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The Use of Grammatical Morphemes by Mandarin-Speaking Children with High Functioning Autism

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Abstract The present study investigated the production of grammatical morphemes by Mandarin-speaking children with high functioning autism. Previous research found that a subgroup of English-speaking children with autism exhibit deficits in the use of grammatical morphemes that mark tense. In order to see whether this impairment in grammatical morphology can be generalised to children with autism from other languages, the present study examined whether or not high-functioning Mandarin-speaking children with autism also exhibit deficits in using grammatical morphemes that mark aspect. The results show that Mandarin-speaking children with autism produced grammatical morphemes significantly less often than age-matched and IQ-matched TD peers as well as MLU-matched TD peers. The implications of these findings for understanding the grammatical abilities of children with autism were discussed.

Keywords Autism · Grammatical morphology · Temporal processing · Event structure · Language development

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Introduction

Autism is a neurodevelopmental disorder characterised by impaired social interaction, problems in verbal and non-verbal communication, and restricted, repetitive and stereotyped patterns of interests and activities (American Psychiatric Association [APA] 2000). The study of language development in children with autism has received considerable attention in recent years. Most previous research focused on their impairments in pragmatic and prosodic abilities (see Diehl et al. 2014; Loukusa and Moilanen 2009; McCann and Peppé 2003; Tager-Flusberg 1999 for relevant reviews). Deficits in pragmatics and prosody are generally viewed as universal among individuals on the autism spectrum (Lord and Paul 1997; McCann and Peppé 2003; Paul et al. 2005; Peppé et al. 2007; Tager-Flusberg 1999). By contrast, the grammatical aspects of language development in autism have been relatively understudied (see Boucher 2012; Eigsti et al. 2007 for relevant reviews). Among the existing studies, the acquisition of grammatical morphology has been the most investigated aspect of grammatical abilities in children with autism. For example, using data from both spontaneous speech and elicited production tasks, Bartolucci and colleagues found that compared to typically developing children (hereafter, TD children), children with autism were less likely to produce grammatical morphemes in obligatory contexts, e.g., articles (e.g., *a, the*), auxiliary and copular verbs (e.g., *is*), past tense (e.g., *-ed*) (Bartolucci and Albers 1974; Bartolucci et al. 1980). The findings were later replicated by Howlin (1984). In a more recent study, Roberts et al. (2004) compared the performance of children with autism and children with specific language impairment (hereafter, SLI) on tense marking. Tense marking is an established clinical marker for SLI in English-speaking

children (Leonard and Deevy 2010; Leonard et al. 1992, 2007; Rice and Wexler 1996; Rice et al. 1995, 1998). English-speaking children with SLI have been found to exhibit deficits in the use of grammatical morphemes that mark tense, including third-person singular present tense (e.g., *-s* in *sings*) and past tense for both regular verbs (e.g., *-ed* in *walked*) and irregular verbs (e.g., *went, fell*). They frequently omit these morphemes in obligatory contexts. So, for example, English-speaking SLI children often say *He walk* instead of *He walks* or *He walked*. Using an elicited production task, Roberts et al. (2004) found that language-impaired children with autism showed the same difficulties in marking tense as observed in children with SLI (cf., Williams et al. 2008[1]).

In fact, parallels in language profiles between children with autism and children with SLI have also been reported in Howlin et al. (2000), Kjelgaard and Tager-Flusberg (2001), Mawhood et al. (2000), and Rapin and Dunn (2003). On the basis of these findings, Tager-Flusberg and colleagues proposed that there exists a partial overlap between the language impairments in autism and in SLI, or at least a subgroup of children with autism have similar language profiles as children with SLI (Kjelgaard and Tager-Flusberg 2001; Roberts et al. 2004; Tager-Flusberg 2006; Tager-Flusberg and Cooper 1999; Tager-Flusberg and Joseph 2003). Although the relationship of the language problems in children with autism and children with SLI still remains an open question (see Boucher 2012; Tomblin 2011 for relevant reviews), previous studies do seem to suggest that comorbid SLI is present in a subgroup of individuals with autism. In addition, these previous studies also suggest that grammatical morphology might be one of the grammatical aspects that are most likely to be impaired in children with autism.

However, most of these previous studies are limited to English-speaking children with autism. Therefore, it is unclear whether these findings are specific to English, or they can be generalised to other languages. Cross-linguistic investigations are necessary in order to see whether or not grammatical morphology poses difficulties for children with autism across languages. The present study addresses this issue by investigating the use of grammatical morphemes by Mandarin-speaking children with high functioning autism. Although Mandarin Chinese does not have grammatical morphemes for tense, it utilises grammatical morphemes to mark aspect, which we discuss below. This raises the possibility that Mandarin-speaking children with autism exhibit difficulties in marking aspect that mirror the difficulties in tense experienced by English-speaking children with autism.

Previous research found that Cantonese-speaking children with SLI are more likely to omit aspectual morphemes than both same-age TD peers and younger TD children (Fletcher et al. 2005; Stokes and Fletcher 2003). Like other Chinese languages, including Mandarin, Cantonese uses grammatical morphemes to mark aspect, though it does not have grammatical morphemes for tense. The finding that Cantonese-speaking children with SLI have difficulty with aspectual morphemes invites the investigation of other Chinese languages, such as Mandarin. Very few studies have investigated the use of aspectual morphemes by Mandarin-speaking children with SLI, presumably due to the fact that SLI is not an established language disorder in China. One study, however, by Cheung (2005), provides preliminary data showing that Taiwan Mandarin-speaking children with SLI also have difficulties in using aspectual morphemes. If similar parallels exist in the language profiles between Mandarin-speaking children with autism and those with SLI as observed in their English counterparts, then we would expect that Mandarin-speaking children with autism (or at least a subgroup of them) will also exhibit deficits in the use of aspectual morphemes.

We focus on high-functioning children with autism. If comorbid SLI is present in a subgroup of individuals with autism, we then expect that the effects of comorbid SLI should be most apparent in high-functioning individuals with autism, as has been observed by Cleland et al. (2010) and Rapin et al. (2009). Compared to high-functioning individuals with autism, the effects of comorbid SLI in lower functioning individuals with autism would be largely masked by factors associated with learning disabilities, as discussed in Boucher (2012). In addition, it has been reported that English-speaking adults with high functioning autism exhibited difficulties in the use of grammatical aspect (Perkins et al. 2006).

Mandarin Chinese and English are typologically distinct languages. If children with autism from the two languages exhibit similar deficits in using grammatical morphemes, this would constitute evidence that an impairment in grammatical morphology might be universal among children with autism across languages. To the best of our knowledge, the present study is the first investigation of language development in Mandarin-speaking children with autism. It will enable us to bring a cross-linguistic perspective to the study of language development in autism, as well as to start constructing a profile of the sparing and loss of language abilities in Mandarin-speaking children with autism.

The paper is structured as follows. First, we briefly discuss the grammatical aspect system in Mandarin Chinese. Then we present the experimental studies investigating the

[1] Williams et al. (2008) reanalysed Roberts et al.'s data and made a case against Roberts et al.'s claim that impairments in tense marking in autism resemble those observed in SLI.

use of aspectual morphemes by Mandarin-speaking children with high functioning autism and their TD peers. Finally, we discuss the implications of the current findings for understanding the grammatical abilities of children with autism.

Grammatical Aspect in Mandarin Chinese

Mandarin Chinese has a rich aspectual system. Aspect is the part of the grammar that marks the temporal flow of events from the speaker's point of view, often indicating whether events are on-going or have been completed. To illustrate using English, the sentence *He is walking* contains the grammatical morpheme *–ing*, which makes it clear that the event of walking is currently in progress. Grammatical morphemes are also used to mark grammatical aspect in Mandarin Chinese. There are four primary aspectual morphemes: the progressive morpheme *zai–*, the durative morpheme *–zhe*, the perfective morpheme *–le*, and the experiential morpheme *–guo* (Chao 1968; Li and Thompson 1981; Yang 1995). In the present study, we focus on the perfective morpheme *–le*. The perfective morpheme *–le* is often used to indicate that an event or action has been completed. Sentence (1) is used to illustrate. Throughout the text, PERF is used to indicate a perfective morpheme.

(1) Xiaonanhai hua-le xiaomao
little boy draw-PERF cat
'The little boy has drawn a cat.'

In sentence (1), the perfective morpheme *–le* is attached to the verb *hua* 'draw', which indicates that the event of drawing has been completed. So the sentence means that the little boy has drawn a cat. It has been reported that TD Mandarin-speaking children begin to use the perfective morpheme *–le* at the age of 2 (Erbaugh 1978). In the present study, we investigate the production of the perfective morpheme *–le* by both children with autism and TD children using an elicited production task. We were interested to see whether children with autism are less likely to produce the perfective morpheme *–le* in the experimental task than their TD peers.

Methods

Participants

Fifty-nine Mandarin-speaking children with high functioning autism participated in the study. They were recruited from the Rehabilitation and Education Centre for Children with Autism, affiliated with the Peking University Sixth Hospital, Beijing, China. Their diagnoses were made by paediatric neurologists at the Peking University Sixth Hospital prior to enrolment to the Centre. To confirm the participants' diagnoses, an expert clinician was asked to observe these children to ensure that they met the DSM-IV-TR (APA 2000) criteria for autistic disorder. Three children did not proceed to the actual experiment, because they did not meet the DSM-IV-TR criteria for autistic disorder. The remaining 56 children all met the DSM-IV-TR criteria for autistic disorder, and none of them were diagnosed with Asperger's disorder or with pervasive developmental disorder–not otherwise specified (PDD–NOS). Each of these 56 children was further evaluated independently by our research team using the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 1999). All the 56 children met the autism cut-off on the ADOS, and thus were included in the final analyses: 18 children were between the ages of 4;2 (years; months) and 4;10 (mean age 4;5), 18 children were between the ages of 5;1 and 5;11 (mean age 5;6) and 20 children were between the ages of 6;1 and 6;5 (mean 6;3). In addition, 77 age-matched typically developing children also participated in the study: 25 children were between the ages of 4;1 and 4;11 (mean age 4;5), 27 children were between the ages of 5;1 and 5;10 (mean 5;6) and 25 children were between the ages of 6;1 and 6;4 (mean age 6;3). They were recruited from the kindergarten at the Beijing Language and Culture University, Beijing, China.

Table 1 Verbal IQ scores and MLU of each participant group (SD in parentheses)

Group	Number	Verbal IQ	MLU
Autism group			
4-Year-olds	18	99.56 (12.46)	4.98 (1.23)
5-Year-olds	18	101.17 (13.55)	5.97 (1.26)
6-Year-olds	20	103.97 (12.92)	6.79 (1.11)
TD group			
4-Year-olds	25	101.68 (14.05)	5.89 (1.21)
5-Year-olds	27	103.98 (11.72)	6.78 (1.12)
6-Year-olds	25	104.77 (12.86)	7.81 (1.06)

The participants' verbal IQ was assessed using the Chinese-Wechsler Young Children Scale of Intelligence (C-WYCSI)—a standardised IQ test designed for Mandarin-speaking children between the ages of 4 and 6.5 (Gong and Dai 1992). The test showed that all the participants, including both the high-functioning children with autism and the TD children, had verbal IQ scores above 80. In addition, in order to assess children's sentence complexity, we measured the Mean Length of Utterance (MLU) of each participant. We recorded 100 utterances for each participant. The participants' utterances were recorded from their interactions with their teachers either in classroom or

Table 2 Verbs in the task and their target forms

Verbs	Target forms with *–le*
hua 'draw'	*hua-le*
zhong 'plant'	*zhong-le*
he 'drink'	*he-le*
chi 'eat'	*chi-le*
da 'build'	*da-le*
si 'tear'	*si-le*
chui 'blow'	*chui-le*
zhua 'catch'	*zhua-le*
mo 'touch'	*mo-le*
xi 'wash'	*xi-le*
zhai 'pick'	*zhai-le*
wei 'feed'	*wei-le*

individual training sessions. In Mandarin Chinese, MLU was often calculated by dividing the total number of words by the number of utterances in each speech sample. In the present study, we followed the common practice of calculating Mandarin MLU by dividing the total number of words in each participant's utterances by the total 100 utterances that were recorded for each participant. The mean IQ score and MLU for each participant group are presented in Table 1.

Differences were observed between the three autism groups and their age-matched TD peers in IQ scores and MLU. The autism 4-year-olds and 5-year-olds had an IQ score that was significantly lower than that of their age-matched TD groups (i.e., autism 4-year-olds vs. TD 4-year-olds, $t(41) = 3.85$, $p < .01$; autism 5-year-olds vs. TD 5-year-olds, $t(43) = 4.28$, $p < .01$). However, there was no significant difference between the IQ scores of the autism 6-year-olds and their age-matched TD peers ($t(43) = .99$, $p = .33$). Although the IQ scores of the autism 5-year-olds and 6-year-olds were lower than their age-matched TD peers, they were comparable with those of the younger TD children (autism 5-year-olds vs. TD 4-year-olds, $t(41) = 1.17$, $p = .25$; autism 6-year-olds vs. TD 5-year-olds, $t(45) = .01$, $p = .99$). With respect to MLU, the three autism groups had an MLU level that is significantly lower than that of their age-matched peers (autism 4-year-olds vs. TD 4-year-olds, $t(41) = 12.93$, $p < .001$; autism 5-year-olds vs. TD 5-year-olds, $t(43) = 13.92$, $p < .001$; autism 6-year-olds vs. TD 6-year-olds, $t(43) = 13.79$, $p < .001$). However, the MLU levels of the autism 5-year-olds and 6-year-olds were comparable with those of the younger TD groups (autism 5-year-olds vs. TD 4-year-olds, $t(41) = 1.27$, $p = .21$; autism 6-year-olds vs. TD 5-year-olds, $t(45) = .16$, $p = .88$).

Procedures

Experimental Task

We used an elicitation production task in which participants were given opportunities to produce 12 target forms with the perfective aspectual morpheme *–le* (see Table 2 for the 12 verbs used in the task and the expected target forms with the aspectual morpheme *–le*). On one typical trial, the experimenter gave the following instructions: "Look! I have two pictures. I will describe the first one, and you tell me about the second one." After placing the first picture (see Fig. 1) in front of the child, the experimenter said "Look! Here is a boy drawing a cat." Then the second picture (see Fig. 2) was placed in front of the child, and the experimenter said "Now he is done with the drawing. Tell me what the boy did." The actual instructions were given in Mandarin Chinese (see "Appendix" for the Mandarin instructions).

Before the experimental session, two practice trials were given to familiarise the participants with the task. The two practice trials were similar to the test trials, both of which were used to elicit the perfective morpheme *–le*. On each of the practice trials, the participant's correct responses were acknowledged and repeated, and an imitation of the target form was requested from the child in case of an incorrect response. For example, when a child participant did not produce the perfective morpheme *–le* after the verb, the experimenter always provided feedback by producing the correct target form with *–le*, and asked the participant to repeat the correct form. These two practice trials were used for training purposes only. All the participants proceeded to the test trials regardless of whether they produced the aspectual morpheme *–le* on either of the practice trials. The practice session was followed by the 12 test trials. Throughout the test trials, the participant was not provided with the target form in the event of an incorrect response. Instead, the child was complimented for participating in the activity, regardless of the accuracy of the responses.

Articulation Test

The omission of the aspectual morphemes could occur due to difficulties in articulating these morphemes. In order to rule out this possibility, an articulation test was conducted after the experimental session. In the articulation test, each participant was asked to produce the perfective morpheme *–le* alone (without a sentence context). All the participants were able to produce the morpheme *–le* properly, indicating that they did not have physical problems in articulating the morpheme. Therefore, they were all included in the final analyses.

Fig. 1 First picture of the example trial

Fig. 2 Second picture of the example trial

Data Treatment

All experimental sessions were audio-recorded, and then transcribed by the experimenter. To assess the transcription reliability, the responses from 30 participants (15 from the autism group and 15 from the TD group) were selected to be scored by a second coder. Overall interrater reliability (calculated per word) was high (.98). Cases in which there was disagreement were discussed with a third coder and a consensus was reached.

Four types of responses were observed in children's productions. Participants' responses to the example trial were used to illustrate. In response to the experimenter's probe sentence "Tell me what the boy did" in the example trial, children produced structures as in examples (2)–(5). Note that in most of the responses, the subject noun phrases of the structures were omitted. These are grammatical structures in Mandarin Chinese, because Mandarin is a pro-drop language in which the subject noun phrases (e.g., the pronoun *ta* 'he' in the structure) can often be omitted when they are contextually available.

(2) Hua-le xiaomao
draw-PERF cat
'(He) has drawn a cat.'

(3) Hua xiaomao le
draw cat PERF
'(He) has drawn a cat.'

(4) Zuo-le hua xiaomao
do-PERF draw cat
'(He) did draw a cat.'

(5) Hua xiaomao
draw cat
'(He) draw a cat.'

In example (2), the perfective morpheme *–le* is attached to the verb *hua* 'draw', which is the expected target form of the verb. In (3), the perfective morpheme *–le* occurs at the end of the sentence. This is also a grammatical form in Mandarin Chinese. The difference between the verb-final *–le* (e.g., (2)) and the sentence-final *–le* (e.g., (3)) is not our concern. For our purposes, it is critical to know that *–le* in both positions indicates the completion of an event. So, in the present study responses containing either the verb-final *–le* or the sentence-final *–le* were coded as target forms. In (4), there are two verbs *zuo* 'do' and *hua* 'draw', and the perfective morpheme *–le* is attached to the first verb *zuo* 'do'. We coded this type of responses as echolalic responses, because the first verb phrase in the response *zuo-le* 'do-PERF' is an immediate repetition of the verb phrase in the probe question in (6).[2]

(6) Gaosu wo xiaonanhai **zuo-le** shenme?
tell me boy **do-PERF** what
'Tell me what the boy did.'

Any responses in which the first verb was an immediate imitation of the verb form in the probe question were coded as echolalic responses. Echolalic responses are a type of typical responses observed in children with autism (see e.g., Roberts et al. 2004; Rutter 1968; Violette and Swisher 1992). The last type of response was provided in example

[2] One reviewer correctly pointed out that though *–le* was used in these echolalic responses, this does not reflect a productive capacity to use this morpheme. In fact, the finding that the participants who produced the *zuo-le* structure always used the perfective morpheme *–le* provided further evidence attesting to the echolalic nature of their responses, because these participants were adhering to the exact verb forms they heard.

(5), which contains the bare verb form *hua* 'draw', with the perfective morpheme *–le* omitted. This type of responses was then coded as bare verb forms.

Results

Proportions of the target forms, the bare verb forms and the echolalic responses were computed for each age group in both the autism and TD populations. Table 3 shows the proportion of the three types of responses by the three autism groups and the three TD groups. In the analyses, we calculated effect size with Cohen's *d* for t-tests. Effect sizes between .2 and .5 are considered small, between .5 and .8 medium, and above .8 large. We calculated effect size with partial eta squared (η^2) for the repeated measures ANOVAs. Values between .01 and .06 are considered a small effect size, between .06 and .14 a medium effect size, and above .14 a large effect size.

Within-Group Comparisons

As indicated in Table 3, the three autism groups exhibited similar response patterns. The autism 4-year-olds, 5-year-olds and 6-year-olds all produced the bare verb forms more often than the target forms and the echolalic responses. Paired samples t-tests showed that the autism 4-year-olds produced significantly more bare verb forms than the target forms ($t(17) = 5.24$, $p < .001$, $d = 3.82$) and the echolalic responses ($t(17) = 9.85$, $p < .001$, $d = 6.10$), so did the autism 5-year-olds (bare forms vs. target forms: $t(17) = 4.20$, $p = .001$, $d = 3.54$; bare forms vs. echolalic responses: $t(17) = 9.76$, $p < .001$, $d = 6.76$) and 6-year-olds (bare forms vs. target forms: $t(19) = 3.83$, $p < .01$, $d = 2.68$; bare forms vs. echolalic responses: $t(19) = 10.71$, $p < .001$, $d = 6.31$). By contrast, the three TD groups all exhibited an opposite pattern compared to the autism groups. The TD 4-year-olds produced the target forms significantly more often than the bare verb forms ($t(24) = 11.18$, $p < .001$, $d = 8.33$) and the echolalic responses ($t(24) = 12.41$, $p < .001$, $d = 9.05$). So did the TD 5-year-olds (target forms vs. bare forms: $t(26) = 9.42$, $p < .001$, $d = 7.42$; target forms vs. echolalic responses: $t(26) = 12.89$, $p < .001$, $d = 11.57$) and 6-year-olds (target forms vs. bare forms: $t(24) = 9.24$, $p < .001$, $d = 10.76$; target forms vs. echolalic responses: $t(24) = 13.98$, $p < .001$, $d = 17.85$).

Between-Group Comparisons

Given that each autism group was comparable on verbal IQ and MLU with the TD group that was a year younger, comparisons were only performed on IQ- and MLU-matched groups but not on age-matched groups. As discussed, the autism 5-year-olds were comparable with the TD 4-year-olds on both IQ and MLU, and the autism 6-year-olds were comparable with the TD 5-year-olds on both IQ and MLU. To measure the differences in response types between the autism group (combining the autism 5-year-olds and 6-year-olds) and the IQ- and MLU-matched TD group (combining the TD 4-year-olds and 5-year-olds), a repeated measures ANOVA was performed with response type (i.e., the target forms, the bare verb forms and the echolalic responses) as the within-subjects factor. There was a significant main effect of response type ($F(2, 176) = 193.66$, $p < .001$, $\eta^2 = .69$). There was also a significant interaction between group and response type ($F(2, 176) = 181.12$, $p < .001$, $\eta^2 = .67$). Post-hoc pairwise comparisons showed that the autism group produced the target forms significantly less often than the IQ- and MLU-matched TD group ($t(88) = 12.27$, $p < .001$, $d = 2.66$), and they produced the bare verb forms and the echolalic responses significantly more often than the IQ- and MLU-matched TD group (bare forms: $t(88) = 14.21$, $p < .001$, $d = 3.34$; echolalic responses: $t(88) = 3.30$, $p = .001$, $d = .71$).

Table 3 Mean proportions of the target forms, bare verb forms and echolalic responses by the autism and TD children (SD in parentheses)

Group	Target forms	Bare verb forms	Echolalic responses
Autism group			
4-Year-olds	25.36 % (10.25)	63.89 % (9.91)	10.75 % (7.32)
5-Year-olds	30.24 % (9.33)	64.40 % (9.98)	7.72 % (6.41)
6-Year-olds	33.25 % (10.56)	60.84 % (10.04)	5.91 % (7.12)
TD group			
4-Year-olds	85.68 % (9.17)	10 % (9.01)	4.32 % (8.81)
5-Year-olds	88.96 % (10.87)	11.04 % (10.12)	0 % (0)
6-Year-olds	92 % (7.29)	8 % (8.29)	0 % (0)

Discussion

The present study investigated the production of grammatical morphemes by Mandarin-speaking children with high functioning autism. We found that compared to the TD children, the high-functioning children with autism produced the target forms containing the perfective morpheme *–le* significantly less often, and they produced the bare verb forms and echolalic responses significantly more often. This is evidence that aspectual morphemes pose difficulties for Mandarin-speaking children with high functioning autism. This difficulty in the use of grammatical morphemes cannot be attributed to their difficulties in

articulating this particular morpheme *–le* in the present study, because all the children passed the articulation test conducted after the experimental session, i.e., they were all able to produce the morpheme *–le* properly. This difficulty cannot be due to their IQ or MLU level (i.e., the (in)ability to produce complex sentences) either, because compared to the IQ- and MLU-matched TD group, the autism group still produced more bare verb forms and fewer target forms. On the basis of these findings, we conclude that Mandarin-speaking children with high functioning autism exhibit difficulties in using grammatical morphemes to mark aspect. A deficit in using aspectual morphemes could be defined as one of the language characteristics of Mandarin-speaking children with high functioning autism.

The current findings also have important implications for understanding the grammatical abilities of children with autism. Previous research found that a subgroup of English-speaking children with autism exhibited deficits in using grammatical morphemes to mark tense (Bartolucci and Albers 1974; Bartolucci et al. 1980; Howlin 1984; Roberts et al. 2004). The present study found that Mandarin-speaking children with autism exhibited deficits in using grammatical morphemes to mark aspect. This cross-linguistic data suggests that children with autism from the two typologically distinct languages exhibit similar deficits in using grammatical morphemes. This finding provides evidence that grammatical morphology might be one of the grammatical aspects that are most likely to be impaired in children with autism across languages.

The current findings can also contribute to our understanding of the relationship between the language problems in autism and in SLI. As discussed in the introduction, previous research seemed to suggest that comorbid SLI is present in a subgroup of individuals with autism (Kjelgaard and Tager-Flusberg 2001; Roberts et al. 2004; Tager-Flusberg 2006; Tager-Flusberg and Cooper 1999; Tager-Flusberg and Joseph 2003). The current findings provide further support for this proposal by adding cross-linguistic evidence that Mandarin-speaking children with autism exhibit same difficulties in using aspectual morphemes as observed in Mandarin-speaking and Cantonese-speaking children with SLI (Cheung 2005; Fletcher et al. 2005; Stokes and Fletcher 2003). However, it remains an open question as to whether the observed similarities in language impairments between the two disorders are simply surface manifestations of the same underlying neuropsychological dysfunction, or they actually involve different underlying causes (see Boucher 2012; Eigsti et al. 2007; Williams et al. 2008 for relevant discussions). The remainder of the discussion discusses two important findings of the present study that might contribute to our understanding of this open question.

One important finding of the present study is that the three groups of high-functioning children with autism all exhibited significant impairments in marking grammatical aspect regardless of their MLU levels. MLU, to some extent, can be used as an indicator of children's language development,[3] or at least the development of their sentence complexity. So, the finding suggests that deficits in grammatical aspect marking are relatively independent of the development of sentence complexity. This finding raises an important question: why does grammatical aspect pose particular problems for children with autism? We discuss this question in relation to the poor "temporal processing" in autism proposed by Boucher (2000, 2001). Boucher proposed that people with autism have fundamental temporal processing difficulties. Deficits of temporal processing would cause problems in the acquisition of deictic temporal concepts whose references vary according to the discourse contexts in which they are used, such as *now, soon, then, before, tomorrow* etc. According to Boucher, the biopsychological mechanisms for analysing and representing the temporal components of event structure might also be impaired in autism. In the present case, the use of aspectual morphemes is closely related to temporal processing, or more precisely, the temporal structures of events. Human languages often use morphology to refer to the temporal structures of events (e.g., *ongoing* vs. *completed*). Consider, for example, the contrast between the *imperfective* versus *perfective* aspect. Imperfective aspect makes specific reference to the internal structure of events by focusing on the ongoing process, but makes no reference to their completion. Perfective aspect refers to events as completed by focusing on the endpoint of the events rather than the ongoing process/internal structure (Comrie 1976; Smith 1991). English uses grammatical morphemes to mark aspect. Examples (7a) and (7b) are used to illustrate. (7a) contains the grammatical morpheme *–ing*, which makes it clear that the event of planting a flower is currently in progress. By contrast, (7b) contains the grammatical morpheme *–ed*, which indicates that the event of planting a flower has been completed.

(7) a. The old lady is planting a flower
b. The old lady has planted a flower

These examples illustrate that the use of grammatical morphemes is closely related to the temporal structures of events, e.g., whether the event is ongoing or has been completed. As discussed, Mandarin Chinese also uses grammatical morphemes to mark grammatical aspect. For example, in the present case the use of the perfective morpheme *–le* indicates the completion of an event. If,

[3] To date there are no standardised tests that can be used to assess Mandarin-speaking children's language development.

according to Boucher (2000, 2001), the biopsychological mechanisms for processing the temporal structures of events are impaired in autism, then it would not be surprising to observe that children with autism exhibit significant difficulties in using grammatical morphemes that mark aspect. Their problems with grammatical aspect might be a consequence of their poor "temporal processing". Of course, further investigations are required in order to test this proposal. One possible study would be a comprehension task in which children with autism are presented with both pictures as in Figs. 1 and 2 while they are listening to sentences like (1), repeated here as (8), and their task is to choose which one of the pictures correctly describes what they hear. According to the poor "temporal processing" account, we would expect that children with autism might not be able to choose the correct picture corresponding to sentence (8) due to their impairments in processing the temporal structures of events. Impairments in temporal processing might be specific to the autism phenotype.

(8) Xiaonanhai hua-le xiaomao
little boy draw-PERF cat
'The little boy has drawn a cat.'

Another interesting finding of the study is that the MLUs of each autism group were significantly shorter than their age-matched TD group. This finding confirms the observation by Eigsti et al. (2007) that high-functioning children with autism exhibited less complex syntax compared to their age-matched TD peers, indicating a clear presence of syntactic deficits in the autism group. The finding also provides evidence in support of an autism-specific syntactic deficits/delay proposed by Eigsti et al. (2007), since the children with autism produced language that was significantly less complex than might be expected for their developmental level.

Taken together, the findings of the present study seem to suggest that the observed similarities between the language impairments in autism and in SLI might be superficial, and they actually involve different underlying causes and might result from distinct pathologies. All the individuals on the autism spectrum probably share certain psychological characteristics that will have potential effects on their language development. Of course, further investigations are required in order to verify these proposals. In addition, we cannot simply generalise our findings to all the Mandarin-speaking children with autism. The present study only focused on children with high functioning autism. Further investigations of lower functioning children with autism are required in order see whether the use of grammatical morphemes in marking aspect poses a universal challenge for all the children on the autism spectrum. In addition, the present study only examined the production of the perfective morpheme *–le*. Further studies on the use of the other three aspectual morphemes (i.e., the progressive morpheme *zai–*, the durative morpheme *–zhe*, and the experiential morpheme *–guo*, as discussed in "Grammatical Aspect in Mandarin Chinese") are also required in order to see whether this deficit applies to all the grammatical morphemes that are used to mark aspect in Mandarin Chinese.

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Appendix: Mandarin Version of the Example Instructions Used in the Task

1. Mandarin instruction: "你看，我这儿有两幅画。 我来说第一幅，然后你告诉我第二 幅，好吗"
English translation: "Look. I have two pictures. I will describe the first one, and you tell me about the second one."
2. Mandarin instruction: "你看，这儿有一个小男孩，他在画板上画小猫"
English translation: "Look. Here is a boy drawing a cat."
3. Mandarin instruction: "现在呢，画画结束。 告诉我小男孩干了什么"
English translation "Now he is done with the drawing. Tell me what the boy did."

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