Revista Argentina de Clínica Psicológica
2021, Vol. XXX, N°1, 908-918
DOI: 10.24205/03276716.2020.2086

A review of research on syntactic and lexical-semantic relationships in children with autism

Shunhua Liu[a]

Abstract
The study of syntactic and lexical-semantic relationships is an important area of psycholinguistics. Based on a review of research on syntactic competence and its relationship with lexical semantics in children with autism, various views have been found among academic researches. Regarding the research on syntactic ability of autistic children, there are three main views: normal, impaired and within-group differences; meanwhile, regarding the research on the relationship between syntactic ability and lexical semantics of children with autism, there are two main views: positive and uncorrelated. On this basis, the shortcomings and further research trends of the research on syntactic ability and lexical semantics of children with autism are proposed.
Keywords: children with autism, syntax, lexical semantics, review

1. Introduction

Autism, with social interaction, verbal and nonverbal communication and behavioural deficits (ritualistic or compulsive stereotyped activities) as the main clinical features, is a type of pervasive neurodevelopmental disorder (APA, 1994) that generally includes classic autism (Kanner's autism), Asperger's syndrome and to-be- Pervasive developmental disorder (PDD-NOS) to be classified, among others. In contrast to the studies on the pragmatics, vocabulary and phonology of children with autism, the national and international studies on the syntactic abilities of children with autism are scarce and have different perspectives. Even the studies that have suggested impairments in the syntactic abilities of children with autism rarely analyse the factors that influence the syntactic abilities of children with autism, but only attribute them to the "perfective acquisition style". In light of the theoretical debate on the relationship between syntax and semantics in psycholinguistics and trend of research on the integration of language abilities in children with autism, some studies have begun to focus on the relationship between syntactic and lexical-semantic abilities in children with autism.

2. The study of syntactic competence in children with autism

Studies on syntactic competence of children with autism have mainly examined the syntactic production ability of children with autism with a few studies analysing the syntactic comprehension ability of children with autism. There are three academic views on the syntactic production ability of children with autism: one believes that the syntactic ability of children with autism is as intact as that of normal children mainly because of delayed development and no impairment; another believes that there is impairment in the syntactic ability of children with autism, often omitting syntactic morphology and low syntactic complexity; whereas another believes that a proportion of children with autism spectrum disorders have no impairments in syntactic ability, but have a slower developmental process than normal children, and that some children with autism have impairments in syntax with most studies using children with specific language impairment (SLI) as a matched reference.

2.1 Normal syntactic ability in children with autism

In the 1970s and 1980s, numerous foreign studies on the abilities of autistic populations in various domains of language found that syntactic abilities of autistic children were relatively normal and not impaired (Bartolucci & Pierce, 1977; Bartolucci et al., 1976; Pierce & Bartolucci, 1977). In terms of episodic studies, follow-up studies of children with autism have shown that the syntactic development process of children with autism is similar to that of normal children, and that specific syntactic structures are acquired in the same order as in normal children, only in a slower process

[a]School of Education Science, Anshun University, Anshun, Guizhou,PR China
Shunhua Liu (1987~), female, a lecturer in the School of Education Science, Anshun University, Master. Research interests: child language development and disorders, cognitive linguistics, psycholinguistics. E-mail: 573460941@qq.com

(Tager-Flusberg, 1990; 1994). In terms of cooccurrence studies, it was also found that children with autism performed the same syntactic abilities such as morphological use and syntactic complexity as the control group of normal children.

2.1.1 Normal syntactic morphology use

Syntactic morphology reflects the syntactic relations between sentence constituents and belongs to the syntactic functional morphemes. The acquisition and correct use of syntactic morphology are an important part of the acquisition of syntactic competence. To learn the grammatical structure of a language, one must learn to use grammatical elements such as morphology that carry grammatical meaning (Brown, 1973; de Villiers and de Villiers, 1973). Brown (1973) through his study of English outlined 13 grammatical morphologies as the criteria for judging the morphological use of children with autism in specific task situations. In the story-telling and story-comprehension tasks, Fein and Waterhouse (1979) specifically examined the acquisition of grammatical morphology in autistic, mentally retarded and normal children, which then found no significant differences in the amount of morphology used and correctness between the autistic and the other two groups with normal acquisition of grammatical morphology. Furthermore, in a natural scenario, Bartolucci, Pierce and Streiner (1980) built on Bartolucci and Albers' (1974) earlier findings examined the order of morphological emergence in autistic and mentally retarded children, demonstrating no differences in the order of grammatical morphology use between autistic and mentally retarded children. No differences were also found when further compared with data from De Villiers' sample of normal children. Thus, it can be concluded that there are no differences between children with autism and the control group of normal children in terms of the amount and correctness of grammatical morphology use or the order of grammatical morphology use.

2.1.2 Normal syntactic complexity

Syntactic complexity increases with the increase and expansion of sentence constituents and syntactic structure. The average sentence length and syntactic complexity of children's discourse increase with age as the number of sentence constituents increases, while syntactic structure expands from simple to complex. Therefore, the average sentence length and syntactic complexity are important indicators of syntactic ability. A review of research on the syntactic abilities of children with autism has also focused on the average discourse length and syntactic complexity of discourse produced by children with autism on standardised tests or specific tasks.

Scarborough (1990) used the Index of Productive Syntax (IPSyn, proposed in Scarborough's 1985 study) to examine the syntactic complexity of discourse produced by children with autism, children with Down syndrome and normal children. The study discovered that children with autism and children in the control group did not differ in overall score for the Syntactic Generation Index in which children with autism had normal syntactic complexity. However, the study did not analyse the specific scores of the IPSyn subscales for children with autism, and it was likely that children with autism scored differently on a subscale from the control group of normal children, but there were no statistical differences in overall performance, which therefore could not account for the specific performance of syntactic competence in children with autism. Tager-Flusberg et al. (1990) remedied this deficiency in their study. They followed the language acquisition of six children with autism and six children with Down syndrome from 12 to 26 months of age. In terms of syntax, the study found that most children with autism and children with Down syndrome did not differ significantly in MLU and syntactic production index scores and had a similar sequence of syntactic development, confirming the authors' previous studies (1981, 1985), which concluded that children with autism do not involve impairments in syntactic competence. The study further analysed the scores of autistic children in each subscale of the Syntactic Production Index and discovered that autistic children scored low in the question negation subscale, but the authors interpreted this as an effect of pragmatic impairment without analysing the reasons in depth.

To further examine the language abilities of children with autism within the normal intelligence range, Kelley et al. (2006) used a series of standardised language tests to compare the language abilities of 14 children with autism with those of six normal children matched for physiological age. In terms of syntax, it was found that the syntactic abilities of children with autism did not differ from those of normal children where there was no impairment in the syntactic abilities of children with autism. In addition, Shulman and Guberman (2007) examined the ability of 13 children with autism, 13 children with SLI and 13 normal children matched on physical age, language

level and gender to learn new word tasks with syntactic cues in sentences and found that all children with autism and normal children were able to learn all new words successfully, while only 4 children with SLI were able to learn them successfully. This suggests that children with autism may be acquiring new words based on relatively intact syntactic abilities, providing inverse evidence that children with autism have relatively intact syntactic abilities and are not impaired.

In summary, the studies concluding that children with autism have normal syntactic abilities were focused on the 1970s and 1980s. These studies, based on either natural corpus or standardised tests, analysed the syntactic performance of subjects in terms of morphology, MLU and syntactic complexity with consistent conclusion that there was no syntactic impairment in autism. However, subjects in studies from the 1970s and 1980s were not diagnosed by standardised autism diagnostic scales, but by a combination of semi-standardised interview tests and psychological tests with a broader diagnosis (Michael Rutter, 2005). In addition, the subjects likely included non-autistic children with better syntactic abilities, which had a greater impact on the experimental results. As a result, a growing number of people have questioned the normal syntactic ability of children with autism.

2.2 Abnormal syntactic ability in children with autism

Since the syntactic abilities of children with autism have been studied in depth, many researchers have found significant impairments in the syntactic development of children with autism. There is a large amount of omission of grammatical morphology in discourse, especially prepositions and tenses. Generated words are short, average discourse length is generally lower than that of normal children and only simple syntactic structures can be used with complex syntactic structures rarely occurring.

2.2.1 Syntactic morphology using omission

In contrast to the normal view of discourse morphology use in autistic children, several studies have found that children with autism frequently omit some syntactic morphologies in discourse communication, especially prepositions, pronouns and tenses, which are omitted and misused more severely. Bartolucci (1980) compared, in general, the occurrence of function words in the discourse of autistic children with oral language skills and children with developmental delay matched to their intellectual age in a given situation and the percentage of correct use of function words in a given situation. The study discovered that the autistic group omitted function words more frequently and used them less correctly. As early as the 1960s, Cunningham (1966) tracked the language development of autistic children from the age of 6 to 11 and found frequent omission of syntactic morphemes or function words such as auxiliaries, plural nouns, pronouns and prepositions in the subjects' discourse use. This omission was similar to the use of early normal children's discourse morphology that Brown later studied. This suggests a significant lag and impairment in the development of syntactic morphology in children with autism. The same finding has been also observed in Churchill's (1972) case study on preposition use where autistic children did not understand the meaning of prepositions such as in, on, under, beside and only used some given prepositions during training based on objects. Ricks and Wing (1976) noted that children with autism are slower than normal in learning small words such as prepositions, conjunctions and pronouns; even when they do learn them, they often omit them from their speech. These studies suggest that children with autism have difficulty acquiring and using syntactic morphological function words such as prepositions and pronouns. In terms of tense use, studies have concluded that autistic children also have some impairments. Bartolucci and Albers (1974) found that autistic children produce less syntactic morphology, especially verb tense, when producing discourse than retarded, normal children. Bartolucci (1982), using Brown's (1973) 14 syntactic morphology, found that children with autism generated and used few past tenses compared to the control group. From the above, it is clear that autistic children have a greater omission or misuse of morphology in everyday or specific discourse, and that morphology reflects the syntactic relations between sentence components; therefore, difficulties in the acquisition and use of morphology in autistic children indicate some degree of impairment in the syntactic abilities of autistic children.

2.2.2 Low syntactic complexity

When MLU is used as a syntactic measure, children with autism have lower MLU scores than normal children (Condouris et al., 2003; Rapin & Dunn, 2003; Kjelgaard & Tager-Flusberg, 2001; Capps et al., 1998; Seal & Bonvillian, 1997). MLU scores tend to overestimate the syntactic development of children with autism compared to

syntactic structure scores (Scarborough et al., 1991); thus, the research on syntactic competence of children with autism tends to use other syntactic measures that are more systematic. It was found that children with autism generated sentences with lower syntactic complexity than normal children in natural discourse or in specific discourse using mainly simple syntactic structures with a narrow range. Pierce and Bartolucciet (1977) examined syntactic use in natural discourse in matched groups of autistic, mentally retarded and normal children with oral language skills and found that in Lee's Developmental Sentence Analysis (Lee's Developmental Sentence Analysis, 1974), children with autism scored lower than other groups, while in Chomsky's Transformational Analysis (Chomsky's Transformational Analysis, 1955), children with autism had higher error rate, mainly omission, and low sentence complexity. This suggests that the syntactic system of children with autism differs from that of normal children or even mentally retarded children, and that they have more severe impairments in syntactic ability. Eigsti et al. (2007) attempted to address the controversy of whether or not children with autism have syntactic impairments by exploring whether children with autism have syntactic ability appropriate to their age. Sixteen children with autism, 16 non-verbal IQ and gender-matched mentally retarded children as well as 16 normal children were selected after controlling for factors such as intelligence, vocabulary level as well as the subjects' educational background and family economic conditions. The MLU and syntactic production index were used to score the sentences extracted from the spontaneous discourse, and the results showed that the autistic group had lower overall scores in MLU and syntactic production index than the matched group. To further examine the performance of syntactic impairment in children with autism, Eigsti analysed the scores of four additional sub-items of the Syntactic Generation Index and found that children with autism scored significantly lower than normal children on two items: verb phrase and sentence structure. There was no significant difference in the scores for noun phrases and question negation. This indicates that children with autism use relatively simple and narrow syntactic structures.

There are fewer studies done on syntactic competence of children with autism in China. Zhang Qin and Zan Fei (2007), through a case tracking survey of a child with autism, found that the average discourse length of autistic children was 3.6 words in their daily discourse with monotonous syntactic structure; 98% of them were single sentences and basically the simplest monotonous sentence structure with low sentence complexity. In her doctoral dissertation, Li (2008) used the MLU, MLU5 (Mean Length of the Longest 5 Sentences) grammar measure to quantify the grammar acquisition rate of four Chinese-speaking children with autism and found that the grammar acquisition rate of the two pairs with MLU true values less than 2 was lower than that of the control group of normal children, whereas the development of MLU5 showed similar results. The rate of grammar acquisition was similar to that of the control group of normal children. This may indicate that the syntactic ability of autistic children gradually improves with age. However, using MLU or MLU5 alone as a syntactic measure has significant shortcomings, especially for older children, where the validity of the MLU measure would be greatly reduced since utterance length reflects specific interactions rather than the acquisition of new linguistic knowledge, and where the increase in syntactic complexity is a reorganisation within the discourse form and no longer reflects the addition of new structures (Eisenberg et al., 2001; Parker & Brorson, 2005). Therefore, the research on syntactic ability of autistic children in China is yet to be deepened, while syntactic evaluation index is a key issue that needs to be addressed urgently.

Researchers have generally attributed the impairment of syntactic ability in children with autism to the "perfect imitation" syntactic acquisition style of autistic children. Tager-Flusberg (1990) found a great deal of imitation in the syntax produced by children with autism through observations. This imitation was due to the fact that children with autism learn differently from ordinary children who rely on information processing; they do not learn syntax through comprehension, which gives a rigid and narrow character to the syntactic use of children with autism (Li, 2008), and unable to use output syntactic structures rationally according to context (Li, 2009). Dalgleish (1975) argued that this is due to deficits in the ability of autistic children to align syntactic stimuli or learn rules for aligning stimuli. This explanation prompts an answer as to why autistic children lack the ability to align syntactic stimuli. Is it because of a deficit in semantic understanding or a lack of knowledge of syntactic rules that leads to incomprehension of the discourse and inability to flexibly change utterances? This remains to be further explored.

In summary, based on avoiding the problem of varying criteria for subject selection in the 1970s

and 1980s studies, researchers have used standardised tests to select subjects, which has contributed to the accuracy of the experimental results, but still has its shortcomings. First, as Eigsti stated in his own study, the subjects were unified as children with autism and therefore could not yet show that the subjects were homogeneous. Second, in terms of the experimental paradigm, the researchers mainly used the naturalistic play method, which collects subjects' naturalistic discourse in free situations. This helps to exclude the influence of subjects, especially autistic children, on the experimental results due to the unfamiliarity of the experimental setting and the experimenter, but the length of the sentences contained in natural discourse and complexity of the sentences are variable. Moreover, Wren's (1985) study with impaired children as well as Southwood and Russell's (2004) study with normal children showed that the lowest syntactic complexity was produced in the free play task. Thus, the use of studies that collect natural discourse may have a greater impact on the experimental results.

2.3 within-group differences in syntactic ability of children with autism

Recent study suggested that there are within-group differences in the syntactic abilities of children with autism. Some children with autism have impaired syntactic abilities, while others have relatively intact syntactic abilities (Condouris, Meyer & Tager-Flusberg, 2003; Rapin & Dunn, 2003; Kjelgaard & Tager-Flusberg, 2001). Since the syntactic performance of children with autism in the presence of syntactic impairment is similar to that of children with SLI, most of these studies have used children with SLI as a matched reference group.

Kjelgaard and Tager-Flusberg (2001) used the syntactic subtests of the Clinical Evaluation of Language Fundamentals (CELF) to study the syntactic abilities of children with autism in various language domains. Formulated Sentences and Recalling Sentences tests were used to study the syntactic abilities of children with autism. Some children with autism were found to produce sentences with low complexity and some syntactic impairments, while others with autism had normal syntactic ability. The same phenomenon of within-group variation in morphological use was also found for children with autism. Tager-Flushberg (2004) used an experimental task to explore the use of third person singular and past tense (regular and irregular) tense markers in children with autism and found that some children with autism had a large amount of omission of these two syntactic morphologies while other children with autism had less omission of these two syntactic morphologies. This further supports the idea of group differences in the syntactic abilities of children with autism. Since children with autism who have syntactic impairments mainly show syntactic omission of both syntactic morphologies especially verb tense and low syntactic complexity, which are also the main manifestations of syntactic impairments in individuals with specific language impairment (SLI), there has been an increasing number of studies examining the relationship between syntactic competence of children with autism and syntactic competence of children with SLI in recent years, such as that by Leyfer and Tager-Flusberg (2008), Lindgren et al. (2009), Simonoff (2009), Rice et al. (2005), Whitehouse (2008), Williams (2008) and Groen (2008). In terms of morphological use, Jenny (2004) specifically examined the performance of children with SLI and a large heterogeneity of children with autism on the third person singular and verb tense, one of the typical features of SLI syntactic impairment. Children with autism with language impairment were found to have many omissions of tense forms in the verb tense task similar to children with SLI, while children with autism without language impairment performed higher than children with SLI in both tasks. Thus, it was further established that there were within-group differences in the syntactic abilities of children with autism. In terms of syntactic complexity, McConnell (2010) compared the performance of children with high-functioning autism, children with SLI, children with autism with language impairment (ASDLI) and normal children in terms of sentence length and syntactic complexity generated when completing a word-generating task and found that children with SLI and ASDLI had lower mean sentence length and sentence complexity than the other groups besides the simple sentence structure generated. In contrast, children with high-functioning autism performed comparably to normal children on both tests. McGregor et al. (2011) found the same result when examining the sentence abilities of children with SLI, children with ASD without syntactic impairment, children with ASDLI with syntactic impairment, children with developmental delay and matched normal children. This view can be seen as a neutralisation of the first two views and seems more reasonable, but there is no formal clinical medical identification regarding the presence of a child with autism with impaired

syntactic ability within the group of children with autism, nor there is a specific diagnostic scale. The identification of children with autism who have been described as having syntactic impairment in research has also been based on scores on relevant syntactic tests such as in the study by McGregor (2011) who used the CELF4 syntactic subtest. This is a simple syntactic test score that classifies children with autism as having impaired syntactic abilities, which is simpler and less analytical than studies focusing on the syntactic abilities of children with autism. This approach appears to be too simplistic and does not analyse the factors influencing the presence of syntactic impairment in children with autism.

3. The study of syntactic-semantic relations in children with autism

There are three theoretical controversies in psycholinguistics concerning the relationship between syntactic and semantic processing. The first is the modularity theory or autonomy theory, which holds that semantic processing and syntactic processing are independent at the beginning of sentence processing and only interact later to jointly complete the comprehension of sentences; the second is the interaction theory, which states that syntactic processing and semantic processing interact and constrain each other in sentence processing, and that lexical information plays a decisive role in various possible syntactic structures that are activated. The third is the simultaneous action theory proposed by Bolland (1997) et al. who combined the first two theories and argued that syntactic processing and semantic processing have no primary or secondary role. Under the influence of these theoretical controversies and the move towards unification of language research in children with autism, a research on syntactic and semantic relations in children with autism has emerged. Looking at the studies related to syntactic and semantic relations in children with autism, most of them support the interaction theory, which states that syntactic and semantic abilities of children with autism are closely related, while some studies support the modularity theory, which finds that syntactic and semantic abilities of children with autism are unrelated.

3.1 Positive correlation between syntactic and semantic abilities in children with autism

Most studies on the relationship between syntactic and lexical-semantic abilities in children with autism found that syntactic and lexical-semantic abilities in children with autism are positively correlated, both are impaired or both are normal. This view supports the interaction theory of syntactic and semantic relationships in which syntactic and semantic processing interact and constrain each other.

Jarrold et al. (1997) investigated the performance of 120 children with autism aged 5 to 19 years on various components of language ability. The study used the British Word Finding Vocabulary Scale (BWFS) and the Test for Reception of Grammar (TRG) to examine the lexical and grammatical abilities of children with autism and found that the subjects' lexical and grammatical abilities were similar and neither had impairment. Norbury (2005) as well as Brock et al. (2008) both found impairments in syntactic ability in children with autism who had low lexical-semantic abilities, could not distinguish well between the secondary semantics of words and could not use word meanings flexibly; nevertheless, children with autism who had age-appropriate and relatively normal syntactic comprehension abilities did not have impairments. However, most of these studies assessed scores based on independent syntactic and lexical-semantic tests and did not delve into the effects of lexical semantics on syntax. To this end, McConnell (2010) examined the complexity of sentences generated by children with autism through a task of sentence construction given words. The study found that word class influenced the complexity of sentences generated by children with autism to some extent, while word meaning had a critically important effect on sentence complexity, and word frequency had a very small effect. This suggests a significant role of vocabulary, especially abstract and concrete word meanings, on syntactic ability in children with autism. The study suggested that the lexical-semantic competence of children with autism has an impact on syntactic competence. Building on McConnell's study, Karla (2011) specifically delved into the relationship between lexical semantics and syntactic competence in children with autism and later found that children with autism who had impairments in syntactic ability scored low on both tasks of vocabulary, while children with autism without syntactic impairments scored significantly higher on both tasks of vocabulary. Similar finding has been also found in the early stages of language acquisition. Susan et al. (2011) observed a positive correlation between syntactic and lexical abilities in young children with autism at 30 months of age. Even in the case of children with autism whose subjects spanned a wide age range and differed widely in intelligence, Condouris et al. (2003) found

a significant positive correlation between syntactic structure scores on clinical assessments of basic language skills and vocabulary scores on the Peabody Picture Vocabulary Test in children with autism. This is the same relationship as that between vocabulary and syntactic ability in normal children's early language development. The above studies suggest that syntactic and lexical-semantic abilities of children with autism influence and interact with each other. Thus, the influence of lexical semantics on syntactic ability should be explored when examining the syntactic ability of children with autism.

3.2 Separation of syntactic and semantic abilities in children with autism

Some studies have found that syntactic and semantic abilities of children with autism are not consistent. The modularity theory, which supports syntactic and semantic relationships, suggested that the human brain has specialised independent syntactic processing mechanisms and advocates syntactic autonomy. Tager-Flusberg (2001) found that older children with autism had the most severe impairments in syntactic ability and lower impairments in lexical ability than in syntactic ability. Kelley et al. (2006) used 10 language tests to compare the language abilities of 14 (2 female 12 males) with autism between the ages of 5 and 9 years old compared to 6 age-matched normal children showing that children with autism did not differ from normal children in their syntactic abilities, but had difficulties with semantics. Eigsti et al. (2007) still observed impairments in syntactic ability in children with autism after controlling for lexical ability-matched subjects. These studies suggest that there are some distinctions between the syntactic and lexical-semantic abilities of children with autism, which do not correlate positively, hence indicating that the intrinsic factors affecting syntactic competence of children with autism need to be further investigated.

4. Shortcomings and trends of previous studies

4.1 The shortcomings

Through the above studies on syntactic ability and syntactic-semantic relations of autistic children, it was still controversial whether or not the syntactic ability of autistic children is impaired and whether or not it is influenced by lexical-semantic ability; therefore, further research is needed regarding the syntactic ability of autistic children and whether or not syntax is influenced by lexical-semantic. While drawing on the previous research results, it was also found in this study that there are still some shortcomings in the previous studies that need to be improved.

One of them is the problem of homogeneity of subjects. Subjects are the objects of study, while the homogeneity of the subjects directly affects experimental results. Previous studies on the syntactic ability of children with autism had some shortcomings in subject selection, such as that the subjects were not selected based on standardised tests for autism in the 1970s and 1980s, and later studies also unified the subjects as children with autism while there are some subcategories of children with autism including high-functioning autism, Asperger's autism and typical autism with different syntactic ability, which is likely to be the reason why the relevant studies found group differences in the syntactic abilities of children with autism. Therefore, it is important to try identifying the homogeneity of the subjects in future experiments.

Second, the selection of the experimental paradigm is a problem. Most of the studies on syntactic ability of children with autism have used the experimental paradigm of free play and collection of natural discourse, which are highly influenced by contextual factors such as pragmatics besides having an impact on the experimental results. Therefore, the present experiments excluded the influence of pragmatic factors to better reflect the syntactic ability of children with autism.

Third, the lack of comprehension task. Studies on syntactic competence of children with autism have mainly used syntactic generation tasks such as natural discourse production and sentence expression. These do not provide a comprehensive picture of the syntactic abilities of children with autism. As Chomsky (1957) argued, the discourse produced at any given time cannot be used as a judgmental indicator of linguistic syntactic competence. Errors in the daily discourse do not indicate that the speaker has not mastered syntax, but only that there are anomalies in the generated discourse. Conversely, even if the generated syntax is correct, it cannot be judged as intact syntactic competence and is likely to be influenced by other factors in the process of syntactic storage to representation. Therefore, the syntactic generation task and the syntactic comprehension task can be used to examine the syntactic competence of Chinese-speaking autistic children more comprehensively.

4.2 The trends

As for the content of study, previous studies on

syntactic competence of children with autism have mainly examined the syntactic competence performance of children with autism and explored the presence of impairments, while few studies have analysed the factors influencing the syntactic competence of children with autism. Since syntactic competence has been found to be very closely related to the development of lexical-semantic competence during the developmental relationship of language in general children (Rollins, 1994), the issue of syntactic and lexical-semantic independence becomes one of the focal points of research in psycholinguistics. Therefore, it should be a trend to investigate the influence of lexical-semantic factors on syntactic ability and infer the relationship between the two while examining whether or not there is impairment in syntactic ability in children with autism.

In terms of experimental design, previous studies on the syntactic ability of children with autism have mainly used naturalistic discourse or standardised tests to examine the syntactic production ability of children with autism, but have neither excluded the influence of pragmatic factors nor examined the syntactic comprehension ability of children with autism in depth. Therefore, the syntactic production ability and syntactic comprehension ability should be investigated together with better control of pragmatic factors as an experimental paradigm for studying the syntactic ability of autistic children.

References

[1] Christopher Jarrold and Jon Brock. (2004). To match or not to match? Methodological issues in autism-related research. Journal of Autism and Developmental Disorders, 1, 81-85.

[2] Cory Shulman and Ainat Guberman. (2007). Acquisition of verb meaning through syntactic cues: A comparison of children with autism, children with specific language impairment (SLI) and children with typical language development (TLD). Journal of Child Language, 34, 411-423.

[3] Elizabeth Kelley, Jennifer J. Paul, Deborah Fein, Letitia R. Naigles. (2006). Residual language deficits in optimal outcome children with a history of autism. Journal of Autism and Developmental Disorders, 36, 807-828.

[4] Giampiero Bartolucci and Robert J. Albers. (1974). Deictic categories in the language of autistic children. Journal of Autism and Childhood Schizophrenia, 2, 131-141.

[5] Giampiero Bartolucci, Sandra Pierce, David Streiner, and Patricia Tolkin Eppel. (1976). Phonological investigation of verbal autistic and mentally retarded subjects. Journal of Autism and Childhood Schizophrenia, 4, 303-316.

[6] Giampiero Bartolucci, Sandra J. Pierce and David Streiner. (1980). Cross-sectional studies of grammatical morphemes in autistic and mentally retarded children. Journal of Autism and Developmental Disorders, 1, 39-50.

[7] Helen Tager-Fiusberg. (1981). On the nature of linguistic functioning in early infantile autism. Journal of Autism and Developmental Disorders, 1, 45-56.

[8] Helen Tager-Flusberg, Susan Calkins, Tina Nolin, Therese Baumberger, Marcia Anderson, and Ann Chadwick-Dias. (1990). A Longitudinal Study of Language Acquisition in Autistic and Down Syndrome Children. Journal of Autism and Developmental Disorders, 1, 1-21.

[9] Helen Tager-Flusberg and Robert M. Joseph. (2003). Identifying neurocognitive phenotypes in autism. Neurocognitive phenotypes in autism, 358, 303-314.

[10] Helen Tager-Flusberg. (2004). Strategies for conducting research on language in autism. Journal of Autism and Developmental Disorders, 1, 75-80.

[11] Hye Kyeung Seung. (2007). Linguistic characteristics of individuals with high functioning autism and Asperger syndrome. Clinical Linguistics and Phonetics, 21(4), 247–259.

[12] Helen Tager-Flusberg. (2006). Defining language phenotypes in autism. Clinical Neuroscience Research, 6,219-224.

[13] Isabelle Rapin, Michelle Dunn. (2003). Update on the language disorders of individuals on the autistic spectrum. Brain and Development, 25, 166-172.

[14] Inge-Marie Eigsti, Loisa Bennetto, Mamta B. Dadlani. (2007). Beyond Pragmatics: Morphosyntactic Development in Autism. Journal of Autism and Developmental Disorders, 37, 1007-1023.

[15] Jill G. de Villers 和 Peter A. de Villiers. (1973). A cross-sectional study of the acquisition of grammatical morphemes in child speech. Journal of Psycholinguistic Research, 3, 267-278.

[16] Jenny A. Roberts, Mabel L. Rice, Helen Tager–Flusberg. (2004). Tense marking in children with autism. Applied Psycholinguistics, 25, 429-448.

[17] Joanne Volden，Jamesie Coolican，Nancy Garon，Julie White，Susan Bryson. (2008).

Brief Report: Pragmatic language in autism spectrum disorder:relationships to measures of ability and disability. Journal of Autism and Developmental Disorders, 39,388-393.

[18] Johanna K. Lake, Shannon Cardy, Karin R. Humphreys. (2010). Brief report: Animacy and word order in individuals with autism spectrum disorders. Journal of Autism and Developmental Disorders, 40, 1161-1164.

[19] Karen Condouris, Echo Meyer, Helen Tager-Flusberg. (2003). The relationship between standardized measures of language and measures of spontaneous speech in children with autism. American Journal of Speech-Language Pathology,12, 349–358.

[20] Karla K. McGregor, Amanda J. Berns, Amanda J. Owen, Sarah A. Michels, Dawna Duff, Alison J. Bahnsen, Melissa Lloyd. (2011). Associations between syntax and the lexicon among children with or without ASD and language impairment. Journal of Autism and Developmental Disorders, DOI 10.1007/s10803-011-1210-4.

[21] Lisa M. Reisinger, Kim M. Cornish,E´ric Fombonne. (2011). Diagnostic differentiation of autism spectrum disorders and pragmatic language impairment. Journal of Autism and Developmental Disorders, DOI 10.1007/s10803-011-1196-y.

[22] Mohammad Ghaziuddin, Philip Thomas, Elizabeth Napier, Gaby Kearney,Luke Tsai, Kathleen Welch and William Fraser. (2000). Brief report: brief syntactic analysis in asperger syndrome: a preliminary study. Journal of Autism and Developmental Disorders, 1, 67-70.

[23] Monique Moore and Sandra Calvert. (2000). Brief report: vocabulary acquisition for children with autism: teacher or computer instruction. Journal of Autism and Developmental Disorders, 4, 359-362.

[24] Margaret M. Kjelgaard and Helen Tager-Flusberg. (2001). An investigation of language impairment in autism: implications for genetic subgroups. Language and Cognitive Processes, 16, 287–308.

[25] Michael Rutter. (2005). Autism research: lessons from the past and prospects for the future. Journal of Autism and Developmental Disorders, 2, 241-257.

[26] Michael R. Perkins, Sushie Dobbinson, Jill Boucher, Simone Bol, Paul Bloom. (2006). Lexical knowledge and lexical use in autism. Journal of Autism and Developmental Disorders, 36, 795-805.

[27] Marilyn A. Nippold. (2009). School-Age Children Talk About Chess: Does Knowledge Drive Syntactic Complexity? Journal of Speech, Language, and Hearing Research, 52, 856–871.

[28] Michele Noterdaeme, Elke Wriedt, Christian Hohne. (2010). Asperger's syndrome and high-functioning autism: language, motor and cognitive profiles. Eur Child Adolesc Psychiatry, 19,475-481.

[29] Naomi Fisher, Francesca Happe´, and Judy Dunn. (2005). The relationship between vocabulary, grammar and false belief task performance in children with autistic spectrum disorders and children with moderate learning difficulties. Journal of Child Psychology and Psychiatry, 4, 409-419.

[30] Patrieia Howlin. (1984). The acquisition of grammatical morphemes in autistic children: a critique and replication of the Findings of Bartolucci, Pierce, and Streiner, 1980. Journal of Autism and Developmental Disorders, 2, 127-136.

[31] Richard F. Cromer. (1981). Developmental language disorders: cognitive processes, semantics, pragmatics, phonology and syntax. Journal of Autism and Developmental Disorders, 1, 57-74.

[32] Rhea Paul，Mary L. Fischer，Donald J Cohen. (1988). Brief report: Sentence comprehension strategies in children with autism and specific language disorders. Journal of Autism and Developmental Disorders, 4, 669-679.

[33] Richard Ingham. (2002). Selective verb deficits in SLI: another look at the autistic spectrum problem. Reading Working Papers in Linguistics, 6, 101-118.

[34] Rebecca J. Landa and Melissa C. Goldberg. (2005). Language, social, and executive functions in high functioning autism: a continuum of performance. Journal of Autism and Developmental Disorders, 5, 557-573.

[35] Rhiannon J. Luyster, Mary Beth Kadlec, Alice Carter, Helen Tager-Flusberg. (2008). Language assessment and development in toddlers with autism spectrum disorders. Journal of Autism and Developmental Disorders, 38, 1426–1438.

[36] Rhiannon Luyster and Catherine Lord. (2009). Word learning in children with autism spectrum disorders. Developmental Psychology, 6, 1774-1786.

[37] Sandra Pierce and Giampiero Bartolucci. (1977). A syntactic investigation of verbal autistic, mentally retarded, and normal children. Journal of Autism and Childhood Schizophrenia, 2,121-134.

[38] Sarah Lister Brook and Dermot M. Bowler.

(1992). Autism by another name? Semantic and pragmatic impairments in children. Journal of Autism and Developmental Disorders, 1, 61-81.

[39] Southwood, F., 和 Russell, A. F. (2004). Comparison of conversation, free play, and story generation as methods of language sample elicitation. Journal of Speech, Language, and Hearing Research, 47, 366–376.

[40] Satu Saalasti，Tuulia Lepisto，Esko Toppila，Teija Kujala，Minna Laakso，Taina Nieminen-von Wendt，Lennart von Wendt，Eira Jansson-Verkasalo. (2008). Language abilities of children with asperger syndrome. Journal of Autism and Developmental Disorders, 38, 1574-1580.

[41] Sophie E. Lind，Dermot M. Bowler. (2009). Language and theory of mind in autism spectrum disorder: the relationship between complement syntax and false belief task performance. Journal of Autism and Developmental Disorders, 39, 929-937.

[42] Susan Ellis Weismer, Catherine Lord, Amy Esler. (2010). Early language patterns of toddlers on the Autism Spectrum Compared to Toddlers with Developmental Delay. Journal of Autism and Developmental Disorders, 40, 1259-1273.

[43] Susan Ellis Weismer，Morton Ann Gernsbacher，Sheri Stronach，Courtney Karasinski，Elizabeth R. Eernisse，Courtney E. Venker，Heidi Sindberg. (2011). Lexical and grammatical skills in toddlers on the autism spectrum compared to late talking toddlers. Journal of Autism and Developmental Disorders, 41, 1065-1075.

[44] Sophieke Koolen, Constance Th. W. M. Vissers, Angelique W. C. J. Hendriks, Jos I. M. Egger, Ludo Verhoeven. (2011). The Interplay between attentional strategies and language processing in High-functioning adults with Autism Spectrum Disorder. Journal of Autism and Developmental Disorders, DOI 10.1007/s10803-011-1310-1.

[45] Terry Bennett，Peter Szatmari，Susan Bryson，Joanne Volden，Lonnie Zwaigenbaum，Liezanne Vaccarella，Eric Duku，Michael Boyle. (2008). Differentiating autism and asperger syndrome on the basis of language delay or impairment. Journal of Autism and Developmental Disorders, 38, 616-625.

[46] Veronica Smith, Pat Mirenda, Anat Zaidman-Zait. (2007). Predictors of expressive vocabulary growth in children with autism. Journal of Speech, Language, and Hearing Research, 50, 149-160.

[47] Wren, C. T. (1985). Collecting language samples from children with syntax problems. Language, Speech, and Hearing Services in Schools, 16, 83–102.

[48] William M. Bolman. (2008). Brief Report: 25-Year Follow-up of a High-functioning Autistic Child. Journal of Autism and Developmental Disorders, 38,181-183.

[49] Chen, Z. L. (2009). Characteristics of the position and relational structure of Chinese relational clauses. Language Science, Vol. 2.

[50] Chen Shun-sen, Bai Xuejun, Zhang Risheng. (2011). Symptoms, Diagnosis and Intervention of Autism Spectrum Disorders. Advances in Psychological Science, Vol. 1.

[51] Gong Shaoying, Peng Danling. (2008). The development of syntactic awareness in Chinese children aged 4-10 years. Psychological Science, Vol. 2.

[52] Gai Xiaosong, Yang Wei, Tai Yu. (2009). Analysis techniques for children's language samples. Advances in Psychological Science, Vol. 6.

[53] Jia, Linxiang. (2007). Language disorders in children with autism and the causes of their formation. Journal of Xuzhou Normal University (Philosophy and Social Science Edition), No. 4.

[54] Liang Weilan, Hao Bo, Wang Shuang, Zhang Zhixiang, T Tarsif, P Fletcher. (2004). A study of syntax and sentence expression length in early childhood. Chinese Journal of Child Health, Vol. 3.

[55] Lu, J. M. (2004). The influence of specific meaning of words on sentence meaning comprehension. Chinese Learning, No. 2.

[56] Liu, Danqing. (2005). A preliminary investigation of the types of relational clause markers in Chinese. Chinese Language, Vol. 1.

[57] Liu, Danqing. (2005). Syntactic structure within small sentences: An excerpt from the Handbook of Syntactic Investigation and Research. World Chinese Language Teaching, Vol. 3.

[58] Liu, Danqing. (2005). The problem of subordinate clauses in grammatical investigation and research. Journal of Contemporary Linguistics, Vol. 3.

[59] Li, Xinzhen. (2007). An introduction to young children's understanding of Chinese grammar and its influencing factors. Studies in Language Theory, Vol. 2.

[60] Li Xiaoyan. (2009). A study of the category characteristics and integration tendencies of language in children with autism. Special

Education in China, No. 11.
[61] Li, Yafei. (2009). The theoretical significance of marginal corpus from the syntactic conditions of juxtaposition structure. Contemporary Linguistics, Vol. 4.
[62] Liu, Yuhong. (2010). Three models for studying the interface between lexical semantics and syntax. Foreign Language Teaching, Vol. 6.
[63] Ma M. (2004). On the modularity of the syntactic processing of sentences. Journal of Northeastern University (Social Science Edition), No. 2.
[64] Tang, Zheng-Da. (2006). Three principles of order type related to relational clauses. Chinese Language, No. 5.
[65] Tang, C.D. (2007). Relational objects and the position of relational clauses - Based on real corpus and typological analysis. Contemporary Linguistics, Vol. 2, 139-150.
[66] Wang YD. (2001). Children's Chinese syntactic acquisition based on cognitive development. Journal of Ningbo University (Educational Science Edition), No. 2.
[67] Wang Chunhui. (2010). Chinese conditional sentence markers and their sequential types. Language Science, Vol. 3.
[68] Wang Wenger. (2010). The current situation and problems of modern Chinese small clauses. Chinese Learning, Vol. 1.
[69] Xu Guangxing. (1999). A review of research on theories of cognitive development and language acquisition in autistic children. Journal of East China Normal University (Education Science Edition), No. 3.
[70] Yang C. G., Zhang T. T. (2010). Cognitive characteristics and neural processing mechanisms of children with autism. Journal of Inner Mongolia Normal University (Education Science Edition), No. 12.
[71] Yin, Hongbo. (2011). Marking, location and interpretation of Chinese purpose clauses. Language Science, Vol. 4.
[72] Zhou Nianli. (2002). Retrospect and exploration of research on cognitive development of autistic children. Special Education in China, Vol. 1.
[73] Zhang, Qin, and Tentative Fei. (2007). Characterization of language skills training for children with autism. Chinese Tissue Engineering Research and Clinical Rehabilitation, Vol. 17.
[74] Zhao Shiju. (2008). Experimental discussion on the role of lexical semantics in determining grammar. Journal of Wuhan University (Humanities Edition), No. 2.
[75] Sarah Ann McConnell. (2010). Sentence complexity in children with autism and specific language impairment. University of Iowa, Master's thesis.