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# Language Abilities in Monolingual- and Bilingual- Exposed Children with Autism or Other Developmental Disorders

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## Abstract

**Background:** Parents and providers are sometimes concerned that exposure to two languages will impair language acquisition in children with autism spectrum disorder (ASD) or other developmental disorders (DD). However, research to date suggests that language milestones and abilities are unaffected by this exposure. The current study explored language abilities in toddlers with ASD or DD exposed to one versus multiple languages, prior to intervention. To our knowledge, this is the largest investigation of language learning in bilingual-exposed (BE) children with ASD.

**Methods:** Participants were 388 children evaluated as part of a larger study on the early detection of ASD. Parents were asked to list all languages that primary caretakers use to communicate with their child. One hundred six BE children (57 ASD, 49 DD) were compared to 282 monolingual-exposed (ME) children (176 ASD, 106 DD). The Mullen Scales of Early Learning assessed nonverbal and verbal abilities. Multiple regression was used to evaluate the relationship of BE to language abilities, beyond the influence of nonverbal cognitive abilities, diagnosis, and socioeconomic status.

**Results:** Results showed greater language impairment in ASD than DD, but no main effect for language exposure group nor any interaction of language group by diagnosis. Results remained consistent after controlling for socioeconomic status.

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Conflicts of Interest
Deborah Fein is part owner of M-CHAT-R, LLC, which receives royalties from companies that incorporate the M-CHAT-R into commercial products and charge for its use. Data reported in the current paper is from the freely available paper version of the M-CHAT-R. Yael Dai, Jeffrey Burke, Letitia Naigles, and Inge-Marie Eigsti declare that they have no potential or competing conflicts of interest.

Compliance with Ethical Standards
Ethical Approval
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.
Informed Consent
Informed consent was obtained from all individual participants in the study.

**Conclusion:** This study suggests that bilingual caregivers can communicate with their children in both languages without adverse effects on their children's language functioning.

**Keywords**

autism; bilingual; language ability; developmental delay

## Introduction

The use of a language other than English in United States homes increased by 148 percent between 1980 and 2009, and growth in the diversity of children's language-learning environments is projected to continue (Ortman & Shin, 2011). It is important to understand the impact of this language diversity on children's language learning. The existing literature comparing language skills of typically developing (TD) children with simultaneous bilingual exposure (BE) (i.e., exposure to two languages at the same time) to their monolingual-exposed (ME) peers is inconsistent. Some studies suggest that BE children achieve language milestones at rates similar to their ME peers (Genesee, Paradis, & Crago, 2004; Kay-Raining Bird, Genesee, & Verhoeven, 2016), whereas others report language delays in BE compared with ME children (Oller, Pearson, & Cobo-Lewis, 2007; Paradis, 2016). TD children who acquire a second language sequentially (i.e., relatively soon after their first language) initially perform developmentally 'behind' in their second language relative to ME children, yet they catch up to their ME peers on this language after a few years of exposure (Paradis, 2016).

Several factors impact the rate and degree of language acquisition in TD children with simultaneous or sequential BE. Specifically, the age at which the child was first exposed to an additional language (Hammer, Komaroff, Rodriguez, Lopez, Scarpino, & Goldstein, 2012; Paradis, 2016), the richness of the language environment (Paradis, 2016), the duration of exposure to the language (Blom & Paradis, 2015; Hammer et al., 2012), maternal education (Hammer et al., 2012), socioeconomic status (Hoff, 2006), maternal immigration status (Winsler et al., 2014), and maternal language proficiency (Hammer et al., 2012) influence children's language abilities. However, research consistently demonstrates that even when TD children experience delays in language acquisition, these disappear by late primary school (Uljarević, Katsos, Hudry, & Gibson, 2016).

The potential effects of BE on language skills in children with autism spectrum disorder (ASD) and other developmental disorders (DD; i.e., cognitive and language disorders) are particularly important as children with these diagnoses, even those exposed to only one language, exhibit impaired language acquisition and functioning. Many parents of young children with developmental delays believe that BE would be advantageous to their children. For example, parents claim that BE would likely have positive influences on their children's intellectual development, social and family involvement, and future employment (Beauchamp & MacLeod, 2017; Hampton et al., 2017; Iarocci, Hutchison, & O'Toole, 2017).

Despite believing that BE is likely to result in several benefits for children with ASD and other DD, bilingual parents also worry that exposure to multiple languages will further disrupt language development in these children (Beauchamp & MacLeod, 2017; Drysdale, van der Meer, & Kagohara, 2015; Hampton, Rabagliati, Sorace, & Fletcher-Watson, 2017; Ijalba, 2016; Kay-Raining Bird, Kremer-Sadlik, 2005; Lamond, & Holden, 2012; Uljarević et al., 2016). Childcare providers from a wide range of disciplines share this belief and recommend that parents of children with neurodevelopmental disorders speak only one language when communicating with their children (Beauchamp & MacLeod, 2017; Ijalba, 2016; Kay-Raining Bird et al., 2012; Kremer-Sadlik, 2005; Yu, 2013).

Bilingual parents, either independently or through internalizing this message from providers, often believe that learning more than one language is too difficult for their child (Ijalba, 2016; Kay-Raining Bird et al., 2012). Therefore, parents of children with developmental delays may believe that they must decide between their child mastering one language, or learning two languages less proficiently (Kay-Raining Bird et al., 2012). In most cases, parents decide to speak to their child in the culture's dominant language (e.g., English in the United States), even when this language is not the parents' native or most proficient language (Hampton et al., 2017; Kremer-Sadlik, 2005; Yu, 2013). This decision is further influenced by the limited availability of early intervention services in languages other than the culture's dominant language, and the fact that subsequent school-based instruction and other societal demands likely will also be in the culture's dominant language (Hampton et al., 2017; Kay-Raining Bird et al., 2012; Yu, 2013).

Several consequences emerge when parents communicate with their children exclusively in the cultural majority language. Parents provide their children's earliest and initially most important language input (Baron-Cohen & Staunton, 1994; Kremer-Sadlik, 2005). Speaking frequently, directly, and responsively to children significantly improves their language development (Hoff, 2006; Hoff & Core, 2013; Weisleder, & Fernald, 2013). However, if a child's input comes primarily from the parent's nondominant, less-proficient language, the child is likely to hear fewer words, inconsistent morphology, and significantly fewer complex grammatical structures (Altan & Hoff, 2018). Therefore, relying on communication in a language in which a parent is not fully fluent may have negative consequences for a child's language acquisition (Place & Hoff, 2011; Ross & Newport, 1996). In an extreme example, one parent reported that she stopped communicating with her children for a year after a speech-language pathologist advised that she only speak to them in English, because she felt unable to communicate effectively in English (Ijalba, 2016). Instead, the mother relied on intervention services and television to promote English language development in her children. Additionally, language is a major avenue of socialization. Children with developmental disorders are often already excluded from family conversations and interactions because of their unique interests and communication deficits (Kremer-Sadlik, 2005). If children are not taught one of the household languages by parents or by intervention providers, they will inevitably be further excluded from the opportunities that engaged dialogue provides for the enhancement of their social skills (Kremer-Sadlik, 2005; Uljarević et al., 2016). Such a decrease in communication reduces the quality of parent-child interactions, which can then cascade into social communication impairments with other communicative partners (Beauchamp & MacLeod, 2017; Charman, 2003; Kremer-Sadlik, 2005).

In addition to the adverse impacts of this decision on children, parental emotions are also affected. First, parents express sadness and a sense of personal loss when they cannot speak with their children in their native language (Fernandez y Garcia, Breslau, Hansen, & Miller, 2012). Second, speaking English is difficult for some bilingual parents, and they worry that channels of communication with their children will be further disrupted if their children do not learn the family's native language (Yu, 2013). Even if parents are capable of speaking English, many bilingual parents report feeling uncomfortable speaking English at home, and they feel that their conversations in English are not as personal and casual as those in their dominant language (Hampton et al., 2017; Yu, 2013). Indeed, bilingual parents with greater language competence in their non-native language reported feeling more comfortable interacting with their child in this language, relative to parents with lower non-native language competence (Hudry, Rumney, Pitt, Barbaro, & Vivanti, 2017). Similarly, adolescents who were not taught the family's native language reported a worse relationship with their parents than peers who learned their parents' native language (Tseng & Fuligni, 2000). Finally, parents of children with developmental disorders report high levels of stress (Estes, Munson, Dawson, Koehler, Zhou, & Abbott, 2009), and advising them to avoid speaking their primary language to their children (and to find caregivers who only speak English) is likely to further compound parental stress. This may be particularly true when grandparents partake in childcare, or are perhaps excluded from doing so because they speak the family's native language exclusively.

Despite the pervasive notion that children with ASD or DD should only be exposed to one language, there is no empirical evidence to support this recommendation. Few studies have explored language development in young bilingual children with ASD; these studies unanimously reported that ME and BE children show similar timing of language milestone acquisition (Beauchamp & MacLeod, 2017; Ohashi et al., 2012) and comparable receptive and expressive language abilities when tested in either English or in their dominant household language (Drysdale, van der Meer, & Kagohara, 2015; Hambly & Fombonne, 2012; Lund, Kohlmeier, & Durán, 2017; Ohashi et al., 2012; Petersen, Marinova-Todd, & Mirenda, 2012; Reetzke, Zou, Sheng, & Katsos, 2015; Valicenti-McDermott et al., 2013). ME and BE children also exhibit similar conceptual language abilities (Hambly & Fombonne, 2012; Petersen et al., 2012). As well, parent reports suggest that older ME and BE children and adolescents with ASD do not differ in functional communication (Iarocci, et al., 2017). Interestingly, children who have a diagnosis of ASD, with simultaneous or sequential BE, demonstrate language skills that are comparable to their ME peers (Ohashi et al., 2012; Petersen et al., 2012; Reetzke et al., 2015; Uljarević et al., 2016; Valicenti-McDermott et al., 2013).

The literature examining the impact of BE on language learning in young children with global developmental delays (i.e., delays in several areas of intellectual functioning, including both verbal and nonverbal skills) is more limited, and most of this research has focused on children with Down syndrome. As with findings for children with ASD, these studies do not show adverse effects of simultaneous exposure to a second language (Beauchamp & MacLeod, 2017). Indeed, ME and BE children with Down syndrome show comparable language abilities in their dominant language (Burgoyne, Duff, Nielsen, Ulicheva, & Snowling, 2016; Feltmate, & Kay-Raining Bird, 2008; Kay-Raining Bird et al., 2016; Uljarević et al., 2016).

Similarly, among children with language disorders and delays (i.e., delays in language functioning only), simultaneous BE children perform similarly to their ME peers on tasks assessing their abilities in both of their languages (Gutiérrez-Clellen, Simon-Cereijido, & Wagner, 2008; Korkman et al., 2012; Paradis, 2016; Paradis, Crago, & Genesee, 2006; Paradis, Crago, Genesee, & Rice, 2003; Uljarević et al., 2016). However, with respect to second-language proficiency, sequential BE children with language delays exhibit deficits in their second language when compared to their language delayed ME peers (Kay-Raining Bird et al., 2016; Paradis, Emmerzael, & Duncan, 2010). Yet, like TD children, after a few years of exposure to the additional language, language delayed children with sequential BE demonstrate language performance similar to ME children (Paradis, 2016; Paradis, Gavruseva, & Haznedar, 2008).

Although the existing research has contributed important findings about language abilities in ME and BE children with ASD, global developmental delay, and language delays, they have several limitations that may compromise their generalizability. First, they may have been underpowered to detect potential differences in language development due to small sample sizes of one to 40 participants in each BE group (Burgoyne et al., 2016; Drysdale et al., 2015; Feltmate & Kay-Raining Bird, 2008; Gutiérrez-Clellen et al., 2008; Hambly & Fombonne, 2012; Korkman et al., 2012; Lund et al., 2017; Ohashi et al., 2012; Paradis et al., 2003; Petersen et al., 2012; Reetzke et al., 2015; Valicenti-McDermott et al., 2013). Second, some studies did not report or control for potential confounds, such as socioeconomic status (Burgoyne et al., 2016; Feltmate & Kay-Raining Bird, 2008; Hambly & Fombonne, 2012; Petersen et al., 2012; Valicenti-McDermott et al., 2013) and nonverbal intelligence (Hambly & Fombonne, 2012; Gutiérrez-Clellen et al., 2008; Reetzke et al., 2015; Valicenti-McDermott et al., 2013), which are associated with children's vocabulary skills (Beauchamp & MacLeod, 2017; Cobo-Lewis, Pearson, Eilers, & Umbel, 2002; Hoff, 2003; Lund et al., 2017; Rosselli, Ardila, Lalwani, & Vélez-Uribe, 2016). Third, the majority of these studies assessed older children (i.e., preschool and school age rather than children under three years), who are expected to have more developed language (Burgoyne et al., 2016; Feltmate & Kay-Raining Bird, 2008; Hambly & Fombonne, 2012; Gutiérrez-Clellen et al., 2008; Iarocci et al., 2017; Korkman et al., 2012; Ohashi et al., 2012; Paradis et al., 2003; Petersen et al., 2012; Reetzke et al., 2015). Finally, although some researchers attempted to include very young children (e.g., Valicenti-McDermott et al., 2013), or to enroll children before intervention took place, others included children who already received a diagnosis or intervention in the dominant language prior to assessment (Ohashi et al., 2012; Petersen et al., 2012; Reetzke et al., 2015). Children often receive speech/language services after receiving a diagnosis, which increases their language functioning (Kremer-Sadlik, 2005). Indeed, in these samples BE children received more speech/language intervention than ME children (Ohashi et al., 2012; Petersen et al., 2012), making it difficult to compare outcomes directly, even though the authors controlled for the amount of intervention exposure in statistical analyses.

The present study aims to enhance the limited literature on this topic by exploring language functioning in ME and BE toddlers with ASD or DD before they have experienced any intervention. We will also examine the impact of socioeconomic status and nonverbal intelligence on language development in this sample. To our knowledge, this is the largest investigation of language abilities in BE children with ASD to date. In line with the literature on language abilities in BE children with ASD and DD, we tested two hypotheses: (1) BE children with ASD or other DD will have similar Receptive Language abilities, when tested in English, to their ME peers, and (2) BE children with ASD or other DD will have similar Expressive Language abilities, in English, to ME children with ASD or other DD.

## Methods

### Participants

Participants were recruited from a larger study on the early detection of pervasive developmental disorders. Children with a parent who was able to read in English were screened using the Modified Checklist for Autism in Toddlers with Follow-Up (M-CHAT/F; Robins, Fein, & Barton, 1999) or the Modified Checklist for Autism in Toddlers, Revised with Follow-Up (M-CHAT-R/F; Robins, Fein, & Barton, 2009) during their pediatric wellness visits at either 18 or 24 months of age. Children who failed the MCHAT(-R) follow-up phone interview were invited for a free diagnostic evaluation at the approximate age of two years at a university-affiliated clinic. Three hundred and eighty-eight of these children were included in the present study. The remaining children were excluded because they had missing data on primary study measures or did not receive a DSM-IV diagnosis of a pervasive developmental disorder or another developmental disorder. We also excluded children who completed the evaluation in Spanish instead of English ($n = 11$) or who were exposed to sign language as their second language ($n$=5); these children form important study groups, with informative developmental trajectories, but the sample size of each group was too small to allow for analysis in the current study.

Participants were 288 males and 100 females who were, on average, 26 months of age (see Table 1). Participants were divided into two diagnostic groups based on DSM-IV-TR criteria (APA, 2000). Criteria for all diagnoses are listed in "Appendix." Diagnoses were made based on clinical best estimate judgment of symptoms, incorporating clinician observation, parental report of the child's abilities, and assessment results. The ASD group ($n = 233$) was comprised of children with DSM-IV Autistic Disorder ($n = 120$), Pervasive Developmental Disorder – Not Otherwise Specified ($n = 95$), and Autism Low Mental Age ($n = 18$). The DD group was comprised of children with a Global Developmental Delay ($n = 103$) or a developmental Language Disorder ($n = 52$). Since our sample only included 17 BE children with a Language Disorder, we combined children with Language Disorders and Global Developmental Delay into the DD group. However, for main outcomes, we ran subsequent regressions to determine whether exposure to a second language affected children with Language Disorders differently than it influenced children with Global Developmental Delay.

Participants were also divided into two language groups, based on parents' report of the languages spoken to the child. The ME children ($n = 282$) were only exposed to English.

The BE children (*n* = 106) were exposed to English and at least one other language. In most cases, BE children were spoken to in English and Spanish (*n* = 68). The remaining 38 children were exposed to 25 different additional languages, with one to three children exposed to each language. Of these children, 28 were exposed to one additional language and 10 were exposed to two additional languages. All children received an evaluation in English. To receive an evaluation in English, at least one primary caregiver had to report being comfortable reading, writing, and speaking in English.

## Procedure

Children who screened at risk on the M-CHAT(-R) and follow-up phone interview were offered a free developmental and diagnostic evaluation, which was completed by a licensed clinical psychologist or developmental pediatrician and by a doctoral student in clinical psychology. During the evaluation, the clinician conducted a clinical interview with the parent to obtain the child's developmental and family history and to assess parental report of their child's functioning. The doctoral student assessed the child's cognitive abilities and autism diagnostic status and severity using the Mullen Scales of Early Learning (MSEL) and the Autism Diagnostic Observation Schedule (ADOS) respectively. The family was offered a brief summary of testing results at the end of the evaluation, and a full written report including recommendations for intervention was mailed home after the evaluation.

## Measures

**Mullen Scales of Early Learning (MSEL; Mullen, 1995).—**The MSEL is a standardized test of developmental level and cognitive ability for children between birth and 68 months of age. For the current study, we administered the Visual Reception and Fine Motor domains to assess nonverbal cognitive functioning, and the Receptive Language and Expressive Language domains to assess verbal abilities. The Receptive Language domain measures a child's understanding of spoken language (i.e., comprehension of words paired with gestures, action words, and questions). The scale includes items such as identifying body parts and following commands. The Expressive Language domain assesses spoken verbal abilities. Specifically, the examiner uses prompts to elicit vocalizations, single words, and two-word phrases. The Expressive Language scale consists of items such as answering questions and naming pictures. The MSEL was normed on a nationally representative sample. Internal consistency ranged from .75 to .83 across domain scales; inter-rater reliability was strong and ranged from .91 to .99 (Mullen, 1995).

**Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000).—**The ADOS is a semistructured assessment designed to measure symptoms of ASD. Module one or two was used to determine diagnostic status for the ASD and DD groups and to assess autism severity. The ADOS has strong psychometric properties (Lord et al., 2000). The calibrated severity score was used as an indicator of ASD severity (Gotham, Pickles, & Lord, 2009). Higher scores indicate greater ASD severity.

All other study information was obtained from the History and Demographics form, which was designed by the project principal investigators. Among these questions, we asked parents to report "all languages spoken in the home." This question was broad and enabled a global view of potential effects of BE. Language dominance (e.g., a report of which language the child used most) was not determined for BE children. We also used income as a metric of socioeconomic status. Income was determined by asking parents to select the category that best represents their annual household income. Brackets ranged from "less than $10,000 " to "greater than $80,000" and were divided by $10,000 increments. When annual income was missing, parents' reported monthly income was converted to yearly income. These categories were then recoded to each bracket's median dollar amount (e.g., below $10,000 was recoded to $5,000 and $10,000 – $20,000 was recoded to $15,000, as in Herlihy et al., 2014). The final income metric consisted of 15 categories, with one representing the lowest annual household income and 15 representing the greatest annual household income. These brackets were not evenly distributed.

## Analytic Plan

Concerns about data normality were assessed. Histograms revealed that MSEL T scores in each domain were not normally distributed because a large number of children received the lowest possible standard score. As a result, we calculated developmental quotients for each MSEL domain by dividing mental age (i.e., age equivalent domain scores) by chronological age and multiplying by 100 (Reitzel et al., 2013). Tests of normality suggested that the distributions of these transformed outcome variables were normal.

A series of analyses were performed to compare the ME and BE groups on characteristics that could potentially influence Receptive and Expressive Language functioning. First, language groups were compared on demographic variables (i.e., age, gender, race/ethnicity, and socioeconomic status) as well as diagnosis (i.e., DD, ASD). Demographic characteristics that did not significantly differ between language groups were not included in further analyses. Independent t-tests were performed to analyze continuous variables and effect sizes were estimated using Cohen's *d*, where 0.2 is considered a small effect, 0.5 denotes a medium effect, and 0.8 indicates a large effect (Cohen, 1988; Rice & Harris, 2005). Chi-square tests of independence were used to examine categorical data, and effect sizes were estimated using *phi* ($\varphi$), where 0.1, 0.3 and 0.5 denote small, medium, and large effect sizes, respectively.

Nonverbal (i.e., Visual Reception and Fine Motor) and verbal (i.e., Receptive Language and Expressive Language) abilities were examined using a series of linear regressions. Each MSEL domain was analyzed using separate models. First, we evaluated the main effect of language group (ME; BE) and diagnosis (DD; ASD), as well as the interaction of language group and diagnosis on each MSEL domain. In models evaluating language functioning, the second set of models then separated the DD group into subgroups of children with language delays (i.e., solely verbal delays) and global developmental delays. These models evaluated the main effect of language group (ME; BE) and diagnosis (language delay, global developmental delay, ASD), as well as the interaction of language group and diagnosis on each MSEL language domain. The third set of models first covaried for characteristics that are related to language abilities and significantly differed by language group (ME, BE) (i.e., socioeconomic status) and then assessed main effects and interactions of language group (ME, BE) and diagnosis (ASD, DD) on Receptive Language and Expressive Language.

Effect sizes for each predictor were estimated using Cohen's $f^2$, where values of .02 or greater are considered small effects, .15 or greater indicate medium effects, and values above .35 denote a large effect (Cohen, 1988). Standardized betas are reported in the text and unstandardized betas are presented in Table 3. Statistical analyses were performed using RStudio, version 3.

## Results

Results of chi-square tests of independence confirmed that the language groups did not differ on gender, $\chi^2(1, N = 388) = .32$, $p = .570$, $\varphi = -.04$, or diagnosis, $\chi^2(1, N = 388) = 2.05$, $p = .152$, $\varphi = -.08$. Similarly, groups did not differ on age, $t(386) = -1.38$, $p = .168$, $d = .16$. Race and ethnicity differed by language group, such that Caucasian, non-Hispanic children comprised a greater portion of the ME group, while minority children were more prevalent in the BE group, with a large effect size, $\chi^2(1, N = 383) = 117$, $p < .001$, $\varphi = -.56$. Income was only available for 256 participants; among these participants, income significantly differed by language group, with a large effect size, $t(254) = 5.25$, $p = < .001$, $d = .76$, (see Table 1). Independent t-tests and chi-square tests of independence indicate that children who were missing annual household income data were more likely to be younger, $t(386) = -2.17$, $p = .030$, $d = .23$, female, $\chi^2$ (1, $N = 388) = 4.32$, $p = .038$, $\varphi = .11$ and have lower MSEL Receptive Language scores, $t(386) = -2.47$, $p = .014$, $d = .26$ compared to participants with complete data. For the total sample, autism severity did not significantly differ for ME children ($M = 4.26$, $SD = 2.63$) compared to BE children ($M = 4.42$, $SD = 2.95$), $t(383) = 0.35$, $p = .725$, $d = .04$.

With regard to nonverbal cognitive ability, language group, diagnosis, and the interaction between language group and diagnosis together accounted for 3.9% of the variance in Visual Reception scores, $F(3,384) = 6.204$, $p < .001$. However, examination of individual predictors indicated that language groups did not significantly differ in Visual Reception abilities, ($\beta = .07$, $SE = 6.30$, $p = .659$). There was a significant difference for diagnostic group ($\beta = .23$, $SE = 2.21$, $p < .001$), though, with the ASD group achieving lower Visual Reception scores than the DD group (see Tables 2 and 3). There was no interaction between language and diagnostic group ($\beta = -.08$, $SE = 4.14$, $p = .595$).

Similarly, for Fine Motor functioning, language group, diagnosis, and the interaction between language group and diagnosis together accounted for 3.1% of the variance in Fine Motor scores, $F(3,384) = 5.079$, $p = .002$. Examination of individual predictors showed no main effect of language group ($\beta = -.09$, $SE = 5.67$, $p = .539$), but there was a main effect of diagnosis, such that children with ASD had significantly lower Fine Motor scores than children with DD ($\beta = .18$, $SE = 1.99$, $p = .003$). No significant interaction emerged between language group and diagnosis in the prediction of Fine Motor abilities ($\beta = .08$, $SE = 3.73$, $p = .625$).

With regard to MSEL Receptive Language scores, together, language group, diagnosis, and the interaction between language group and diagnosis accounted for 11.4% of the variance in Receptive Language scores, $F(3,384) = 17.580$, $p < .001$. There was no main effect of language group for Receptive Language ability ($\beta = -.03$, $SE = 7.19$, $p = .856$). However, diagnosis accounted for significant variability in Receptive Language, such that children with ASD had lower Receptive Language skills than children with DD (β = .36, *SE* = 2.52, $p$ <.001); the interaction between diagnosis and language group was not significant (β = -.08, *SE* = 4.73, $p$ = .612). We then explored whether results remained consistent if we compared Receptive Language functioning among the three diagnostic groups (ASD, Global Developmental Delay, Language Disorder). In this model, language group, diagnosis, and the interaction between language group and diagnosis accounted for 14.1% of the variance in Receptive Language scores, $F(5,382) = 13.746$, $p < .001$. Examination of individual predictors again indicated no main effect of language group for Receptive Language ability (β = -.15, *SE* = 4.30, $p$ = .096). Diagnosis accounted for significant variability in Receptive Language, such that children with Language Disorders had higher language functioning than children with Global Developmental Delay (β = .48, *SE* = 4.17, $p$ = .003), who had significantly higher language functioning than children with ASD (β = -.24, *SE* = 2.84, $p$ < .001). The interaction between diagnosis and language group was not significant in the prediction of Receptive Language when children with Global Developmental Delay were compared to children with Language Disorders (β = .10, *SE* = 7.36, $p$ =.732), nor when children with Global Developmental Delay were compared to children with ASD (β = .07, *SE* = 5.29, $p$ = .511).

Since annual household income differed by language group, and household income is related to children's language development, we explored whether results remained consistent after controlling for income. In the subset of participants who had income data, income, language group, diagnosis, and the interaction between language group and diagnosis together accounted for 10.1% of the variance in Receptive Language scores, $F(4,251) = 8.200$, $p < .001$. Examination of individual predictors revealed that annual household income did not significantly predict Receptive Language ability (β = .11, *SE* = .30, $p$ = .096) and there was still no effect of language group on Receptive Language after controlling for income (β = .02, *SE* = 9.75, $p$ = .903).

With regard to Expressive Language scores, language group, diagnosis, and the interaction between language group and diagnosis accounted for 3.9% of the variance, $F(3,384) = 6.282$, $p < .001$. Examination of individual predictors indicated that Expressive Language did not differ by language group (β = -.05, *SE* = 6.60, $p$ = .757), but did differ by diagnosis, with lower scores for the ASD group compared to DD (β = .22, *SE* = 2.32, $p$ < .001). The interaction between diagnosis and language group was not significant (β = -.02, *SE* = 4.34, $p$ = .893). Upon separating DD into subgroups of children with Language Disorder and Global Developmental Delay, language group, diagnosis, and the interaction between language group and diagnosis accounted for 7.5% of the variance, $F(5,382) = 7.262$, $p < .001$. Examination of individual predictors indicated that, like in the first model, language group continued to not predict Expressive Language abilities (β = -.07, *SE* = 3.93, $p$ = .459). Diagnosis significantly predicted Expressive Language for children with Language Disorder, such that children with Language Disorder had significantly higher language functioning than children with Global Developmental Delay (β = .60, *SE* = 3.82, $p$ < .001). However diagnosis did not predict Expressive Language for children with ASD, in comparison to children with Global Developmental Delay (β = -.09, *SE* = 2.61, $p$ = .122). The interaction between diagnosis and language group was not significant in the prediction of Expressive

Language when children with Global Developmental Delay were compared to children with Language Disorder (β = -.07, *SE* = 6.73, *p* =.827), nor when children with Global Developmental Delay were compared to children with ASD (β = .01, *SE* = 4.84, *p* = .952).

When income was added to the model, all variables together accounted for 3.5% of the variance in Expressive Language scores, $F(4,251) = 3.324$, $p = .011$. As an individual predictor, annual household income captured significant variability in Expressive Language abilities (β = .14, *SE* = .27, *p* = .028). After controlling for income, language group remained non-significant in the prediction of Expressive Language (β = .19, *SE* = 8.76, *p* = .306). All regression models are summarized in Table 3.

## Discussion

This study compared Receptive and Expressive Language functioning in ME and BE toddlers with developmental disorders who had yet to experience clinical intervention. A main effect of diagnosis was observed, such that children with ASD performed worse on all domains of cognitive functioning (MSEL Visual Reception, Fine Motor, Receptive Language, and Expressive Language) than children with DD. Within DD, children with global delays performed worse in both Expressive and Receptive language than children who had solely verbal delays. However, contrary to common professional beliefs about the deleterious effects of dual-language exposure, we did not observe a main effect of language exposure on either nonverbal cognitive functioning or language abilities, nor significant interactions involving diagnosis and language group. Further, upon dividing the DD group to look more specifically at children with Language Disorders versus those with Global Developmental Delay, we did not observe a main effect of language exposure on verbal abilities, nor a significant interaction between language group and diagnosis. This suggests that exposure to more than one language does not influence children with ASD, Global Developmental Delay, or Language Disorder differently. With groups matched on gender, age, and nonverbal cognitive ability, exposure to more than one language did not appear to diminish children's Receptive or Expressive English language ability. These results were maintained after controlling for socioeconomic status.

These findings are consistent with the limited research on language development and functioning in preschool- and school-age children with ASD, which have consistently suggested similar language abilities in ME and BE children (Hambly & Fombonne, 2012; Ohashi et al., 2012; Petersen et al., 2012; Reetzke et al., 2015; Valicenti-McDermott et al., 2013). Similarly, our results are consistent with the DD literature, which suggests that ME and BE children with DD perform similarly when their Receptive and Expressive Language abilities are tested in the dominant language (Burgoyne et al., 2016; Feltmate, & Kay-Raining Bird, 2008; Gutiérrez-Clellen et al., 2008; Korkman et al., 2012; Paradis et al., 2003).

The current study extends previous studies investigating language functioning in BE children in several ways. First, it comprises the largest ASD sample to date, to our knowledge. Second, participants in both language groups were similar in important demographic variables, such as age and gender, in autism severity and in nonverbal cognitive abilities. One unmatched variable that has been shown to influence language acquisition, socioeconomic status, was statistically controlled in the analyses. Third, we assessed younger children (toddlers) to determine if there are any potential differences in early language development and functioning. Finally, we assessed children's language functioning at the time of diagnosis, before they received any intervention, permitting an evaluation of their language ability without any confounding effects of services. These extensions, and the replication of results that add to a limited literature, increase the generalizability of the observed results of similar language functioning in ME and BE children with ASD and other developmental delays.

## Limitations and Future Directions

This study had several limitations that warrant comment. Since language exposure was one section of a long and complex history and not the primary focus of the data collection, we did not obtain information about the frequency or source of exposure to each language, or the fluency of each language in the home. Studies suggest that children learn a language better when it is spoken directly to them (Hambly & Fombonne, 2014; Weisleder & Fernald, 2013) and when words are used in a variety of sentence structures (Hoff, 2006). Therefore, additional information about the frequency and the context in which each language is spoken to the child may be related to language development in BE children with developmental delays. Similarly, we only tested children's language functioning in English. Understanding whether English was the participants' primary language and assessing children's language functioning in both their dominant and secondary languages will inform language-learning capabilities of BE children with developmental delays.

The present study did not assess whether BE children were exposed to multiple languages simultaneously or sequentially; however, because these children were very young at the time of assessment, it is likely that they were exposed to all languages simultaneously. In contrast to the ASD literature, the existing research on children with DD suggests a meaningful distinction between simultaneous and sequential language learning. Therefore, it is particularly important for future research on children with DD to acquire information about the timing of language exposure, as well as the levels of input received from native vs. non-native speakers (Place & Hoff, 2011). Other factors that may influence language acquisition include the number of languages in the multilingual homes (2 versus more) and the closeness of the relationship between those languages and English.

Even though our study had a large sample relative to other such studies, there were few BE children with solely verbal delays ($n = 17$). Therefore, although we explored the interaction between language exposure and diagnosis, for children with Language Disorder versus Global Developmental Delay, on children's Receptive and Expressive Language abilities, it is possible that this analysis was underpowered to detect a potentially meaningful interaction.

Moreover, we used annual household income as a proxy for SES; however, the majority of the research on language development relies on maternal education, as well as income, as this may be a more influential predictor (Hammer et al., 2012; Rojas, Iglesias, Bunta, Goldstein, Goldenberg, & Reese, 2016), especially for immigrant parents who may have more advanced education than reflected by their income. Although it would have been preferable to control for income and maternal education, the majority of the mothers in the present study did not report their education, precluding its use as a meaningful variable in analyses.

Further, verbal ability was assessed with the MSEL, which may not be detailed enough to detect subtle variations in the earliest stages of language acquisition, prior to phrase speech. The vocabulary items on the MSEL do not provide a comprehensive evaluation of a child's entire vocabulary and syntactic knowledge to distinguish the context-specific nature of bilingual exposure. Still, the current study supported results observed in studies that used more specific and discriminating measures, such as the MacArthur-Bates Communicative Development Inventories, to measure language ability in BE children with ASD (Hambly & Fombonne, 2012; Hambly & Fombonne, 2014).

Finally, it is possible that low nonverbal cognitive functioning contributed to the lack of difference in observed language performance in ME and BE children with developmental disorders (see Table 2 and "Appendix"). Since many children received the lowest possible T score on the MSEL, the lack of variance in scores may have reduced ability to identify subtle differences in language ability between ME and BE children. Specifically, the language domains in the MSEL have three critical points: preverbal items, vocabulary items, and items to assess children's grammar (Naigles, et al., 2017). Most participants reached ceiling after the initial preverbal items, and very few children reached the items that assessed grammar, thereby precluding the ability to better distinguish language abilities in these children. Future studies should explore the role of cognitive functioning in a sample with a wider range of such functioning. Research that includes children with a broader range of cognitive functioning, particularly in a population of individuals with ASD, will help to clarify how cognitive ability influences the relationship between the number of languages a child is exposed to and the child's language functioning.

### Implications

Overall, these findings reflect those of the previous literature and suggest that bilingual parents of children who have developmental disorders can communicate with their children in both languages without harm to their children's language development. In light of the profound negative effects on both parents and children of limiting parent-child exchanges to one language in multi-language households, and the lack of empirical support to warrant this communication strategy, providers should reconsider the recommendations they provide to bilingual parents of children who have developmental delays. In terms of public health policy, the existing approach of offering intervention services predominantly in the culture's dominant language may merit reexamination.

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# Appendix: Diagnostic Criteria

## Autistic Disorder

- At least two symptoms in Cluster 1 (Social) DSM-IV-TR checklist relative to developmental level

  AND

- At least one symptom in Cluster 2 (Communication)

  AND

- At least one symptom in Cluster 3 (Repetitive and/or Restricted Interests and Behaviors)

  AND

- Child displays 6 or more total symptoms

  AND

- Onset was before age 3

  AND

- Child's age equivalence must be 12 months or higher on at least one of the following: Mullen Visual Reception, Receptive language, or Expressive Language

## ASD-Low Mental Age

- Child displays at least 1 symptom from Cluster 1 (Social): must have 1 symptom other than lack of interest in peers

  AND

- Child displays at least 1 other symptom from Cluster 2 (Communication) and/or Cluster 3 (Repetitive and/or Restricted Interests and Behaviors)

  AND

- Child's Mullen Scores on Visual Reception, Receptive Language, and Expressive Language and Vineland scores on Communication and Social subdomains are ALL less than or equal to 12 months age equivalent

## Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS)

- At least one symptom in Cluster 1 (Social) DSM-IV-TR checklist relative to developmental level.Cannot include only peer relationship.

  AND

- At least one symptom in Cluster 2 (Communication) and/or Cluster 3 (Repetitive and/or Restricted Interests and Behaviors)

AND

- Child does not meet criteria for Autistic Disorder, Asperger's Disorder, or Rett's Syndrome

  AND

- Symptoms noted on checklist cannot be better accounted for by another disorder (e.g., reactive attachment disorder)

  AND

- Child's age equivalence must be 12 months or greater on at least one of the following: Mullen Visual Reception, Receptive Language, or Expressive Language

  AND

- Child displays clinically significant impairment in home, school, and/or community settings

## Global Developmental Delay

- Delay of at least 1.5 standard deviations on at least one of the following: Mullen Visual Reception, Mullen Fine Motor, Vineland Motor Skills

  AND

- Delay of at least 1.5 standard deviations on at least one of the following: Mullen Expressive Language, Mullen Receptive Language, Vineland Communication

  AND

- At least one from the 2 categories above must be a delay on the Mullen

## Language Disorder

- Delay of more than 2 standard deviations on at least one of the following: Mullen Expressive Language, Mullen Receptive Language, Vineland Communication

  AND

- Receptive or Expressive language skills at least 1 standard deviation below nonverbal IQ, as assessed by the Mullen

  AND

- No delay of greater than 2 standard deviations on the Mullen Visual Reception domain

  AND

- Use and understanding of non-verbal communication and imaginative language functions within the normal range

  AND

- Does not meet criteria for ASD

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## Highlights

- Similar Receptive and Expressive Language abilities were observed in monolingual- compared to bilingual-exposed children, matched on age, gender, autism severity, and nonverbal cognitive abilities.
- Results remained consistent after controlling for income.
- Bilingual parents and caregivers can communicate in both languages with their children with autism and other developmental delays without apparent adverse effects on their children's language functioning.

**Table 1.**

Sample demographics

| | ME (N= 282) | BE (N=106) | Statistics | | | |
|---|---|---|---|---|---|---|
| | | | $\chi 2$ | *df* | *p* | *φ* |
| **Gender** | | | | | | |
| Female | 25% | 28% | 0.32 | 1 | .570 | −.04 |
| Male | 75% | 72% | | | | |
| **Diagnosis** | | | | | | |
| ASD | 62% | 54% | 2.05 | 1 | .152 | −.08 |
| DD (LD,GDD) | 38% (33%,67%) | 46% (35%,65%) | | | | |
| **Race/Ethnicity** | | | | | | |
| Caucasian | 82% | 23% | | | | |
| Hispanic/Latino | 5% | 47% | | | | |
| African | 8% | 10% | | | | |
| American | | | 117 | 1 | <.001*** | −.56 |
| Asian | 1% | 11% | | | | |
| Other | 3% | 5% | | | | |
| Missing | 1% | 4% | | | | |
| | | | *t* | *df* | *p* | *d* |
| **Age M(SD)** | 26 (5) | 26 (5) | −1.38 | 386 | .168 | .16 |
| **Income** | 10 | 6 | 5.25 | 254 | <.001*** | .76 |

*Note.* LD = Language Delay; GDD = Global Developmental Delay;. ME = Monolingual exposed; BE =Bilingual exposed. Gender, diagnosis, and race/ethnicity are presented as percentages. Due to low cell counts for multiple racial/ethnic groups, children in the Hispanic/Latino, African American, Asian, and Other groups were combined into one “minority” group and compared to Caucasian children for analyses. Age is presented in months. SES is presented as mean income bracket, with a range of 1–15.

* < .05,

** < .01,

*** <.001.

**Table 2.**

MSEL Developmental Quotients by diagnosis and language group

| | ASD | | DD | |
|---|---|---|---|---|
| | **ME**<br>**M (SD)** | **BE**<br>**M (SD)** | **ME**<br>**M (SD)** | **BE**<br>**M (SD)** |
| ***MSEL Developmental Quotient Score*** | | | | |
| Visual Reception | 66.16 ( 17.64) | 66.74 ( 20.93) | 74.79 ( 17.41) | 73.16 ( 16.72) |
| Fine Motor | 72.16 (15.79) | 70.5 (15.80) | 78.15 (16.68) | 78.31 (16.98) |
| Receptive Language | 47.55 (21.48) | 43.85 (20.50) | 63.36 (20.62) | 57.26 (16.22) |
| Expressive Language | 49.77 (20.23) | 47.14 (18.88) | 58.20 (17.75) | 54.99 (15.47) |

*Note*. MSEL = Mullen Scales of Early Learning; ME = Monolingual exposed; BE = Bilingual exposed. Statistics comparing performance on MSEL domains by both language and diagnostic groups are presented in Table 3 and outlined in the Results.

**Table 3.**

Tests of language group and diagnosis in the prediction of MSEL abilities, using multiple linear regressions

| | B | SE | p | 95% CI | | $f^2$ (ES) |
|---|---|---|---|---|---|---|
| **Visual Reception** | | | | | | |
| Model 1 | | | | | | |
| Intercept | 57.53 | 3.23 | <.001 | 51.19 | 63.87 | |
| Language Group (BE) | 2.78 | 6.30 | .659 | −9.61 | 15.17 | .002 |
| Diagnosis (DD) | 8.63 | 2.21 | < .001*** | 4.28 | 12.98 | .037 |
| Language Group * Diagnosis | −2.21 | 4.14 | .595 | −10.35 | 5.94 | .002 |
| **Fine Motor** | | | | | | |
| Model 1 | | | | | | |
| Intercept | 66.17 | 2.90 | <.001 | 60.51 | 71.88 | |
| Language Group (BE) | −3.49 | 5.67 | .539 | −14.64 | 7.66 | .001 |
| Diagnosis (DD) | 5.99 | 1.99 | .003** | 2.08 | 9.91 | .022 |
| Language Group * Diagnosis | 1.83 | 3.73 | .625 | −5.51 | 9.16 | .002 |
| **Receptive Language** | | | | | | |
| Model 1 | | | | | | |
| Intercept | 31.74 | 3 .68 | <.001 | 24.51 | 38.98 | |
| Language Group (BE) | −1.31 | 7.19 | .856 | −15.44 | 12.82 | .002 |
| Diagnosis (DD) | 15.81 | 2.52 | <.001*** | 10.85 | 20.77 | .099 |
| Language Group * Diagnosis | −2.40 | 4.73 | .612 | −11.69 | 6.89 | .002 |
| Model 2 | | | | | | |
| Intercept | 59.36 | 2.41 | <.001 | 54.65 | 64.07 | |
| Language Group (BE) | −7.18 | 4.30 | .096 | −15.63 | 1.27 | .006 |
| Diagnosis (LD) | 12.13 | 4.17 | .003** | 3.93 | 20.33 | .110 |
| Diagnosis (ASD) | −11.81 | 2.84 | <.001*** | −17.39 | −6.22 | .042 |
| Language Group * LD | 2.52 | 7.36 | .732 | −11.95 | 16.98 | .003 |
| Language Group * ASD | 3.48 | 5.29 | .511 | −6.92 | 13.87 | .002 |
| Model 3 | | | | | | |
| Intercept | 28.47 | 5.80 | <.001 | 17.04 | 39.89 | |

| | B | SE | *p* | 95% CI | | $f^2$ (ES) |
|---|---|---|---|---|---|---|
| Income | 0.50 | 0.30 | .096 | −0.09 | 1.09 | .014 |
| Language Group (BE) | 1.19 | 9.75 | .903 | −18.00 | 20.38 | .004 |
| Diagnosis (DD) | 16.09 | 3.28 | < .001*** | 9.64 | 22.55 | .091 |
| Language Group * Diagnosis | −3.48 | 6.54 | .595 | −16.36 | 9.41 | .003 |
| **Expressive Language** | | | | | | |
| Model 1 | | | | | | |
| Intercept | 41.34 | 3.38 | <.001 | 34.71 | 48.10 | |
| Language Group (BE) | −2.04 | 6.60 | .757 | −15.01 | 10.93 | .003 |
| Diagnosis (DD) | 8.43 | 2.32 | < .001*** | 3.88 | 12.98 | .031 |
| Language Group * Diagnosis | −0.58 | 4.34 | .893 | −9.11 | 7.95 | .003 |
| Model 2 | | | | | | |
| Intercept | 53.81 | 2.19 | <.001 | 49.48 | 58.11 | |
| Language Group (BE) | −2.92 | 3.93 | .459 | −10.65 | 4.82 | .001 |
| Diagnosis (LD) | 13.32 | 3.82 | 0.001** | 5.82 | 20.83 | .029 |
| Diagnosis (ASD) | −4.03 | 2.60 | .122 | −9.14 | 1.08 | .004 |
| Language Group * LD | −1.48 | 6.73 | .827 | −14.71 | 11.76 | .002 |
| Language Group * ASD | .29 | 4.84 | .952 | −9.22 | 9.81 | .002 |
| Model 3 | | | | | | |
| Intercept | 36.07 | 5.22 | <.001 | 25.79 | 6.34 | |
| Income | 0.59 | 0.27 | .028* | 0.06 | 1.12 | .004 |
| Language Group (BE) | 9.01 | 8.76 | .306 | −8.26 | 26.26 | <.001 |
| Diagnosis (DD) | 8.06 | 2.95 | .007** | 2.26 | 13.87 | .026 |
| Language Group * Diagnosis | −7.61 | 5.88 | .197 | −19.20 | 3.98 | .002 |

*Note*: LD = Language Disorder; GDD = Global Developmental Delay. Model 1 indicates Language Group + Diagnosis (ASD, DD) + Language Group * Diagnosis. Model 2 indicates Language Group + Diagnosis (ASD, LD, GDD) + Language Group * Diagnosis. GDD is the reference group in this model. Model 3 indicates Income + Language Group + Diagnosis (ASD, DD) + Language Group * Diagnosis. CI = confidence interval. ES indicates effect size measured using Cohen’s f2 where f2 ≤.02 denotes a small effect, ≥ .15 denotes a medium effect, and ≥ .35 denotes a large effect.

* < .05,

** < .01,

*** <.001