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Parents Report Fewer Executive Functioning Problems and Repetitive Behaviors in Young Dual-Language Speakers with Autism

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Abstract

More dual language learners (DLLs) are being identified early with autism spectrum disorder (ASD). However, many families are still being advised against dual language exposure, despite a lack of evidence of negative impacts on language development in ASD. Research in typically developing children has noted advantages for bilinguals in domains such as executive functioning and social skills, but less is known about the effects in ASD. The present study evaluated differences in executive functioning and social communication in young children (n=55) with ASD. Dual-language learners with ASD had significantly fewer parent reported executive functioning problems and repetitive behaviors; parent-reported social communication skills were generally comparable across groups. Our findings indicate that the bilingual advantage in executive functioning may extend to children with neurodevelopmental conditions.

Keywords

autism spectrum disorder; bilingualism; executive functioning

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Nearly a quarter of children in the United States live in a household where a language other than English is spoken (U.S. Census Bureau, 2017), though less than 10% of students are officially designated as English language learners in the public-school system (US Department of Education, 2017). As awareness and recognition of autism spectrum disorder (ASD) has grown, ASD is increasingly recognized in early childhood in ethnic and linguistic minority families, who have long been under-diagnosed or delayed in diagnosis, though disparities in diagnostic rates continue (Baio et al., 2018). This includes a growing number

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of dual-language learners (DLLs), that is, children who are exposed to two languages in early development (Drysdale, van der Meer, & Kagohara, 2015; Kogan et al., 2018). As ASD has profound impacts on the development of early language and communication skills, early exposure to multiple languages presents an obvious challenge to families and providers working with these children. Immigrant parents of children with ASD who speak minority languages at home (e.g., languages other than English in the US) commonly report that they have been advised by professionals, or have decided on their own, not to speak their native language to their child (Kay Raining-Bird, Lamond, & Holden, 2012; Yu, 2013). Providers and families cite a range of reasons driving this decision, including the risks of further delaying language development, exacerbating existing language impairments, limiting progress in the primary language of the child's nation of residence, and difficulties building the foundational language skills needed for learning (Yu, 2013).

On its surface, limiting children with ASD to single-language exposure seems like a practical approach; yet there are important factors that complicate this decision. Although families may have some knowledge of the dominant societal language, they may not have sufficient fluency to be appropriate language models for their children or to feel confident communicating with their child in that language. This can result in parents interacting with their children less often or for briefer periods, providing fewer opportunities for children with ASD to build important social communication and interaction skills (Lund, Kohlmeier, & Durán, 2017). Moreover, in exerting increased cognitive effort to speak in their second language, parents may be less able to attend to other important aspects of communication that are particularly critical for children with ASD, such as vocal intonation or conversational reciprocity (Lund et al., 2017). Lack of fluency in the home language may also isolate the child from their community and cultural group in significant ways, limiting the development of their cultural identity and ability to engage with their families and communities (Lund et al., 2017). The development of cultural competency across communities is one reason that immigrant families of children with developmental disabilities cite for wanting their child to be fluent in two or more languages, along with enhanced career opportunities and broadening their child's life experiences (Yu, 2013).

In addition to these parent-identified benefits of bilingualism, there is a well-established research base in neurotypical bilingual adults and typically developing DLLs that has shown that these individuals are not negatively impacted by dual-language exposure and may in fact have important cognitive advantages (Bialystok, 2018). Potential differences in language skills have been investigated through both acquisition of early language milestones, as well as later vocabulary and grammar skills. Typically developing young DLLs do not show significant delays in attainment of early language milestones (e.g., first words, use of grammatical forms) when their total language skills (i.e., when assessed across both languages) are accounted for, though they may show mild delays relative to monolingual peers in single-language skills (Genesee & Nicoladis, 2006; Hoff et al., 2012). Later in development, typically developing bilingual children and neurotypical bilingual adults generally continue to demonstrate statistically significant, though not clinically significant, reductions in vocabulary size and verbal fluency in single language skills, with some variability in findings across studies (Adesope, Lavin, Thompson, & Ungerleider, 2010; Rivera Mindt et al., 2008). Findings are similar when monolingual and bilingual children with specific language impairment are compared, and current conceptualizations focus on supporting language impaired DLLs to develop strong skills in both languages, rather than choosing a single language of intervention (Bedore & Peña, 2008; Kohnert, 2010). Moreover, at least some studies have found specific linguistic advantages for typically developing bilingual children and neurotypical adults over monolinguals, including enhanced phonological and metalinguistic awareness, as well as faster lexical retrieval abilities (Adesope et al., 2010). The level of impact dual-language learning confers on linguistic abilities is also affected by other factors, such as amount and timing of exposure to each language, parents' linguistic abilities, socioeconomic status, and cultural practices (Genesee & Nicoladis, 2006).

Bilingualism has also been associated with other important cognitive advantages in typically developing children and neurotypical adults, with some of the strongest findings in the domain of executive functioning (EF; Bialystok, 2018; Halle et al., 2014). EF is a broad and complex area of cognitive functioning, which includes discrete skills such as attentional control, working memory, impulse control, organization, and cognitive and behavioral flexibility. Bilinguals tend to show better EF on average than their monolingual peers across a range of specific skills on both informant report and performance-based tasks, with particular advantages in cognitive flexibility and attentional control (Adesope et al., 2010; Bialystok, 2009), including in very young children (Engel de Abreu, Cruz-Santos, Tourinho, Martin, & Bialystok, 2012). Social competence has also been identified as an area of strength for DLLs, with specific advantages in social skills with executive demands, such as theory of mind and conflict resolution (Adesope et al., 2010; Bialystok, 2009). Increased social competence in DLLs is thought to be driven by increased sensitivity to communication cues, as well as enhanced attentional control and cognitive flexibility, which in turn enables them to be more effective social problem-solvers. A number of other potential cognitive benefits of bilingualism have also been identified (most with clear correlations with EF skills), including advantages in metacognitive skills, abstract reasoning, problem solving, cognitive efficiency, and memory (Adesope et al., 2010; Bialystok, 2009), with many findings also evident in very young children (Barac, Bialystok, Castro, & Sanchez, 2014). It is also notable that there are deep connections underlying these distinct cognitive domains, such that stronger EF abilities are associated with higher linguistic, social, and academic skills (McClelland, Cameron, Wanless, & Murray, 2006; Shonkoff, 2011). Although the direction of effects is not clear, some have hypothesized that bilingualism may drive improvements in EF, in turn driving other cognitive advantages (Bialystok, 2009). As noted previously, cultural, socioeconomic, and parental factors also moderate the effects of bilingualism on cognitive and social skills (Bialystok, 2018). While cognitive impacts of bilingualism have been broadly investigated among neurotypical adults and typically developing children, there is limited research into its effects in individuals with neurodevelopmental conditions, despite the relevance of these cognitive domains to autism and related conditions (e.g., Attention-Deficit/Hyperactivity Disorder).

EF and social skills represent two domains of particular interest for investigation, as they have fairly well established bilingual advantages in neurotypical individuals, as reviewed above, and are also critical to positive outcomes in ASD. Although impairments in EF are not considered core to the diagnosis of ASD, EF deficits have been identified in autism

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across the lifespan (APA, 2013; Rosenthal et al., 2013). Deficits have been reported in a broad range of specific EF skills in individuals with ASD, with the strongest findings in the area of flexibility (Granader et al., 2014; Kenworthy, Yerys, Anthony, & Wallace, 2008). Notably, EF deficits emerge in early childhood in autism (Garon, Bryson, & Smith, 2008; Smithson et al., 2013) and predict long-term outcomes in critical areas such as adaptive functioning, often more strongly than other factors such as IQ and ASD symptoms severity (McLean, Johnson, Zimak, Joseph, & Morrow, 2014; Pugliese et al., 2015). In addition, some prior studies have found links between EF skills and autism symptoms, including restricted/repetitive behaviors and interests (RRBIs) (LeMonda, Holtzer, & Goldman, 2012; Miller, Ragozzino, Cook, Sweeney, & Mosconi, 2015; Mostert-Kerckhoffs, Staal, Houben, & de Jonge, 2015) and social skills (Leung, Vogan, Powell, Anagnostou, & Taylor, 2016; McEvoy, Rogers, & Pennington, 1993; Pugliese et al., 2015). Social skills are considered a core feature of ASD and critical to diagnosing and treating this condition (APA, 2013). Despite being a primary target of ASD intervention throughout the lifespan, deficits in social skills tend to persist and are also related to long-term quality of life, including vocational success, engagement in relationships and leisure activities, and broad emotional well-being (Eaves & Ho, 2008; Orsmond, Krauss, & Seltzer, 2004; Tobin, Drager, & Richardson, 2014). Even when core language skills are intact, individuals with ASD continue to show deficits in social communication (Klin et al., 2007).

Research on the impacts of dual-language exposure on ASD is a steadily growing field, which until now has focused largely on language development. Prior studies have consistently found that DLLs with ASD do not have greater language delays or impairments than their monolingual peers on average (Lund et al., 2017). Current research does not show evidence of differences between DLLs and monolinguals with ASD in attainment of early language milestones or performance on standardized language tests administered in the dominant societal language (Hambly & Fombonne, 2012; Iarocci, Hutchison, & O’Toole, 2017; Reetzke, Zou, Sheng, & Katsos, 2015; Valicenti-McDermott et al., 2013). Notably, these studies have not yet carefully characterized and analyzed the effects of known moderators (e.g., level of exposure to each language, socioeconomic status), which may impact findings (Wang et al., 2018). Though less-studied than core language skills, early social communication skills also appear to be similar across DLLs and monolinguals with ASD, with some studies actually noting advantages for DLLs in discrete areas such as nonverbal communication and symbolic play (Ohashi et al., 2012; Valicenti-McDermott et al., 2013; Wang, Jegathesan, Young, Huber, & Minhas, 2018; Zhou et al., 2017). Thus, current findings do not support the “common wisdom” that children with ASD who are exposed to more than one language are vulnerable to increased language delays. There are very few published studies exploring differences in EF between DLLs and monolinguals with ASD. One study reported advantages on performance-based tasks of attentional control in Greek-Albanian bilingual children with ASD (Baldimtsi, Peristeri, Tsimpli, & Nicolopoulou, 2016), and another found reduced parent-reported EF problems in a Canadian sample of bilingual children with ASD (Iarocci, Hutchison, & O’Toole, 2017). A third study, however, found no differences on performance-based tasks of inhibitory control or flexibility in an internationally-recruited sample of Japanese-English bilingual children (Li, Oi, Gondo, & Matsui, 2017). Of note, all of these studies were conducted with school-age children; this is relevant in that the overwhelming majority of children with ASD will receive intervention and education in the dominant societal language and most parents continue to report emphasis on single-language skills for these children. Thus, it is possible that any cognitive impacts of dual-language exposure among children with ASD would potentially be diluted over time, in contrast to typically developing children who are more likely to maintain their bilingualism. Thus, there is a need for investigations into how dual-language exposure impacts development in young children with ASD.

The present study was the first to investigate the effects of dual-language exposure on both executive functioning and autistic traits in young children with ASD. We hypothesized that in comparison to monolinguals with ASD, DLLs with ASD would have fewer parent-reported EF problems, as well as advantages in parent-reported and clinician-rated social communication skills, based on prior findings and theory. Additionally, exploratory analyses were undertaken to assess possible differences in rates of restricted/repetitive behaviors and interests (RRBIs), given prior studies finding a link between RRBIs and EF in children with ASD.

Methods

Participants

This project used archival data and was conducted in compliance with standards established by the institution’s Institutional Review Board (IRB), including procedures for informed consent. 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.

Participants were identified from a clinic-based sample of over 2,000 patients seen for an autism evaluation at a multidisciplinary specialty clinic within a pediatric hospital in the Washington, DC metropolitan area. Although this was a sample of convenience, it was deemed a uniquely valuable and novel sample of young children who received gold-standard diagnostic and parent-report measures of autistic traits and EF and who represented a diversity of linguistic and ethnic backgrounds. All children resided in the United States at the time of the evaluation, and thus had at least some exposure to English. Children were designated as either monolinguals or DLLs, based on parent report on a demographic questionnaire and/or as reported in clinical interview, consistent with procedures used in prior studies in this area (e.g.., Iarocci et al., 2017; Ohashi et al., 2012; Valicenti-McDermott et al., 2013). Each parent indicated in questionnaire or interview whether the child was exposed to a non-English language in the home, and if so, what language(s) were spoken and the proportion of the time each language was spoken to the child (i.e., via parent response to the question “What percentage of the time is each language spoken in the home?”). All children designated as DLLs and included in these analyses were reported by parents to be exposed to a non-English language ≥10% of the time. Children with <10% exposure to a second language were excluded from analyses.

From the initial sample, a subsample (n= 55) was identified who were under age 6 years, had information available about language exposure status (as some parents did not report this information in the full sample), received a clinical diagnosis of ASD, and had complete data available on measures of interest. The cutoff age of 6 was chosen based on our hypotheses focusing on early language development, as well as the parent-report measures of interest, which change in format at age 6 years (see Measures). Among DLLs (n=24), there were 13 distinct non-English languages spoken at home (Amharic, Arabic, Mandarin Chinese, Hebrew, Igbo, Jamaican Creole, Korean, Mongolian, Punjabi, Slovac, Spanish, Tagalog, and Yoruba). All DLLs were exposed to only one non-English language at home. The most common non-English language was Spanish (n=7), followed by Arabic (n=3) and Amharic (n=3). The vast majority of the final included sample of DLLs (91.67%, N=22) were reported to have ≥20% exposure to a non-English language and half of DLLs (50%, N=12) were reported to have ≥50% exposure to a non-English language. There were no significant differences between the DLL and monolingual children in age [t(53)= .18, p=.86] or in parent education [t(31)= −.46, p=.65], though the dual-language group trended towards greater proportion of males [X^2(1, N=55)=3.62, p=.06]. Of note, data on parent education were not consistently available across participants. As expected, the racial/ethnic composition of the groups differed significantly [X^2(4, N=54)=13.64, p=.009]. See Table 1 for details.

Procedures

All evaluations were performed by a licensed clinical psychologist working independently, or by a multidisciplinary team composed of licensed clinical psychologist and either a licensed speech/language pathologist or a board-certified developmental pediatrician. All clinicians had obtained advanced training in gold-standard diagnostic tools and developed specific expertise in ASD and related developmental disabilities. Clinical decision-making about ASD diagnoses was performed by trained and experienced clinicians using The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; APA, 2013) along with gold-standard diagnostic tools. All participants received a clinical diagnosis of ASD and also met diagnostic cutoff criteria on the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord, Luyster, Gotham, & Guthrie. 2012), defined as “autism spectrum” or “autism” on the Module 1 or Module 2. Given the young age of these children, the focus of the evaluation is on providing a rapid diagnostic assessment to rule autism in or out; thus, direct testing of developmental level or cognitive abilities is not routinely performed.

Routinely in this clinic, clinicians see young children who are exposed to a non-English language at home and who are considered minimally verbal, as well as more verbally capable young children whose dominant language is English or Spanish, some of whom are exposed to another non-English language at home. For all children, the ADOS-2 is administered primarily in English by an English-speaking clinician. Children who are exposed to Spanish at home are often assigned to Spanish-speaking clinicians, and thus may have a bilingual administration of the ADOS-2 (i.e., primary administration in English, with additional presses offered in Spanish if the child is unresponsive to English). The wide range of languages spoken by the patients and families in this clinic prohibits complete administration of the ADOS-2 in languages other than English or Spanish. For all children, parents are present for administration of the ADOS-2, as required by these modules, and are asked to interact with their child in their usual language for activities that require parent-child interaction, and if/when their child approaches them. If a child speaks and the clinician is unable to understand him/her, either because the child is speaking in a non-English language (other than Spanish) or because the child is using an English word approximation not readily recognized by the clinician, clinicians ask parents to clarify. . Thus, final coding of a child's language skills is based primarily on observations of English verbalizations, but may also include verbalizations in another language. It is also notable that many of the children exposed to a non-English language at home develop equivalent or greater fluency in English, even in early childhood, due to the provision of early intervention services in English. Unfortunately, the child's language dominance, presence and use of interpreters, and use of non-English languages during the ADOS-2 is not tracked in our clinical database, due to the complexity of these questions, and thus cannot be analyzed in the present study. When available and appropriate, parent-report measures listed below were provided to the family in Spanish. Otherwise, measures were available only in English. If an interpreter was present for the appointment, he/she may have assisted the family with completion of English-language forms. Some families also receive assistance in completing forms prior to the appointment by social workers or other professionals not associated with this clinic.

Measures

All participants were administered the ADOS-2 for diagnostic ascertainment, as noted above. All families were also asked to complete additional parent-report measures of autistic symptoms, executive functioning, and adaptive skills.

Autism Diagnostic Observation Schedule—The ADOS-2 (Lord et al., 2012) is a play-based assessment of social communication skills and autistic traits, designed to be administered by a trained clinician. There are five different modules of the ADOS-2: Modules 1–4 and the Toddler Module. The trained clinician determines which module should be administered based on the age and estimated language level of the individual. All participants in this study were assessed using either Module 1 (Pre-Verbal/Single Words, Age 31+ months) or Module 2 (Phrase Speech) of the ADOS-2. Participants who fell within the targeted age range but received a Module 3 (Fluent Speech, Child/Adolescent) were excluded, as the focus of this study was on young children in early stages of language development. Following administration of the ADOS-2, the clinician rates the child on several different behaviors (or items), using an ordinal scale, where 0 indicates no evidence of impairment, 1 indicates mild impairment, and 2–3 indicates significant impairment. Scores from selected items are then summed to create a Social Affect score and a Restricted/Repetitive Behaviors score. These two summary scores are then totaled to generate an algorithm score compared to diagnostic cutoff criteria for Modules 1–4. An ADOS-2 Comparison Score is also generated, based on the child's total algorithm score and age, which indicates on a scale of 1–10 the level of autism spectrum symptoms the child showed during the ADOS-2.

Social Responsiveness Scale-2, Preschool (SRS2-P)—The Social Responsiveness Scale-2 (SRS-2; Constantino & Gruber, 2012) is a sex-normed parent-report measure of autistic traits for children ages 2.5–4.5 years. Parents rate their children on several different behaviors, using a Likert scale of 1–4. T-scores are generated for five treatments scales of ASD traits: Social Awareness, Social Cognition, Social Motivation, Social Communication, and Restricted/Repetitive Behaviors, along with a Total score and two DSM-5 compatible subscales: Social Communication and Interaction and Restricted Interests and Repetitive Behavior. Across all scales, higher scores indicate higher levels of autistic traits. The DSM-5 compatible subscales have been found to be the most reliable and discriminative scores on this measure (Frazier et al., 2014), and thus these two subscales were used to assess parent-reported social interaction skills and repetitive behaviors.

Vineland Adaptive Behavior Scales, Second Edition (Vineland-II): Caregiver Rating Form—The Vineland-II (Sparrow, Ciccheti, & Balla, 2005) is a sex-normed and age-normed measure that assesses adaptive behavior skills in individuals from birth to age 90 and divides adaptive behavior into three broad domains in this age group: communication skills, daily living skills, and social skills. Standard scores are generated for each domain, as well as for the Adaptive Behavior Composite (ABC). Higher scores on this measure are indicative of greater competence (i.e., better adaptive behavior). The Communication skills domain was used as a parent-report measure of language skills. This was considered the primary measure of language skills, given that the ADOS-2 language rating is a very limited assessment and was performed by primarily English-speaking clinicians with all participants. The Caregiver Rating Form (i.e., questionnaire format) was completed independently by parents.

Behavior Rating Inventory of Executive Functioning, Preschool (BRIEF-P)—The BRIEF-P (Gioia, Espy, & Isquith, 2003) is an age-normed, informant-report measure of EF skills in preschool children (ages 2 to 5 years, 11 months), designed to be completed by parents, teachers, or other caregivers. The BRIEF-P taps five domains: Inhibit, Shift, Emotional Control, Working Memory, and Plan/Organize, which are combined to form three indices (Inhibitory Self-Control, Flexibility, and Emerging Metacognition) and a Global Executive Composite score (GEC). For the present study, the Inhibit and Shift subscales were analyzed, along with the GEC, in line with prior research showing that bilingualism is associated with improved attentional control and cognitive flexibility, as well as EF broadly in neurotypicals.

Data Analyses

Study data were managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at Children's National Medical Center. REDCap is a secure, web-based application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources. Data were analyzed using SPSSv25 (IBM Corp., 2017). As noted above, there were no differences between monolinguals and DLLs in age or parent education, but there was a trend towards a greater proportion of males in the DLL group. As all measures of interest, with the exception of the ADOS-2, are gender-normed, gender was controlled for only in the ADOS-2 analyses. Differences in overall clinician-rated autism symptoms on the ADOS-2 were assessed using chi-square, logistic regression, and two-way ANOVA, controlling for gender. A series of t-tests was used to analyze differences in critical areas of EF on the BRIEF-P, as well as parent-rated social skills and communication skills on the Vineland-II. ANCOVA with age as a covariate was used to assess differences in the Social Communication and Interaction (SCI) subscale and the Restricted Interests and Repetitive Behavior (RRB) subscale on the SRS2-P, as these scores are not age-normed. Effect sizes were reported, using Cohen's d and partial η^2, despite the small sample size, consistent with APA recommendations (APA, 2015). The False Discovery Rate procedure (Benjamini & Hochberg, 1995) was used to control for Type I error rate across all analyses. All dependent variables of interest met the assumption of normality, with skewness values ranging from −0.37 to .63 and kurtosis values ranging from −1.16 to .54.

Results

Our first hypothesis was that DLL children would have fewer deficits in EF skills known to be positively impacted by bilingualism in typically developing children– namely, inhibitory control and cognitive flexibility. Consistent with our hypotheses, parents of DLL children endorsed significantly fewer flexibility deficits on the Shift subscale [$t(53)= 2.18$, $p=.03$, Cohen's $d=.60$] and significantly fewer executive deficits overall on the Global Executive Composite [$t(53)= 2.23$, $p=.03$, Cohen's $d=.62$] of the BRIEF-P (Figure 1). Parents of DLL children also endorsed fewer impulsive problems on the Inhibit subscale [$t(53)= 1.86$, $p=.07$, Cohen's $d=.51$] of the BRIEF-P, at the trend level, with a medium effect size. Related to this hypothesis, exploratory analyses were also undertaken to evaluate differences in RRBIs across groups, given the association between RRBIs and cognitive flexibility in monolingual children with ASD. Consistent with the proposed relationships between cognitive flexibility and RRBIs, parents of DLL children also endorsed significantly fewer RRBI symptoms on the SRS2-P, after controlling for age, with a medium effect seize[$F(2,52)= 4.63$, $p=.04$, partial $\eta^2=.08$] (Table 2).

Our second hypothesis was that DLLs would show advantages in social-communication skills through both clinical assessment (ADOS-2) and parent-report (Vineland-II, SRS2-P). Because the module of the ADOS-2 administered is determined in part by clinician-estimated (English) language ability and language skills are correlated with social communication skills, module of administration by group and clinician-rated English language skills were first examined. After controlling for gender, there were significant differences in module administered, such that DLL children were nearly four times as likely as monolingual children to be evaluated on Module 1 (Table 3; $OR=3.91$, $p=.03$). Within each module of the ADOS-2, clinicians directly rate a child's overall expressive language abilities on an ordinal scale on a single item. Scores on this item were compared to examine whether differences in clinician-rated expressive language skills in English differed across groups. There were no significant differences between DLLs and monolinguals on this item within the subsamples administered the Module 1 [$X^2(2, N=21) =.19$, $p=.91$], or the Module

2 [X^2(2, N=34)=.48, p=.79], indicating that clinicians were likely choosing the correct module for each child's expressive language skills in English.

Two-way ANOVA was used to assess effects of language exposure and gender (to control for trend-level group differences in gender distribution) on clinician-rated autistic symptoms on the ADOS-2 Comparison Score, which assesses overall autistic symptom severity across Modules 1 and 2 (Table 3). Results showed no main effect of language exposure on clinician-rated symptom severity [F(1,51)=.22, p=.64, partial η^2=.004] and also no interaction effect with gender [F(1,51)=1.24, p=.27, partial η^2=.02]. There were also no significant differences in parent-reported social-communication skills on the Vineland-II Communication scale [t(53)= −.16, p=.87, Cohen's d=.04] or Socialization scale [t(53)= −.10, p=.92, Cohen's d=.03]. On the SRS-2 Social-Communication and Interaction scale, there was a trend towards parents of DLLs endorsing fewer socio-communicative deficits, after controlling for age, with a medium effect size [F(2,52)= 2.89, p=.09, partial η^2=.05] (Table 2).

Discussion

This study was the first to investigate the effects of dual-language exposure on executive functioning (EF) skills in young children with ASD, enabling prospective examination of early developmental pathways in linguistically diverse children with ASD. Our findings indicate that the bilingual advantage in EF observed in typically developing children may extend to young children with ASD as well, potentially providing a foundation for advantages in EF-related outcomes, such as academic and adaptive skills. It is particularly noteworthy that among monolinguals, parent-report of EF problems fell in the clinical range on average, while DLL children's scores fell in the non-clinical range on average, indicating that this difference was not only statistically significant, but also clinically meaningful. Although EF was measured solely by parent report in this study, it is unlikely that the findings are driven solely by cultural differences in parent reporting, given the broad diversity of languages and cultures represented in both the DLL and monolingual samples, along with prior findings in typically developing children of a bilingual advantage on both parent report and performance-based assessment. While there has been limited investigation into the effects of dual-language exposure on the cognitive development of children with ASD, our findings support a clear need for further investigation in this area. Cognitive skills, including EF, are vulnerable in children with ASD and strongly linked to outcomes; however, these findings suggest that there may be a protective effect of dual-language exposure for children with ASD. Moreover, our exploratory analyses found fewer parent-reported RRBIs in young dual-language learners (DLLs) with ASD as well. As ours is the first study to report a difference in RRBIs between DLLs and monolinguals, these findings should be considered preliminary and should be interpreted with caution. If replicated in future studies, however, this advantage could have important implications for treatment, as well as for our understanding of the neuropsychological underpinnings of the autistic phenotype.

Findings regarding early socio-communicative skills were somewhat mixed. Generally, both clinician observation and parent report showed no significant group differences in socio-communicative skills; however, there were indications of a possible bilingual advantage on the SRS2-P. As the questionnaire format of the Vineland-II was used (rather than clinician interview format), the findings of relative strengths for DLLs on the SRS2-P are likely not a reflection of clinician versus parent perspective. The format of the SRS2-P as a Likert scale measure, specifically designed to characterize the intensity of autistic traits, may make it more sensitive to these differences. However, this finding should be interpreted cautiously, as the results overall were generally not indicative of differences across groups in socio-communicative skills. As findings in prior studies have generally shown advantages for typically developing DLLs in more advanced social skills, such as perspective taking and resolving interpersonal conflict, it is possible that social advantage for bilinguals does not emerge until middle childhood. It may also be that there are more discrete social advantages conferred by dual-language exposure in early childhood (e.g., in eye contact, symbolic play), as found in some prior studies, which are not readily captured through parent report. Given that findings regarding language skills were somewhat mixed in the present sample, it is also possible that the lack of a bilingual advantage in this group is attributable to greater language deficits in the DLLs, in turn “washing out” potential socio-communicative advantages. Social advantages among typically developing bilinguals are also a less robust finding than that of EF advantages (Bialystok, 2009), and thus may be less likely to be found in individuals with ASD.

The present results generally support prior findings that exposure to multiple languages does not negatively impact communication in young children with ASD, as parents reported equivalent communication skills across groups on the Vineland-II. However, it is also notable that clinicians were more likely to administer lower language-level ADOS module to DLL children, indicating that these children were perceived by clinicians as presenting with reduced expressive language skills in English. It is also possible that clinicians chose to give Module 1 over Module 2 to DLLs to reduce the influence of dual-language exposure on the ADOS administration. Given that the subsamples of children within Module 1 and Module 2 administrations were rated similarly on their overall language abilities, this seems most likely to be a reflection of true differences in (English) language skills, rather than clinical bias in module selection. As language skills were not the primary focus of the present study, and thus were assessed in a very limited manner, our findings should be considered in the larger context of prior studies that have not reported differences in language skills between these groups. Nonetheless, the clinician observations of reduced English-language skills in the present study may have important implications for treatment. If these children are characterized as “more language delayed” due to lack of English language skills, despite parent report of equivalent daily communication abilities, parents may be further discouraged from interacting with their children in their native language, either by providers or through their own decision-making. This in turn may reduce parents’ ability to engage in rich socio-communicative interactions with their children that enable them to build key nonverbal communication and symbolic play abilities long-term. Conversely, if dual-language exposure does delay early language development in children with ASD, counter to findings in prior studies, these children may require additional clinical supports (e.g., increased speech/language instruction, earlier access to English language instruction) to build early competency in English to enable greater benefits from early intervention.

Overall, the findings of this study extend the work of prior research in building our understanding of how dual-language exposure impacts the development of young children with ASD. There is now an increasingly well-established literature indicating that, as in typically developing children, exposure to multiple languages does not have adverse impacts on the language skills of young children with ASD. Having demonstrated that dual-language exposure meets the “first do harm” criterion, research is now needed to understand the impacts that dual-language exposure does have on children with ASD, including possible benefits. Clinically, it is vital to consider the importance of enabling children with ASD to connect to their families and home cultures in meaningful ways, which has its own inherent value. The value of connecting meaningfully with parents is perhaps even enhanced in ASD, as parents play an increasingly vital role in generalizing and supporting socio-communicative interventions in the home. Moreover, present findings support a potential protective effect of bilingualism for young children with ASD. Further studies are needed to better understand this, as well as the ways in which early intervention services and language exposure may interact and influence developmental trajectories. For example, there may be a dosage effect of dual-language exposure, such that children with ASD who maintain high levels of dual-language exposure throughout their development may demonstrate greater protective effects than those whose dual-language exposure is minimized, thus making dual-language exposure an integral part of intervention, rather than something that should be minimized. Interestingly, at least two studies have found that bilingual children make greater progress when ABA services provided in their home language, potentially supporting this theory (Jones et al., 2011; Lang et al., 2011). Further work is needed to potentially replicate and better understand these findings. The present study also underscores the call for greater diversity in ASD research samples. By routinely limiting our samples to families who are proficient in English, or by failing to do adequate outreach into communities of color, we greatly limit our understanding of ASD. The growing body of research into sex differences in ASD has illustrated that there are important aspects of the autistic experience, which are missed by researchers when we fail to recruit sufficiently diverse and representative samples. In order to understand ASD, in the way it is experienced by real autistic people and their families, we must ensure that our samples are representative of the broad diversity found in the autistic community.

This study had a number of important strengths, including the use of a real-world clinical sample, with a broad diversity of languages spoken and cultural backgrounds included in both the DLL and monolingual samples. The samples were also well-matched with regards to sociodemographic data, including parent education. Gold standard diagnostic procedures and well-established parent report measures were utilized. However, it is also important to acknowledge the limitations of this study. Gold standard diagnostic procedures are not readily adapted to the unusually vast cultural and linguistic diversity of our sample. Clinicians were not fluent in all languages spoken by participating families, and thus the evaluations of social-communication skills are subject to limitations in clinician knowledge of language and cultural practices within each group. While these limitations are somewhat mitigated by our use of parent report data, the reliance on parent report leaves open the possibility that observed differences are in patterns of parent response to these measures, rather than underlying skills. However, given the wide cultural diversity across the entire sample and the similarity of families in parent education, this possibility seems less likely. The access of Spanish-speaking families, but not speakers of other languages, to materials in their home language may also have influenced our sample of DLLs, such it likely included Spanish-speaking parents with a range of English fluency but speakers of other languages with greater English fluency. The lack of data regarding child's language dominance, presence and use of interpreters, and any use of non-English languages during the ADOS-2 also limited our ability to assess the potential of these factors on our findings. We are also limited by our reliance on parent-estimated reports of the child's exposure to each language, as opposed to detailed characterizations of language exposure often used in investigations of typically-developing bilinguals.

Future research is needed to extend the present findings through structured assessment of dual-language exposure "dosage," as well as direct assessment of child socio-communicative and cognitive abilities. Additional research is also needed to better understand the relationships between dual-language exposure, early skill development, and long-term outcomes, as well as the ways in which intervention changes these relationships. Our current findings can be leveraged to shift clinical practice to better support linguistically diverse families and to drive new research questions regarding the complex interaction of language, culture and cognition as drivers of positive outcomes in ASD.

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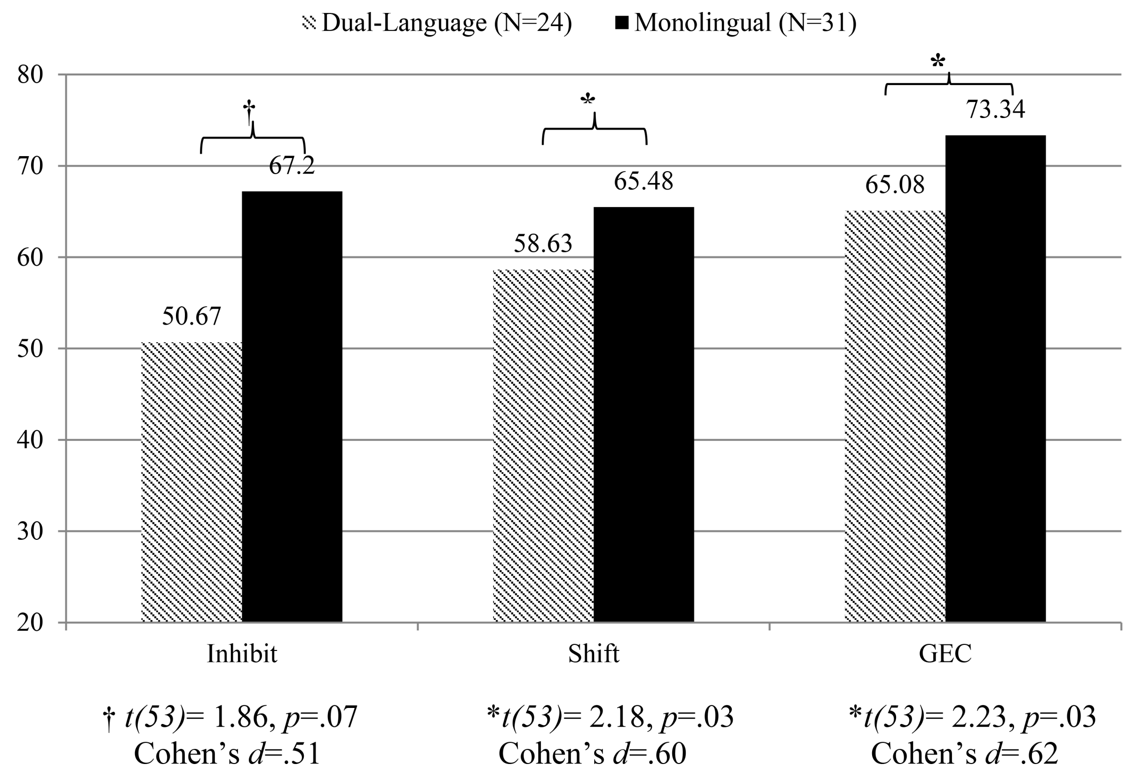

Figure 1:

Parent-Reported Executive Functioning by Language Exposure

Table 1:

Demographics by Language Exposure

	Dual-Language (*N*=24)	**Monolingual (*N*=31)**	**Test-Statistic**
Age	4.73 (.57)	4.76 (.67)	$t(53)$= .18, p=.86
Gender (% male)	91.67% (*N*=22)	70.97% (*N*=22)	X^2(1, N=55)=3.62, p=.06
Parent Education (Years)	18.00 (2.63) (*N*=12)	17.61 (2.14) (*N*=19)	$t(31)$= −.46, p=.65
Child Race/Ethnicity	Asian (N=5) Black (N=6) White (N=6) Latinx (N=5) Multiracial (N=1) Missing (N=1)	Asian (N=1) Black (N=12) White (N=15) Latinx (N=0) Multiracial (N=3) Missing (N=0)	X^2(4, N=54)=13.64, p=.009

Table 2:

Parent-Reported Autism Traits by Language Exposure

	Dual-Language Mean (SD) N=24	Monolingual Mean (SD) N=31	Test-Statistic
Vineland-II: Communication	77.38 (17.73)	76.68 (14.55)	$t(53)= -.16$, $p=.87$, Cohen's $d=.04$
Vineland-II: Socialization	74.96 (13.33)	74.61 (12.29)	$t(53)= -.10$, $p=.92$, Cohen's $d=.03$
SRS: Social-Communication & Interaction	61.29 (9.31)	66.39 (11.90)	$F(2,52)= 2.89$, $p=.09$, $\eta^2=.05$
SRS: Restricted/Repetitive Behaviors	61.92 (13.71)	69.95 (12.53)	$t(53)= 2.18$, $p=.03$, Cohen's $d=.59$

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Table 3:

Clinician-Rated Autism Traits by Language Exposure

	Dual-Language (*N*=24)	**Monolingual (*N*=31)**	**Test Statistic**
ADOS-2 Module Administered	Module 1 *N*=14	Module 1 *N*=7	$\beta = -1.36$, Wald χ^2=4.89, *p*=.03
	Module 2 *N*=10	Module 2 *N*=24	OR= 3.91
ADOS-2 Overall Total	Mean (SD)	Mean (SD)	
Module 1	20.86 (4.07)	23.00 (2.71)	
Module 2	18.10 (3.93)	17.79 (4.05)	
ADOS-2 Comparison Score	8.04 (1.46)	8.26 (1.53)	*t(53)*= .53, *p*=.60