



Conversation Skills in Chinese-Speaking Preschoolers with Autism: The Contributing Role of Parents' Verbal Responsiveness

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Abstract

Children with autism spectrum disorder (ASD) have conversation deficits, yet the growth of conversation abilities is understudied, especially in Chinese-speaking populations. Little is known about whether their parents' verbal responsiveness and redirectives are related to their conversation skills. Children with ASD ($N = 37$; $M = 5;5$) and their parents contributed their language samples. These children interacted with their parents at four time points over nine months. The number of conversational turns and the proportion of child-initiated conversation (but not the proportion of children's appropriate responses) grew over nine months. After controlling for time, autism severity, and language skills, parents' verbal responsiveness positively predicted children's appropriate responses. Parents' redirectives negatively predicted the proportion of children's appropriate responses and the number of conversational turns.

Keywords Conversation abilities · Parental inputs · Intervention · Naturalistic language sampling · Chinese-speaking

Introduction

Autism spectrum disorder (ASD) is widely recognized as a complex, heterogeneous neurodevelopmental condition that affects about one in 54 individuals (National Centers on Birth Defects and Developmental Disabilities, 2020). According to the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychological Association; 2013), individuals with ASD have

impairments in social communication and interaction, and they produce restricted and repetitive behaviors. Regarding social interaction, impairments in pragmatic speech appear across different language levels and ages along the autism spectrum (e.g., Baird & Norbury, 2016; Lam & Yeung, 2012; Tager-Flusberg et al., 2005; Volden et al., 2009). The present study focuses on the pragmatic speech produced by Chinese-speaking children during conversation. According to the Education Bureau in Hong Kong, the number of students recently diagnosed with ASD was 7200 in 2015/16, 8600 in 2016/17, and 10,300 in 2017/18, representing a 20% rise each year (EDB, 2016; 2017; 2018). With such a large number of young children diagnosed with ASD, it is crucial to understand language and communication impairments, particularly deficits in conversation, in Chinese-speaking children, for designing effective intervention. Thus, we here ask whether conversation skills grow over time in Chinese-speaking young children and the extent to which their elicitation of appropriate responses during conversation is affected by their parents.

Conversational interactions require a range of pragmatic skills such as turn-taking, topic initiation, and topic maintenance (Ninio & Snow, 1996; Wetherby, 2006). Previous research has reported deficits in conversational turn-taking and maintaining topics during conversation in verbal children with ASD (Landa et al., 1992; Tager-Flusberg &

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Anderson, 1991). Specifically, compared to children without ASD, these children are found to have difficulties in expanding conversational topics, maintaining appropriate and relevant topics, and engaging in turn-taking, thus resulting in little reciprocal conversation (Bauminger-Zviely & Agam-Ben-Artzi, 2014; Capps et al., 1998; Jones & Schwartz, 2009; Lam & Yeung, 2012; Losh & Capps, 2003). These deficits persist when these children become adolescents (e.g., Adams et al., 2002; Koning & Magill-Evans, 2001; Paul et al., 2009; Philofsky et al., 2007). Of these studies, Paul et al. (2009) identified three major pragmatic difficulties: topic management, quantity and type of information provided, and reciprocity.

However, the development of conversation skills is understudied and the findings to date are inconclusive. In one of the few studies undertaken, Hale and Tager-Flusberg (2005) tested 57 children with high-functioning ASD (average IQ = 77) at two time points over a year, observing conversations with their parents. These children were found to have made significant improvement in their ability to maintain a topic of discourse and to present a significant reduction in imitation of their parents' speech. In a recent study by DiStefano et al. (2016), 55 children with low-functioning ASD and minimal verbal skills participated in an intervention program in one of two joint engagement-based intervention conditions. Children in both conditions showed improvement in the length and frequency of their communication interchanges over the course of the intervention. On the contrary, Tager-Flusberg and Anderson (1991) found that children diagnosed with ASD did not show any developmental change in discourse ability over a year. However, only six children participated in their study. Given the heterogeneity of language abilities in ASD, it is difficult to detect developmental change in such a small group of children.

Besides the inconclusive findings on the developmental changes of conversation skills, the aforementioned studies focused on English-speaking children with ASD and none of them examined the conversational skills of Chinese-speaking children with ASD or documented their growth of these skills over time. Only a small number of studies investigated the verbal and nonverbal communication in Chinese-speaking children with ASD (So et al., 2015; So & Wong, 2018; Su et al., 2018; Yi et al., 2013; Zhou et al., 2015). Of these studies, Su et al. (2018) examined expressive language development in a sample of 160 participants between 17 and 84 months old Chinese preschoolers with ASD. Parents completed the Putonghua Communicative Development Inventory-Toddler form (Tardif & Fletcher 2008). Three subgroups (low verbal, middle verbal, and high verbal) were defined based on the total vocabulary production. The three subgroups displayed discrepancies in lexical components (e.g., the proportion and total utterance on nouns, verbs, and pronouns), syntax, and MLU. These

results suggested that there are variations in language abilities in Chinese-speaking children. In another study, So and colleagues found that school-aged Chinese-speaking children with ASD gesture less often and use fewer types of gestures, especially markers, in comparison to age-matched peers with typical development, and have difficulty producing iconic gestures to identify referents (So et al., 2015). However, these studies did not study conversation abilities. Without knowing their conversation deficits and growth trajectories, it is challenging to design effective intervention for Chinese-speaking children.

As a result, the first objective of the present study was to document the growth of conversational skills in Chinese-speaking preschool children with ASD over nine months at four time points. Changes were modeled over time. In this study, we collected naturalistic language samples from parent–child dyads. Naturalistic language samples carry detailed language information regarding children's initiation of conversation, appropriate responses to the parents, and their maintenance of conversation (DiStefano et al., 2016).

Parents provide “around the clock” intervention for children with ASD (Koegel et al., 1995), even though many receive regular interventions from outside the family. Therefore, besides characterizing the conversational skills of Chinese-speaking children with ASD over time, we investigated whether parents' verbal responsiveness and redirectives in a conversation would elicit children's appropriate responses and then increase the number of conversation turns. Parents' verbal responsiveness refers to the utterances that follow the child's focus of attention, actions, and communications (Landry et al., 2000; McDuffie & Yoder, 2010; Siller & Sigman, 2002; Yoder & Warren, 1999). Parents' redirectives refer to the utterances that require the child to stop attending to the event, object, or person with which they are engaged and attend to something else (McCathren et al., 1995).

Since the 70s and 80s, researchers have suggested parents or therapists adopt a child-oriented or scaffolded approach when interacting with children with developmental disabilities (Bruner, 1978; Nelson, 1989). Under this approach, parents should follow the child's lead, respond to, and expand or recast the child's initiations while keeping the meaning of the child's utterances in order to foster their children's verbal participation. Previous findings have shown that children with developmental delay or developmental disabilities are more likely to converse on the topics that were continued by their parents on the immediately preceding topic of children's interests than the topics initiated by the parents (Yoder & Davies, 1990; Yoder et al., 1992). Besides expansion and recast, questions asked by parents may elicit children's continuations too. In an experiment conducted by Yoder and colleagues, an adult experimenter interacted with children with developmental delay using two different styles—topic-continuing wh-questions and topic-continuing

comments (Yoder et al., 1994). Their findings showed that topic-continuing wh-questions are more likely than comments to elicit child continuations.

Adults' or parents' verbal responsiveness can elicit further children conversation for a few reasons. First, the child may be interested in maintaining an interaction about a topic they had previously shown interest in (Olsen-Fulero & Conforti, 1983). Based on this view, the child is more likely to maintain an established topic when confronted with an adult utterance that maintains the child's topic than when the adult initiates a new topic. Second, it may be easier for the child to understand adult speech that continues the established topics and attentional lead, which results in less information processing load (Bloom et al., 1976; Landry & Chapieski, 1989).

However, the aforementioned studies, which investigated the influence of parents' verbal responsiveness on children's participation in a conversation, only examined children with developmental delays (especially those with Down Syndrome). To date, no study has examined children with ASD. It is crucial to understand whether parents' verbal responsiveness would facilitate the elicitation of appropriate responses in these children who are found to show deficits in responding to their parents in a conversation. If so, therapists can recommend scaffolding strategies for developing conversation skills to parents of children with ASD.

Nonetheless, a few studies have reported that parents' verbal responsiveness facilitates play behaviors and joint attention in children with ASD. A study by Bottema-Beutel and colleagues examined 98 parent-child dyads (Bottema-Beutel et al., 2018b) of which 50 were young children with ASD and their parents, and 48 were toddlers with typical development and their parents, with the children in both groups having a mental age of 13 months. Their study found that child toy play was more likely to elicit follow-in utterances (utterances that relate to the child's attentional focus) from the parents of children with ASD than from those of children with typical development. In turn, these follow-in utterances had a facilitative effect on the functional play of children with ASD, whereas caregiver-focused utterances had an inhibitory effect. Another study by Bottema-Beutel and colleagues also found that parents' follow-in utterances elicited supported joint engagement in both young children with ASD and typical development, with strong association in children with ASD (Bottema-Beutel et al., 2018a). In contrast with follow-in utterances, redirectives are negatively related to joint attention as the child is required to shift the focus of attention and follow the adult's need in order to establish joint attention with the adult (Landry & Chapieski, 1989).

Abundant research also reported the positive influence of parents' verbal responsiveness on language development

in children with ASD (e.g., Bottema-Beutel et al., 2014; Dimitrova et al., 2015; McDuffie & Yoder, 2010; Haebig et al., 2013a, b; see reviews in Edmunds et al., 2019). McDuffie and Yoder (2010) categorized verbal responsiveness into follow-in comments ('utterances that follow the child's focus of attention and describe what the child is looking at or playing with, without conveying the expectation that the child do something different or respond verbally to the parent') and follow-in directives ('utterances that follow the child's current focus of attention and convey a request for the child to change some aspect of his/her play with toys or to provide a verbal response') (p. 1032). In their study, they followed preschoolers with ASD over 6 months and measured the vocabulary they produced in play episodes at two time points. They found that parent follow-in comments and follow-in directives at baseline significantly predicted children's vocabulary use 6 months later. Similarly, Haebig, McDuffie, and Weismer (2013a, b) found that follow-in directives are positively associated with language comprehension and production a year later in children who were minimally verbal or verbally fluent, while follow-in comments have the same facilitating effect only in children who were minimally verbal. Siller and Sigman (2002, 2008) even found that follow-in comments could predict gains in language skills 10 and 16 years later in children with ASD. In contrast with follow-in comments or directives, relatively less is known about how parents' redirectives influence language development in children with ASD. Besides, the relationship between redirectives and language development for typically developing children and children with developmental delays is either negative or non-significant (Crawley & Spiker, 1983; Harris, 1994; Tomasello & Farrar, 1986).

Taken together, previous research has shown parents' verbal responsiveness has positive impact on the elicitation of contingent play and joint attention behaviors and even on long-term language development in children with ASD. However, no study to date has examined the influence of parents' verbal responsiveness and redirectives in these children's participation in a conversation. Specifically, would children with ASD be more likely to elicit appropriate responses under parents' verbal responsiveness than under parents' redirectives? The second objective of the present study addressed this question. Based on the findings of the previous studies that showed the positive influence of parents' verbal responsiveness in children's behaviors and language skills, we hypothesized that parents' verbal responsiveness would positively predict the proportion of appropriate responses from their children and hence the number of conversational turns. In contrast, redirectives would negatively predict appropriate responses and conversational turns in their children.

Methods

Participants

The participants in the current study were identified from the larger Robot for Autism Behavioral Intervention project (RABI; So, 2020), an intervention conducted at The Chinese University of Hong Kong for (Cantonese) Chinese-speaking individuals with ASD aged three to 18 years. A subset of these participants ($N = 37$; 32 males) contributed language samples over a nine-month intervention. On average, they were 5;5 ($SD = 10.46$ months; ranging from 49 to 100 months). Data were collected at The Chinese University of Hong Kong.

All children participating in the study had been diagnosed with ASD between the ages of 18 and 36 months ($M = 27.24$; $SD = 5.12$) by pediatricians at the Child Assessment Centre for the Department of Health in Hong Kong. Their ASD diagnoses were further confirmed by the research team using the Autism Diagnostic Observation Schedule—Second Edition (ADOS-2; Lord et al., 2012) and by pediatricians from the Pamela Youde Child Assessment Centre, Hong Kong, who used the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; APA, 2013). All the children met the ADOS-2 and DSM-5 criteria for ASD. They were attending either a special care center or a mainstream kindergarten in Hong Kong at the time of the present study.

All the procedures were approved by the institutional review board of the first author's university, in compliance with the Declaration of Helsinki (Survey and Behavioral Research Ethics Reference No. SBRE-19-307). We obtained the parents' informed consent prior to the start of the study. The children also gave their verbal consent to participation, which was required for children of this age by the institutional review board of the university.

Assessments

Autism Diagnostic Observation Schedule—Second Edition (ADOS-2)

The ADOS-2 assesses and diagnoses ASD across age, developmental level, and language skills (Lord et al., 2012). In the present study, it was conducted by a trained professional who had completed ADOS-2 Advanced/Research Training. ADOS comparison scores converted from the total raw scores according to the age of the children were reported here.

Childhood Autism Rating Scale™—Second Edition (CARS™-2)

The CARS-2 helps to identify children with ASD and to determine symptom severity through quantifiable ratings based on direct observation by the first author (Schopler et al., 2010). Children's standardized scores were reported.

Social Responsiveness Scale—Second Edition (SRS-2)

Caregivers of the participating children were administered SRS-2; Constantino & Gruver, 2012). The SRS-2 has 65 questions scored 0 to 3 on a Likert-type scale, which identifies the severity of social impairment in individuals with ASD. Children's total scores on the SRS-2 were reported.

Kaufmasean Brief Intelligence Test—Second Edition (KBIT-2)

The KBIT-2 assesses both verbal and nonverbal intelligence in people from four through 90 years of age (Kaufman, 2004). It is composed of two separate scales: the Verbal Scale contains two kinds of items—verbal knowledge and riddles—both of which assess crystallized ability (knowledge of words and their meanings); the Nonverbal Scale includes a matrices subtest that assesses fluid thinking—the ability to solve new problems by perceiving relationships and completing analogies. Test items are free of cultural and gender bias. Children's standardized verbal and nonverbal scores, plus a composite IQ, were reported.

Mullen Scales of Early Learning (MSEL)

The MSEL measures children's abilities in four cognitive domains: visual reception, fine motor skills, receptive language, and expressive language (Mullen, 1995). MSEL is usually administered to children up to 68 months old¹. We focused on receptive and expressive language skills and reported children's age equivalent language scores.

Table 1 shows the descriptive statistics of age and performance in various assessment tasks. All the children but one had an ADOS score equal to or greater than the cutoff point and were thus confirmed to have ASD. The child with an ADOS score lower than the cutoff point was not excluded as he had been diagnosed with ASD when he was two and

¹ Eight children aged above 68 months old. Thus, MSEL might not accurately measure their expressive and receptive language abilities. However, note that these eight children, like most of the children participating in this study, were found to have delay in their receptive and expressive language abilities (receptive language age equivalent: $M=58.12$; $SD=8.32$; expressive language age equivalent: $M=46.34$; $SD=6.48$). Thus, their language abilities still fell within the language age equivalent range in MSEL.

Table 1 Descriptive statistics of age and assessments

Measures		Mean	SD	Median	Range
Age		66.14	10.46	66	49–100
ADOS	Social affect	8.76	4.68	9	1–20
	Restrictive and repetitive behavior	2.05	1.91	2	0–6
	comparison score	5.51	2.8	6	1–10
CARS		29.05	3.86	28.72	21.1–35.47
SRS		90.49	26.79	90	41–156
MSEL	Receptive language	52.76	10.39	55	30–69
	Expressive language	43.89	8.6	43	31–67
KBIT	Verbal	97.68	23.82	102	33–142
	Nonverbal	99.46	21.13	97	65–147
	Total	100.41	21.02	101	57–147

ADOS Autism Diagnostic Observation Schedule, CARS Childhood Autism Rating Scale, SRS Social Responsiveness Scale, MSEL Mullen Scales of Early Learning Scale, KBIT Kaufman Brief Intelligence Test–2nd Edition.

the findings were the same after including his data. All the children had high cognitive functioning (total IQ ~ 100) but most had delayed expressive and receptive language abilities as indicated by their performance in MSEL.

Parent–Child Interaction

Parents interacted with their children for 20 minutes in a treatment room at four time points. Each time, the child was presented with a standardized set of age-appropriate toys and their parent was instructed to play with the child as they normally would at home. All participating children and their parents played with the same set of toys at each time point; however, the toy sets were different across the four time points. Each session was video-recorded using two cameras with high-definition zoom-in functions to capture the head and hand movements of parent and child.

Transcriptions

The language samples were transcribed by research assistants trained in the Codes for the Human Analysis of Transcripts (CHAT) format using Computerized Language Analysis (CLAN) software (MacWhinney, 2000). Each language sample was transcribed verbatim by one transcriber, who viewed each recording multiple times until the entire sample was transcribed. Following CHAT coding conventions, utterances or portions of utterances that could not be fully transcribed after three viewings were indicated as unintelligible. A consensus procedure was implemented: the transcribers

viewed each other's video recordings while reading the initial transcriptions (Shriberg et al., 1984). When errors or discrepancies were discovered, the transcribers discussed among themselves until agreement was reached. Otherwise, those utterances or portions of utterances were considered unintelligible.

Coding

We first identified the conversation topic of each utterance. Topic was defined by the referent object and ongoing actions for events (Yoder & Davies, 1990). Parents and children played with standardized toy sets, such as police figurines, puzzles, a cash register, and model dinosaurs, which were placed on the table. They mainly conversed about these toys during interactions. Utterances that were not related to these toys were excluded from further coding. Utterances that were unintelligible were also removed. We report here the number of conversation topics in each parent-child dyad.

For each conversation topic, we identified parents' verbal responsiveness and redirectives based on the coding system established in the studies by Yoder and colleagues (Yoder & Davies, 1990; Yoder et al., 1994). Parents' utterances were coded as verbal responsiveness when these utterances (either in the form of questions or non-questions) had the same or related topic to the preceding utterances, assuming that the non-initiating partner had talked about the topic at least once in that exchange. Utterances were coded as redirectives when their topic was unrelated to that of the preceding utterance or when these utterances were about a topic that the non-initiating partner had not yet talked about during the conversation. We calculated the proportions of verbal responsiveness and redirectives.

Similarly, children's utterances were coded as responses or initiation of conversation. Children's utterances were coded as responses if they were responding to their parents' preceding utterances. We examined whether these responses were appropriate in a conversation. A response was considered appropriate when it was relevant to the conversation topics either verbally or nonverbally. Examples of appropriate response were asking a follow-up question (e.g., "How much does it cost?" when playing with a toy cash register), showing understanding or agreement with the previous utterance (e.g., "ok" or nodding), and sharing/giving qualifying and relevant information (e.g., "This dinosaur can fly! Look at me!"). Examples of inappropriate responses were echolalia (i.e., repetition of what has just been said), idiosyncratic speech (e.g., singing a song when asked, "What is it?"), and sharing/giving inadequate and irrelevant information (e.g., saying, "One, two, three, four" while pointing to the dinosaurs in response to the question, "Where is the dinosaur?"). Responses were coded as nil if the child did not respond and the parent prompted him/her. We calculated the proportion

of children's appropriate responses, that is, the number of utterances showing children's appropriate responses divided by the total number of utterances. Children's utterances were coded as initiation of conversation if their topics were unrelated to the preceding utterances.

We also counted the number of conversational turns taken by parent and child in each conversation topic. A conversational turn was counted in pairs: one utterance by adult/child and then one by child/adult in response, with the second utterance being contingent upon the first. For example, if a child spoke and his/her parent responded, or vice versa, that would count as one turn. If the child responded to the adult on the same conversation topic, and the parent responded again, that was considered two conversational turns.

We established the reliability of our measures by asking a second individual to transcribe 20% of the videotaped sessions. Agreement between the coders was 93.87% for the identification of conversation topics (Cohen's Kappa = 0.91, $p < 0.001$), 99.85% for the identification of the initiator of the conversation (Cohen's Kappa = 0.98, $p < 0.001$), and 87.32% for the identification of the appropriateness of response (Cohen's Kappa = 0.85, $p < 0.001$).

Results

Overall, there were a total of 2368 conversation topics with 987 conversational turns across 37 children over four time points. On average, each parent-child dyad had 15.38 conversation topics ($SD = 5.28$; ranging from 10.73 to 19.59) and 2.23 conversational turns for each topic ($SD = 0.72$; ranging from 1.77 to 3.31). Altogether there were 4461 utterances; of which 63% contributed by the parents ($N = 2810$) and the rest by their children ($N = 1651$). Of the utterances produced by the parents, 67.37% were coded as verbal responsiveness and the remaining were redirectives. Of the utterances produced by the children, 65.88% were responding to their parents while the rest were initiation of conversation. We first examined whether there was growth in the children's conversation skills (appropriate responses, maintenance of conversation, and initiation of conversation) over nine months, followed by the association of parents' verbal responsiveness and redirectives and children's appropriate responses.

Growth of Conversational Skills

Figure 1 shows the changes of different conversational skills across the children at four time points while Figure 2 plots the growth of different conversation skills for each child over the same time period.

Separate hierarchical linear modeling (HLM) analyses were conducted to model the growth curve trajectories for different conversation skills (Garson, 2013). For each ability, we first fit the data to a null model to test whether there was significant variation across individuals, and if so, we fit the data using two unconditional growth models: (i) a random intercept model measuring the overall fixed effect for time across all children given their different initial levels of the target outcome; and (ii) a random intercept and slope model measuring the overall fixed effect for time and examining whether the slope of the time effect varied across children. Log likelihood and Chi-squared test were also used to determine the best model fit. Data analyses were conducted by R (version 3.6.1) using the "lme4" package.

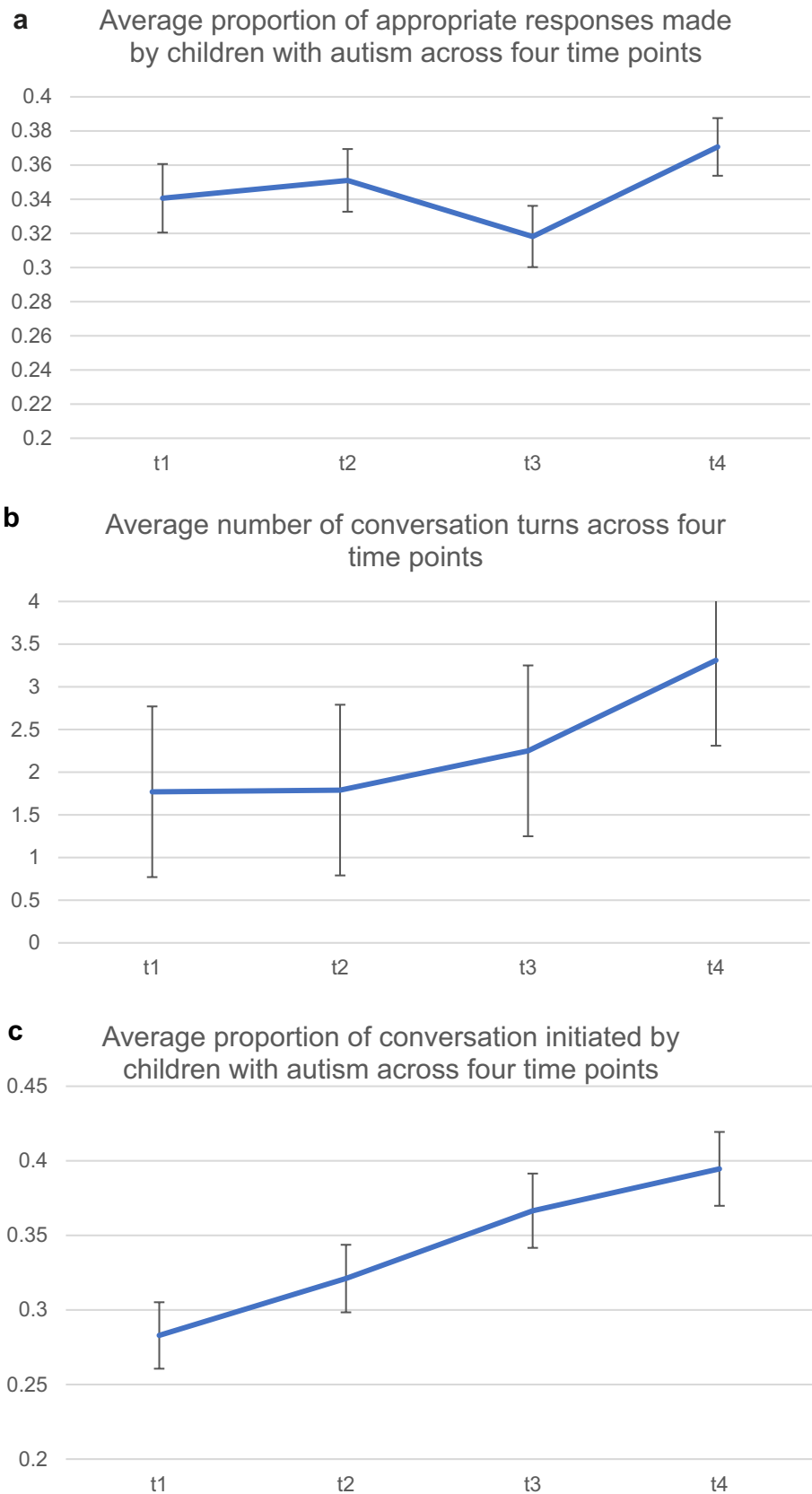
We first fit an HLM with the proportion of appropriate responses as the outcome variable (Table 2). There was significant variation in the proportion of appropriate responses across the children ($\beta = 0.35$, $SE < 0.01$). Time as the fixed effect was then entered into the random intercept model and the random intercept and slope model. The results show that the time effect was not significant, suggesting that the improvement in the appropriate responses over time was not evident.

We next turned to the maintenance of conversation, that is, the number of conversational turns, as the outcome variable (Table 3). There was significant variation in the number of conversational turns across the children ($\beta = 2.03$, $SE = 0.11$). The time effect of conversational turns was significant ($\beta = 0.15$, $SE = 0.05$), suggesting that there was improvement in the number of conversational turns over time. There was no significant variation in the improvement rate across the children. The random intercept and slope model, which incorporated individual variation in growth rate, did not have a better fit than the random intercept model.

Finally, we examined whether there were changes in the proportion of conversation initiated by the children (see Table 4). There was significant variation in the proportion of child-initiated conversation ($\beta = 0.34$, $SE = 0.02$). The time effect was significant ($\beta = 0.04$, $SE = 0.01$). There was no significant variation in the growth rate across the children. The random intercept and slope model did not have a better fit than the random intercept model.

To summarize, some of the conversation skills (conversation turns and child-initiated conversation) grew over the course of nine months in the children with ASD. Next, we examined whether parents' verbal responsiveness and redirectives in interactions with their children were related to their children's appropriate responses and maintenance of conversation. We here fit the data using random intercept models for the rest of the analyses.

Fig. 1 Developmental changes in conversation abilities across children: **a** average proportion of appropriate responses given by children with ASD over time; **b** average number of conversational turns over time; and **c** average proportion of conversation initiated by children with ASD over time. *Notes* The proportion of appropriate responses was calculated as the total number of children's appropriate responses across all conversation topics divided by the total number of children's responses (including children's appropriate responses, inappropriate responses, and nil responses). The proportion of conversation topics initiated by children was calculated as the total number of conversation topics initiated by children divided by the total number of conversation topics initiated by children and parents.



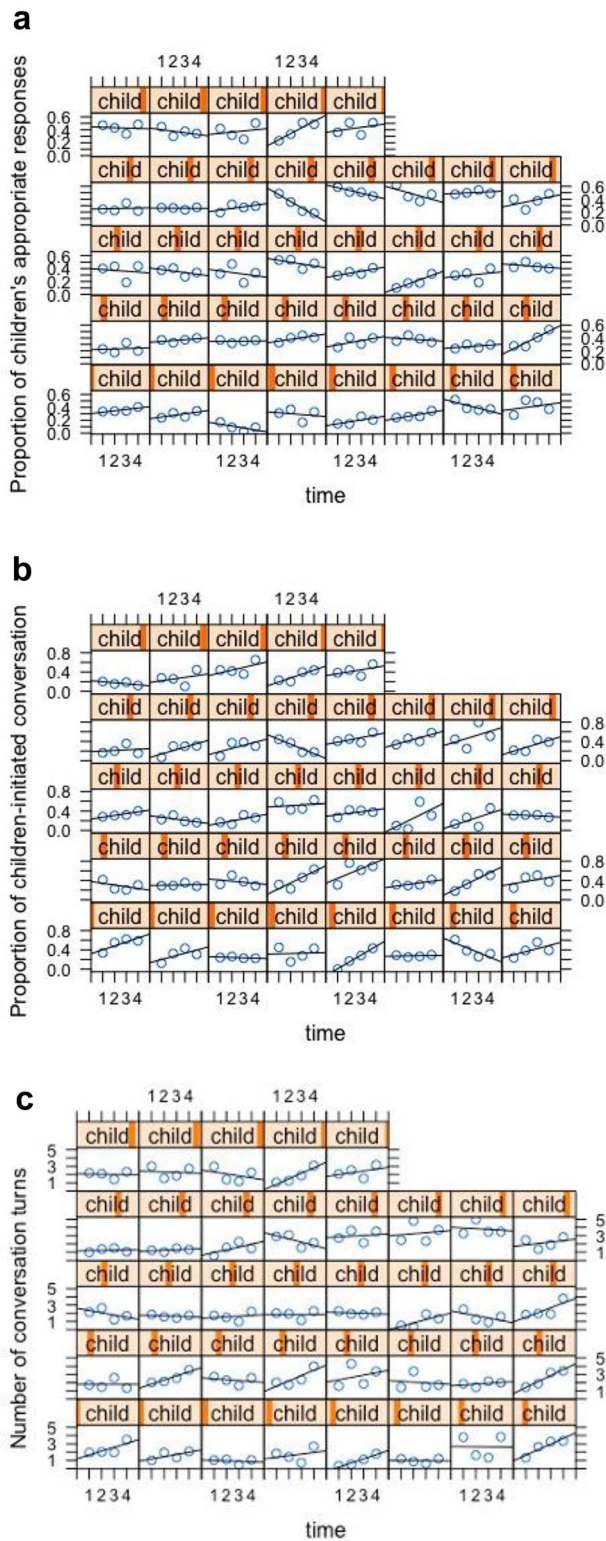


Fig. 2 Growth plots of children's conversation abilities: **a** proportion of individual children's appropriate responses; **b** number of conversational turns of individual children; and **c** proportion of conversation topics initiated by individual children.

The Influence of Parents' Verbal Responsiveness and Redirectives in Conversation in Their Children's Conversation Skills

Before examining the effects of parents' verbal responsiveness and redirectives, we first determined the variables (autism severity, language abilities, cognitive functioning) that should be controlled for in the random intercept models. Table 5 shows the correlation among children's different conversation skills, their autism severity and language and cognitive abilities, and their parents' responsiveness. The results show that autism severity assessed by the ADOS, language abilities measured by the MSEL, and cognitive functioning measured by the KBIT-2 correlated with some of the children's conversation skills and parents' responses. Therefore, we entered the ADOS comparison score and the MSEL expressive age equivalent language score into the random intercept models.

We started by setting the proportion of children's appropriate responses as the outcome variable and parent verbal responsiveness and redirectives as predictors in two separate models (Table 6). In Model 1, we entered parent redirectives manifested in parent-initiated conversation. After controlling for time, the ADOS, and the MSEL, there was a significant negative relationship between the proportion of parents' redirectives and that of children's appropriate responses ($\beta = -0.28$, $SE = 0.05$), indicating that the more parents redirect the topics of the conversation, the less likely children were to provide appropriate responses. In Model 2, we added parents' verbal responsiveness and found a significant positive relationship with children's appropriate responses ($\beta = 0.25$, $SE = 0.07$), that is, the more parents continued the established conversation topics, the more likely their children were to respond appropriately in the conversation as well. Additionally, Model 2 fit better than Model 1 ($\chi^2(1) = 13.31$, $p < 0.001$).

We next set the number of conversational turns as the outcome variable (Table 7). We first entered the ADOS, the MSEL, and parents' redirectives into Model 1. The proportion of parents' redirectives was found to have a negative relationship with the number of conversational turns ($\beta = 0.51$, $SE = 0.11$). We then entered the proportion of parents' verbal responsiveness into Model 2, which was not found to be significant.

Discussion

Few studies have examined social communication and language skills in Chinese-speaking children with ASD (e.g., So et al., 2015; Su et al., 2018). To date, no research has examined the conversation skills of Chinese-speaking children with ASD and their changes over time. Documenting

Table 2 Hierarchical linear modeling analyses for the proportion of appropriate responses by children with ASD

Appropriate response		Null model	Unconditional growth models	
			Random intercept model (Model A)	Random intercept and slope model (Model B)
Fixed effects		β (SE)	β (SE)	β (SE)
	Intercept	0.35***(0.01)	0.34***(0.02)	0.34***(0.02)
	Time	/	0.01 (0.01)	0.01 (0.01)
Random effects		σ^2 (SD)	σ^2 (SD)	σ^2 (SD)
	Between-person variance	0.006 (0.08)	0.006 (0.08)	0.0088 (0.09)
	Time variance	/	/	0.0003 (0.02)
	Residual variance	0.0061 (0.08)	0.0061 (0.08)	0.0056 (0.07)
Model comparisons	ICC ^a	0.51	0.51	0.61
	Log likelihood	136.8	137.3	138.1
		Null model vs. Model A: $\chi^2(1) = 0.99, p = 0.32$; Model A vs. Model B: $\chi^2(2) = 1.65, p = 0.44$; Null model vs. Model B: $\chi^2(3) = 2.65, p = 0.45$		

ICC Intra-class correlation coefficient

Table 3 Hierarchical linear modeling analyses for the number of conversational turns

Conversational turns		Null model	Unconditional growth models	
			Random intercept model (Model A)	Random intercept and slope model (Model B)
Fixed effects		β (SE)	β (SE)	β (SE)
	Intercept	2.03*** (0.11)	1.81*** (0.13)	1.81*** (0.13)
	Time	/	0.15** (0.05)	0.15** (0.05)
Random effects		σ^2 (SD)	σ^2 (SD)	σ^2 (SD)
	Between-person variance	0.288 (0.54)	0.298 (0.55)	0.2574 (0.51)
	Time variance			0.0006 (0.03)
	Residual variance	0.54 (0.73)	0.50 (0.71)	0.50 (0.71)
Model comparisons	ICC	0.35	0.37	0.34
	Log likelihood	-185.2	-181.4	-181.3
		Null model vs. Model A: $\chi^2(1) = 7.67, p = 0.006$; Model A vs. Model B: $\chi^2(2) = 0.18, p = 0.914$; Null model vs. Model B: $\chi^2(3) = 7.85, p < 0.05$		

ICC Intra-class correlation coefficient

the changes of conversation skills in Chinese-speaking children and their relation to parents' verbal responsiveness and redirectives is critical for designing early intervention. This study is the first to investigate the conversation abilities in (Cantonese) Chinese-speaking children with ASD. It reveals two major findings: (i) some aspects of conversation skills may grow over time in Chinese-speaking children with ASD; and (ii) parents' verbal responsiveness, not redirectives, is positively related to their children's production of appropriate responses.

The first objective of the present study was to model the changes of conversation skills in (Cantonese) Chinese-speaking children with ASD aged four to eight years at four

time points over nine months. All the children had high cognitive functioning but delayed expressive and receptive language skills. Naturalistic language samples were collected from interactions with their parents, which allowed us to examine their abilities to initiate conversations, provide appropriate responses, and maintain conversations in a social context (DiStefano et al., 2016). We found that there was significant improvement in the proportion of conversation initiated by children (10%) and the number of conversational turns (from 1.77 turns to 3.31) from time point 1 to time point 4. These results are consistent with those reported in previous studies which found that children with ASD made significant improvement in their ability to maintain

Table 4 Hierarchical linear modeling analyses for the proportion of child-initiated conversation

Child-initiated conversation		Null model	Unconditional growth models	
			random intercept model (Model A)	Random intercept and slope model (Model B)
Fixed effects		β (SE)	β (SE)	β (SE)
	Intercept	0.34*** (0.02)	0.28*** (0.02)	0.28*** (0.02)
	Time	/	0.04*** (0.01)	0.04*** (0.01)
Random effects		σ^2 (SD)	σ^2 (SD)	σ^2 (SD)
	Between-person variance	0.006 (0.08)	0.007 (0.08)	0.0042 (0.07)
	Time variance			0.0005 (0.02)
	Residual variance	0.016 (0.13)	0.01 (0.12)	0.01 (0.11)
Model comparisons	ICC	0.27	0.33	0.25
	Log likelihood	79.0	88.0	89.1
		Null model vs. Model A: $\chi^2(1) = 18.09, p < 0.001$; Model A vs. Model B: $\chi^2(2) = 2.071, p = 0.355$; Null model vs. Model B: $\chi^2(3) = 20.164, p < 0.001$		

ICC Intra-class correlation coefficient

conversation and in the length and frequency of communication interchanges (DiStefano et al, 2016; Hale & Tager-Flusberg, 2005). While the improvement of the proportion of appropriate responses was not significant, there is evidence showing a rising trend (from 0.34 to 0.37), especially at time point 4, when the number of conversational turns also drastically increased. We expect that this improvement will be more remarkable later.

The second objective of the study was to find whether parents' verbal responsiveness and redirectives were related to the elicitation of appropriate responses from their children. One of our findings supported the hypothesis that parents' verbal responsiveness positively predicted their children's elicitation of appropriate responses. This result is consistent with previous findings (Yoder & Davies, 1990; Yoder et al., 1992) that have shown children with developmental delay were more likely to verbally participate in the conversation when their parents continued the children's topic than when they initiated their own topics. Parents' verbal responsiveness scaffolds their children to provide appropriate responses. By continuing the topics that are of children's interest, children find it easier to understand adult speech and be motivated to continue the conversation and respond to their parents appropriately (Yoder et al., 1994). However, our findings did not provide strong evidence showing that parents' verbal responsiveness positively predicted the number of conversation turns.

In contrast, parents' redirectives negatively predicted the children's elicitation of appropriate responses and the number of conversation turns. Some researchers proposed that children with ASD who engage in stereotypic behaviors

might need redirectives (i.e., verbal responses that initiate a new topic and require the child to stop attending to the event, object, or person that they are engaged with and attend to something else) to facilitate their interactions with adults (McCathren et al., 1995). However, our findings have shown that parents' redirectives inhibited elicitation of appropriate responses. In comparison to parents' verbal responsiveness, parent redirectives may be more challenging for children with ASD when parents end the current conversation and switch to a different topic. The topic proposed by parents may not interest their children or be familiar to them. Besides, children may prefer conversing on the current topic rather than a new topic proposed by the parent. As a result, parents' redirectives may result in fewer appropriate responses from children in a conversation, thereby reducing the number of conversational turns.

Putting the findings of the parents' verbal responsiveness and redirectives together, we may conclude that continuing the topics that are of children's interest instead of redirecting children's attention to other topics would increase their appropriate responses and help maintain the conversation. Previous research has shown that parents' responsiveness facilitates language development (especially vocabulary use) in children with ASD (McDuffie & Yoder, 2010; Haebig et al., 2013a, b). Yet, no study to date has examined these children's responses toward their parents' verbal responsiveness and redirectives. The current study fills this gap in the literature.

Our results can provide clinicians or therapists with guidance when offering advice to parents about how they can facilitate the development of conversation abilities at home.

Table 5 Correlation coefficients among variables

	KBIT	ADOS	MSEL_EL	MSEL_RL	Conversation turns	Children appropriate responses	Children inappropriate responses	Children NIL responses	Parents' verbal responsiveness	Parents' redirectives
KBIT	–									
ADOS	–0.34*	–								
MSEL_EL	0.521**	–0.295	–							
MSEL_RL	0.523**	–0.2	0.72***	–						
Conversation turns	0.021	0.129	–0.105	–0.03	–					
Children appropriate responses	0.119	–0.004	–0.009	0.91***	–					
Children inappropriate responses	–0.318*	0.285	–0.047	–0.426**	0.453**	–				
Children NIL responses	0.005	–0.119	0.072	–0.921***	–0.426**	0.04	–			
Parents' verbal responsiveness	0.305*	–0.315*	–0.03	0.249	0.467**	–0.701***	–0.214	–		
Parents' redirectiveness	0.178	–0.279	0.106	–0.705***	–0.542***	–0.133	0.656***	0.4*	–	

Numbers below the diagonal are the unadjusted correlation coefficients and those above the diagonal are the Bonferroni-adjusted correlation coefficients
ADOS: Autism Diagnostic Observation Schedule, *MSEL-EL*: Mullen Scales of Early Learning Language, *MSEL-RL*: Mullen Scales of Early Learning Scale Receptive Language, *KBIT*: Kaufman Brief Intelligence Test—2nd Edition.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

As the persons who provide “around the clock” intervention for children with ASD (Koegel et al., 1995), parents can scaffold their children’s participation in a conversation by continuing the topics that they are interested in, thus providing them with more opportunities to practice their speech production. Besides, parents can further elaborate the children’s responses, which allows the children to gain inputs from their parents, hence enhancing their vocabulary and other aspects of language skills.

Limitations

Though our study is pioneering research into the conversation abilities of Chinese-speaking children with ASD, it has a few limitations. Our language samples were collected from only 37 children. Even though they were followed at four time points, this is too small a sample. There were also far more males than females. While this reflects more boys than girls diagnosed with ASD, it is important consider possible gender effect. Future studies would benefit from larger samples, which can also involve more female individuals with ASD. Additionally, we only included children aged four to eight years, but heterogeneity of language abilities has been observed along the lifespan in individuals with ASD (Fountain et al., 2012; Pickles et al., 2014). Besides different age groups, future research should explore both verbal and nonverbal measures of conversation ability (Lord & Paul, 1997; Young et al., 2005). Finally, research on the verbal responsiveness of parents and its effect on the language acquisition of children with ASD is still in its infancy (Naigles, 2013). More studies should examine the casual relationship between parental inputs and language development and compare the effect of parents’ verbal responsiveness in the language development in children with ASD to typically developing children and / or children with other developmental disorders.

Conclusions

To conclude, some aspects of conversation abilities may grow over time in Chinese-speaking children with ASD. Parents’ verbal responsiveness fosters elicitation of appropriate responses in children with ASD. However, parents’ redirectives might make it challenging for children to respond appropriately and even discourage them from maintaining conversations.

Table 6. Random intercept model with the proportion of children's appropriate responses as the outcome variable

Predictors	β	SE	95%CI of β	t	Pseudo- R^2
Model 1					0.29
Intercept	0.57***	0.09	[0.39, 0.74]	6.64	
Time	-0.00	0.01	[-0.02, 0.01]	-0.82	
MSEL-EL	0.00	0.00	[0.00, 0.00]	0.66	
ADOS	-0.01**	0.00	[-0.02, 0.00]	-3.08	
Parents' redirectives	-0.28***	0.05	[-0.39, -0.17]	-5.23	
Model 2					0.36
Intercept	0.43***	0.09	[0.25, 0.60]	4.83	
Time	0.00	0.01	[-0.01, 0.01]	0.02	
MSEL-EL	0.00	0.00	[0.00, 0.00]	0.64	
ADOS	-0.01**	0.00	[-0.02, 0.00]	-3.04	
Parents' redirectives	-0.38***	0.06	[-0.49, -0.26]	-6.61	
Parents' verbal responsiveness	0.25***	0.07	[0.12, 0.38]	3.75	
Model comparisons	Model 1 vs. Model 2: $\chi^2(1) = 13.31, p < 0.001$				

MSEL-EL Mullen Scale of Early Learning-Expressive Language, *ADOS* Autism Diagnostic Observation Schedule

Table 7 Random intercept model with the number of conversational turns as the outcome variable

Predictors	β	SE	95% CI of β	t	Pseudo- R^2
Model 1					0.31
Intercept	3.59***	0.65	[2.28, 4.87]	5.55	
Time	0.04	0.05	[-0.06, 0.14]	0.80	
MSEL_EL	0.01	0.01	[-0.01, 0.03]	1.15	
ADOS	-0.05	0.03	[-0.11, 0.01]	-1.57	
Parents' redirectives	-2.83***	0.45	[-3.74, -1.92]	-6.24	
Model 2					0.32
Intercept	3.08***	0.72	[1.62, 4.51]	4.26	
Time	0.06	0.05	[-0.04, 0.16]	1.12	
MSEL_EL	0.01	0.01	[-0.01, 0.03]	1.13	
ADOS	-0.04	0.03	[-0.10, 0.02]	-1.44	
Parents' redirectives	-3.16***	0.50	[-4.17, -2.16]	-6.32	
Parents' verbal responsiveness	0.89	0.58	[-0.26, 2.04]	1.52	
Model comparisons	Model 1 vs. Model 2: $\chi^2(1) = 2.30, p = 0.123$				

MSEL-EL Mullen Scale of Early Learning-Expressive Language, *ADOS* Autism Diagnostic Observation Schedule.

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Author Contributions WCSO wrote the manuscript and designed the study. WCSO and XKS analyzed the data. WWL, TW, OKL, and YH collected and coded the data.

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Availability of Data and Materials The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing Interests: The authors declare that they have no competing interest.

Ethical Approval All of the procedures were approved by the Survey and Behavioral Research Ethics Committee of the first author's university, in compliance with the Declaration of Helsinki (SBRE-19-307).

Informed Consent We obtained parents' informed consent prior to the study. The participants also gave their assent to participate in this study.

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