Journal of Autism and Developmental Disorders (2022) 52:339–348
https://doi.org/10.1007/s10803-021-04940-x

ORIGINAL PAPER

Longitudinal Social and Communication Outcomes in Children with Autism Raised in Bi/Multilingual Environments

Samantha Siyambalapitiya[1,2] · Jessica Paynter[2,3] · Vishnu K. K. Nair[4] · Christina Reuterskiöld[5] · Madonna Tucker[6] · David Trembath[2]

Accepted: 16 February 2021 / Published online: 10 March 2021

Abstract

Globally, there are more bilingual speakers than monolingual speakers; however, scant research evidence exists regarding social communication development and outcomes for bilingual children with autism spectrum disorder (ASD). A stronger evidence base will facilitate health professionals and educators providing accurate recommendations regarding language use. This study employed a longitudinal cohort design to compare social and communication skills, at baseline and over 12 months, for 60 monolingual and 60 bilingual children with ASD receiving community based early intervention. We found few differences at intake, and no difference in the magnitude of change over 12 months for this cohort. Findings support the notion that there is no basis on which to discourage home language use with bilingual children with ASD.

Keywords Autism · Bilingualism · Early intervention · Home language · Social-communication outcomes

With high levels of international migration (United Nations, Department of Social & Economic Affairs, Population Division, 2017) and globalization, it is anticipated that societies will become increasingly multilingual across the world (Abutalebi & Weekes, 2014). Health professionals and educators will work with more individuals from culturally and linguistically diverse (CALD) backgrounds, leading to complexity in service delivery due to potential cultural and language differences. This complexity is likely to be particularly evident when working with CALD individuals with complex communication disability, such as Autism Spectrum Disorder (ASD). Children with ASD have pervasive social and communication impairments alongside restricted, repetitive, ritualistic, and or sensory behaviours (American Psychiatric Association, 2019), affecting as many as one in 40 children based on parental reports of prevalence (Kogan et al. 2018). Given that as many as 30% of children with ASD do not develop phrase-level speech (Norrelgen et al. 2015), it is critical that child, family, and contextual factors that promote the most positive communication outcomes be identified. For children with ASD being raised in bilingual or multilingual homes, this includes having a strong evidence base to guide clinical practice and parent education about language use.

Most existing research involving children with ASD has focused on communication development and outcomes in a single language (generally English); therefore, there is minimal research evidence to support recommendations for professionals working with bilingual children with ASD (e.g. Kay-Raining Bird et al. 2016; Summers et al. 2017). The lack of evidence may result in educators and health professionals providing conflicting or inaccurate advice to parents of bilingual children with ASD, such as to use only one language at home (e.g. Kay-Raining Bird et al. 2012; Yu, 2013, 2016), or to use only the majority community language (Jegatheesan, 2011). Given the centrality of language to social participation, education, and social and emotional

✉ Samantha Siyambalapitiya
s.siyambalapitiya@griffith.edu.au

1 School of Allied Health Sciences, Griffith University, Brisbane, Australia

2 Menzies Health Institute Queensland, Griffith University, Gold Coast, Australia

3 School of Applied Psychology, Griffith University, Gold Coast, Australia

4 Department of Communication Sciences and Disorders, West Virginia University, Morgantown, USA

5 Department of Communicative Sciences and Disorders, New York University, New York, USA

6 AEIOU Foundation, Brisbane, Australia

development; it is imperative that parents, clinicians, and educators have clear evidence on which to base recommendations regarding language use in the home environment.

The benefits of using multiple languages in childhood is well established, with evidence for positive effects on cognitive, linguistic, and academic skills (e.g. Lazaruk, 2007). Findings support the existence of two separate language systems early in life for typically developing dual language learners (Hammer et al. 2014). Hence, exposure to more than one language is not confusing for children raised in bilingual families, as they can successfully learn two languages at the same time (Hoff & Core, 2015). Nevertheless, there have been suggestions that parents should speak to their children in the majority language, regardless of parental proficiency in that language (Greene, 1998; Kremer-Sadlik, 2005). This is likely due to the assumption that single language use would reduce the complexity of the linguistic input and facilitate language processing and learning in bilingual children with ASD (Kremer-Sadlik, 2005). Yu (2013) conducted phenomenological analysis of interviews examining language practices of Chinese-English immigrant mothers of children with ASD and reported rare use of the home language (L1) after the diagnosis of ASD. The author noted that this was not due to parents believing that bilingualism would have negative effects on language development, but due to their concern that use of L1 might hinder intervention progress and lead to problems with accessing intervention. Supporting the parents' first assertion that bilingualism would not have a negative effect, is a growing body of evidence indicating that raising children with ASD in bilingual environments has no negative effects and may in some cases have positive effects on their social communication, cognitive development and pragmatic development (e.g. Gonzalez-Barrero & Nadig, 2019; Hambly & Fombonne, 2012; Petersen et al. 2012; Reetzke et al. 2015; Uljarević et al. 2016). The second assertion, that bilingualism in the home may hinder language outcomes for children receiving intervention, has not been investigated in any depth.

To date, studies examining the possible influence of bilingualism on communication development in children with ASD have primarily employed cross-sectional designs, consistently finding no significant differences between children raised in monolingual versus bilingual homes. Available evidence from these studies regarding the nature of social and communicative development in children with ASD indicates that bilingual and monolingual children perform similarly on measures of early language abilities and functional communication skills (Ohashi et al. 2012), receptive and expressive language (Valicenti-McDermott et al. 2013), vocabulary (Petersen et al. 2012), social abilities (Hambly & Fombonne, 2012) and diagnostic characteristics (Ohashi et al. 2012). A number of recent review studies examining cognitive, language, or social abilities of children with ASD raised in bilingual and monolingual families also failed to identify any detrimental effects of bilingualism on these domains (e.g. Drysdale et al. 2015; Kay-Raining Bird et al. 2016; Wang et al. 2018).

These findings from cross-sectional studies are encouraging and suggest only few or no meaningful differences between bilingual and monolingual children with ASD. Although existing findings negate concerns regarding bilingualism being detrimental for children with ASD, only a handful of studies have investigated outcomes for these children when receiving intervention. To the best of our knowledge only four published studies (Lang et al. 2011; Seung et al. 2006; Summers et al. 2017; Zhou et al. 2017) have examined the outcomes of bilingual children with ASD receiving intervention. Three of these studies explored outcomes for bilingual children receiving intervention in two languages; whilst one study investigated longitudinal outcomes in the language of instruction, of bilingual children receiving early intervention programs. Seung et al. (2006), for example, investigated, longitudinal treatment outcomes of a Korean-English bilingual child with ASD over a period of two years. The treatment was provided in L1 (Korean) for the first twelve months, followed by intervention in English. The results indicated that the child made significant gains in both L1 and L2 across a number of receptive and expressive language abilities, including improvement in vocabulary, following one-step commands, a significant increase in functional outcomes, and a decrease in behaviors of concern. Similar improvements in functional outcomes were reported in a study investigating bilingual versus monolingual intervention for children with ASD. Summers et al. (2017) employed a single subject, rapid, alternating treatment design to provide intervention to two bilingual children with ASD. The two treatment conditions were bilingual (clinician used both Spanish and English) and monolingual (clinician spoke English only). Results indicated that language skills improved in both the bilingual and monolingual conditions; with one child showing better maintenance of acquired skills in the bilingual condition. Based on the preliminary findings, Summers et al. (2017) recommended that clinicians consider supporting both languages of a bilingual child. Lang et al. (2011) provided language intervention using Discrete Trial Training (DTT; a behavior modification intervention technique that is widely used for children with ASD) to a Spanish–English bilingual four-year-old child with ASD. DTT was administered in both Spanish (home language) and English (school language) and evaluated using an alternative treatment design. Results showed more improvement in Spanish compared to English, with the child producing more correct responses and engaging in fewer challenging behaviours following treatment in L1. Collectively, these cross-sectional studies indicate support for providing intervention to bilingual children in both of their languages.

To date, only one study has investigated the longitudinal social and communication intervention outcomes, in the language of instruction, in bilingual children with ASD receiving early intervention (Zhou et al. 2017). The researchers analysed cross-sectional and longitudinal data from thirteen children from bilingual homes, aged between 12 and 26 months, in response to early ASD intervention. Early intervention programs for children with ASD, such as the one described in this study, are a common service delivery model for children with ASD in many countries (e.g., United States, United Kingdom, Australia). The bilingual children showed comparable performance to monolingual children on all social and language skills and the authors asserted there was no support for the notion that exposure to a second language should be avoided in children with ASD.

While these findings are promising, there is a need for replication in other cohorts of children receiving early intervention programs, particularly involving larger sample sizes and within well-described intervention programs. Such studies have more explanatory power given that language and social development is measured before and after the effects of intervention programs that may influence development in these children. Studies following children over time will also provide a better understanding of the relationship between home language, and social and communication outcomes following intervention. This knowledge will inform clinical recommendations to parents regarding use of home language/s. The current study therefore investigated outcomes of children with ASD, raised in both bilingual and monolingual homes, receiving early intervention. Social and communication skills were measured in the language of instruction at entry to the intervention program and again 12 months later. Specifically, this study examined the following questions:

- Is there any difference in social and communication characteristics between children raised in monolingual versus bilingual environments at entry to the intervention program?
- Following 12 months of intervention in the societal language (English), is there any difference in the amount of within-program change made by children raised in monolingual versus bilingual environments?

Method

Design

We used a longitudinal cohort design to compare the social and communication skills at intake, and any changes in these skills over twelve months, in children with ASD receiving comprehensive early intervention. The study was conducted as part of larger longitudinal studies of intervention outcomes for children with ASD, with ethical approval granted by the relevant university and organisation ethics committees.

Participants

The participants were 120 children (60 bilingual/monolingual matched pairs) with ASD, who received early intervention through a large autism-specific community provider across one state in Australia. Bilingual children were selected for inclusion in the study based on demographic survey data completed at intake to the program, indicating that the primary language spoken at home was a language other than English. With English being the language of instruction and dominant societal language, these children were being raised in bilingual/multilingual environments. In total, 38 different languages (other than English) were reported to be spoken at home, with some families reporting more than one language spoken at home. Languages spoken were from diverse global regions including Asian, European, African, Middle Eastern and Pasifika languages. The most common were Vietnamese ($n=6$), Punjabi ($n=5$), Samoan ($n=3$), Japanese ($n=3$), and Cantonese ($n=3$). Monolingual children, who were those reported to be English-speaking only, were then matched to bilingual children on the basis of completed assessment points, time between assessments, chronological age, previous language intervention, gender, nonverbal developmental quotient, and socio-economic status as outlined below. Groups were not matched on the dependent variables (social communication and language measures), as comparison on these variables at intake and over time was the focus of planned analyses.

Data were extracted from three databases, across four sites aligned with the same autism early intervention service, with an initial total data set of 300 individuals. Cases were only included in the analysis if their ASD diagnosis was verified via a score ≥ 11 on the Social Communication Questionnaire (SCQ; Rutter et al. 2003) or where SCQ was absent, an Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2012 calibrated severity score of ≥ 5 (autism spectrum classification, Lord et al. 2012) resulting in exclusion of 19 cases. A further nine cases were excluded due to reported hearing or vision impairment. Twenty-four cases were excluded due to their initial assessment being more than six months from early intervention entry. Finally, we excluded one case where language/s at home were not recorded, and one where the second language was sign language as we were most interested in spoken second languages. The final data set included 185 children who were monolingual English-speaking only (75.5%), 37 cases with English as primary language and additional language/s used

at home (15.1%), and 23 with a language other than English as the primary language at home (9.4%).

Following initial application of inclusion/exclusion criteria, cases deemed to be bilingual (i.e., more than one language used in their home environment) ($n = 60$) were then individually matched with monolingual cases. Cases were matched as closely as possible in order of selected variables (see Table 1 for details of matching criteria), until either only one match remained, or all possible criteria were matched. Where no exact matches were found on a variable (e.g., all prior criteria matched but there were no exact matches on the next specific variable, such as no match for accessing a speech pathologist), matching on the next variable was completed (e.g., Early Childhood Development Program attendance to narrow and so on). Where more than one possible match remained a random number generator was used to select the target case ($n = 11$). For matched cases, only one variable (speech pathology intervention access) showed a significant small difference at a group level, with more monolingual children (81.4%) accessing speech pathology services than bilingual (64.4%; see Table 1).

Measures for Social and Communication Skills

Social Communication Questionnaire (SCQ)

The SCQ is a parent/caregiver report which includes 40 yes/no questions scored as 0 or 1. A score of 1 is assigned for observed atypical behavior and a score of 0 is given if this is not observed. The areas included are Reciprocal Social Interaction Domain, Communication Domain and Restricted Repetitive and Stereotyped Patterns of Behavior Domain. The total raw score which is a sum of items endorsed was used as a measure of autism characteristics as per previous ASD research (e.g. Paynter et al. 2018).

Vineland Adaptive Behaviour Scales—2nd Edition (VABS-II) Parent Form (Sparrow et al. 2005)

The VABS-II, is a parent/caregiver report form which provides measures in four different domains of adaptive skills: Communication, Daily Living Skills, Socialization and Motor Skills. It is suitable to administer to individuals from birth across the lifespan. This measure shows good psychometric properties (Sparrow et al. 2005) and has been widely used to assess changes in adaptive behaviour in other ASD early intervention studies (e.g. Paynter et al. 2015; Vivanti, et al. 2014). Standard scores derived from manual norms (Sparrow et al. 2005) which have a mean of 100 and standard deviation of 15 were used in analyses.

The Mullen Scales of Early Learning (MSEL; Mullen, 1995)

The MSEL is a standardized assessment which assesses language, motor and perceptual abilities in children aged birth to five, and is commonly used to assess cognitive functioning

Table 1 Comparison of monolingual and multilingual cases on matching criteria

Matching criteria	Pairs matching (/60)	Monolingual (n = 60)	Multilingual (n = 60)	Statistical comparison
		Mean (SD)	Mean (SD)	
1. Time between assessments (at least six months if two assessments for bilingual^)	49/49^	11.96 (1.87)	11.90 (2.55)	$t(86.22) = .14$, $p = .89$, $d = .03$
2. Chronological age (within 6 months)	60	45.57 (9.32)	44.80 (9.41)	$t(118) = .39$, $p = .70$, $d = .07$
3. Nonverbal DQ within 10 points	60	54.07 (17.60)	53.92 (16.81)	$t(118) = .05$, $p = .96$, $d = .008$
		Number (%)	Number (%)	
4. Gender (number and % male)	58	49/60 (81.7%)	49/60 (81.7%)	$\chi^2(1) = < .01$, $p = 1.00$, $\varphi = < .001$
5. T1 Previous Speech Pathology Services (dichotomous)	50	48 (81.4%)	38 (64.4%)	$\chi^2(1) = 4.29$, $p = .04$*, $\varphi = .19$
6. T1 Early Childhood Development Program attendance prior to entry (Special Education Kindergarten) (dichotomous)	55	15/59 (25.4%)	19/59 (32.2%)	$\chi^2(1) = .66$, $p = .42$, $\varphi = .08$
7. T1 Mainstream (inclusive) childcare/ kindergarten attendance prior to entry (dichotomous)	50	23/59 (39.0%)	26/59 (44.1%)	$\chi^2(1) = .31$, $p = .58$, $\varphi = .05$
8. Adults in household (% with two)	54	58/60 96.7%	53/60 (89.8%)	$\chi^2(3) = 2.88$, $p = .41$, Cramer's V = .16
9. Number of children in household (SD)	34	1.92 (.75)	2.00 (1.03)	$t(115) = .61$, $p = .45$, $d = .09$
10. Number of younger siblings (SD)	29	.38 (.56)	.42 (.60)	$t(111) = .42$, $p = .67$, $d = .06$
11. Number of older siblings (SD)	24	.64 (.70)	.67 (1.00)	$t(111) = .15$, $p = .88$, $d = .03$
12. Child medication use (dichotomous)	42	14/59 (23.7%)	12/59 (20.3%)	$\chi^2(1) = .197$, $p = .66$, $\varphi = .04$

^Where bilingual only had an intake assessment ($n = 11$), this criterion was omitted; *$p < .05$, two-tailed

in young children with ASD (e.g. Paynter et al. 2018; see discussion in Riley et al. 2019). The Visual Reception, Fine Motor, Receptive Language, and Expressive Language subscales were administered, however only the receptive and expressive language subscales were of interest for the present study. As per previous ASD research (e.g. Paynter et al. 2018; Yang et al. 2016), developmental quotients (DQs) were used as the main unit of analysis as young children with ASD commonly do not reach the basal for calculation of raw scores. These were calculated for expressive and receptive language separately by dividing chidren's age equivalent scores by their chronological age and multiplying by 100.

Procedures

Intervention

All children received the same naturalistic developmental behavioral intervention (Schreibman et al. 2015) that was a full-time (20–25 h of intervention per week), group-based program that aligned with Australian guidelines for good practice (Prior & Roberts, 2012). The manualized program used a combination of practices drawn from empirically supported approaches outlined in the literature (Wong et al. 2015). The intervention was multidisciplinary and included speech therapy, occupational therapy, and early education professional involvement. The program was delivered in classrooms via small (1–4 children) and large (10–12 children) group activities with a staff member, and an adult–child ratio of approximately 1:4. The program covered eleven domains: classroom attending, echoics, visual perception, social skills, play skills, self-help, intra-verbals, receptive and expressive language, imitation, and academic skills, as outlined in previous publications (Paynter & Falvey-Henderson, 2011; Paynter et al. 2012). This program included for example in a day, an initial circle time as a large group (targeting e.g., social skills, academic skills), smaller group learning centres targeting specific child goals (e.g. expressive/receptive language, imitation, academic skills), outside play/play skills, snack times, toileting/self-help, a second learning centre or large group activity, lunch/play, rest times, and final large group circle time to end the day. As part of the program, children completed assessments on entry (Time 1; T1) and following 12 months of participation (Time 2; T2), and/or on exit (whichever came first). For the purposes of this study only the first two time points were used.

Data Analysis

To address the research questions, change scores were calculated for key variables measuring social communication outcomes (MSEL receptive language DQ, MSEL expressive language DQ, VABS communication SS, VABS socialization SS, and SCQ total), by subtracting the T1 score from the T2 score. Data were then screened for missing items, assumptions for parametric analysis, and for potentially confounding effects of group differences in speech pathology services. To address the first research question (i.e., potential differences in social communication between monolingual and bilingual children at entry to the program), independent groups t-tests were conducted on key variables at T1. To address the second research question (i.e., amount of within-program change for monolingual vs bilingual children), change scores were compared using independent groups t-tests. Independent groups t-tests were selected as opposed to matched, as while effort was made to match participants on potentially confounding variables as closely as possible, this was an imperfect match. Given the exploratory nature of the study, with the aim to highlight areas for future in-depth investigation, and given the limited research in the area to date, increased risk of Type 2 errors was considered more concerning (i.e. false negatives) than increased risk of Type 1 (i.e., false positives), thus adjustment was not made to control for multiple comparisons (increasing risk of Type 1/family-wise errors), with a p-value of 0.05 retained for analyses. Effect sizes are provided for comparisons using Cohen's d and the conventions of 0.2 for small, 0.5 for medium, and 0.8 for large (Cohen, 1998).

Results

Data Screening

During matching it was observed that one bilingual participant had the exact same assessment date recorded for Time 2 which appeared to be duplication of intake results based on date of assessments (i.e. entry error) and this datapoint was removed; the case was retained for T1 only. There were 16.08% missing data on variables used in analyses, however these were missing completely at random (MCAR) (Little's MCAR Test, $\chi^2(86) = 60.55$, $p = 0.98$). Data were deleted listwise by analysis. Data were screened for meeting assumptions for independent groups analysis and were approximately normally distributed (Shapiro–Wilk, $p > 0.05$), with one exception, T1 VABS Socialisations SS. QQ Plots were thus examined and were deemed acceptable since removal of outliers did not impact on normality. Outliers were detected in box plots on change in SCQ ($n = 2$), T1 MSEL receptive language DQ ($n = 5$), T1 MSEL expressive language DQ ($n = 1$), change in MSEL expressive language DQ ($n = 3$), and T1 VABS Socialization SS ($n = 3$). Data were inspected and one data point was due to an entry error of age equivalent that was corrected. All other scores appeared to be genuine responses and analysis was thus conducted with and without inclusion of outliers. Outliers were excluded

for socialization due to being influential datapoints; for other variables, outliers were retained as they were not influential datapoints. Where Levene's test indicated violation of the assumption of homogeneity of variances ($p < 0.05$) Welch's t-test is reported. As groups differed on whether they had accessed speech pathology services or not at T1, data were screened for whether those who accessed speech pathology services showed different outcomes on dependent variables of interest (MSEL DQ, receptive and expressive language scores T1 and change scores; VABS SS communication and socialization scores at T1 and change scores; SCQ T1 and change score) and no significant differences were found (via independent t-tests), with all $p > 0.05$. As such, access to speech pathology was not controlled in group comparisons. Finally, within the bi/multilingual group, those children with English as the primary language at home ($n = 37$) and those with another language as the primary language ($n = 23$) were compared, with no differences (all ps > 0.05) at T1, or in change scores on key variables, and were thus combined for comparison to the monolingual group.

Social and Communication Skills at Intake (T1)

As displayed in Table 2, there were no significant differences between children from monolingual versus bilingual families in autism characteristics, expressive language evaluated one-on-one, or communication as rated by parents. Children who were monolingual performed higher on receptive language assessment than children who were bilingual, with a medium effect size. Parents rated children's social skills higher in the monolingual group than the bilingual group with a small-medium effect size.

Social Communication Skills Development (T2-T1)

As shown in Table 3, there were no significant group differences in the changes made in social communication skills over 12 months; the magnitude of differences was also small. This included parent-reported autism characteristics, communication and social skills, as well as direct assessments of receptive and expressive language. In both groups, children appeared to show an increase in receptive and expressive language skills in direct assessments, consistent with parent reports. Scores suggested decreases in autism characteristics. However, it is noted this was not compared statistically, as it was not the focus of this study. Parent-rated socialization scores suggested minimal changes over time. Twenty-two participants did not have any T2 data (e.g., due to exiting the program), therefore, it was of interest whether those children had differed on key T1 measures (nonverbal developmental quotient, autism characteristics, receptive language, expressive language, parent-rated communication, parent-rated socialization). Analysis using independent samples t-tests showed there were no significant differences between those who completed T2 assessments and those for whom T2 data was not available, with all $p > 0.05$.

Discussion

The overarching aim of this study was to contribute evidence that can help inform language recommendations for children with ASD raised in bilingual environments. Using a larger cohort than has previously been reported, we found that that bilingual children with ASD made similar progress in social and communication development as their

Table 2 Social Communication Skills across Monolingual and Bilingual Children at T1

	Monolingual	Bilingual	*t*	*df*	*p*	*d*
Autism Characteristics (SCQ Total Score)	19.27 (5.47)	17.82 (5.26)	1.42	109	.16	0.27
Receptive Language (MSEL DQ)	41.36 (20.31)	32.17 (17.10)	2.67	114.29	.009*	0.49
Expressive Language (MSEL DQ)	42.14 (22.06)	36.82 (15.36)	1.53	105.32	.13	0.28
Parent-rated Communication (VABS SS)	66.81 (13.40)	63.22 (15.12)	1.32	109	.19	0.25
Parent-rated Socialisation (VABS SS)	71.27 (10.25)	66.82 (8.59)	2.42	105	.02*	0.47

*$p < .05$ significance of t-test (two-tailed), *df* degrees of freedom, *d* Cohen's d

Table 3 Changes (Δ) in Social Communication Skills from T1 to T2

	Monolingual	Bilingual	*t*	*df*	*p*	*d*
Δ Autism Characteristics	− 3.48 (6.99)	− 1.18 (4.46)	− 1.78	70.26	.08	0.39
Δ Receptive Language (MSEL DQ)	8.91 (13.66)	9.92 (9.83)	− 0.44	89.051	.67	0.08
Δ Expressive Language (MSEL DQ)	4.46 (14.60)	4.42 (12.31)	.013	96	.99	0.002
Δ Parent-rated Communication (VABS SS)	5.00 (10.04)	5.53 (10.58)	− 0.23	79	.82	0.05
Δ Parent-rated Socialisation (VABS SS)	1.37 (8.91)	− 0.87 (9.14)	1.10	77	.28	0.25

p significance of t-test (two-tailed), *df* degrees of freedom, *d* Cohen's d

monolingual peers while receiving early intervention over a 12-month period. Our results add to the growing evidence that there are no detrimental consequences of bilingualism on the communication development of children with ASD and that educators and health professionals should be supportive of parents choosing to use their home language with children with ASD.

Comparing Children at Intake to Intervention

The first aim of our study was to examine possible differences in social and communication characteristics between children raised in monolingual versus bilingual environments, at entry to the intervention program conducted in the main societal language (i.e., English). We found no significant differences (and note also small effect sizes in each case) using the broad measure of autism characteristics (SCQ), a direct assessment of expressive language skills (MSEL), and a broad parent-report measure of children's communication (VABS-II). Nevertheless, bilingual children were found to perform lower on direct assessment of receptive language skills (MSEL) and the parent-reported measure of social skills (VABS-II), findings that warrant further investigation. It should be noted that the receptive language scores obtained only measured language development in English and therefore do not reflect receptive language skills of the bilingual children in their home language.

Previous research investigating bilingual language development has indicated that bilingual children may appear to lag behind monolingual children when measures are only obtained in one language (Hoff & Core, 2015). To better capture bilingual language development, an additive approach, such as conceptual scoring—which gives credit to word meanings known in both languages—may be a more accurate approach with bilingual children (Hoff & Core, 2015; Monsrud et al. 2019). However, the findings of the present study are in contrast to earlier studies investigating communication in monolingual and bilingual children with ASD which have generally found no differences between these groups in receptive and expressive language, or for social skills (Wang et al. 2018; Yael et al. 2018). Receptive language and social skills are known predictors of later outcomes so any replicated difference in these skills would further highlight the clinical need for early identification and intervention. In addition, these findings, along with the fact that fewer bilingual children had accessed speech-pathology services prior to entry compared with monolingual children, may indicate that bilingual children must demonstrate relatively more severe difficulties in order to be considered in need of services. Previous research from the USA has indicated that children from ethnically diverse backgrounds may be diagnosed later than children from mainstream backgrounds, and that their families may experience greater difficulty accessing services (Stahmer et al. 2019). That said, the parent-reported measures indicated no significant differences (and only a small effect) for communication broadly between monolingual and bilingual children. This measure asks parents to consider their children's skills across a range of everyday environments, as opposed to the structured direct assessment of specific skills, thus highlighting the importance of combining multiple pieces of information when evaluating children's development.

Differences in socialisation between the groups, albeit with only small-medium effect and relying on the parent-reported measure only, are worthy of further exploration. We suggest that in this case, taking into account possible differences in cultural social norms would be important as these may account for some differences in terms of opportunities and expectations to demonstrate the specific skills featured in the scale. Previous research has identified cross-cultural differences in caregiver reported symptoms of ASD, although the authors suggested that socialization and communication behaviours may be more universal while identification of restricted, repetitive behaviours may be more culturally subjective (Matson et al. 2017). A qualitative exploration of similarities and differences in children's skills across groups would be beneficial to account for any differences in expectations, approaches, and norms.

Comparing Change During Intervention

The second aim of the study was to explore possible differences in the amount of within-program change made by children raised in monolingual versus bilingual environments following 12 months of intervention. It is important to note that we examined change within the program, as opposed to an experimental evaluation of change resulting from the program, and thus findings are presented, and must be interpreted, accordingly. We found no significant differences in the gains made by children in each group on any of the direct or parent-reported measures over time, with small effect sizes in all cases. Notably, we also found no significant differences between groups on any of the measures at time 2, suggesting that the small-medium differences, at entry, in receptive language (direct assessment) and socialisation (parent-reported) had resolved. The findings are thus consistent with those of previous cross-sectional studies indicating either non-significant or positive differences in social and communication skills in bilingual children with ASD compared to monolingual peers (Petersen et al. 2012; Zhou et al. 2017).

Our findings extend those of previous research, finding no significant differences in the amount of change over time for children receiving the comprehensive program. An important aspect of this study is the size of the sample, which substantially exceeds those of previous studies and is

relevant in terms of external validity. In particular, we note that our sample included children with heterogenous social, communication, cognitive, and behavioral profiles, reflecting the broader community, including children who were minimally verbal. Thus, the findings are relevant to clinicians working in community settings, where children routinely present with complex profiles of strengths and needs. While replication and extension of this research is clearly warranted, the findings at this point lend further support to families making decisions regarding language based on their personal, cultural, and contextual factors that are critical for such decisions, rather than concerns regarding the impact on the learning of their children with ASD.

Limitations and Future Directions

This study adds to the scant existing literature exploring possible impact of bilingual language environments on social communication outcomes in children with ASD receiving early intervention, through a longitudinal lens. Although the study supports previous findings that bilingualism does not produce any negative impact, several limitations of the current study should be acknowledged. Firstly, we used a dichotomous parent-report measure of bilingualism (i.e., Language spoken at home = English or other), which is a relatively crude measure of bilingual language environment. More refined measures of bilingual language history and skills might also explore, for example, age and order of language acquisition, amount of exposure to each language, and parental proficiency in each language. Another potential limitation of the present study is that the language ability of the parents of children raised in bilingual environments may have influenced validity of the parent report measures. To address this issue in future research, although it may be a challenging endeavor, it would be valuable to combine parent-report measures with more objective measures such as video recordings or a 'talk pedometer' (e.g. LENA Research Foundation, 2015), particularly to better explore language changes over time.

Secondly, our measures, although some of the most widely used in relation to social and communication skills in children with ASD, were all administered in English. It is unclear, therefore, how the children raised in bilingual environments would have performed on measures in their other languages. Given that over 30 different languages were spoken at home across the bilingual participant group, assessment in languages other than English was not feasible in the present study. In addition, for many of the languages spoken by the bilingual participants, there are no existing standardized measures in these languages, or translated assessment protocols that do exist may lack validity (e.g. Al Maskari et al. 2018; Bedore & Pena, 2008; Hus, 2017). Future studies could explore which assessment methods may be feasible and effective in investigating social communication skills in a cohort of speakers from diverse language and cultural backgrounds, such as use of dynamic assessment approaches or a universal and culture-specific resource kit (see Hus, 2017). Studies could also explore any differences in communication outcomes across different languages or language types by collecting group data from larger samples of speakers from diverse language backgrounds. Given that bilingual children can differ in proficiency across their spoken languages, as well as manner of acquisition (e.g. simultaneous vs sequential) it may also be more useful to do group comparisons between children with comparable levels of proficiency in each language, or similar mode of acquisition, rather than comparing their performance to that of monolingual children. Alternatively, bilingualism could be treated as a continuous variable to better capture individual differences associated with amount of exposure or level of proficiency on outcomes, particularly since there may be much individual variation in the quality of language environment, amount of language exposure and parental language proficiency across different bilingual children.

Findings from this study have also highlighted the significant challenges associated with conducting assessment and providing intervention in home languages when children hail from diverse backgrounds. To address the diversity of language backgrounds found in many societies (e.g. Australia, UK, USA), future studies could also investigate implementation of parent-mediated interventions in the home language or interventions delivered with the assistance of professional interpreters or bicultural workers. More studies are also needed to explore whether there are benefits of providing intervention in both of a bilingual child's languages.

Conclusion

The present study found no differences between longitudinal social communication outcomes for monolingual and bilingual children with ASD participating in an early intervention program. The findings lend further weight to the recommendation that families of children with ASD being raised in bilingual environments should be encouraged to use their home language if they wish, without fear of a detrimental effect on social communication outcomes. Future avenues for research with bilingual children with ASD could include exploring improved measurement of both languages of bilingual speakers receiving intervention, parent-mediated interventions to encourage use and stimulation of home languages, and whether there are beneficial effects of providing bilingual intervention.

Acknowledgments This project was supported by the AEIOU Foundation. During the preparation of this paper, Vishnu KK Nair was supported by a post-doctoral fellowship from the NYU Steinhardt School

of Culture and Human Development. Portions of this work were presented at the 2019 American Speech-Language-Hearing (ASHA) Convention in Orlando, Florida, United States.

Author Contributions All authors contributed to the study conception and design. JP and MT contributed to collection of the original data, and JP led the analyses. All authors contributed to the first and subsequent drafts of the manuscript, and read and approved the final version of the manuscript.

References

Abutalebi, J., & Weekes, B. S. (2014). The cognitive neurology of bilingualism in the age of globalization. *Behavioural Neurology, 2014,* 536727. https://doi.org/10.1155/2014/536727

Al Maskari, T. S., Melville, C. A., & Willis, D. S. (2018). Systematic review: Cultural adaptation and feasibility of screening for autism in non-English speaking countries. *International Journal of Mental Health Systems, 12,* 22. https://doi.org/10.1186/s13033-018-0200-8

American Psychiatric Association (2019). What is autism spectrum disorder? Retrieved from https://www.psychiatry.org/patients-families/autism/what-is-autism-spectrum-disorder.

Bedore, L. M., & Pena, E. D. (2008). Assessment of bilingual children for identification of language impairment: Current findings and implications for practice. *International Journal of Bilingual Education and Bilingualism, 11*(1), 1–29.

Cohen, J. (1998). *Statistical power Analysis for the Behavioral Sciences* (2nd ed.). Erlbaum.

Drysdale, H., van der Meer, L., & Kagohara, D. (2015). Children with autism spectrum disorder from bilingual families: A systematic review. *Journal of Autism and Developmental Disorders, 2*(1), 26–38.

Gonzalez-Barrero, A. M., & Nadig, A. S. (2019). Can bilingualism mitigate set-shifting difficulties in children with Autism Spectrum Disorders? *Child Development, 90*(4), 1043–1060.

Greene, J. P. (1998). *A meta-analysis of the effectiveness of bilingual education*. Tomas Rivera Policy Institute.

Hambly, C., & Fombonne, E. (2012). The impact of bilingual environments on language development in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(7), 1342–1352.

Hammer, C. S., Hoff, E., Uchikoshi, Y., Gillander, Y., Castro, D. C., & Sandilos, L. E. (2014). The language and literacy development of young dual language learners: A critical review. *Early Childhood Research Quarterly, 29,* 715–733.

Hoff, E., & Core, C. (2015). What clinicians need to know about bilingual development. *Seminars in Speech and Language, 36*(2), 89–99.

Hus, Y. (2017). Issues in identification and assessment of children with autism and a proposed resource toolkit for speech-language pathologists. *Folia Phoniatrica et Logopaedica, 69,* 27–37.

Jegatheesan, B. (2011). Multilingual development in children with autism: Perspectives of South Asian Muslim immigrant parents on raising a child with a communicative disorder in multilingual contexts. *Bilingual Research Journal, 34*(2), 185–200.

Kay-Raining Bird, E., Genesee, F., & Verhoeven, L. (2016). Bilingualism in children with developmental disorders: A narrative review. *Journal of communication disorders, 63,* 1–14.

Kay-Raining Bird, E., Lamond, E., & Holden, J. (2012). Survey of bilingualism in autism spectrum disorders. *International Journal of Language & Communication Disorders, 47*(1), 52–64.

Kogan, M. D., Vladutiu, C. J., Schieve, L. A., Ghandour, R. M., Blumberg, S. J., Zablotsky, B., & Lu, M. C. (2018). The prevalence of parent-reported autism spectrum disorder among US children. *Pediatrics, 142*(6), e20174161.

Kremer-Sadlik, T (2005). To be or not to be bilingual: Autistic children from multilingual families. In *Proceedings of the 4th International Symposium on Bilingualism* (pp. 1225–1234).

Lang, R., Rispoli, M., Sigafoos, J., Lancioni, G., Andrews, A., & Ortega, L. (2011). Effects of language of instruction on response accuracy and challenging behavior in a child with autism. *Journal of Behavioral Education, 20*(4), 252–259.

Lazaruk, W. (2007). Linguistic, academic, and cognitive benefits of French immersion. *Canadian Modern Language Review, 63*(5), 605–627.

LENA Research Foundation. (2015). User Guide LENA Pro. Retrieved from https://cdn.shopify.com/s/files/1/0596/9601/files/LENA_Pro_User_Guide.pdf?6014727090441220586.

Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., & Bishop, S. L. (2012). *Autism diagnostic observation schedule* (2nd ed.). Western Psychological Services.

Matson, J. L., Matheis, M., Burns, C. O., Esposito, G., Venuti, P., Pisual, E., & Goldin, R. L. . (2017). Examining cross-cultural differences in autism spectrum disorder: A multinational comparison from Greece, Italy, Japan, Poland, and the United States. *European Psychiatry, 42,* 70–76.

Monsrud, M., Rydland, V., Geva, E., Thurmann-Moe, A., & Lyster, S. (2019). The advantages of jointly considering first and second language vocabulary skills among emergent bilingual children. *International Journal of Bilingual Education and Bilingualism*. https://doi.org/10.1080/13670050.2019.1624685

Mullen, E. M. (1995). *Mullen Scales of Early Learning* (AGS). American Guidance Service Inc.

Norrelgen, F., Fernell, E., Eriksson, M., Hedvall, A., Persson, C., Sjolin, M., & Kjellmer, L. (2015). Children with autism spectrum disorders who do not develop phrase speech in the preschool years. *Autism, 19*(8), 934–943. https://doi.org/10.1177/1362361314556782

Ohashi, J. K., Mirenda, P., Marinova-Todd, S., Hambly, C., Fombonne, E., Szatmari, P., Bryson, S., Roberts, W., Smith, I., Vaillancourt, T., Volden, J., Waddell, C., Zwaigenbaum, L., Georgiades, S., Duku, E., & Thompson., A., the Pathways in ASD Study team (2012). Comparing early language development in monolingual- and bilingual-exposed young children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6*(2), 890–897.

Paynter, J., & Falvey-Henderson, F. (2011). AEIOU Foundation: A full-time early intervention service for children with Autism Spectrum Disorders. *Talkabout, 24*(1), 15–19.

Paynter, J., Scott, J., Beamish, W., Duhig, M., & Heussler, H. (2012). A pilot study of the effects of an Australian centre-based early intervention program for children with autism. *The Open Pediatric Medicine Journal, 6,* 7–14. https://doi.org/10.2174/1874309901206010007

Paynter, J., Riley, E., Beamish, W., Scott, J., & Heussler, H. (2015). Brief report: An evaluation of an Australian autism-specific early intervention programme. *International Journal of Special Education, 30*(2), 1–7.

Paynter, J., Trembath, D., & Lane, A. (2018). Differential outcome subgroups in children with autism spectrum disorder attending early intervention. *Journal of Intellectual Disability Research, 62,* 650–659. https://doi.org/10.1111/jir.12504

Petersen, J. M., Marinova-Todd, S. H., & Mirenda, P. (2012). Brief report: An exploratory study of lexical skills in bilingual children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 42*(7), 1499–1503.

Prior, M., & Roberts, J. (2012). *Early Intervention for Children with Autism Spectrum Disorders: 'Guidelines for Good Practice'.*

Retrieved from https://www.dss.gov.au/our-responsibilities/disability-and-carers/program-services/for-people-with-disability/early-intervention-for-children-with-autism-spectrum-disorders-guidelines-for-good-practice-2012.

Reetzke, R., Zou, X., Sheng, L., & Katsos, N. (2015). Communicative development in bilingually exposed Chinese children with autism spectrum disorders. *Journal of Speech, Language, and Hearing Research, 58*(3), 813–825.

Riley, E., Paynter, J., & Gilmore, L. (2019). Comparing the mullen scales of early learning and the preschool language scale—fifth edition for young children with autism spectrum disorder. *Advances in Neurodevelopmental Disorders, 3*(1), 29–37. https://doi.org/10.1007/s41252-018-0084-2

Rutter, M., Bailey, A., & Lord, C. (2003). *The Social Communication Questionnaire*. Western Psychological Services.

Schreibman, L., Dawson, G., Stahmer, A., Landa, R., Rogers, S., McGee, G., & Halladay, A. (2015). Naturalistic developmental behavioral interventions: Empirically validated treatments for Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-015-2407-8

Seung, H., Siddiqi, S., & Elder, J. H. (2006). Intervention outcomes of a bilingual child with autism. *Journal of Medical Speech-Language Pathology, 14*(1), 53–64.

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *Vineland Adaptive Behavior Scales - 2nd Edition (Vineland - II)*. Pearson Assessments.

Stahmer, A. C., Vejnoska, S., Iadarola, S., Straiton, D., Segovia, F. R., & Luelmo., …Kasari, C. . (2019). Caregiver voices: Cross-cultural input on improving access to autism services. *Journal of Racial and Ethnic Health Disparities, 6,* 752–773.

Summers, C., Smith, V., Mueller, V., Alexander, V., & Muzza, A. (2017). Language of intervention in bilingual children with Autism Spectrum Disorders. *Perspectives of the ASHA Special Interest Groups, 2*(1), 203–211.

Uljarević, M., Katsos, N., Hudry, K., & Gibson, J. L. (2016). Practitioner Review: Multilingualism and neurodevelopmental disorders – an overview of recent research and discussion of clinical implications. *Journal of Child Psychology and Psychiatry, 57*(11), 1205–1217. https://doi.org/10.1111/jcpp.12596

United Nations, Department of Social and Economic Affairs, Population Division. (2017). *International Migration Report 2017: Highlights*. Retrieved from https://www.un.org/development/desa/publications/international-migration-report-2017.html.

Valicenti-McDermott, M., Tarshis, N., Schouls, M., Galdston, M., Hottinger, K., Seijo, R., Shulman, L., & Shinnar, S. (2013). Language differences between monolingual English and bilingual English-Spanish young children with autism spectrum disorders. *Journal of Child Neurology, 28*(7), 945–948.

Vivanti, G., Paynter, J., Duncan, E., Fothergill, H., Dissanayake, C., & Rogers, S. (2014). Effectiveness and feasibility of the Early Start Denver Model implemented in a group-based community child-care setting. *Journal of Autism and Developmental Disorders, 44*(12), 3140–3153. https://doi.org/10.1007/s10803-014-2168-9

Wang, M., Jegathesan, T., Young, E., Huber, J., & Minhas, R. (2018). Raising children with Autism Spectrum Disorders in monolingual vs bilingual homes: A scoping review. *Journal of Developmental & Behavioral Pediatrics, 39*(5), 434–446.

Wong, C., Odom, S., Hume, K., Cox, A., Fettig, A., Kucharczyk, S., & Schultz, T. (2015). Evidence-based practices for children, youth, and young adults with Autism Spectrum Disorder: A comprehensive review. *Journal of Autism and Developmental Disorders, 45*(7), 1951–1966. https://doi.org/10.1007/s10803-014-2351-z

Yael, G. D., Burke, J. D., Naigles, L., Eigsti, I.-M., & Fein, D. (2018). Language abilities in monolingual- and bilingual- exposed children with autism or other developmental disorders. *Research in Autism Spectrum Disorders, 55,* 38–49.

Yang, S., Paynter, J. M., & Gilmore, L. (2016). Vineland Adaptive Behavior Scales: II Profile of young children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 46,* 64–73. https://doi.org/10.1007/s10803-015-2543-1

Yu, B. (2013). Issues in bilingualism and heritage language maintenance: Perspectives of minority-language mothers of children with autism spectrum disorders. *American Journal of Speech-Language Pathology, 22*(1), 10–24.

Yu, B. (2016). Bilingualism as conceptualized and bilingualism as lived: A critical examination of the monolingual socialization of a child with Autism in a bilingual family. *Journal of Autism and Developmental Disorders, 46*(2), 424–435.

Zhou, V., Munson, J. A., Greenson, J., Hou, Y., Rogers, S., & Estes, A. M. (2017). An exploratory longitudinal study of social and language outcomes in children with autism in bilingual home environments. *Autism, 23,* 1–11.