Language comprehension and production in Croatian children with autism spectrum disorder (pre-reading period)

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ABSTRACT

Language comprehension and production in the pre-reading years significantly influence the acquisition of reading skills. This study compared differences in pre-reading skills between 10 children showing typical development and 10 children with high-functioning autism (HFA) or Asperger syndrome speaking Croatian, a morphologically rich language for which few studies on acquisition of pre-reading skills have been conducted. Children 5-7 years old were tested using the Peabody Picture Vocabulary Test (PPVT-III-HR), Test for Reception of Grammar (TROG-2:HR), and the Teddy Test for Expression of Semantic Bonds and Morphological Closure. The two groups performed similarly on the PPVT-III-HR and TROG-2:HR tests, while typically developing children performed significantly better on the Teddy Test. This differential performance appears to be due, at least in part, to defects in expression of semantic connections, grammar difficulties, and other linguistic specificities documented in children with HFA or Asperger syndrome, such as idiosyncratic language use, neologisms and meticulous language.

Key words: prereading skills, language comprehension, language production, autism spectrum disorder, high-functioning autism, Asperger syndrome

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1. INTRODUCTION

Reading is a complex language skill crucial for social and professional life and intertwined with other developmental areas such as attention, memory, language and motivation. Reading is a cognitive psycholinguistic activity, but it is also a social activity (Anderson et al, 1985) that depends, in part, on exposure to print and interest in books within the family environment. Interest in print, phonological awareness, vocabulary, narrative ability, and letter naming are pre-reading skills crucial for acquisition of reading and writing abilities These reading abilities involve decoding as well as comprehension, which are therefore important to assess in children who face problems with language acquisition and reading. For example, children with autism spectrum disorder (ASD) are a heterogeneous group with deficits of varying degrees in communication, language and (pre-)reading skills (Tager-Flusberg 2006). Children with Asperger syndrome or high-functioning autism (HFA) have average or above-average cognitive ability but also show key features of ASD (American Psychiatric Association 1994), and so are grouped with other types of ASD in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). When reading, children with Asperger syndrome can show appropriate decoding skills and so can understand facts, but they have difficulties drawing conclusions (Myels & Simpson 2002). Myles and Simpson (2002) found that children with Asperger syndrome may present seemingly appropriate verbal expression but perform significantly less well on written tasks, and they experience significant difficulties with problem-solving and language-based critical thinking. It can be difficult for them to understand oral messages and come up with logical solutions in everyday situations. Their meticulous style, seemingly advanced vocabulary and ability to recall words „mask" their limitations in higher-level thinking and understanding.

Children with Asperger syndrome or HFA acquire phonology and syntax as typically developing children do. For example, Paynter and Peterson (2009) found that children with Asperger syndrome or HFA performed as well as typically developing children on the Peabody Picture Vocabulary Test (PPVT) and Test for Reception of Grammar (TROG). However, these children show deficits in pragmatics (using language in a social context), semantics (acquiring multiple meanings) and prosody (atypical pitch, emphasis and rhythm) (Atwood 1998). Generally, children with ASD rely on gestalt language processing that leads to the impression of sophisticated language skills, but deeper assessment can reveal less sophisticated language understanding and phrasal structures. For example, children with Asperger syndrome can have a large word repertoire, but they use it stereotypically in a particular context and rarely demonstrate syntactic flexibility, meaning that they fail to adjust messages to particular social contexts.

In their study of children with Asperger syndrome or HFA, Noterdaeme et al (2010) noted that HFA was associated with significant impairments in expressive language (vocabulary and grammar) and receptive language (understanding of words and sentences), based on performance on the TROG. Among children with Asperger syndrome, 30% had clear deficits in receptive language, even though parents reported typical or above-average early language development. In their study of children with Asperger syndrome, Saalasti and al (2008) found that they understood oral demands significantly less well than typically developing children, which may relate to impairments in self-regulation, planning and translating information into motor activities.

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Children with ASD also employ neologisms and show idiosyncratic use of language, employing standard words or phrases in an atypical yet context-appropriate way (Volden & Lord 1991). For example, the child may say that he „*od-sprema igračke*" („un-put toys away") to indicate that he takes toys out of the toybox, or he may refer to the elbow as the „ankle on the hand". Often these idiosyncratic uses of language involve phrases typical for adults but not children; as a result, the children's sentences can sound very „polished" and detailed, yet unnaturally precise and too literate.

The pre-reading language impairments of children with ASD appear to translate into difficulties acquiring reading skills. Children with HFA have decoding skills comparable to those of typically developing children, but they show deficits in decoding non-words, in understanding language and in comprehending what they read (Nation, Clarke, Wright and Williams, 2006., Randi, Newman and Grigorenko, 2010, Šimleša & Ljubešić 2009). In fact, hyperlexia – in which decoding skills outstrip reading comprehension – is present in many children with ASD. These deficits in reading comprehension lead to lower scores on tests of vocabulary and language comprehension. The inability of children with ASD to apply their unusually rich lexical knowledge during task organization or execution influences later acquisition of reading skills, academic and social performance (Attwood 1998, 2015).

2. PURPOSE

Language comprehension and production were compared between Croatian children with HFA or Asperger syndrome and typically developing Croatian children. At the start of this research, we hypothesized that the two groups would show no significant differences in (1) receptive vocabulary, (2) grammar reception or (3) semantic bond understanding. In contrast, we hypothesized that (4) the two groups would differ significantly in language production (morphological closure).

3. METHODS

3.1 Participants

The study involved 10 Croatian children diagnosed with HFA or Asperger syndrome and 10 typically developing Croatian children, all enrolled in regular preschool programs. Children with HFA or Asperger syndrome had been diagnosed with ASD and were receiving professional support. They were also assessed as having average or above-average cognitive ability, defined as a score of at least 80 on a standard IQ test (Raven 1974). Children were 5-7 years old, when children in Croatia are preparing to enter the formal education system. The group of ASD children comprised 7 boys and 3 girls; the group of typically developing children, 3 boys and 7 girls. Oral consent was obtained from all children, and written informed consent was obtained from their parents or legal guardians. The study protocol was approved by the Research Ethics Committee of the Faculty of Education and Rehabilitation Science of the University of Zagreb.

3.2 Assessment instruments

All children were assessed in terms of language comprehension, language production and general cognitive abilites using the following standardized tests: the Croatian version of the most recent PPVT (PPVT-III-HR; Dunn, Dunn, Kovačević et al. 2013), the Croatian version of the latest TROG (TROG-II-HR; Bishop, Kuvač Kraljević, Hržica et al. 2003), the Teddy Test for Expressing Semantic Bonds (Friedrich 1998), the Morphological Closure subtest of the Illinois Test of Psycholinguistic Abilities, and Raven's Progressive Matrices (Raven, 1947). The PPVT-III-HR focuses on semantic aspects of language understanding; the TROG-2:HR, on grammar aspects of language understanding; the Teddy Test and Morphological Closure subtest, on language production; and the Raven's test, on cognitive ability.

3.3. Assessment procedure

Each participant was assessed individually during the regular preschool day. The entire assessment lasted approximately 90 min, and it required attracting and keeping the child's attention. The assessment proved to be too demanding for some participants in both the ASD and typically developing children, who were therefore assessed during two separate visits to the preschool.

On the PPVT and TROG, participants examined four pictures and had to name the key word (in the case of PPVT) or sentence (in the case of TROG). Performance was assessed using standardized measures as described (Dunn et al 2010). On the Teddy Test, participants examined seven pictures of a teddy bear engaged in different activities (combing his fur, drawing, watering flowers, eating, collecting apples, brushing teeth, feeding a fish), then for each picture they answered five questions. Each question covered one of five aspects: (1) the semantic relationship between the doer of the activity and the activity in the picture, (2) the relationship between the activity shown in the picture and the object held by the bear, (3) the instrument, (4) the location shown in the picture, and the (5) purpose of the activity. Answers on each question were assigned 0 or 1 point, so the total possible score on the Teddy test was 35. Answers were evaluated according to their grammatical quality and their appropiateness. For example, for the question „What is the teddy bear doing?", a response of «*češlja se*»/"combing himself" was considered correct, while a response of «*kosa*»/„hair" was considered incorrect because the participant did not show knowledge of the activity (e.g. the teddy bear was holding a comb in his hand). Responses involving neologisms (e.g. «*češaljkom*»/ «with a comb») were also considered incorrect, as were a child's failure to respond or a child's indication that he or she did not know the answer.

On the Morphological Closure subtest of the Illinois Test of Psycholinguistic Abilities, participants were shown pictures to which the examiner provided a verbal description, such as «*There is a cat under the table.*" Then the examiner would say an oral prompt, „*Where is the cat here?"*, to which the child would need to respond, „*The cat is on the table.*" Only one phrase or word was considered correct: for example, for the prompt, „This bicycle belongs to *Ivan* [John]. Whose bicycle is this?", a response of «It's the guy's/boy's» was scored as incorrect, while «It is Ivan's [John's]» was considered correct. Since the subtest has 36 questions, the maximum score was 36.

Raven's Progressive Matrices is a nonverbal cognitive test designed for children aged 5 to 11 years (Raven 1974). In this test, participants examine picture on a colored

background and must indicate the missing part of the biggest picture. Performance on this test was used in the present study only to verify that children could be included in the study; it was not used for detailed assessment of language ability.

3.4. Data analysis

The results of all tests were analyzed qualitatively, and the results for all but the Teddy Test and Morphological Closure subtest were also analyzed quantitatively using SPPS and non-parametric statistics

because of the small number of participants. Differences between the two groups of children were assessed for significance using the Mann-Whitney U test (rank-sum test).

4. RESULTS AND DISCUSSION

The study participants are described in Table 1, and their performance on the various assessment instruments are presented in Table 2.

Table 1. Chronological age of the participants

Group	N	Min	Max	M	SD
All	20	4; 11	7; 05	5; 5	0.71
Children with HFA or Asperger syndrome	10	4; 11	7; 05	5; 3	0.78
Typically developing children	10	5; 02	6; 6	5; 7	0.56

Table 2. Performance on language assessment instruments.

Instrument	Group	N	Min	Max	M*	SD**
PPVT	HFA or Asperger	10	70	135	103. 1	19.42
	Typically developing	10	99	134	111. 4	9.91
TROG-2:HR	HFA or Asperger	10	69	115	91. 1	14.22
	Typically developing	10	81	108	92. 7	10.03
Teddy Test	HFA or Asperger	10	14	34	27.9	6.12
	Typically developing	10	30	35	32. 8	1.62
Morphological Closure subtest	HFA or Asperger	10	4	27	15. 1	8.6
	Typically developing	10	16	28	22.9	5.09

*Mean

** Standard deviation.

4.1. Vocabulary aspects of language understanding

Based on the PPVT, children with HFA or Asperger syndrome showed similarly broad vocabulary spans as typically developing children (Mann-Whitney U test, z = -1.554, p > 0.05). This confirms the first hypothesis and accords with previous work (Paynter & Peterson 2009). A trend of greater scattering of the results can be seen in the group of participants with the HFA or Asperger syndrome (Table 1).

4.2. Grammar aspects of language understanding

Based on the TROG-2, children with HFA or Asperger syndrome showed similar ability as typically developing children to understand complex syntactic structures in Croatian (Mann-Whitney U test, z = -0.265, p > 0.05). These results confirm our second hypothesis and accord with previous studies (Saalasti et al. 2008, Paynter & Peterson 2009). This result is consistent with the idea that HFA and Asperger syndrome need not involve quantitative differences in the processing of sentence structure, but they do involve atypical language understanding in everyday situations.

4.3. Semantic bonds/relationships in language processing

Children with HFA or Asperger syndrome were significantly worse than typically developing children at expressing semantic bonds on the Teddy Test (Mann-Whitney U test, z = -2.48, p < 0.05). This result confirms the third hypothesis of the research. In addition, analysis of each of the five semantic relationships explored on the Teddy Test revealed that children with HFA or Asperger syndrome were significantly less proficient than typically developing children at recognizing the relationship between the doer of the activity and the activity, recognizing the relationship between the activity and the object, and defining the activity being performed by the doer (Table 3). Even though children with HFA or Asperger syndrome performed significantly less well than typically developing children on the question covering the relationship between activity and object, this question was one of the easiest for both groups of children. The two groups were similar in their ability to recognize the object, location and purpose of the activity.

Table 3. Comparative performance on the five semantic relationships on the Teddy Test

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Relationship	Group	N	M	SD	z*	p*
Doer of the activity : activity	HFA or Asperger	10	8.05	80. 50	-2.03	0.04
	Typically developing	10	12.95	129. 50		
Activity : object	HFA or Asperger	10	8.45	84. 50	-1.93	0.05
	Typically developing	10	12.55	125. 50		
Instrument	HFA or Asperger	10	8. 55	88. 50	-1.64	0.1
	Typically developing	10	12.45	124. 50		
Location	HFA or Asperger	10	8. 80	88	-1.35	0.18
	Typically developing	10	12.20	122		
Purpose	HFA or Asperger	10	8.65	86.50	-1.46	0.14
	Typically developing	10	12. 35	123. 50		

*Mann-Whitney U test

Evaluation of the answers of children with HFA or Asperger syndrome revealed language features characteristic of those disorders. Some answers were semantically appropriate but followed by grammar errors, such as errors in verb use («*prat-i zube*»/"he wash teeth", «*ona [je] prala zube*/"she brushed teeth" [requires auxiliary verb *je* in Croatian]), and syntactic errors («*češlja se na glavu*/»combs on the head»). In contrast, no grammatical errors were observed among typically developing children. Grammatically erroneous responses were defined as correct because the goal was to assess semantic knowledge rather than grammar rules. In contrast, responses with semantic errors were defined as incorrect, such as because the child did not recognize the activity (e.g. drawing), giving instead a closely related response such as writing or coloring. Semantic errors were observed in both groups of children; among typically developing children, for example, one child answered «*In the frying pan*» in response to the question «*Where are flowers growing?*»; and one child answered «*On the pavement*» in response to the question «*Where is the teddy bear drawing*?», when the correct answer was «*On the board*».

Responses of some children with HFA or Asperger syndrome showed idiosyncratic use of language, neologisms and meticulous speech (Figure 1), especially on the question covering the purpose of the activity («*Why is the teddy bear brushing his teeth?*»). Some answers were not semantically typical for chronological age, such as «*Because it is part of photosynthesis*». Several children with HFA or Asperger syndrome did not understand the questions themselves, which was especially true on the question covering the purpose of the activity.

Question	*Typical responses*
What is the bear using to water flowers?	That buckets.
	With a watering shovel.

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With what is the bear eating?	Tomato.
Why is the bear watering flowers?	The flowers is thirsty.
	Because it is part of photosynthesis.
Why does the bear brush his teeth?	Because something hurts in tooth one.
	So that bacteria don't get in.
Why does the bear draw the sun?	Because he has to teach the dog.
	Because he's doing the magic board *[reference to children's TV show]*.
	Because he doesn't know how the weather will be.
	I cannot think that.
Why does the bear brush his fur?	Because flies bite him and makes him itch.
	Well, to be handsome.
Why is the bear collecting apples?	Because he's hungry again, he is thirsty and wants apple juice.
	So at home.
	Because they fell.
What is the bear eating?	Potato with banana.
Where are flowers growing?	In some ball.
With what does the bear pick up apples?	With a dirty hand.
Where (in what) do fish swim?	In the little sea.
	They swim in a bucket.
What is the bear watering?	Red kec *[neologism]. [When asked «What is a kec?», the child responds, «A new flower.»]*.

Figure 1. Typical responses of children with HFA or Asperger syndrome on the Teddy Test.

These results on the Teddy Test suggest that in the preschool period, children with HFA or Asperger syndrome seem to understand language better than they can express some semantic relationships.

4. 4. Morphological closure in language production

The Morphological Closure subtest focused on grammar, in contrast to the Teddy Test focusing on semantics. Typically developing children performed significantly better on the Morphological Closure subtest (Mann-Whitney U test, z = -2.315, p < 0.05), confirming the fourth hypothesis. The most difficult tasks for children with HFA or Asperger syndrome were recognizing the palatalization sound change ("vuk-vuče") and singular-plural suppletives ("*čovjek-ljudi*", "man-people"), for which none of these children answered correctly. Nine of 10 children answered incorrectly on questions related to irregular adjective comparison ("*puno, više, najviše*"/"much, more, most"; "*dobar, bolji, najbolji*"/"good, better, best") as well as the sound change of a "non-existing *a*" ("*nepostojano a*", "*ovca-ovaca*"). Similarly, rates of incorrect responses among typically developing children were highest for singular-plural suppletives and the "non-existing *a*". Typically developing children had less difficulty than the other group recognizing palatalization sound change.

Eight of 10 children with HFA or Asperger syndrome incorrectly responded to questions related to the differences between the present-completed and present-incomplete forms of the same verb ("*vješati/objesiti*", "hanging/hang") and to some questions related to the sound change in the palatalization. Most children also failed to use the correct form of the plural noun because they did not understand the analogy with the presented example. For example, with an image involving spiders, most children did not use the correct plural form "*pauci*" but instead they counted the number of objects ("*četiri pauka*", "four spiders"), which was not counted as a correct answer. Such answers point to problems in understanding other people's intentions and expectations (Atwood 2015). Children did correctly report the plural of the feminine noun "*haljina/haljine*" (dress/dresses). Some children also came up with neologisms, such as „*ciglar*" instead of „*zidar*" („bricker" instead of „bricklayer") and „*kopalica*" instead of „*lopata*" („digger" instead of „shovel").

Our results suggest that Croatian children with HFA or Asperger syndrome share similar vocabulary knowledge as typically developing children, but they have difficulties using the vocabulary, often resorting to idiosyncratic word usage, neologisms and precise speech, which can sound confusing or strange to an interlocutor who has not shared the child's experiences. This is consistent with previous work showing that children with HFA or Asperger syndrome possess stable syntax and receptive vocabulary at a similar level as typically developing children, but they have deficits in understanding metaphor, irony, and double meanings (Attwood, 1998). Indeed, the children in our study with HFA or Asperger syndrome showed stable understanding of complex syntactic structures on the TROG-2:HR test, while showing difficulties in expression (grammar-filling tasks). Kamio et al. (2007) also reported that children with HFA perform well on measures of semantic knowledge but nevertheless process language

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differently from typically developing children. The available evidence, then, suggests that children with HFA or Asperger syndrome have a wide repertoire of words for specific contexts, but they have deficits in higher-level language processing that results in inflexibility, which in turn means difficulty in adapting messages to the social context. The stable receptive language skills of children with HFA or Asperger syndrome may reflect their intelligence, which is strongly connected to language skills, especially vocabulary measures (Kjelgaard and Tager-Flusberg, 2001).

Our findings are consistent with previous work showing that children with HFA or Asperger syndrome show no deficits in language reception (Saalasti et al. 2008, Paynter & Peterson, 2009), and our findings contrast with work suggesting that such deficits do exist (Noterdaeme et al. 2010.). This discrepancy highlights the difficulties of assessing the full range of language abilities and potential deficits of children with HFA or Asperger syndrome. For example, it may not be reliable to compare a child's performance on expressive and receptive skills because the tests reflect not only language knowledge, but also other factors such as attention and pragmatic comprehension of instructions.

The observation, in the present study and in the literature, that children with HFA or Asperger syndrome possess good vocabulary but use it with difficulty has implications for their later reading learning in school. Language comprehension is connected to decoding skills in preschool (Mason, 1992). For one thing, our results showing no significant receptive difficulties on PPVT suggest that these children will not have decoding difficulties in their formal

education (Venter, Lord and Schopler., 1992). On other other hand, several studies have reported that they have deficits in reading comprehension (Nation et al. 2006, Randi et al. 2010). It is possible that these deficits are caused by factors not captured well in studies based on standardized assessment instruments. In this regard, it is important to keep in mind the specific socio-cognitive situation of children with HFA or Asperger syndrome. Their meticulous style, seemingly advanced vocabulary usage and word recall ability can mask higher-level difficulties with understanding and expressing language.

5. CONCLUSION

This study examined language comprehension and production by preschool children with HFA or Asperger syndrome in Croatia, since these abilities help predict later success or difficulties with reading. Furthermore, we are unaware of studies of language comprehension and production by preschool children with HFA or Asperger syndrome acquiring Croatian. The results suggest that these children show similar receptive lexical knowledge and grammar comprehension as typically developing children, but that they present deficits in expressing semantic connections and in grammar, particularly in favor of idiosyncratic language usage and neologisms. Qualitative analysis of responses reveals problems in understanding other people's intentions and expectations. These deficits should be addressed before the start of formal education in order to facilitate reading acquisition, academic performance and social participation.

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