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Research Article

# Communicative Development in Bilingually Exposed Chinese Children With Autism Spectrum Disorders

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**Purpose:** We examined the association of bilingual exposure with structural and pragmatic language development in Chinese children with autism spectrum disorders (ASDs).
**Method:** The parents of 54 children with ASD exposed to 1 ($n$ = 31) or 2 ($n$ = 23) Chinese languages completed (a) a questionnaire to evaluate their child's competence in structural language and pragmatic ability in their dominant language (Children's Communication Checklist–Second Edition; Bishop, 2006), and (b) a questionnaire to assess their child's social functioning (Social Responsiveness Scale; Constantino & Gruber, 2005; Wang, Lee, Chen, & Hsu, 2012). In addition, parents completed thorough interviews regarding the linguistic environment of their children (Language Environment Interview; Hambly & Fombonne, 2011).
**Results:** Multivariate analyses of variance revealed that bilingually exposed children with ASD did not demonstrate significantly different performance on any standard measure relative to their monolingual peers.
**Conclusions:** The findings suggest that bilingual language exposure is not associated with additional challenges for the development of the dominant language in children with ASD. The lack of negative associations in our sample is not likely to be due to the comparatively early diagnosis and/or intervention that are available in other countries. We discuss implications for decisions regarding the linguistic environment of children with ASD.

Among parents and professionals, there is a common, albeit empirically unsupported belief that bilingual exposure (BE) may be detrimental to the language development of children with neurodevelopmental and other related disabilities (Fernandez y Garcia, Breslau, Hansen, & Miller, 2012; Hambly & Fombonne, 2011; Kay-Raining Bird, Lamond, & Holden, 2012; Kremer-Sadlik, 2005; Wharton, Levine, Miller, Breslau, & Greenspan, 2000; Yu, 2013). For example, qualitative ethnographic and survey-based studies indicate that parents of children with autism spectrum disorders (ASDs) express uncertainty when making decisions about BE for their children (Kay-Raining Bird et al., 2012; Kremer-Sadlik, 2005; Yu, 2013). One of the main reasons is a lack of robust information on if children with ASD have the ability to thrive in an environment in which more than one language is spoken. In the past, a lack of information to guide bilingual parents of typically developing children resulted in parents limiting language input to only one language (Kay-Raining Bird et al., 2012; McCabe et al., 2013). This parental practice is likely exacerbated in cases of families who are raising children with diagnosed neurodevelopmental and other related disabilities.

Professionals also may not have access to up-to-date information on these issues. Professional bodies have tried to address misconceptions by discouraging their members from recommending that bilingual families stop using two languages with their children (see, for example, the United Kingdom's Royal College of Speech & Language Therapists, 2006, recommendations and Espinosa, 2013, for recommendations to teachers in the United States). This kind of "language loss" may not only deprive children of a rich linguistic input, but might also prevent children from gaining the cultural and social advantages of being exposed to two languages. Furthermore, such a practice may further encourage features of autistic behavior as it has the potential to promote social isolation from parents and siblings and other key caregivers in the child's environment (Kremer-Sadlik, 2005).

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The number of children raised in a bilingual environment is on the rise in the United States, Europe, and throughout the rest of the world (Crystal, 1997), and bilingualism may soon become the norm rather than the exception. With the prevalence of ASD at a recently estimated one in 68 individuals (Baio, 2012), it is expedient to better understand how exposure to two languages interacts with ASD in order to better inform evidence-based practice and ultimately provide essential guidance to parents, clinicians, and other professionals who make decisions for this population.

To date, an emerging body of evidence has reported that bilingual language exposure does not have an adverse effect on the linguistic development of children with ASD (Hambly & Fombonne, 2011; Ohashi et al., 2012; Petersen, Marinova-Todd, & Mirenda, 2012). In this article, we utilize parental questionnaires to investigate the effect of BE on the development of the dominant language in Chinese-speaking children with ASD. Our aim was to complement the existing body of literature by focusing on two particular areas: structural language (which encompasses vocabulary, grammar, and pronunciation—the skills that are necessary in order to produce and comprehend well-formed sentences) and pragmatic language (which involves the skills required to use sentences felicitously in a conversational context). Moreover, this is the first study to explore the extent to which BE interacts with communicative ability in children with ASD in a non-Western context. To this end, we first turn to the emerging body of literature that has investigated the extent to which BE interacts with structural and pragmatic language competence in children with and without ASD and related communication disorders.

## *BE and Structural Language in Children With and Without ASD*

By definition, children exposed to two languages receive less input in each of them relative to monolingual children. As a result, the progression of language development of bilingual children may initially be timed behind that of monolingual children in terms of vocabulary and grammar (Paradis, Genesee, & Crago, 2011; Pearson, Fernandez, & Oller, 1993). However, the trajectory of development largely follows a similar path, and the differences found among monolingual and bilingual children have been explained as a function of the amount of input children receive in each language rather than constituting an atypical pattern (Paradis et al., 2011). For example, slower vocabulary development in the early stages of life may be overcome with consistent exposure to both languages throughout childhood (Bialystok, 2001). The conclusion of this body of literature is that BE does not have an adverse effect on the development of structural language skills in neurotypical bilingual children.

To date, many studies have investigated the language competence of monolingual children with ASD, but little is known about the effect of BE on ASD. In monolingual children with ASD, it is well established that language abilities may range from nonverbal to advanced (Rice, Warren, & Betz, 2005). Even for the most verbally competent children with ASD, whose standardized core language scores are within the normal range, it is possible that there persists a deficit in pragmatic competence, which is a hallmark characteristic of this disorder (Bishop, 2000; Rice et al., 2005; Volden & Phillips, 2010).

In general, the presence of a developmental impairment in and of itself does not seem to interact with BE in a detrimental way to give rise to a significantly delayed or deviant profile of language acquisition. To be specific, research examining the interaction between BE and children with specific language impairment (SLI; Gutierrez-Clellen, Simon-Cereijido, & Wagner, 2008; Orgassa & Weerman, 2008; Paradis, Crago, Genesee, & Rice, 2003; Steenge, 2006) along with BE in children with Down syndrome (Feltmate & Kay-Raining Bird, 2008; Kay-Raining Bird et al., 2005) suggests that bilingually exposed children do not exhibit lower performance than monolingual children matched on age, diagnosis, and nonverbal intelligence. (For an overview, see Paradis, 2010. We note that hereafter we adopt the distinction between bilingually exposed children and bilingual children. The former term does not imply that a child is necessarily able to communicate in both languages and is appropriate for studies that measure language competence in only one of the two languages in the child's environment, which is sometimes the case in the studies we review.)

In regard to ASD, Hambly and Fombonne (2011) investigated early language milestones and vocabulary size in monolingual ($n$ = 30) and bilingual and multilingual ($n$ = 45) children with ASD (aged 36–78 months), who were exposed to English and French or to English or French and one of several other languages (Spanish, Italian, Hebrew, Chinese, Farsi, Romanian, or Tamil). The bilingual/multilingual group was further split into simultaneous and sequential subgroups, depending on whether a child was exposed to two or more languages in his or her first year of life. Hambly and Fombonne (2011) used adaptations of the MacArthur Communicative Development Inventory (CDI; Fenson et al., 1993) in all the languages spoken by the children and reported vocabulary in the dominant language as well as conceptual vocabulary (which consisted of all the words in the dominant language plus all the words from the other language not on the CDI in the dominant language). They further administered the Language Environment Interview (LEI, developed by the authors) to measure the extent and type of bilingualism as well as standardized parent questionnaires, such as the Vineland Adaptive Behavior Scales (VABS; Sparrow, Cicchetti, & Balla, 2005), to measure communication, practical aspects of daily living, and social functioning and the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) to measure social functioning and communicative behavior. Results indicated that bilingual and multilingual children with ASD did not experience additional delays in any aspect of language development compared to monolingual peers as measured by the CDI and the receptive and expressive language components

of the VABS. These findings held for both the simultaneous and the sequential subgroups. Also, no statistically significant differences in social functioning were observed using the SRS (although only the general score for the SRS was reported).

In related research, Petersen et al. (2012) conducted a study with a specific focus on the lexical development of 14 English–Chinese simultaneous bilingual children with ASD compared to 14 English monolingual peers with ASD. The bilingual children (aged 43–73 months) primarily spoke either Mandarin or Cantonese at home, with English spoken in community settings. Petersen et al. utilized both the English and Chinese CDI to estimate each participant's vocabulary in the language(s) they spoke and to further calculate total vocabulary (which was the sum of the raw scores of the CDI in the two languages they spoke) and conceptual vocabulary. For the monolingual group, total and conceptual vocabulary were, in both cases, the raw score of the CDI in English. The authors additionally administered the Mullen Scales of Early Learning (Mullen, 1995), which was utilized to estimate the nonverbal IQ of the participants by combining the Mullen Scales of Early Learning Visual Reception and Fine Motor subscales. Because bilingual children had a significantly higher nonverbal IQ, this measure was used as a covariate in all further analyses. The findings of this study revealed that bilingual children outperformed monolingual children in terms of total vocabulary, and there were no differences between the two groups' conceptual vocabulary scores or their English vocabulary scores.

Ohashi et al. (2012) further explored the impact of BE on language development in children with ASD and attempted to minimize factors that may have skewed previous findings. To be specific, they matched participants for nonverbal IQ and chronological age and ensured the absence of intervention, as different amounts of intervention for the groups of children tested in previous studies may have skewed the findings. To this end, the early language abilities of young monolingual children ($n$ = 40) and bilingually exposed children with ASD ($n$ = 20) aged 31–52 months were investigated through data collection within a few months of ASD diagnosis. The bilingually exposed children in Ohashi et al. were exposed simultaneously to English or French and one more language from a wide variety of languages, and the monolingual children were exposed to either English or French only. The Preschool Language Scale–Fourth Edition (Zimmerman, Steiner, & Pond, 2002) and parent questionnaires such as the VABS for language skills and social functioning (Sparrow et al., 2005) were utilized to measure comprehension of spoken language, expressive language, social interaction, and cognitive function. The results of this study again indicated that BE did not inhibit language or social functioning development in children with ASD when compared to monolingual peers.

Last, Valicenti-McDermott et al. (2013) compared the expressive and receptive language skills of 40 monolingual English and 40 bilingually exposed English–Spanish children with ASD. The authors utilized retrospective speech and language evaluations from the toddlers (mean age = 26 months) to compare the two groups on demographics (e.g., age at evaluation, gender, ethnicity, and level of maternal education), overall development, autistic characteristics, and expressive and receptive language skills as well as communicative behavior such as the use of gestures and greetings. Each participant evaluation included the Rossetti Infant-Toddler Language Scale (Rossetti, 1990), which is a criterion reference test administered to capture infant and toddler preverbal and verbal performance. As in the three previous studies, the expressive and receptive language development of bilingually exposed children with ASD did not lag behind their age-matched monolingual peers. Nevertheless, through parent report and observation scales, the bilingually exposed children with autism were found to produce significantly more prelinguistic proto-imperative gestures (e.g., pointing and leading a caregiver to desired objects) as well as prelinguistic cooing when compared to monolingual age-matched peers. The higher use of gestures compared to monolingual children has also been documented in typically developing bilingual children as well (Nicoladis, Mayberry, & Genesee, 1999; Pika, Nicoladis, & Marentette, 2006).

The evidence presented in this section indicates that BE is not associated with a deficit in language development or in social functioning in children with ASD. The lack of an association is not specific to some particular combination of languages as testified to by the numerous combinations of languages that have been tested in the previous studies. Moreover, it seems that the lack of association is documented even when factors such as age, nonverbal IQ, intervention, and socioeconomic status are taken into account.

We highlight that the detailed focus of this research has been expressive and receptive language competence with vocabulary and grammar as well as the age when developmental milestones, such as age of first word, are met. However, there is a paucity of evidence exploring bilingual children's competence with other salient aspects of communication, such as pragmatics, to which we turn in the next section.

### *Pragmatic Language Competence in Bilingual Children With and Without ASD*

Pragmatic language competence involves the ability to use words and sentences in ways that are appropriate to the conversational context. There is ample evidence that children with ASD face significant difficulties in this respect. Qualitative studies report odd and inappropriate conversational behavior (see Volden & Phillips, 2010, p. 204), which has been considered the hallmark of autism early on. Moreover, quantitative experimental research with direct child observation suggests that children with ASD have difficulty (a) in detecting violations of maxims of conversation (Surian, Baron-Cohen, & van der Lely,

1996), and their challenge is greater than that faced by children with SLI, who have comparable structural language skills; (b) in understanding figurative language (Happé, 1993; the challenge being greater than that faced by a group of children with moderate learning difficulties); (c) in using preceding context to disambiguate polysemous words (Jolliffe & Baron-Cohen, 1999); and (d) in managing topic maintenance and topic shifts (Volden & Phillips, 2010) among others.

Turning to bilingualism and pragmatics, there is only a small body of research and exclusively with typically developing bilingual children. A series of experimental studies by Siegal and colleagues (Siegal, Iozzi, & Surian, 2009; Siegal et al., 2010) demonstrated that typically developing bilingual children outperform monolingual children at detecting violations of Gricean maxims of conversation. For example, Siegal et al. (2009) report that 3- to 6-year-old Italian–Slovenian bilingual children were better at detecting when the speaker fails to be informative, truthful, relevant, concise, and polite compared to Italian monolingual children. Siegal et al. (2010) extend this finding to 3- to 6-year-old children speaking one or more of four languages: English, German, Italian, and Japanese. In a similar manner, Antoniou, Katsos, Grohmann, and Kambanaros (2013) report preliminary findings from an experimental study that 6- to 12-year-old Greek–English bilingual children performed comparably to Greek monolingual children at drawing inferences that elaborate on what was explicitly said (e.g., they are better at inferring that not all of the boxes have a token when the speaker says, "Some of the boxes have a token"). In these studies, the advantage or lack of disadvantage in pragmatics arises even with the bilingual group performing lower than their monolingual peers on structural language in the language of testing.

### *The Current Study*

To our knowledge, there are no studies of bilingually exposed children with ASD that report pragmatic language competence, as defined in the previous section. Given the central role of pragmatic language in communication and the pronounced challenges with pragmatics in children with ASD, this is a gap in knowledge that we aim to address. In the following investigation, we set out to compare structural language (vocabulary, grammar, and pronunciation) and pragmatic language competence between monolingual and bilingually exposed children with ASD. Based on the extensive body of literature on monolingual children with ASD, we expect that all children with ASD (whether exposed to one language or two) will have low scores in structural and pragmatic language compared to what would be expected of their typically developing peers. Given what is already reported about BE and the structural language of children with ASD, we posit that BE will not be associated with additional structural language deficits in children with ASD when compared to their monolingual peers with ASD. Extrapolating from the literature on typically developing bilingual children and pragmatic language competence, we predict that BE will not be associated with additional pragmatic language difficulties in children with ASD when compared to their monolingual peers with ASD (and may even be associated with advantages).

Our sample is drawn from Chinese-speaking children living in Southeast China. To the best of our knowledge, this is the first study on BE and communicative development in children with ASD outside of a Western context. Although it is interesting to compare the findings between studies in Western and non-Western contexts on the grounds that attitudes toward autism, standards of diagnosis, and health and education provision vary significantly (Huang, Jia, & Wheeler, 2013; Sun, Allison, Auyeung, et al., 2013; Sun, Allison, Matthews, et al., 2013), we note that there is no reason why we would predict that BE would have different effects in different cultural and linguistic contexts.

Last, in our study, we focused on children's competence in the dominant language. Although parents and caregivers of the bilingually exposed children in our sample informed us that their children were using both languages in everyday communication, we did not quantify the extent to which the children were competent (expressively or receptively) in their second language. We refer to these children in our study as bilingually exposed rather than bilingual.

## Method

The research took place in Guangzhou, China. The guidelines for ethical clinical research set by the Third Affiliated Hospital of Sun Yat-sen University in Guangzhou were followed.

### *Participants*

A total of 102 families of Chinese children diagnosed with ASD were recruited from Guangzhou, China, to participate in this study. Two thirds of the children ($n$ = 67) were patients at the Third Affiliated Hospital of Sun Yat-sen University's Department of Child Development and Behavior and were recruited during clinic visits and parent seminars. The remaining third ($n$ = 33) were recruited from the Guangzhou Cana School, a school exclusively for children on the autism spectrum.

*Chinese language background.* The families that participated in this study spoke one or more of the following languages: Mandarin (or Putonghua, the People's Republic of China's official language), Yue (of which Cantonese is a major dialect), Hakka, Xiang, and Southern Min (or Min Nan). According to the World Atlas of Linguistic Structures (http://wals.info/, retrieved on September 10, 2013) and Ethnologue (http://www.ethnologue.com/, retrieved on September 10, 2013), these languages should be treated as mutually unintelligible languages, each containing separate dialects (which, in some cases, such as the case of dialects of Min, may also be mutually unintelligible). As an analogy, Tardif, Fletcher, Liang, and Kaciroti (2009) compare the difference between Mandarin and Cantonese to that

between related but not mutually intelligible languages of the same family, for example, French and Spanish. Both of these are Romance languages, but despite similarities in grammar, vocabulary, and phonology, a monolingual speaker of one cannot understand a monolingual speaker of the other. Thus, for the purpose of this study, we treat participants exposed to two of the languages in our sample as bilingually rather than bidialectally exposed.

In regard to Chinese written language, since the 1950s, the government of the People's Republic of China in mainland China has promoted the simplification of Chinese characters and their use as the writing system for all languages spoken in China (for a discussion, see Chen, Ku, Koyama, Anderson, & Li, 2008). This means that Mandarin, Cantonese, and other minority languages in China share the same writing system represented by Chinese simplified characters based on standard Mandarin, despite phonological, semantic, and syntactic differences. This gives rise to a situation of multiple languages in the oral format but not in written form. To give a concrete example, the very same text written in Chinese simplified characters can be read by educated speakers of either Mandarin or Cantonese even though they would be assigning to the characters a different phonological form depending on the language they speak. As To, Law, and Li (2012, p. 211) state, "Speakers of different Chinese dialects are usually mutually unintelligible to each other while being able to communicate with each other through written Chinese."

*Inclusionary/Exclusionary criteria.* Participants were recruited based on the following inclusion criteria: (a) a clinical diagnosis of ASD by an interdisciplinary team of pediatricians and psychologists. Diagnosis was made according to the *Chinese Classification and Diagnosis Criteria of Mental Disorders* (3rd ed.; Chinese Society of Psychiatry, 2001), which is based on the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text revision; American Psychiatric Association, 2000) and the *ICD-10 Classification of Mental and Behavioural Disorders* criteria (World Health Organization, 1993; for an overview of the context and prevalence of ASD diagnosis in China, see Huang et al., 2013; Sun, Allison, Auyeung, et al., 2013; Sun, Allison, Matthews, et al., 2013). An expert developmental pediatrician, together with a general pediatrician and a psychologist at the Third Affiliated Hospital of Sun Yat-sen University, came to a consensus diagnosis based on all available information obtained during the hospital diagnostic assessment. This assessment included clinical interviews with both caretakers and children (depending on age and verbal ability), in addition to psychometric tests, such as the Psychoeducational Profile–Third Edition (Schopler, Lansing, Reichler, & Marcus, 2003). Inclusion criteria for the current study additionally required (b) a chronological age of at least 45 months at the time of testing (which is the lowest cutoff age for the standardized questionnaires implemented) and (c) at least one parent or caregiver with the ability to read and write simplified Chinese characters and speak Mandarin or Cantonese. This final inclusion criterion was implemented to ensure effective communication between the caregivers and researchers as well as to further guarantee the most accurate completion of the parental questionnaires. According to the diagnostic reports, 90 children were diagnosed with ASD, seven with Asperger syndrome, and five with pervasive developmental disorder–not otherwise specified (PDD-NOS).

Children were excluded from the study if they (a) were nonverbal (decision based on information given on the Alberta Language Environment Questionnaire, ALEQ; Paradis, 2011); (b) had a co-occurring developmental disability, such as an intellectual disability; or (c) a diagnosis of severe hearing impairment. In total, 79 children aged 45–98 months (mean = 61) were kept in the sample.

*Confirmation of ASD diagnosis.* To add further support to the diagnostic procedure for ASD, at a second stage and as an additional criterion, we selected only those participants whose individual scores fell within the ASD or PDD-NOS range on the Social Communication Questionnaire (SCQ; Gau et al., 2011; Rutter, Bailey, & Lord, 2003). The SCQ is a parental questionnaire that has been found to correlate well with the Autism Diagnostic Interview–Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994; the cutoff score for ASD or PDD-NOS in the SCQ is 15 or above). The mean score of the whole group of 79 participants on the SCQ was 19, well beyond the cutoff point. However, when the SCQ cutoff criterion was applied to each individual participant, the sample decreased to 54 children, including four children with a diagnosis for PDD-NOS, four with Asperger syndrome, and the remaining 46 with a diagnosis of ASD. In the remainder of the article, we report the findings in detail for this subset of 54 participants, who were more strictly screened for ASD.

*Participant language profiles.* The participants were categorized as monolingual or bilingually exposed based on their language history as measured by the LEI (Hambly & Fombonne, 2011). BE was defined by (a) ongoing exposure to two mutually unintelligible Chinese languages, one of which had to be Mandarin or Cantonese (again, to ensure that parents and children could communicate effectively with the research assistants administering the tasks), and (b) more than 20% overall lifetime exposure to each of the two languages, evidenced by the lifetime language ratio in the LEI. Based on these criteria, out of the 54 children with ASD, 23 were assigned to the BE group and 31 to the monolingual group. The children in the monolingual group were exposed to either Mandarin ($n$ = 21), a Yue family language (Cantonese = 8; Yangjianghua = 1), or a Southern Min family language (Chaozhouhua = 1). The children in the BE group were all exposed to Mandarin and a Chinese minority language. The minority language was either from the Yue language family (total $n$ = 17; Cantonese = 15; Yangjianghua = 2), the Southern Min language family (total $n$ = 4; Hainanese = 2; Chaoshanhua = 1; Chaozhouhua = 1), the Hakka language family (Sichuanese = 1), or the Xiang language family (Hunanese = 1).

*Participant general background characteristics.* The background characteristics of the 54 participants in our study are presented in Table 1. The monolingual and BE

**Table 1.** Background characteristics of participant groups.

| Characteristics N (female) | Monolingual 31 (6) | | Bilingual 23 (5) | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *t* | *p* |
| Age in months | 59.77 | 12.07 | 60.78 | 11.00 | 0.31 | .75 |
| Age at diagnosis (months) | 46.29 | 14.98 | 40.83 | 14.85 | 3.96 | <.001 |
| Family SES | 40.27 | 14.45 | 40.57 | 15.75 | 0.07 | .94 |
| LR | 97.52 | 4.70 | 69.22 | 9.48 | −14.43 | <.001 |
| LR Recent | 95.42 | 11.16 | 57.52 | 20.38 | −8.75 | <.001 |
| SCQ raw score | 21.32 | 4.03 | 21.26 | 5.30 | −0.04 | .96 |

*Note.* *Family SES* is the socioeconomic status of the parents as measured by the Alberta Language Environment Questionnaire (Paradis, 2011). *LR* is the ratio of a child's exposure to the dominant language in her environment throughout her lifetime. *LR Recent* is the ratio of a child's exposure to the dominant language in her environment in the 6 months prior to testing. *SCQ* is the raw score of the Chinese version of the Social Communication Questionnaire (Gau et al., 2011). All comparisons are by means of independent-sample *t* tests.

groups did not differ significantly in terms of chronological age, family socioeconomic status, and severity of ASD as measured by the SCQ. There was a significant difference in terms of age at diagnosis with the BE group diagnosed half a year earlier than the monolingual group on average. This finding is further examined in the Discussion section. As expected, the two groups differed in terms of extent of exposure to two or more languages over the child's lifetime (lifetime ratio; LR) and in the last 6 months prior to testing (LR Recent). On either measure, the monolingual group had less than 5% exposure to a second language, and the BE group had 30% (LR) to 40% (LR Recent) exposure to a second language.

## *Procedure*

*Standardized measures.* We used the simplified Chinese characters versions of the ALEQ (Paradis, 2011), the SCQ (Gau et al., 2011; Rutter et al., 2003), the LEI (Hambly & Fombonne, 2011), the Children's Communication Checklist–2 (CCC-2; Bishop, 2006; Lam & Ho, 2014), and the SRS (Constantino & Gruber, 2005; Wang, Lee, Chen, & Hsu, 2012). The first two questionnaires were used to capture participant demographic characteristics, such as socioeconomic status, and to further confirm the diagnosis of ASD. The LEI was used to group participants as monolingual or bilingually exposed and to quantify the extent of BE. Last, the final two questionnaires yielded measures of our dependent variables, namely structural language and pragmatics (CCC-2) and social functioning (SRS; with a particular interest in the Social Communication subscale, see below).

When not mentioned otherwise, the simplified Chinese character versions were translated into simplified Chinese characters from the English version and back-translated to English by native speakers of Mandarin and Cantonese under the supervision of one of the coauthors. Southern Chinese cultural and linguistic differences were taken into account, and examples of any adaptations made by the authors are given below.

The ALEQ (Paradis, 2011) elicits information about the children's family background. It has been designed in collaboration with specialist consultants to be appropriate for families from different cultural backgrounds. Among other population groups, it has been administered to Mandarin- and Cantonese-speaking immigrant families in Canada (Paradis, 2011). We used a subset of the questionnaire concerning the parents' occupation, education, gender, and marital/cohabitation status in order to calculate a score for family socioeconomic status using the metric proposed by Hollingshead (2011). This metric returns a six-tier classification of social strata, with scores ranging from 8 to 66. Both groups in our study had an average score of just over 40 (which is in the lowest range of the second highest social stratum), with individual families in each group spread throughout all the other social strata except the lowest one.

The SCQ (Rutter et al., 2003) is a 40-item parent questionnaire designed and validated for use as a screening instrument in children aged 4 years and older. The items of the SCQ are derived from the ADI-R (Lord et al., 1994) and have been established as valid measurements for the diagnosis of autism against the ADI-R (Lord et al., 1994). Nineteen items rate current behavior and 20 items rate behavior when the child was 4–5 years old. The first item is about the level of current language and is not included in the total score. Each item is scored 0 or 1, with 1 indicating the presence of the autistic characteristic. The statistically derived cutoff score for ASD or PDD-NOS is ≥ 15. The Chinese version of the SCQ that we used was the adaptation by Gau et al. (2011), which took into consideration culture-relevant and colloquial expressions. This version is a reliable and valid instrument for rating autistic symptoms in Chinese-speaking populations, with test–retest reliability (intraclass correlations = 0.77–0.78), internal consistency (a = 0.73–0.91), and concurrent validity (Pearson correlation up to .65) well in the satisfactory range.

The LEI (Hambly & Fombonne, 2011) captures major language changes across a child's lifetime and ultimately yields an LR of bilingual exposure as well as an LR for the last 6 months (LR Recent). The LEI was administered during a 30-min phone interview with a caregiver by a trained medical student who was a native bilingual Mandarin–Cantonese speaker. During the interview, the informant provided a detailed history of all caregivers' amount and duration of care for each 6-month period of the child's life. The detailed history section additionally included the caregivers' place of birth, level of fluency in all languages spoken at home, and reasons for language changes. Language exposure information was also gathered across day-care and school environments. Following the interview, major language exposure changes (e.g., languages added or dropped) were identified, and data for each caregiver was summarized and totaled for each

6-month period of time since birth. Each caregiver's language input was weighted using a scale that was based on the relative amounts of direct (e.g., one-to-one) caregiver–child communication. For example, input from a parent with a full-time job received a lower weight than input from a caregiver (e.g., a grandparent) with primary childcare responsibilities. The final LR represents a composite average exposure (e.g., 55% Mandarin/45% Cantonese) in direct caregiver–child interactions; it does not reflect the amount of passive exposure via indirect exposure in the home. The language heard by the child most often during their lifetime was labeled their dominant exposure language.

The CCC-2 (Bishop, 2006) is a 70-item rating scale that provides the linguistic and communicative profile of children of at least 4 years of age. Items assess the prevalence of structural language and pragmatic strengths (in Items 1–50) and weaknesses (Items 51–70) on a 4-point scale. Scores of 0 are assigned for behaviors that appear *less than once a week or never*, 1 = *at least once a week, but not every day*; 2 = *once or twice a day*; 3 = *several times (more than twice) a day (or always)*. The CCC-2 is divided into 10 subscales (with seven items each): Four subscales assess aspects of structural language (subscale A: speech, B: syntax, C: semantics, D: coherence), four assess aspects of pragmatics (E: inappropriate initiation, F: scripted language, G: use of context, H: nonverbal communication), and two assess aspects of autistic behavior (I: social relations, J: interests). The items in the four pragmatic subscales of the CCC-2 measure a wide range of pragmatic skills (or lack of them). For example, items in subscale E: inappropriate initiation address the management of information flow (including adherence to Gricean maxims such as "be informative" and "be relevant"). Items in subscale F: scripted language address the use of formulaic expressions and tone of voice. Items in subscale G: use of context address the use of context to understand people's intentions, for example, understanding language too literally as well as the need to adhere to politeness norms depending on the status of the interlocutor. Items in subscale H: nonverbal communication address gesture, gaze, and posture during conversation.

In addition to composite scores for structural language (subscales A + B + C + D) and pragmatics (subscales E + F + G + H), the CCC-2 returns a general communication composite (GCC; subscales A + B + C + D + E + F + G + H), which reports on the presence of language impairment in general. It also calculates a social interaction difference index (SIDI; subscales A + B + C + D – E – H – I – J, that is, structural language minus some of the pragmatic language and autistic behavior subscales), which reports whether the language difficulties are more similar to those reported in (structural) language impairment, such as SLI, or the difficulties reported in ASD. A negative score on SIDI suggests a profile found in ASD. Standard scores for subscales have a mean of 10 and standard deviation of 3, with lower scores suggesting greater difficulties.

The CCC-2 has been used extensively to identify the strengths and weaknesses of populations with developmental disorders in regard to structural language and/or pragmatic language competence in many different populations with developmental disorders; for example, Geurts et al. (2004) used it in ASD and attention-deficit/hyperactivity disorder; Hoffmann, Martens, Fox, Rabidoux, and Andridge (2013) in Williams syndrome; Norbury, Nash, Baird, and Bishop (2004) in SLI, pragmatic language impairment, and ASD; Philofsky, Fidler, and Hepburn, (2007) in ASD and Williams syndrome; Timler (2014) in attention-deficit/hyperactivity disorder; and Volden and Phillips (2010) in ASD. Although we are not aware of studies that used the CCC-2 with bilingually exposed children, the CCC-2 has been used in languages other than English, including Cantonese (Lam & Ho, 2014), Dutch (Ketelaars, Cuperus, van Daal, Jansonius, & Verhoeven, 2009), Finnish (Yliherva, Loukusa, Väisänen, Pyper, & Moilanen, 2009), Norwegian (Helland, Biringer, Helland, & Heimann, 2009), and Thai (Chuthapisith, Taycharpipranai, Roongpraiwan, & Ruangdaraganon, 2014).

The Chinese version of the CCC-2 that we used was based on the adaptation by Lam and Ho (2014) of the original CCC-2 from English to Cantonese Chinese using traditional Chinese characters. The changes by Lam and Ho consisted of "slight cultural adaptations" (p. 11), mostly in examples that were provided to illustrate each phenomenon under question rather than in the kind of question asked. For example, the target word from the English semantics subscale item that refers to *rhinoceros* ("Forgets words s/he knows – e.g., instead of *rhinoceros* may say 'you know, the animal with the horn on its nose. . .'") was changed to *elephant* as this was deemed to be a more familiar animal for the Cantonese-speaking children. The version used in the current research study was based on the adaptation by Lam and Ho, with a few further changes based upon piloting and feedback from clinicians and parents. For example, the original English item from the semantics subscale "Mixes up words of similar meaning, e.g., might say *dog* for *fox*, or *screwdriver* for *hammer*" was revised to "might say 狗 *G u* (*dog*) for 狼 *Láng* (*wolf*), or 袜子 *Wàzi* (*sock*) for 鞋子 *Xiézi* (*shoe*)." Another example of modifications we made concerns the speech subscale. For example, an original English item states, "Mispronounces *th* for *s* or *g* for *d*. . ." Because *th* does not exist in the Mandarin phonemic inventory, this question was revised to "Mispronounces *zh* for *sh* or *g* for *d*, e.g., 猪 *zhū* (*pig*) for 书 *Shū* (*book*) or 高 *gāo* (*tall*) for 刀 *dāo* (*knife*)." Also, we used simplified rather than traditional Chinese characters.

The Mandarin Chinese version of the CCC-2 that we used was identical to the Cantonese one, with a few changes to reflect particular features of Mandarin Chinese (for example, using the name of a well-known cartoon character as an illustration of possible errors in pronunciation).

Our native-speaking consultants considered that all the items in the pragmatics subscales of the CCC-2 were

fully appropriate for children and families in a Chinese context. Lam and Ho (2014) do not report reliability and validity measures for their Chinese adaptation of the CCC-2. The British and American versions (Bishop, 2003 and 2006, respectively) report internal consistency reliability coefficients over .90. For our own adaptation in Chinese, we performed first- versus second-half reliability analyses for the items that measured communicative weaknesses (Items 1–50), for the items that measured communicative strengths (51–70), and for all items together. We found high levels of Cronbach's alpha with good to excellent reliability, ranging from 0.87 to 0.93. These values do not seem far from the reliability coefficients of the two English versions.

The SRS (Constantino & Gruber, 2005) is a 65-item rating scale completed by parents or teachers in order to assess autistic traits in children aged 4 to 18 years. Each item is scored from 0 (*never true*) to 3 (*almost always true*). Total scores range from 0 to 195. Higher scores suggest greater difficulties. Scores of 60 or above have been shown to correlate strongly with a clinically identified ASD diagnosis (Constantino et al., 2003, 2007), and scores above 75 suggest risk of severe autism. The SRS is divided into five subscales: social awareness, social cognition, social communication, social motivation, and mannerisms. The SRS has been used as a general screening tool for autism (Constantino et al., 2003, 2007; Norris & Lecavalier, 2010) in the United States and the United Kingdom. Moreover, the SRS has been validated cross-culturally; for example, Wang et al. (2012) utilized the Mandarin Chinese version of the SRS to differentiate autistic characteristics from other neuropsychological features in a Mandarin-speaking sample in Taiwan.

Hambly and Fombonne (2011) administered the SRS in a sample of bilingual children and used the SRS total score as a measure of a child's overall social functioning. In our study, we are also interested in the SRS total score as an indication of social functioning. In addition, we are particularly interested in the social communication subscale specifically (as noted earlier, Hambly & Fombonne only report the total score of the SRS). This subscale includes several items that address pragmatic language competence (as we defined it in the introduction) that have overlap with items in the four pragmatic subscales of the CCC-2.

The Mandarin adaptation of the SRS that we used was validated by Wang et al. (2012). This version of the SRS has a sensitivity of 66% and a specificity of 89% for detecting children with ASD among a group of typically developing children, attention-deficit/hyperactivity disorder, and developmental delay. Cronbach's alpha coefficient for the full scale ranged from good to excellent, especially for the clinical groups (alpha range = 0.87–0.94). Wang et al. report that alpha scores for the subscales varied across study groups, with social communication (range = 0.83–0.88 for clinical groups) and mannerisms (range = 0.73–0.90 for clinical groups) having higher alphas and social awareness with lower alphas (range = 0.43–0.55).

*Data collection.* The ALEQ, SRS, and CCC-2 were disseminated as a package accompanied by an information and consent form to interested families during clinic visits and family seminars at the Third Affiliated Hospital of Sun Yat-sen University and Guangzhou Cana School. In cases in which more than one language was spoken in the environment, families were instructed to answer the items in the CCC-2 and the SRS that pertained to language with reference to what they perceived to be the child's dominant language. Subsequent analysis of the LEI data from each family corroborated the family's choice of dominant language in every case. Families that met the inclusionary criteria then received the LEI and the SCQ. Furthermore, questions that were incomplete or unanswered from the first assessment package were then followed up at the end of the LEI, which was administered via phone interview. The assessments were administered by trained research assistants from the Third Affiliated Hospital of Sun Yat-sen University who were blind to the specific purposes of this research. Twenty percent of the assessments were scored by a second group of research assistants to confirm reliability of the assessments.

## Results

### *Structural and Pragmatic Language Competence and Social Functioning*

The results on the dependent measures are reported in Table 2. To investigate group differences, we ran multivariate analyses of variance (ANOVAs) with group (monolingual vs. bilingually exposed) as the between-subjects independent variable and each of the two screening tools (CCC-2, SRS) subscales and composite scores as within-subjects dependent variables. The use of multivariate ANOVAs is expected to decrease the possibility of Type I error compared to multiple pairwise comparisons between the groups. In regard to the CCC-2, a 2 (between-subjects: monolingual vs. BE) × 14 (within-subjects: CCC_GCC, CCC_SIDI, CCC_structural language composite, CCC_pragmatics composite, and the 10 CCC-2 individual subscales) revealed no main effect of group, Pillai's Trace = .15, $F(11, 38) = 0.63$, $p = .79$, *ns*. Another multivariate ANOVA was run for the SRS. A 2 (between-subjects: monolingual vs. BE) × 6 (within-subjects: SRS_scaled score and the five SRS individual subscales) analysis again revealed no main effect of group, Pillai's Trace = 1.76, $F(6, 47) = 1.66$, $p = .15$, *ns*. Last, an independent-samples *t* test on age of first word also revealed no reliable difference between groups.

As anticipated, in comparison to what would be expected for neurotypical participants, both groups had substantially low scores in the CCC-2. The structural language composite of the CCC-2 was 5.67 ($SD = 2.2$) for the monolingual group and 6.45 ($SD = 2.29$) for the BE group, with a normative standard score of 10 and standard deviation of 3, and the GCC scores were 43.17 and 47.67, respectively. We further investigated if these scores are within the range typically expected for verbal children with

**Table 2.** Mean scores and standard deviations of the two groups in the test variables.

| Test variables | Monolingual (*n* = 31) | | Bilingual (*n* = 23) | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *f* | *p* |
| CCC_GCC | 43.17 | 16.54 | 47.67 | 16.70 | 0.89 | .35 |
| CCC_SIDI | –1.45 | 6.06 | –3.52 | 10.42 | 0.79 | .38 |
| CCC_Structural language composite | 5.67 | 2.2 | 6.45 | 2.79 | 1.73 | .20 |
| CCC_Pragmatics composite | 4.91 | 2.14 | 5.04 | 1.91 | 0.13 | .72 |
| CCC_Speech | 6.74 | 2.91 | 7.96 | 3.31 | 2.56 | .12 |
| CCC_Syntax | 4.84 | 2.58 | 5.52 | 2.81 | 1.31 | .26 |
| CCC_Semantics | 6.23 | 3.13 | 7.39 | 4.02 | 1.51 | .23 |
| CCC_Coherence | 4.87 | 2.5 | 4.91 | 2.87 | 0.04 | .84 |
| CCC_Initiation | 7.52 | 3.16 | 7.22 | 2.54 | 0.00 | 1.00 |
| CCC_Scripted | 3.97 | 2.32 | 4.91 | 2.43 | 1.65 | .21 |
| CCC_Context | 4.84 | 2.88 | 4.17 | 2.27 | 0.52 | .48 |
| CCC_Nonverbal | 3.32 | 2.3 | 3.87 | 2.9 | 0.54 | .46 |
| CCC_Relations | 3.61 | 2.91 | 4.3 | 2.82 | 1.02 | .32 |
| CCC_Interests | 6.55 | 3.34 | 6.87 | 3.09 | 0.05 | .83 |
| SRS_Scaled | 80.45 | 8.97 | 76.83 | 7.95 | 2.37 | .13 |
| SRS_Awareness | 12.52 | 2.08 | 11.48 | 3.49 | 1.86 | .17 |
| SRS_Cognition | 19.35 | 4.21 | 18.83 | 4.28 | 0.21 | .65 |
| SRS_Communication | 36.87 | 8.48 | 32.48 | 8.93 | 3.38 | .072 |
| SRS_Motivation | 16.42 | 5.8 | 15.22 | 4.1 | 0.71 | .40 |
| SRS_Mannerism | 16.48 | 6.36 | 16.22 | 5.57 | 0.02 | .90 |
| Age of First Words (in months)* | 21.39 | 12.46 | 20.96 | 11.29 | 0.13 | .89 |

*Note.* *CCC* is the Childhood Communication Checklist–2 (CCC-2; Bishop, 2006), which has 10 subscales (speech, syntax, semantics, coherence, initiation, scripted language, context, nonverbal communication, relations, and interests). Scores in the subscales are scaled. *CCC_GCC* is the general communication composite of CCC-2, and *CCC_SIDI* is the social interaction difference index. *CCC_Structural language composite* is the average of subscales A–D of the CCC-2, and *CCC_Pragmatics composite* is the average of subscales E–H. Lower scores in the CCC-2 subscales indicate more difficulties. *SRS* is the Chinese version of the Social Responsiveness Scale (Wang et al., 2012), which has five subscales (awareness, cognition, communication, motivation, mannerism). Higher scores on the SRS indicate more social communication difficulties.

*The test statistic in this case is the *t* for independent-samples comparisons.

ASD. Although the norming study of the CCC-2 (Norbury et al., 2004) does not report structural language composite scores, it does report the GCC, which includes all the structural language and pragmatics subscales (A–H). Norbury et al. (2004) reported that UK children in a PDD-NOS group had a GCC score of 25.6, children in a high-functioning autism group had a score of 28.16, children in an Asperger disorder group had a score of 60.86, and typically developing children had a score of 100.24. With GCC scores of 43.17 and 47.67, respectively, our monolingual and bilingually exposed groups with ASD scored within the range that would be expected from a sample whose clinical diagnosis included all three groups, PDD-NOS, high-functioning autism, and Asperger disorder. The negative scores on SIDI indicate that the linguistic profile of both groups is more similar to that of ASD than to that of other disorders such as SLI.

Two further questions were explored. First, does the balance of BE affect the children's competence with language? That is, within the BE group of 23 participants, the ratio of language use ranged from almost exactly balanced use of two languages (e.g., 54%–46%) to a pattern in which one of the two languages was clearly dominant (e.g., 80%–20%). Using the LEI, LR can be coded over the child's lifetime or over the 6 months prior to testing. We first ran bivariate correlations between LR and the 14 dependent variables we derived from the CCC-2 and then the six dependent variables we derived from the SRS, using the Bonferroni correction for multiple comparisons in each case (the significance threshold was adjusted to 0.0035 for the variables from the CCC-2 and to 0.0083 from the SRS). The correlations revealed no significant association between LR and any measure of the CCC-2 or the SRS (all $r$s < .39, all $p$s > .05, n.s.). A new set of bivariate correlations between LR Recent and the dependent variables from the CCC-2 and the SRS again revealed no significant correlations (all $r$s < .32, all $p$s > .5, *ns*; the correlation between the CCC-2 social interests subscale and LR Recent returned $r = -.47$, and $p = .022$, which is below the conventional level of .05 but not below the Bonferroni-adjusted threshold).

The second question was if the age of onset of exposure to a second language affected performance in the dependent variables. Although we did not have enough participants in our sample of 23 BE children to split the group into sequential and simultaneous bilinguals as Hambly and Fombonne (2011) did, we can address this question by searching for correlations between age of second language onset and the dependent variables derived from the CCC-2 and the SRS. Again, no such correlations were significant (all $r$s < .031, all $p$s > .05, *ns*; the correlation between the CCC-2 social interests subscale and age

of onset returned $r = .41$, and $p = .047$, which is below the conventional level of .05 but not below the Bonferroni-adjusted threshold).

## Discussion

Previous studies have investigated whether BE is associated with additional difficulties for the language development of children with ASD (Hambly & Fombonne, 2011; Ohashi et al., 2012; Petersen et al., 2012; Valicenti-McDermott et al., 2013). These studies have used parental questionnaires and direct testing focusing predominantly on structural language (vocabulary, grammar, and pronunciation). The consistent finding is that there is no adverse association between BE (whether sequential or simultaneous) and language development with either the dominant or the nondominant language. In fact, it has been reported that bilingual children may actually have a larger vocabulary if total vocabulary is taken into account (Petersen et al., 2012).

The current study sought to extend these findings by using the CCC-2 to measure not only structural language but also pragmatic language competence. In addition, we administered the SRS with the aim to investigate social functioning in general (we also noted that the social communication subscale of the SRS has partial overlap with the pragmatics component of the CCC-2). In a sample of 31 monolingual and 23 bilingually exposed children with ASD, we found that BE was not associated with any additional difficulties or delays on any of our dependent measures. Within the bilingually exposed group, the ratio of language use and age of second language onset were not found to correlate reliably with any measure. In both the correlations with language ratio and the age of onset, there was a tendency for an association with the CCC-2 social interests subscale, and this may be an avenue for future research with larger samples and/or more refined measures on social interests.

To our knowledge, this is the first study in a non-Western context that reports BE is not associated with additional structural language and pragmatic difficulties in young children with ASD. This is an important finding coming from a country in which childhood autism is underdiagnosed (Huang et al., 2013; Sun, Allison, Matthews, et al., 2013), and there is a comparative lack of services available to autistic individuals and their families (Huang et al., 2013; Sun, Allison, Auyeung, et al., 2013). In this context, the lack of negative associations is not likely to be due to the earlier diagnosis and/or enhanced health and education services afforded in other parts of the world.

Last, in the Results section, we noted an unexpected finding concerning the age of diagnosis of ASD. Children in the BE group received a medical diagnosis at a significantly younger age than their monolingual peers by half a year (40 vs. 46 months; $t = 3.96$, $p < .001$, $r = .96$). A difference in age of diagnosis is not reported in any other study on this topic, although we note that previous work has taken place only in Western contexts. Further research is required on this matter, first to confirm if the difference in age of diagnosis is a robust and replicable finding in the Chinese context and then to interpret it, possibly in relation to attitudes toward BE among parents and professionals.

### *Study Limitations*

Regarding the limitations of this research, we note that our findings cannot be generalized to the whole range of the ASD continuum because nonverbal participants and/or participants with intellectual disabilities were excluded from the study. Moreover, the relatively small sample size and the statistical corrections we applied for multiple comparisons may have obscured group differences and/or correlations. Future work may be able to improve on this respect and also to go beyond the exclusive use of parental reports and to use direct speech and language measurements and observations of participants. In addition, we only obtained and reported data from the children's dominant language, and the conclusions we reach do not extend to the children's nondominant language (although, as mentioned in the literature review, other studies report that no negative association was apparent in the bilingual children's nondominant languages as well, e.g., Hambly & Fombonne, 2011). A better characterization of the general cognitive development of the participants would also have been desirable, for example, in terms of nonverbal IQ, executive functioning, and theory-of-mind skills. Furthermore, in addition to the questions highlighted earlier in this section, there are several key issues that our study does not address. First of all, as with other, similar studies in this area, our findings only apply to early language development in children with ASD, and effects of bilingualism (either positive or negative) might become evident as children develop and progress through school (and the associated later language development and literacy skills). Another key question is whether better mastery of the home language also leads to stronger command of the language that is dominant in society. This is a robust finding in typically developing bilinguals (see Bialystok, 2001; McCabe et al., 2013) and one of the major arguments in favor of supporting the home language.

### *Clinical Implications*

Given these limitations, the take-home message from the current work is that for preschool- and early school-age verbal children with ASD, BE is not adversely associated with language development in their dominant language, whether in terms of structural or pragmatic language competence. Taking into consideration the wider picture from the small but growing body of research on the topic, the evidence consistently indicates the absence of a negative association between BE and the early linguistic development of children with ASD. This emerging picture has implications for clinical and educational practice. It is widely reported that parents of bilingually (and multilingually) exposed children are advised against maintaining

a bi- or multilingual environment at home (see Fernandez y Garcia et al., 2012; Hambly & Fombonne, 2011; Kay-Raining Bird et al., 2012; Kremer-Sadlik, 2005; Wharton et al., 2000; Yu, 2013) despite the lack of an evidence base to this conclusion. Parents who follow this advice often describe the switch to a monolingual pattern as a loss and may struggle to cope with communicating in the society's dominant language if they are not already competent with it themselves (Fernandez y Garcia et al., 2012). Caution against offering such advice can be found in several key guidelines on the grounds of potentially adverse emotional, cultural, social, and language effects (see, for example, McCabe et al., 2013), which are endorsed by the American Pediatrics Association, the Royal College of Speech and Language Therapists report (2005) for speech and language therapists in the United Kingdom, and Espinosa (2013) for teachers in the United States. It is therefore important that professionals are up to date with the emerging evidence, which indicates that exposure to two languages in the home environment is not associated with adverse effects in ASD (and this is in line with the findings on BE in other developmental disorders, such as SLI [Paradis, 2010] and Down syndrome [Feltmate & Kay-Raining Bird, 2008]). This message is worth communicating to families and other professionals using all means available, including home visitation programs, health care settings, center-based early childhood programs, and mass media (see McCabe et al., 2013).

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