brief Intelligence Test*-2 (Kaufman & Kaufman, 2004). No Verbal IQ score was reported. Children with autism were identified as ASD language impaired (ASDLI) if they scored < 8 (e.g. at least 1 *SD* below the M) on the syntactic subtests (Formulated Sentences and Recalling Sentences) of the CELF—4 (Semel et al., 2003). Likewise, the group of children with SLI, also language impaired, scored more than 1 SD below the mean (e.g. < 8) on the syntactic subtests of the CELF-4. The non-syntactic impaired ASD group scored > 7 on the syntactic subtests of the CELF-4. Breadth and depth of lexical knowledge was assessed using two experimental semantic activities and standardized vocabulary tests, specifically the PPVT-III (Dunn & Dunn, 1997) and the Expressive Vocabulary Test (EVT) (Williams, 2007). The two experimental lexical-semantic tasks were verbal definitions and verbal association tasks. In addition, each participant completed an experimental measure of sentence production, using a sentence formulation format. Each of the three experimental measures used the same 40 concrete and abstract noun and verb stimuli that varied in frequency of occurrence. For the sentence production task, children were asked to produce a sentence for each of the 40 stimuli words; sentences were analyzed for syntactic complexity. The definition task required the child to generate a definition for each of the 40 word stimuli, while the association task asked the child to provide a word association for each word. Children's responses on both the definition and word association tasks were scored using scales from 0-3 for level of completeness, thus generating sensitive measures of depth of word knowledge.

Results showed that the ASDLI group produced fewer clauses during the sentence production task, similar to the SLI group, than the non-language impaired group of children with ASD . This finding was not surprising since the ASDLI and the SLI children were identified as having deficits in syntax prior to the experimental procedures. When breadth and depth of the semantic lexicon was considered, the children with ASDLI and SLI scored below average on the receptive vocabulary measure (PPVT-III), but showed greater deficits for expressive vocabulary, scoring more than one-standard deviation below average on the expressive vocabulary test (EVT) . The non-language impaired ASD group scored within the expected average range for age, much like the typically developing children. Likewise, the ASDLI and SLI groups showed shallow depth of word knowledge producing more incomplete or partially complete word definitions and less mature word associations than the ASD and age-matched typically developing children. A positive correlation was also found between expressive syntax as measured by the sentence formulation and sentence repetition tasks on the CELF-4 and depth of lexical knowledge as measured by the definition and word association tasks. The researchers concluded that the presence or absence of syntactic deficits in verbal, HFA children with ASD predict the breadth and depth of inherent lexical knowledge of the child. Not all children with HFA have syntactic deficits, but when they do, language impaired HFA perform similarly to SLI children and demonstrate sparse lexical semantic knowledge.

3. Language abilities of children with high-functioning autism: Executive function

Impairments in Executive Function (EF) in individuals with idiopathic autism have been hypothesized to be a causal link to the variability in language functioning seen in HFA. Executive function is evident in cognitive behaviors such as planning and cognitive flexibility, referred to as set-shifting; children with autism have been shown to demonstrate impairments in both aspects of EF (cf. Landa and Goldberg, 2005). Working memory, another feature of EF, has also been reported as impaired in individuals with autism (Bennetto, Pennington, & Rogers, 1996; Smith Gabig, 2008). Researchers hypothesize that impairments in EF are mirrored in specific aspects of language, such as complex syntactic and lexical-semantic processing , and that language variability and language competence can be predicted from executive functioning (Landa & Goldberg ; 2005).
A recent study by Landa & Goldberg (2005) examined language functioning relative to social functioning and executive functioning (EF) in 19 school-age children with idiopathic autism (*Mean Age* = 11; range 7.3-17.3), and a Full-Scale IQ in the average range (*M* = 109.7; range 81-139). Notably, there was a 9 - point difference between the Verbal IQ (*M* = 113.5; range 90-142) and the Nonverbal IQ scores (M = 104.6; range = 74-135), a difference considered to be indicative of discrepant cognitive functioning between domains for the group, as a whole, in the study (Black, Wallace, Sokoloff & Kentworthy, 2009). Landa & Goldberg (2005) studied two aspects of language function, expressive syntax and comprehension of figurative language , and three areas of EF:, *spatial working memory*, *planning*, and *cognitive flexibility* in children with HFA and two control groups, one age-matched group, and one IQ matched group. The researchers chose to examine expressive syntax through a sentence formulation task, hypothesizing that complex sentence formulation would be impaired in the HFA children and that compromised syntactic ability would be related to poor performance on EF tasks of spatial memory, planning and cognitive-flexibility. Likewise, a task of figurative language was chosen to evaluate abstract language processing and cognitive flexibility in EF, the ability to shift from one meaning of a word or phrase to another meaning. In addition, the researchers hypothesized that social functioning would also be related to language competence. The researchers hypothesized that children with HFA would perform less well than age-matched, typically developing counterparts on the language and the EF measures , and that specific aspects of language would be correlated with EF and social function.
The Formulated Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R; Semel, Wiig, & Secord, 1987) was administered to assess the ability to form grammatically and semantically correct sentences. The Test of Language Competence (TLC; Wiig & Secord, 1989) was used to assed the comprehension and interpretation of metaphors and figures-of-speech. Executive function was assessed using selected tasks from the *Cambridge Neuropsychological Test Automated Battery* (CANTAB; Cambridge Cognition, 1996). The subtests used were spatial working memory (SWM), the *Stockings of Cambridge* test, (a measure of spatial planning), and the *Intra-Dimensional/Extra-Dimensional Shift* task to assess cognitive flexibility (set-shifting). All three EF tasks were administered electronically using a PC with a LCD flat panel display touchscreen (cf. Landa & Goldberg , 2005, for a complete description of tasks and procedures). Social functioning was examined using the Social Domain summary score of the Autism Diagnostic Interview (ADI) or the Autism Diagnostic Observation Scale (ADOS).

Results were mixed; the children with HFA showed variable performance on both language measures and measures of EF, ranging from unimpaired to impaired functioning in both domains. The HFA group, as a whole, scored significantly below age and IQ matched controls on the measures of expressive grammar/syntax and understanding and use of figurative language. The investigators noted that, despite having intact IQ (Full Scale, Verbal, and Performance IQ), the majority of the children in the HFA group were impaired in both these areas of language function. The authors suggest that the integrity of the grammar system of children with HFA may be compromised even in the face of fluent verbal ability and the use of full sentences in spontaneous speech. Likewise, impaired abstract language processing, evident in difficulty understanding and interpreting non-literal metaphors and figures-of-speech, is also compromised and may contribute to social dysfunction and poor reading comprehension often seen in children with HFA.
As stated, the HF group also demonstrated more difficulty on all aspects of EF measured in this study including spatial working memory (SWM) , planning, and cognitive flexibility. On the SWM task, children needed to search for a blue token in boxes and to collect enough blue tokens to fill a container on the right-side of the screen. Children with HFA made more within-search and between –search errors, often returning to a previously searched box, a form of perseveration and poor search strategy. Similarly, the children with HFA had more difficulty with the planning task than the typically developing age-matched and IQ-matched groups of children. However, no significant difference between children with HFA and the age-matched or IQ control groups was noted on the cognitive flexibility task. Contrary to the original hypothesis by the researchers, that aspects of EF would be correlated with grammaticality and abstract language processing, no significant correlations were found between aspects of EF and the language measures. Nevertheless, the observed EF difficulty seen in children with HFA for planning and spatial working memory suggests that they have difficulty with frontally mediated task performance relative to age peers.

4. Language abilities of children with high-functioning autism: Neuropsychological perspective

In addition to examining the role of EF, other investigators explore language variability in HFA via a neuropsychological model of language that makes a distinction between basic, mechanical use of language and more complex language skills that require the application of procedural knowledge to complete, such as the language used while reasoning, analyzing, and inferencing (Minshew, Goldstein, Taylor, & Siegel, 1994; Minshew, Goldstein, Siegel, 1995). Minshew et al. (1995) hypothesized that the variability and scatter in language profiles seen in individuals with HFA is characterized by a distinction between intact mechanical versus impaired procedural language abilities that require more complex information processing. The investigators examined 62 individuals with HFA and 50 neurologically and psychiatrically healthy control subjects who met the same distribution of age and IQ as the HFA group. Individuals were included in the study if they had a Verbal and Full Scale IQ of at least 70, and showed academic achievement at the 2nd grade level in reading, spelling, and mathematical skills. The diagnosis of HFA was verified through evaluation of clinical history and current symptoms by a clinical expert using either the ADOS (Lord, et al., 1989) or the ADI-R (LeCouteur et al., 1989). The mean age for the autistic group was 17.79 (SD = 10), and the mean age for the control group was 16.91 (SD =

9.96). The mean Verbal IQ and Full Scale IQ for the HFA group was > 90 (VIQ = 94; SD = 16.9; Mean FSIQ = 93 , SD = 14.4), similar to the control group.
Tests requiring basic mechanical or procedural language versus complex information processing were chosen to test the hypothesis that individuals with HFA would perform differently between these two distinctive types of language function. Five language tasks were used to assess basic procedural use of language: Animal Naming (Goodglass & Kaplan, 1972), Controlled Oral-Word Association (Benton & Hamsher, 1976), and three basic reading subtests (Word Attack, Word Identification, Visual-Auditory Learning) of the Woodcock Reading Mastery Test-Revised (WRMT-R) (Woodcock, 1987). More complex propositional language functioning was assessed by two reading comprehension subtests of the WRMT-R (Word Comprehension, Passage Comprehension), four measures of inferencing and figurative language from the Test of Language Competence (TLC; Wiig & Secord, 1985), and two measures of attention and working memory from the *Detroit Test of Learning Aptitude-2* (DTLA-2; Hammill, 1985) , the Oral Directions and Word Repetition subtests. Table 1 contains the list of tests used to tap basic/mechanical language versus complex propositional language. Results of the study confirmed the hypothesis that individuals with HFA are unimpaired in basic, procedural language, yet demonstrate significant impairment in more complex, propositional language observed in impaired expressive formulation, verbal reasoning, and figurative language. Minshew and colleagues attribute the deficits seen in language and reading comprehension and in the understanding and use of complex language as reflective of broad deficits in information processing for individuals with HFA.

Mechanical or Procedural Language Skills	Complex Language Skills
Animal Naming	Test of Language Competence (TLC) • Ambiguous Sentences • Making Inferences • Recreating Sentences • Metaphoric Expressions
Controlled Oral Word Reading Association	Detroit Test of Learning Aptitude (DTLA) • Oral Directions • Word Recall
WRMT-R • Word-Attack • Word Identification • Visual-auditory Learning	WRMT-R • Word Comprehension • Passage Comprehension

Table 1. Tests Used to Assess Mechanical/Procedural Basic Language and Complex Language Skills (adapted from Minshew, Goldstein, & Siegel, 1995).

4.1 Summary of language abilities in HFA

In summary, children with HFA vary considerably in language functioning with some children demonstrating normal language abilities, and some exhibiting impaired language functioning, scoring one or two standard deviations below expected standard scores for chronological age on language tasks measuring complex language processing. Severe or profound language impairment is not found in the profile of language performance in high-functioning, verbal, fluent autism. Based on the studies reviewed, a number of trends can me seen in the research about language functioning in *fluent autism*:

- Children with HFA are more likely to be able to attend to and complete standardized language and academic achievement testing.
- Intact verbal ability is often associated with a Higher Full Scale and /or Verbal IQ. Children with HFA and a FSIQ > 90 may present with language abilities in the normal range on standardized testing , including the areas of lexical-semantic processing and morphosyntactic abilities
- A FSIQ between 70-84 is often accompanied by borderline to impaired language functioning in both lexical-semantic and morphosyntactic domains.
- A pattern of better expressive language composite scores over receptive composite scores may be seen on the CELF, suggesting that the overall fluent verbal ability of children with HFA appears better than the ability to understand and process language. This trend may be reversed when performance on receptive/expressive vocabulary tests is examined. When comparing the PPVT and the EVT standard scores, language impaired HFA children score significantly poorer on the expressive measure than the receptive measure suggesting that naming and retrieving labels for objects/actions is more difficult for language impaired children with HFA.
- The presence or absence of syntactic deficits predicts overall language competence. Children with HFA who are display syntactic ability in the normal range, evidenced by the ability to formulate grammatically and semantically correct sentences, also demonstrate adequate lexical-semantic processing for vocabulary, word associations, and definitions. Children with HFA who have deficits in syntax usually demonstrate difficulty in the lexical-semantic aspects of language competence as well, including shallow breadth and depth of word knowledge.
- Language ability may be intact for basic, procedural language function, yet impaired for more complex language abilities such as understanding and using figurative language, completing complex oral directions, recalling words, and reading comprehension.

5. Variability in word reading accuracy and reading comprehension in children with HFA

Two skills are necessary for children to become independent readers: they must be able to decode the individual words on the page and they must be able to comprehend the text. The Simple View of Reading (Gough & Tunmer, 1986; Hoover & Gough, 1990) defines reading ability as a function of decoding and language comprehension skills. Word reading accuracy refers to single word reading in general, either by sight word recognition, word reading via the phonetic decoding of graphemes to phonemes, (e.g. sounding-out the printed word to its phonological corollary), or by determining the word pronunciation through structural analogy (Ehri, 1998). Text comprehension refers to the cognitive processes involved in transforming print into meaning. (Coltheart, 2006). Although intricately related, there is evidence that skill in word reading recognition is necessary, but not sufficient, for reading comprehension. Individuals may demonstrate adequate and fluent word recognition yet have poor reading comprehension referred to as a specific comprehension deficit (Cain & Oakhill, 2007). Despite the importance of literacy to academic functioning and social achievement, relatively few studies focus on reading ability in children with HFA.

5.1 Word reading accuracy

Research is beginning to emerge in the literature that shows word reading ability is quite variable within the ASD population (Nation, Clarke, Wright, & Williams, 2006; Smith Gabig, 2010). There is a common belief in educational settings and clinical practice that children and adolescents with ASD have advanced word reading, referred to as *hyperlexia*, yet have significant difficulty in reading comprehension. However, recent research challenges this notion of advance word reading skill in ASD (Nation et al, 2006; Smith Gabig, 2010). A recent investigation by Nation, et al. (2006) focused on patterns of component reading skills (e.g. single word identification, nonword decoding, reading text accuracy, and text comprehension) in 41 children with ASD between 6 and 15 years (Mean age = 10.8). Intellectual functioning was measured via the *Block Design* subtest from the *Wechsler Intelligence Scale for Children* (WISC-III; Wechsler, 1992), a measure of nonverbal intelligence. The Block Design mean score for the group was 8.4 (SD = 5.58) , based on a subtest mean of 10, SD +/- 3, indicating that , as a group, the participants scored in the normal range of nonverbal intelligence. However, there is a large standard deviation, so some of the children scored in the mentally retarded range for nonverbal intelligence, other scores in the normal range or above for nonverbal intelligence. Although a HFA subgroup of children cannot be extrapolated from this study, it is included here as a general discussion of overall patterns of reading ability in a heterogeneous group of children with ASD, and nonverbal intellectual ability in the average range. Sixteen of the subjects with ASD met the diagnostic criteria for autism, while 13 met the diagnostic criteria for atypical autism. The remaining children with ASD were considered as Asperger's syndrome. The investigators measured word reading, nonword decoding ability, reading connected text, and reading comprehension. There were two measures of oral language: a receptive vocabulary measure and an oral language comprehension task taken from the WISC-III. Nine (22%) of the children were completely unable to read at all; these children were excluded from further analyses. The 32 participants who were able to complete the reading assessment battery showed word reading accuracy (e.g. word reading, nonword decoding, text reading) in the normal range , although significant variability in performance was noted in the range of scores and in behavioral observation. Some children with ASD show accurate word reading yet were poor comprehenders, other children showed poor word reading ability for real words and nonwords, and some were able to read real words adequately, but could not apply phonetic decoding skills for nonwords (Nation, et al., 2006). Nation and her colleagues speculated that children with autism may have difficulty applying phonological coding strategies when faced with unfamiliar letter sequences as in a nonsense word reading , and may be relying on a visual association or visual memory when asked to read aloud words in a word identification reading task.

Discrepancies in word reading accuracy and weak phonetic decoding have also been reported for children with HFA (Smith Gabig, 2010). Fourteen school-age children with autism, and 10 age-matched, typically developing (TD) children between 5-7 years, were given two measures of single word recognition during reading, the word identification (WID) subtest and the phonetic decoding of nonwords, or word attack (WATTK) subtest from the Woodcock Reading Mastery Test-Revised (Woodcock, 1987). The children with HFA demonstrated nonverbal intelligence in the average range (M = 96; SD = 8), measured using the short nonverbal cognitive composite from the *Differential Abilities Scale (DAS*), (Elliot, 1983). Two measures of phonological awareness ability were also given to the two groups of children, the *elision* task (ELI) and a *sound blending* task (BLW) from the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1999). Receptive vocabulary and speech articulation skill was also measured using the *Peabody Picture Vocabulary Test-Revised*, (PPVT-R, Dunn & Dunn, 1997) and the articulation subtest of the *Test of Language Development –Primary* (TOLD-P; Newcomer & Hammill, 1997).

Word reading accuracy scores for WID and WATTK were in the average range for both groups of children, and no significant difference was seen for word reading accuracy between the HFA and the TD groups. However, children with HFA showed a statistical performance bias for single real word reading over phonetic decoding in nonword reading, a pattern not seen in the typically developing children. Although scoring within the average range of expected performance for age, clinical observation of nonword reading indicated that the children with autism struggled more with reading nonwords than real words, suggesting a divergence in ability between the direct lexical route to reading words and the indirect, non-lexical route involving a phonological recoding of an unfamiliar, written word (Coltheart, 2006; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). A closer investigation of the individual word recognition profiles of each child with autism by Smith Gabig (2010) revealed that 60% (n = 9) struggled while reading nonwords, characterized by slow and labored decoding attempts that often were not accurate. Two of the children (22%) attempted to parse the individual graphemes/phoneme relationship and sound-out the nonword but could not blend the individual phonemes into a whole. The remaining two children (22%) were able to decode the nonwords rapidly and efficiently.

Adequate word recognition has also been demonstrated in older, high-functioning adolescents with autism. Minshew et al. (1994) examined academic achievement, including reading ability, in 54 high-functioning (FSIQ Mean = 95; SD 15.5) adolescent males and an age, gender, and cognitively-matched control group of 41 typically developing males. Reading ability was evaluated using the *Woodcock Reading Mastery Test-Revised* (Woodcock, 1987) and subtests from the *Kaufman Test of Educational Achievement* (Kaufman & Kaufman, 1995). They also included measures of complex oral language processing including the Oral Directions and Word Sequences subtests form the *Detroit Test of Learning Aprtitude-2* (Hammill, 1985). Results indicated that the HFA adolescents performed similarly to their age-matched counterparts in both word identification (sight-word vocabulary reading) and word attack (decoding of nonwords). However, contrary to the results reported by Nation et al. (2006) , and Smith Gabig, (2010) Minshew and colleagues found that nonword reading was slightly better than sight-word identification in the HFA adolescents, suggesting a heightened ability to apply phonetic analysis skills to decode nonwords. As expected, performance on the passage comprehension measure was significantly different between the two groups, with the adolescents with autism scoring significantly lower than the age-matched, typically developing cohorts. The HFA group also scored lower and statistically different on the oral language measures (e.g. Oral Directions ; Word Sequences *DTLA-2*). As noted previously , Minshew and colleagues found significant differences for composite scores that contrasted basic, mechanic/procedural skills versus more complex language comprehension skills. Both oral and reading composite comprehension scores were lower for the HFA group relative to composite scores for basic mechanical skill, exemplified in word identification and word decoding in reading.

5.2 Phonological awareness

Research over the past 30 years has shown that to be a good and accurate word reader or decoder, one must have a strong conceptualization of the underlying phonological structure of words (cf. National Reading Panel, 2000). Conscious awareness of the discrete sounds in words and the ability to manipulate sounds in words is critically tied to the development of word recognition and decoding ability in reading (Bradley & Bryant, 1983; Fox. & Routh , 1975; Liberman, Shankweiler, et al., 1974; Stanovich, 1986; Swank & Catts, 1994; Wagner & Torgesen, 1987). In order to acquire accuracy and speed in word recognition while reading, a child must apply knowledge of the sound structure represented by letters and letter combinations seen in print. Phonological awareness has been shown to play a critical role in both the decoding of unfamiliar words but also in the expansion of a sight-word vocabulary that can be easily recognized orthographically and transformed into its spoken form (Ehri, 1998; Share & Stanovich, 1995). Although phonological awareness plays a central role in development and accuracy of word reading ability little direct evidence exists on the emergence of phonological awareness ability and its relationship to word reach development and accuracy in children with ASD.

Children with HFA have also been shown to score below age-matched, typically developing children on tasks of phonological awareness (Smith Gabig , 2010). Fourteen children with high-functioning autism were given two measures of phonological awareness, a sound blending task and an elision task, which required the child to segment words into smaller parts. The children were also given two word reading measures from the WRMT-R (Woodcock, 1987) single word reading (Word Identification) and the phonetic decoding of nonwords (Word Attack). All participants were also tested for receptive vocabulary, using the PPVT-R (Dunn & Dunn, 1997), and speech articulation.

Dunn & Dunn, 1997), and speech articulation. The children with HFA scored significantly below their age-matched counterparts for phonological awareness and receptive vocabulary. There was no difference between the HFA group and the TD children on the word reading measures, or speech articulation. Also, no correlation was found between measures of phonological awareness and measures of word reading for the children with HFA, unlike the TD group who demonstrated a strong relationship between phoneme segmentation ability on the elision task and phonetic decoding of unfamiliar nonwords. Research on typically developing children has shown a strong and predictive relationship between phoneme awareness and word reading ability (Liberman, et al., 1974; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987).

Phonological awareness is a metalinguistic skill that may be inhibited in development for children with autism. Perhaps there are linguistic factors that may influence the development of phonological awareness. In the Smith Gabig (2010) study, a measure of receptive vocabulary (PPVT-R; Dunn & Dunn, 1997), was significantly related to performance on the elision task of phonological awareness for the children with HFA ($r = .62$, $p < .01$). The positive relationship between receptive vocabulary score and performance on the elision task for the HFA children suggests that reduced vocabulary size may hinder and delay the development of more cognitively demanding phonological analysis skills by the children with autism. There is increasing evidence that vocabulary size and phonological similarity among words in the lexicon helps to explain individual differences in aspects of phonological awareness, in typically developing children (Metsala, 1997; Metsala, 1999; Metsala & Walley, 1998; Rvaachew, 2006; Service, 2006). Evidence for this theoretical framework is seen in studies that demonstrate that typically developing children are sensitive to the phonotactic probability of nonwords (Edwards, Beckman, & Munson, 2004). Phonotactic probability refers to the likelihood that sublexical sequences of sounds may occur in a lexical item and is related to stored phonological representations and abstractions of lexemes in the lexicon. As children's vocabulary increases, their stored representations of possible phonetic sequences become more robust and defined, facilitating the phonological parsing words. In this study, the children with autism had lower overall receptive vocabulary scores than the typically developing children, consistent with the extant research demonstrating reduced vocabulary size for age (Kjelgaard, & Tager-Flusberg, 2001; Tager-Flusberg, 2003). This limitation in oral language functioning may have a significant impact on the development of phonological awareness ability in the children.

5.3 Reading comprehension

Reading comprehension is the cognitive ability in which meaning is assigned to written text. It is often described as an interactive process between the reader, the text, and the context (Cain & Oakhill, 2007; Whittaker, Gambrell, & Morrow, 2004). In order to comprehend written text, one must construct meaning of individual words, phrases, and sentences and integrate smaller aspects of meaning into the whole, constructing the larger meaning contained within the connected text. As one reads, one draws upon general knowledge to help process text and construct meaning. Children with autism often demonstrate reading comprehension difficulty, despite adequate word reading ability (Nation et al., 2006). Two factors may influence reading comprehension and literacy in children with autism. One factor is oral language competence, especially competence in the structural aspects of language (phonology, morphology, and syntax). The other factor as a possible source of variability in literacy achievement and reading comprehension is cognitive deficits (Norbury & Nation, 2010). Nation et al. (2006) reported significant variability in reading comprehension in 32 high-functioning children with autism, with the majority of the children (65%; N = 20) showing moderately impaired reading comprehension scores 1 SD below the expected mean, while the remaining 12 children (N = 38%) demonstrating significantly impaired reading comprehension, scoring more than 2 SD's below expected norms for age. Nation et al. divided the group of children into two groups, those scoring more than 2 SD below the mean (*Poor Comprehenders* ; SS < 85) and a group scoring 1 SD below expected performance for age (*Skilled Comprehenders* ; SS > 85. *Poor Comprehenders* showed adequate word reading accuracy, yet displayed significant impairments in oral language measures, (e.g. receptive vocabulary, oral comprehension) and low average nonverbal ability (Mean = 7.7; SD = 6.6) compared to the *Skilled Comprehenders* who demonstrated accurate word reading ability, as well receptive vocabulary and nonverbal ability in the average range. Thus, it appears that oral language competence and average cognitive ability bodes better for reading comprehension ability in children with HFA.

5.4 Influence of oral language competence and literacy

A recent study by Norbury & Nation (2010) directly addressed the question of the influence of oral language competence to reading comprehension and word reading accuracy in children with HFA. The researchers examined two phenotypes of individuals with HFA: one group with age-appropriate structural language (ALN), and a group with structural language deficits (ALI). Twenty-seven adolescent males were recruited for the study.

Thirteen adolescents with HFA were identified as language impaired via clinical history and current testing, scoring at least -1.25 SD on the Recalling Sentences subtest of the CELF (Semel, et al., 2003). The remaining 14 HFA adolescents demonstrated normal language functioning. Nonverbal ability was in the average range for both groups of adolescents with HFA. Nineteen age-matched and cognitive-matched typically developing adolescents were also recruited. The researches measured word reading ability, text reading accuracy, and reading comprehension using standardized test. Experimental measures were used to explore the adolescents' ability to use integrative and inferential comprehension monitoring processes while reading. Oral language competence was assessed for receptive vocabulary, nonword repetition, and oral language comprehension. Results revealed that language status was related to accuracy in word reading. The ALI group showed lower word reading and decoding ability than the ALN group, yet the ALN group also scored lower than the TD control group, suggesting that in addition to language status, group status influences word reading ability. In addition, language status also influenced comprehension monitoring and inferencing with the ALI group scoring significantly lower than the ALN and TD groups. Further analysis revealed that oral language competence uniquely influenced reading comprehension, beyond any variance accounted for word-reading accuracy alone. It appears that oral language competence uniquely contributes to reading comprehension.

5.5 Summary of variability in word reading and reading comprehension

High-functioning children with autism demonstrate variability in reading skill with some individuals able to read and decode words accurately with good passage comprehension, while others demonstrate a discrepancy between the domains of word reading accuracy and comprehension, with poor comprehension for connected text. Although word reading accuracy for sight words and for phonetic decoding of nonwords appears average for age in the HFA children, several studies have noted that phonetic decoding of nonwords is weaker, or less developed, than single word reading (Nation et al., 2006; Smith Gabig, 2010), although one study (Minshew et al., 1994) reported the reverse finding, that nonword reading had an advantage over real word reading. From a neuropsychological perspective, word reading accuracy is considered a basic/mechanical, procedural skill (Minshew et al., 1994; 1995) while text comprehension is considered as complex information processing. The significant contribution of oral language competence to reading comprehension cannot be ignored. HFA adolescents with structural language impairment are at high risk for impaired reading comprehension and its component skills, such as comprehension monitoring and inferencing.

6. Overall conclusions: Variability in language and reading

Significant variability is seen in language and literacy functioning in children with HFA, influenced by intellectual ability and oral language competence. Verbal children meeting the IQ criterion to be considered as having HFA demonstrate one of two oral language profiles: intact oral language ability or mild to moderate oral language difficulty in the domains of lexical –semantic and morphosyntactic processing. Those children with HFA and intact oral language functioning also score in the average to above average range for intellectual functioning. Lower intellectual achievement, in the low average or below average range (yet absent mental retardation), is associated with language deficits. Likewise, oral language competence and cognitive ability influence word reading accuracy and reading comprehension in HFA. It appears that deficits in receptive vocabulary and complex oral language processing, as well as below average nonverbal cognitive ability (absent mental retardation), are associated with variable performance on word reading accuracy, phonological processing, and poor reading comprehension. Skilled reading comprehenders demonstrate the opposite profile: accurate word reading ability, oral language in the average range, and average nonverbal intellectual achievement. What is not fully known is the relationship between the clinical history of the scope and severity of the symptom of speech language delay in the preschool years, later resolved or recovered, and language and reading functioning in the school-age child or adolescent with HFA. Do those children with HFA, with a clinical history of mild to moderate oral language delay and nonverbal intelligence in the average to above average range , go on to achieve adequate reading competence when oral language issues are recovered or resolved? Future research should address the trajectory of language development, overall language competence, and reading achievement associated with average to below average (absent mental retardation) intellectual functioning in children with HFA. Such research may inform us regarding those variables that most likely predict later average oral language and literacy functioning in children with HFA, and influence the intervention practices for children with HFA.

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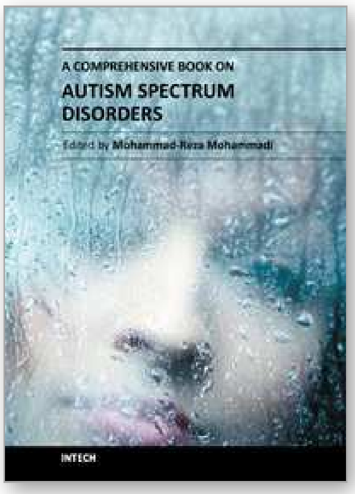

A Comprehensive Book on Autism Spectrum Disorders
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The aim of the book is to serve for clinical, practical, basic and scholarly practices. In twentyfive chapters it covers the most important topics related to Autism Spectrum Disorders in the efficient way and aims to be useful for health professionals in training or clinicians seeking an update. Different people with autism can have very different symptoms.Â Autism is considered to be a â€œspectrumâ€ disorder, a group of disorders with similar features. Some people may experience merely mild disturbances, while the others have very serious symptoms. This book is aimed to be used as a textbook for child and adolescent psychiatry fellowship training and will serve as a reference for practicing psychologists, child and adolescent psychiatrists, general psychiatrists, pediatricians, child neurologists, nurses, social workers and family physicians. A free access to the full-text electronic version of the book via Intech reading platform at http://www.intechweb.org is a great bonus.

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