



Characteristics in the Speech of Chinese Children with Autism Spectrum Disorders

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Abstract. Autism Spectrum Disorder (ASD) has garnered significant attention due to deficits in social behavior and communication. This neurodevelopmental disorder often manifests early in life and is commonly characterized by delayed language development. In recent years, the global prevalence of children with ASD has been rising, leading to increased scientific research and greater focus on this population. This study examines Mandarin-speaking children with ASD, summarizing and analyzing the language deficits they exhibit. Findings indicate that these children experience difficulties in phonology, morphosyntax, and pragmatics, and display atypical developmental features compared to typically developing peers. These include differences in pronunciation and intonation, excessive use of nouns, greater reliance on onomatopoeic words and exclamations, and limited ability to organize macro-narrative structures. The results of this study offer insights for identifying and supporting the intervention for Mandarin-speaking children with ASD.

Keywords: Chinese Children with ASD, Phonology, Morpho-syntax, Pragmatics

1 Introduction

Autism spectrum disorders (ASD) are a neurodevelopmental syndrome that occurs in the early stages of life. It is characterized by deficits in social reciprocity and communication, as well as by excessively repetitive behaviors. According to the definition by American Psychiatric Association, the deficits in social behavior include the lack of interactivity in social interactions, the absence of non-verbal communication behaviors used in social interactions, and the deficiency in skills related to establishing, maintaining, and understanding relationships [1]. The constantly rising prevalence of ASD has made it a public health issue that being globally recognized. The prevalence of autism spectrum disorders reported in the U.S. and non-U.S. countries, as reported by the American Psychiatric Association [1], is approaching 1% of each country's population. And the prevalence of autism and its related disorders has been rising globally as public awareness of these disorders continues to grow, diagnostic concepts expand, disorders are reclassified, and testing improves. In more recent research, the global prevalence of

ASD is 0.6% [2]. In China, a study found that the prevalence of children with ASD in mainland China has been 0.7% since 2017, which is an increasing trend compared to the previous prevalence, with urban children having a higher prevalence than rural children [3]. In terms of the gender distribution pattern of the ASD population, boys are more likely to have autism than girls, both worldwide and in mainland China. In China, the prevalence of ASD in boys is statistically 1.0%, significantly higher than the 0.2% in girls, with a ratio of 5:1 [3].

Defects in social behavior and communication are the main characteristics. Due to social interaction problems, delayed language development is frequently involved in the first symptoms of ASD, and almost all people with autism have a history of delayed language development. Communication-related barriers may manifest as delayed or complete lack of oral language development, and individuals with adequate verbal abilities still face significant difficulties in initiating or maintaining conversations with others, also includes stereotyped and use of language or the use of specific language repetitively, and lack of variability and spontaneity in pretend or imitation games [4].

Since social deficits are an important feature of ASD and speech is integral to social behavior, it has been suggested that severe delays in speech development may be a predictor of poor prognosis [5], and the relationship between speech disorders and autism is an important area of research. The early detection of autism spectrum disorders not only can reduce the prevalence of developmental disorders but also can help to improve communication skills in patients [2]. Therefore, it is crucial to study the speech characteristics of the ASD population, not only to help provide more detailed and precise criteria for determining autism, but also to guide the direction of tools and materials for later intervention. Thus, the present study analyzed the speech characteristics of Chinese autism by dividing them into three parts, including phonology, morpho-syntax, and pragmatics, and summarized and classified their characteristics based on the collected literatures in order to provide a more detailed theoretical basis for the speech of children with ASD on the basis of existing studies. And to point out the direction for possible future research.

2 Difficiencies of the Speech Characteristics

Children with Autism Spectrum Disorders show difficulties in language and social interactions. And the individuals' language skills of ASD children are also one of the strongest and significant predictors of their long-term social and adaptive outcomes. Therefore, their pragmatic and grammatical skills have been the focus of the research on their language skills development. In addition, studies have also found that there is a high correlation between the severity of phonological problems and language disorders of children with ASD, and the performance of their patients' rhythms is highly correlated with their communication level are closely related [6]. Therefore, this study summarizes and analyzes the language performance characteristics of Mandarin-speaking autism spectrum disorders children based on the classification of phonological performance, performance of lexical and syntactic applications, and pragmatic features.

2.1 Phonology

Phonology refers to the study of speech sounds and pronunciations of a particular language. Current research has confirmed the presence of delayed phonological development in children with autism. Wu et al [6] studied the phonological acquisition and development among the group of Mandarin-speaking children with ASD. The study argued that children with autism may have a slower development of phonological acquisition and show a typical sequence. It is believed that the development of phonological acquisition in children with ASD increases with age and reaches parity when their age of language is the same as that of 3-year-old to 6-year-old typically developing children.

The experiment used a Mandarin picture-viewing naming task to measure the participants' phonology performance, including 21 consonants, 36 rhymes and 4 tones in Mandarin. The results of the study showing that children with ASD had the highest mean correctness for rhymes, followed by tones, and finally for consonants. The children with ASD aged 3 to 6 years had significantly lower scores for consonants, rhymes, tones, and overall phonological system than age-matched children with TD. The group of children in the ASD group had significantly lower rates of correctly pronouncing the consonants /x, t h, and l/, the rhymes /jau, jou, and wo/, and the tertiary (low upper) tones than the TD group. Moreover, the phonological abilities of children with autism improved with age. The results showed that the developmental sequence of children with ASD also showed atypicality. Some 3-year-old to 6-year-old children with autism had a close level of phonological development with typically developing children, while some others lagged significantly behind. This suggesting that there are large individual differences in the phonological development of children with ASD [6].

In addition, atypical rhymes have been suggested as a feature of speech in children with ASD. In non-vocalized languages, the acoustic properties of rhymes in children with autism have been shown to be abnormal. As for the issue of vocal output in autistic children who are native speakers of a tonal language (Chinese), another study demonstrated differences in pitch, tone length, and tone strength comparing ASD children with typically developing children. The participants in the study were eight children aged 4-10 years old, and the experiment used picture naming to allow participants to independently produce single, double, and soft words, which were extracted and analyzed by recording and labeling the parameters. The study found that the mean pitch of children with ASD was higher than the group of typically developing children for both single and double words. In terms of sound length, there was no significant difference between ASD and typical developing groups of children. In terms of tone intensity, children with autism were lower than normal children. As for soft words, children with ASD had a longer pitch length, and there was no significant difference in tone strength on the side. It was found that the vocal abnormalities were mainly at the pitch level. Children with autism have some atypical features in the output of single words, double words and soft tones [7].

2.2 Morpho-Syntax

Besides the phonological deficient, the speech disorders of ASD children also manifest in terms of vocabulary and syntax. Vocabulary is a key aspect of language development that is closely related to the reading and writing skills in the future. And exploring the interconnected roles of vocabulary and syntax has become an integral part of further understanding the internal structure of language skills in children with ASD. Moreover, examining lexical and syntactic patterns in children with ASD is critical to assessing, understanding, and developing the language skills of children with ASD.

It has been shown that the receptive and expressive vocabularies of children with ASD is significantly lower than normally developing children. Liu et al [8] investigated the expressive vocabulary profiles of 3-year-old to 6-year-old Mandarin-speaking children with ASD. Based on the grammatical features of Mandarin, a 10-minute spontaneous speech sample from a parent and child free play session was analyzed. The results revealed that although the use of onomatopoeia gradually decreases as children's language ability develops, the frequency of onomatopoeia is still higher in children with ASD. In addition, in the 11 categories of content word and 5 categories of function word, the number of words and the number of categories possessed by children with ASD were significantly lower than those of the TD group. Notably, the number of common noun categories and the number of pronoun tokens were significantly lower in the ASD children group than in the developmental delay group, suggesting that children with ASD have potential difficulties in noun learning. In addition, children with ASD used a significantly higher proportion of exclamations than developmental delay group of children, and exclamations were the most frequently used lexical category in the expressive vocabulary of the autism group. In particular, responding functional exclamations were predominantly used, especially those indicating affirmation, such as "um" and "oh." Liu's study found that children with ASD showed significantly lower proficiency in standardized assessments and natural language samples compare to children with developmental delays, which may indicate an atypical lexical learning mechanism of ASD children. They also suggested the importance of tailored vocabulary interventions for children with autism [8].

Another study revealed the interrelationships between lexical and grammatical of Mandarin-speaking children with ASD. There were eighty-one L1 Mandarin children with ASD between 2-year-old and 7-year-old participated in the trial, and natural language samples were collected and analyzed from the process of learning through these children in clinician-child interactions. The results found that, in terms of vocabulary, there were significant age-specific differences between children with ASD in terms of real words, imaginary words, and lexical categories. Nouns and verbs were two dominant lexical categories, with Mandarin-speaking children with ASD producing significantly more noun types than verb types. In terms of grammar, Mandarin children with ASD produced more NPs, VPs, ADVPs, and IPs than other syntactic structures and spoke more noun subjects, gerund-modifiers, and direct objects. Grammatical development was better for 5 to 6 years old Mandarin children with ASD than for 3 to 4 years old group. The trends in the use of syntactic structure, grammatical relations, and grammatical complexity were similar across age groups. More importantly, this study found

a strong correlational effect between vocabulary production and grammatical development for the children with ASD, implying that the development of syntactic structure, grammatical demands, and grammatical complexity is closely related to vocabulary categories [9].

2.3 Pragmatics

Furthermore, the deficient that used to construct speech that need to combined pronunciation, vocabulary, and syntax in the real social context also appear in ASD children. Pragmatics can be referred to the use of language in social situations, and good pragmatics requires the integration of cognitive and linguistic skills to combine vocabulary to form sentences at different levels of structure, of which narrative skills can be a good way to examine the level of pragmatics. Good narratives require pragmatic skills to determine the focus of the narration and to choose appropriate forms of expression according to the situation and the audience [10] [11]. Therefore, research examining the narrative abilities of children with ASD not only helps to understand the mechanisms of language learning in children with autism, but also helps to provide them with language assistance and advice at an early age.

Wong et al's [10] study compared the early pragmatic language skills of normal and ASD children, revealing the pragmatic skills of children with ASD. Native Cantonese-speaking children with ASD were recruited to participate in an online test. Recordings of the ASD children's output responses and parent-child interaction sessions were analyzed according to the Language Skills Scale. The results revealed significant differences in pragmatic language skill scores between normally developing children and ASD children, and that early pragmatic language skills were poorer in children with ASD, especially in the two pragmatic skill subscales of communicative intention and discourse management. In addition, research has shown that the early pragmatic language development of children with ASD is also related to the family climate. Parental pragmatic behavior, as reflected in the quantity and quality of parent-child interactions, predicts children's pragmatic skills.

He et al [11] used the Narrative Assessment Program-2 to obtain narrative samples from Mandarin-speaking kindergarten children with autism. Children's wordless picture book narratives were analyzed for story length (including total number of words and discourse), language proficiency (including average discourse length, average length of the five longest discourses, number of different words, and vocabulary diversity), and Narrative Assessment Program-2 scores. The results showed that at the level of microstructural narrative competence, children with ASD did not differ significantly from normally developing children in terms of story length, despite having a lower vocabulary than the general population. And, in the early stages of complex sentence acquisition, children with autism may show comparable abilities to their developmentally delayed peers. However, children with autism have significantly poorer macrostructural narrative skills than developmentally delayed children, and the study found that children with ASD performed more poorly in story grammar. This suggesting that children with ASD face significant challenges in organizing plot structure in particular.

3 Discussion and Conclusion

The current study summarizes and analyzes the speech characteristics of Chinese children with ASD based on three aspects: phonology, morphosyntax, and pragmatics. At the phonological level, the acquisition and development of speech in autistic children lags behind that of their peers, and shows an atypical developmental sequence and features. Specifically, mispronunciation of consonants and the tertiary tone was the main feature, and abnormalities of tones were mainly reflected at the pitch level. At the morphosyntactic level, Chinese-speaking children with autism were found to use two main lexical categories, nouns and verbs, with a strong noun bias in particular. They also used a lower number of word classes and words than normal children, with a higher frequency of onomatopoeia and exclamations. At the pragmatic level, early autistic children have comparable microstructural narrative skills to normally developing children, but are less able to organize plot structure at the macro level. And are more deficient in early pragmatic language skills, especially in both communicative intent and discourse management.

3.1 Limitations and Future Directions

The current study focuses on the oral aspect of speech output, however other aspects of output, such as writing, and other aspects of language proficiency, such as listening and reading, should also be studied more comprehensively. Based on the above information and the process of articles collection, it is found that the direction of research in the Chinese ASD community was overbroad. There is some variability in the research methods used and a lack of standardized research paradigms. Therefore, in order to facilitate the development of a more detailed and comprehensive research system for the Chinese autism population, the following recommendations are made.

The first suggestion is that the assessment and development of the scales for ASD children should be more in line with the Chinese context. Due to the differences in language types between Chinese, English and other Eurasian languages, there are characteristic differences between languages, and scales that are applicable to Europe and the United States may not be appropriate for use with Chinese children. There are also differences in language performance between people with different language backgrounds, leading to inconsistent findings across languages. This inconsistency in language performance exists not only between China and other countries, but perhaps also between different linguistic regions in China, for example, in southwestern China, and in southeastern China, where children with autism in dialectal areas may be affected by different dialects of their native language. Since much of the existing research findings are focusing on Mandarin-speaking children with autism, it results in many findings that may not be generalizable to non-Mandarin-speaking populations. Thus, future research should consider comparing the differences in language performance between Chinese and foreign children with autism, and may further explore whether there are relatively different language performance characteristics of children with autism from different dialectal regions within mainland China.

In addition, there exists a variety of measurements for research on the topic of autism. In addition to collecting linguistic information for textual analysis, there have been many studies in recent years that have also utilized AI and other intelligent toolkits for screening and measurement, and it has been widely used to study the sensitivity to information of children with ASD from the perspective of neural mechanisms (ERPs, fMRIs, Eye-Tracking). However, future research could try to combine these components and measure the relationship between different dimensions of language performance, indicating whether they are independent of each other or influence each other.

Third, because language delays and milder communication difficulties in autism overlap with many other disorders [12]. Some studies have also revealed that some deficits, such as speech perception deficits and motor speech deficits, often co-occur with ASD. And atypical speech patterns may be associated with poor speech perception feedback and speech motor control deficits in children with ASD [6]. The impact of other disorders on language performance should not be ignored, and further refinements are needed for methods of controlling for the impact of other disorders on the speech of children with ASD.

Fourth, consideration should be given to measuring specific language deficits across age groups and language levels. Existing research exists for individuals with autism at different ages, with large age-group differences. However, there may be differences in language levels across age groups. Whereas future studies could attempt to compare longitudinally the differences and trends in the performance of children with ASD in different age groups, they could also consider comparing horizontally the language performance presented by individuals with autism of different language levels in the same age group, so as to better provide careful directional guidance for intervention methods.

Finally, individual differences should be emphasized. In these articles, the main focus has been on the general trend of language expression in Chinese children with autism. Since individuals with autism may behave differently in each individual [13], individual differences in autism should also be explored in more detail in the future studies.

3.2 General Conclusion

The speech performance characteristics of children with ASD perform worse than those of normal children at the phonological, morphosyntactic, and pragmatic levels, and the linguistic abilities of children with ASD in China have atypical development and characteristics compared with those of normally developing children.

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