July 2021

The Adaptive, Social, Communication, and Cognitive Skills of Monolingual and Bilingual Toddlers with Autism

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by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in School Psychology
Department of Educational and Psychological Services
College of Education
University of South Florida

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Date of Approval:
June 23, 2021

Keywords: bilingualism, early childhood, language development, dual language learners,
developmental disabilities

Acknowledgements

I would like to acknowledge and thank the many individuals who made this study possible. First, I am thankful for the support and guidance of my doctoral committee, Drs. Kathy Bradley-Klug, Emily Shaffer-Hudkins, Lisa M. Lopez, and Robert Dedrick. I am grateful for their mentorship, advice, support, encouragement, and feedback throughout all stages of this project and my doctoral studies. In addition, I would not have been able to finish this dissertation without the love and support of my family. Ish for his encouragement, friendship, and dedication. Lorena for her optimism, joy, and patience while she waited for me to finish "one more part" so I could play with her. Baby boy who is on the way and giving us all a lot to look forward to. My parents and Cristi who went over and beyond on the weekends (and always) to support me in completing my studies. Thank you to Pilar who has always believed in me and makes the best coffee! Next, I want to thank Dr. Shaffer-Hudkins and Kera Hebert from the Bay Area Early Steps program for their help with the data and many small details of the project. Finally, I want to acknowledge the children with autism who I have been blessed to work and laugh with thus far. I will continue to keep learning about autism and rooting for you.

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Abstract

The rates of Autism Spectrum Disorder (ASD; Center for Disease Control [CDC], 2019) and bilingual individuals are rapidly increasing in the United States (Zeigler & Camarota, 2019). Yet, research on the global development of bilingual children with ASD is limited. Despite the lack of research in this vein, educators and clinicians are tasked with the assessment and intervention planning for culturally and linguistically diverse (CLD) children with ASD (Dilly & Hall, 2019). There are mixed findings regarding the effect of bilingual exposure on the development of adaptive, social, communication, and cognitive skills of children with ASD (e.g., Hambly & Fombonne, 2012; Valicenti-McDermott et al., 2012). Research is needed in order to better understand the role that language exposure (i.e., monolingual or bilingual) plays in the overall development of children with ASD. In order to address this gap in the literature, the present study examined the extent to which language exposure (i.e., monolingual or bilingual) is related to the adaptive, social, communication, and cognitive skills of toddlers with ASD. Secondary data from 30 toddlers with ASD collected between 2019-2021 by a local Part C early intervention program were analyzed. The sample included 19 male and 11 female toddlers between 31-35 months of age (*Mdn*= 33 months). The toddlers were being raised either monolingually (N= 21) or bilingually (N = 9). The children were administered the Battelle Developmental Inventory-2nd Edition (BDI-2; Newborg, 2005) to measure their development of cognitive, adaptive, social, and communication skills. Based on previous research on adaptive, social, communication, and cognitive development of bilinguals with ASD, monolingual and bilingual toddlers with ASD were expected to be equally proficient across these skills. That is, nonsignificant differences between the two groups were expected and would indicate that bilingual language exposure does not negatively impact their development. First, a series of multiple regressions was conducted for the BDI-2 domain and Cognitive subdomain scores with language exposure (i.e., monolingual or bilingual) as the independent variable, while controlling for sex (i.e., male or female). Next, a series of multiple regressions was conducted for the discrete early communication skills. Although this study was underpowered, results from this study were similar to prior research demonstrating that bilingualism does not harm or delay the adaptive, social, communication, and cognitive development of toddlers with ASD. Implications from this study are discussed to improve the practice of clinicians and researchers who work with young children with ASD.

Chapter 1: Introduction

Statement of the Problem

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM–5), Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is characterized by significant challenges in social communication and interaction, as well as instances of restricted and repetitive behavior, activities, and or interests (American Psychiatric Association, 2013). The Center for Disease Control (CDC) reports that one in every 59 children have ASD (Christenson et al., 2018) and the prevalence rate of ASD is rising (CDC, 2019). ASD symptoms include significant delays in verbal and non-verbal communication, as well as challenges in social and occupational functioning. Given the communication and social challenges that children with ASD experience and the rising rates of bilingualism in the United States (Goldstein, 2011), it is important to understand how bilingual language exposure is related to the development of children with ASD. Although U.S. public schools have approximately 80,000 bilingual students with ASD (Baio et al., 2018), research on culturally and linguistically diverse (CLD) children with ASD is limited. Normative development of CLD children and best practices in ASD identification in CLD children are understudied, presenting difficulties for health and educational professionals who provide services for CLD children with ASD (Wallis & Pinto-Marin, 2008). Bilingual children and ethno-racial minorities in the United States receive an ASD diagnosis at an older age compared to monolingual Caucasian children with ASD (Mandell, Morales, et al., 2010; Mandell, Wiggins, et al., 2009; Morrier & Hess, 2012; Morrier et al., 2008). A delay in ASD identification limits the opportunities a child has for early intervention services. Thus, understanding the global development of young bilingual children with ASD is imperative for earlier diagnosis and access to evidence-based services (Fahim & Nedwick, 2014). In order to address this gap in the literature, the present study compares the adaptive, social, communication, and cognitive skills of monolingual and bilingual toddlers with ASD.

Theoretical Framework

The present study examined the relationship between monolingual versus bilingual language exposure and the adaptive, social, communication, and cognitive skills of children with ASD as guided by ecological (Bronfenbrenner, 1994) and socio-cultural models (Castro et al., 2013) of child development.

According to the ecological model of human development (Bronfenbrenner, 1994), child development is shaped by the dynamic interactions between a child and variables within the child's environment (e.g., language exposure). The child is at the center of the model (e.g., ASD status, genetic disposition, interests, abilities) and is influenced by factors within five levels of the environment: child's closest relationships and environments (i.e., microsystem), the relationships between those in the microsystem (i.e., mesosystem), indirect factors that influence the child, microsystem, and mesosystem (i.e., exosystem), broad cultural and social factors (i.e., macrosystem), and events that occur over time (i.e., chronosystem). Each level of the ecological model of human development influences all other levels dynamically. For example, a child's interest in social interaction is likely to evoke positive social exchanges with parents and caregivers, thus increasing the amount of time a parent or caregiver initiates social interaction exchanges with the child in the future. However, there are several cultural factors that influence the development of bilingual toddlers in the United States for which this theory does not fully account for.

According to a socio-cultural model of human development developed by Castro et al. (2013), there are early childhood experiences that are unique to bilingual children in the United States. Based on Vygotsky's (1978) and Rogoff's (2003) theories, Castro et al. (2013) posit that these cultural differences between bilingual and monolingual children in the United States result in different developmental trajectories for each group. For example, some bilingual children in the United States have added stressors (e.g., live in low-income homes, identify as an ethnic and or linguistic minority, have restricted access to healthcare) that influence their early development. The present study compares the adaptive, social, communication, and cognitive skills of monolingual and bilingual toddlers with ASD as guided by these frameworks. The following sections describe bilingualism and ASD in early childhood.

Bilingualism and Early Child Development

Childhood bilingualism is common worldwide (Grosjean, 2010, 2015) and is growing in the United States (Goldstein, 2011). Today, one fourth of United States children live in a home in which a language other than English is spoken. The majority of these homes are bilingual (i.e., English and the home language) with varying adult English-language proficiency levels (Ryan, 2013). Additionally, United States public schools teach speakers of over 400 languages across the nation (Office of English Language Acquisition [OELA], 2018). The developmental trajectories (i.e., experiences, milestones, abilities) of bilingual children are different than the trajectories of monolingual children, but these variations do not indicate a developmental disability or delay (Barac et al., 2014; Halle et al., 2014; Hammer et al., 2014).

Bilingual children may acquire two or more languages simultaneously since infancy or they may acquire each language sequentially before eight years old (Paradis et al., 2011). Both types of bilingual children are able to acquire high proficiency in each language if exposed to sufficient linguistic input in each language (Hammer et al., 2014). Behavioral and neuroanatomical research that indicates that the younger a child is when a given language is acquired, the more native-like the child's proficiency is likely to be in that language (Birdsong, 2018). Thus, supporting bilingual language development in young children exposed to two or more languages is beneficial even at an early age. Although there are several social challenges that bilingual children in the United States may encounter (Phillips et al., 2017), bilingualism in itself is not harmful for healthy child development (Bialystok & Werker, 2017) and has several benefits throughout the lifespan (Bialystok, Craik, & Luk, 2012). For example, bilingual children demonstrate certain cognitive (e.g., Barac, Moreno, & Bialystok, 2016) and socio-emotional (e.g., Hans, 2010) advantages compared to their monolingual peers. However, research on the effects of bilingualism on the development of children with ASD is emerging. The following section briefly describes what is known about the development of young bilingual children with ASD.

Early Childhood Development of Bilinguals with Autism Spectrum Disorder

Given the rise of bilingualism (Goldstein, 2011) and ASD (CDC, 2019) in the United States, health and educational professionals need to understand the effects of bilingual language exposure on the global development of young children with ASD. However, research on bilingualism in children with ASD is limited and has yielded mixed results. Most research in this vein has focused on the language development of bilingual children with ASD, but there also is research that focuses on the adaptive, social, and cognitive development of bilingual children with ASD. Most studies have not found any significant developmental differences between monolingual and bilingual infants, toddlers, and or preschoolers with ASD (e.g., Dai et al., 2018; Hamby & Fombonne, 2012; Zhou et al., 2019), suggesting that bilingualism does not delay the global development of young children with ASD. Interestingly, several studies found significant advantages for children with ASD who are exposed to two or more languages (e.g., Hambly & Fombonne, 2014; Iarocci et al., 2017), compared to children with ASD exposed to only one language. In contrast, one study found significant disadvantages for bilingual children with ASD compared to monolingual children with ASD (Chaidez et al., 2012). As such, the variability of these findings leaves the question of the effects of bilingualism on the global development of children with ASD inconclusive. This section includes a brief summary of research on the effects of bilingualism on the adaptive, social, communication, and cognitive skills of young children with ASD.

Adaptive Development

Adaptive skills are life skills that the average person uses in everyday tasks in order to function independently (Gerhardt & Crimmins, 2013). Examples of adaptive skills for toddlers include removing shoes, drinking from a cup independently, and hand washing with minimal assistance. Research has found that children with ASD tend to have significant challenges with adaptive skill development compared to their typically developing peers (Carter et al., 1996). The current literature base includes a small selection of studies that have compared the adaptive skills of monolingual and bilingual children with ASD (Chaidez et al., 2012; Hambly & Fombonne, 2012; Valicenti-McDermott et al., 2019). These three studies have focused on children under six years of age and have found that there are no statistically significant adaptive skill differences between both groups of children with ASD. Additionally, Valicenti-McDermott et al. (2013) found that English-Spanish bilingual toddlers scored significantly higher (p = .009) than their monolingual English-speaking peers on an adaptive skill measure. Valicenti-McDermott et al. (2013) did not discuss this finding so interpretation of this apparent bilingual advantage is limited. The sample sizes in these studies ranged from 75 (Hamby & Fombonne, 2012) to 1061 (Chaidez et al., 2012). All results indicate that bilingual language exposure does not intensify the challenges that children with ASD experience in developing age-appropriate adaptive skills. However, given the small number of studies in this vein, more research is needed to better understand the effect of bilingual language exposure on the adaptive development of children with ASD.

Social Development

Social skills are verbal and nonverbal skills that an individual uses to appropriately interact with other individuals in their environment (Gerhardt & Crimmins, 2013). Examples of social skills for toddlers include imitating others' speech, interest in and engagement with other children, and finding simple resolutions for disagreements (CDC, n.d.). Children with ASD have significant delays in verbal and non-verbal social skills (APA, 2013). Social communication and interaction challenges are a defining characteristic of ASD (APA, 2013). Children with ASD tend to have a reduced interest in social interactions, significant challenges in social learning situations, and engage in atypical verbal (e.g., odd intonation, echolalia) and non-verbal mannerisms (e.g., inappropriate eye contact). These social impairments present several challenges for individuals with ASD throughout the lifespan (Howlin et al., 2000; Matson et al., 2007). There is a significant amount of research on the social skills of children with ASD. However, there are only a few studies comparing the social skills of monolingual and bilingual children with ASD (Hambly & Fombonne, 2012, 2014; Valicenti-McDermott et al., 2019; Zhou et al., 2019). The four studies focused on children under seven years of age and all results indicate that there are no statistically significant social skill differences between both groups of children with ASD. It is noted that all of these studies measured social skills with the Vineland Adaptive Behavior Scales—Second Edition (Vineland-II). The sample sizes in these studies range from 33 (Hambly & Fombonne, 2014) to 165 (Valicenti-McDermott et al., 2019). Given the limited amount of research on the social skills of bilingual children with ASD, more research is needed to better understand the effect of bilingual language exposure on the social development of children with ASD.

Language Development

Language acquisition in early childhood is driven by biological capacities and is highly influenced by environmental factors throughout the lifespan. Research indicates that language begins to develop in utero (e.g., Minai et al., 2017). Even before speaking their first words, infants develop receptive language skills (e.g., differentiate sound patterns between different languages) that they use to learn about the world around them, expressive language skills (e.g., cooing) that they use to engage with others, and early social communication skills (e.g., gesturing, following someone else's eye gaze) that they use to interact socially with others. Language development includes the development of several complex skills that are used to understand and produce the sounds (i.e., phonology), words (i.e., semantics), and grammar (i.e., morphology and syntax) of any given language(s) to which the child is exposed to. Additionally, language skills include several functional social communication skills that are used when speaking with others (i.e., pragmatics). When learning about a certain formal property of language, children first learn receptive language skills and then children develop expressive language skills for that property of language. The acquisition of all of these language skills depends on the quantity and quality of the linguistic input that children are exposed to in their early environments (Hammer et al., 2014). Children with ASD tend to experience significant receptive and expressive language delays (Tager-Flusberg et al., 2005). For example, compared to their typically developing peers, children with ASD present with significant delays or impairments in their use of communicative gestures (e.g., pointing) that precede more complex expressive language skills (Tager-Flusberg et al., 2005). Relative to other developmental domains, the language development of bilingual children with ASD has been studied more extensively. Studies on the language development of children with ASD cover a broad range of language skills (e.g., grammatical markers, item identification, lexicon size) in various languages and will be discussed in detail in Chapter 2. The studies used various different measures and had sample sizes that range from 15 (Sen & Geetha, 2011) to 1061 (Chaidez et al., 2012), with the majority having sample sizes under 80. Research comparing the language skills of monolinguals and bilinguals with ASD have produced mixed results. Most studies have found that there are no statistically significant language skill differences between both groups of children with ASD (e.g., Dai et al., 2019; Zhou et al., 2019) and several studies have found a statistically significant advantage for bilingual children with ASD on various language skills (e.g., vocabulary size; Peterson et al., 2012). Although most studies indicate that bilingualism does not have adverse effects on the language development of children with ASD, one study has found a statistically significant disadvantage in the language skills of bilingual children with ASD (Chaidez et al., 2012). Given the broad range of language skills and mixed findings to date, more research is needed to better understand the effect of bilingual language exposure on the language development of children with ASD.

Cognitive Development

Cognitive skills are learning, thinking, and problem-solving skills that children use to learn about and plan their actions in the world around them (CDC, n.d.). Examples of cognitive skills for toddlers include solving a simple puzzle of fewer than four pieces; engaging in pretend play with dolls, animals, and people; and unscrewing a jar lid in order to retrieve an object inside (CDC, n.d.). Children with ASD tend to experience significant delays in cognitive skills compared to their typically developing peers (Granader et al., 2014; Pellicano, 2010). Over half of individuals with ASD experience cognitive delays that meet the diagnostic criteria for an Intellectual Disability

(ID; Dykens & Lense 2011). Children with ASD with ID are less likely to make positive adaptive, social, and language skill growth over time compared to children with ASD without ID (Howlin, 2005). Although research indicates that typically developing bilingual infants and children tend to demonstrate certain cognitive skill advantages compared to their monolingual peers (e.g., Brito & Barr, 2014; Singh et al., 2015), there is very little research comparing the cognitive skills of young monolingual and bilingual children with ASD. One study found that card sorting (i.e., cognitive flexibility) tasks were significantly easier for bilingual children with ASD compared to monolingual children with ASD (Gonzalez-Barrero & Nadig, 2017). Other research has found that there are no differences in parent-reported measures of cognitive skills of bilingual and monolingual children with ASD (Gonzalez-Barrero & Nadig, 2017; Iarocci et al., 2017). The sample sizes in these studies range from 40 (Gonzalez-Barrero & Nadig, 2017) to 174 (Iarocci et al., 2017). Further research is needed as the few studies on the cognitive development of bilingual children with ASD have yielded mixed results.

Purpose of the Study

The aim of this study was to investigate the extent to which language exposure (i.e., monolingual or bilingual) is related to the adaptive, social, communication, and cognitive development of young children with ASD. This study expanded upon research on the influences of monolingual and bilingual language exposure on the development of children with ASD by focusing on various developmental outcomes (i.e., adaptive, social, communication, and cognitive) and using direct standardized measures of each of the children's skill domains instead of parent report.

Research Questions

To compare the effects of monolingual and bilingual language exposure on the adaptive, social, communication, and cognitive development of toddlers with ASD, the following research questions were addressed using reviews of developmental evaluations conducted for toddlers with ASD:

1. To what extent is language exposure (i.e., monolingual or bilingual) related to the **adaptive skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?
2. To what extent is language exposure (i.e., monolingual or bilingual) related to the **social skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?
3. To what extent is language exposure (i.e., monolingual or bilingual) related to the **communication skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?
4. To what extent is language exposure (i.e., monolingual or bilingual) related to the **cognitive skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?
5. To what extent is language exposure (i.e., monolingual or bilingual) related to the following **discrete early communication skills** of toddlers with ASD when controlling for sex (i.e., male or female)?
    1. Attending to someone speaking to him or her for at least 10 seconds
    2. Babbling
    3. Vocalizing
    4. Producing monosyllabic sounds
    5. Imitating speech sounds
    6. Using communicative gestures (e.g., pointing to request an item)

7. Using 10 or more words
8. Using two-word phrases

Significance of the Study

Given that the prevalence rates of ASD and bilingualism in the United States are increasing (CDC, 2019; Goldstein, 2011), it is important to understand the effects of bilingualism on the overall development of children with ASD. Research clearly established that early childhood is a critical time for human development, yet little is known about the effects of bilingualism on the development of toddlers with ASD. Research on typically developing children has indicated that bilingualism does not hinder healthy child development (Hoff, 2015a). However, research on the effects of bilingualism on the adaptive, social, communication, and cognitive development of children with ASD is limited and has yielded mixed results. This study aimed to fill this knowledge gap by comparing the adaptive, social, communication, and cognitive skills of monolingual and simultaneous bilingual toddlers with ASD. The results of the study may inform the research agendas of educational and medical stakeholders who serve children with ASD exposed to two or more languages during the critical period of language development.

Definitions of Terms

Independent Variables

The independent variable in the present study is the child's language exposure (i.e., monolingual or bilingual). For the purposes of this study, a monolingual toddler is defined as a child between 12-36 months old who is exposed to and interacted with in one language in different settings and by all caregivers. A bilingual toddler is defined as a child between 12-36 months of age who is regularly exposed to and interacted with in two or more languages. Given that all of the bilingual children in the current study were exposed to two languages before 36-months of age, all of the children in the present study are simultaneous bilinguals.

Dependent Variables

The dependent variables in the present study are the toddlers' adaptive, social, communication, and cognitive skills, measured using the Battelle Developmental Inventory-2nd Edition Normative Update (BDI-2 NU; Newborg, 2016). The scores from four BDI-2 NU domain areas and the respective subdomains were used in analyses. Additionally, item-level analyses were conducted for items with previous empirical evidence of differences between monolingual and bilingual children with ASD.

Adaptive Skills

Adaptive skills are defined as daily life skills or tasks that a child uses in their everyday life in order to function with age-appropriate independence (Gerhardt & Crimmins, 2013). Examples of adaptive skills include feeding and dressing oneself. In the current study, adaptive skills were measured using the Adaptive (ADP) domain score and the Self-Care (SC) and Personal Responsibility (PR) subdomain scores of the BDI-2 NU.

Social Skills

Social skills are defined as verbal and nonverbal behaviors used when interacting with others (Gerhardt & Crimmins, 2013). Examples of social skills include appropriate facial affect, eye contact, and efforts to communicate with others. In the current study, social skills were measured using the Personal-Social (P-S) domain and Adult Interaction (AI), Peer Interaction (PrI), and Self-Concept and Social Role (SR) subdomain scores of the BDI-2 NU.

Language Skills

Language skills are defined as receptive and expressive communication abilities in any language that allow an individual to process, understand, and produce grammatical and lexical linguistic forms when interacting with others and in cognitive processes. In the current study, language skills were measured using the Communication (COM) domain and Receptive Communication (RC) and Expressive Communication (EC) subdomain scores of the BDI-2 NU.

Cognitive Skills

Cognitive skills are defined as the thinking and processing abilities needed for learning, paying attention, and problem solving (Gonzalez-Barrero & Nadig, 2017). Examples of cognitive skills include sorting items (e.g., by shape or color) and following directions. Cognitive skills were measured using the Cognitive (COG) domain and Attention and Memory (AM), Reasoning and Academic Skills (RA), and Perception and Concepts (PC) subdomain scores of the BDI-2 NU.

Chapter 2: Review of Literature

Although the majority of people in the world are bilingual (Ansaldo et al., 2008; Grosjean, 2010), original research on bilingualism in the United States considered bilingual language development to be a non-normative variation of monolingual language development (Hoff, 2015a). Bilingualism has now been empirically established to be a typical experience for humans worldwide (Grosjean, 2015). Research indicates that bilingualism has many socio-cultural, economical, and cognitive benefits (e.g., Agirdag, 2014; Goetz, 2003; Grin et al., 2010; Grosjean, 2010; Poarch & Bialystok, 2015). Despite the empirical support for bilingualism, emerging bilingualism is considered by many in the United States to be a risk factor in healthy child development. Negative perceptions and misunderstandings of bilingualism are theorized to be one of the catalysts for the poor academic and social achievement of bilingual children in the United States (National Academies of Sciences, Engineering, and Medicine [NASEM], 2017). These outcomes are especially concerning given that the rate of bilingual children in the United States is increasing (Goldstein, 2011). A young bilingual child is sometimes referred to as an emerging bilingual, dual language learner (DLL), or English language learner (ELL) in research and practice. For the purposes of this project, the term bilingual child is used to describe a DLL, emerging bilingual, or young ELL, and the term monolingual child will be used to describe children who are only exposed to one language.

Given that most early intervention services for children with developmental delays (DDs) in the United States are in English, children with DDs with limited English proficiency are at-risk for poor outcomes due to limited access to early intervention services in their home language

(Marinova-Todd et al., 2016). One DD that is increasing in prevalence is Autism Spectrum Disorder (ASD), a neurodevelopmental disorder that presents significant challenges in social communication and interaction, as well as patterns of restricted and repetitive behavior, interests, and or activities (DSM-5; American Psychiatric Association, 2013). There are approximately 80,000 bilingual students with ASD enrolled in United States public schools (Baio et al., 2018). The rates of ASD (Center for Disease Control ([CDC], 2019) and bilingual children in the United States (Goldstein, 2011) are rising, yet research on the bilingual development of children with ASD is limited. In order to address this gap in the literature, the present study investigates the extent to which a young child's language exposure (i.e., monolingual or bilingual) influences the global development of infants and toddlers with ASD. Specifically, the present study compared the adaptive, social, communication, and cognitive skills of toddlers with ASD who had early exposure to one or two languages.

This chapter reviews some of the relevant literature regarding the global development of young monolingual and bilingual children with ASD, as well as research on the effects of language exposure on the adaptive, social, communication, and cognitive skill development of young children with ASD. The existing research on developmental patterns of monolingual and bilingual children has focused primarily on typically developing children. First, the theoretical frameworks that guide the conceptualization of bilingual child development in the United States are discussed. Second, this chapter describes some of the characteristics of bilingual children and young children with ASD. Finally, this chapter describes what is known about the effects of monolingual versus bilingual language exposure on the development of adaptive, social, communication, and cognitive skills of children with ASD.

Theoretical Framework

Ecological and socio-cultural theories guide models of early development of bilingual children. These theories posit that child development is greatly influenced by variables within the environment in which the children interact regularly, such as the language(s) they are exposed to at home and in the community. This section will review ecological (i.e., Bronfenbrenner, 1994; Vélez-Agosto et al., 2017) and socio-cultural (i.e., Castro et al., 2013) theories of child development which provide the conceptual framework for the current study.

Ecological Model of Human Development

The Ecological Model of Human Development posits that child development is shaped by the interactions between a child's individual characteristics (e.g., maturational constraints, genetics, cognitive abilities, etc.) and various environmental factors found in different levels of the model: the microsystem, mesosystem, exosystem, macrosystem, and chronosystem (Bronfenbrenner, 1994). According to this model, the child's immediate and closest relationships and environments, such as the relationships between the child's parents and therapist, are located in the microsystem. Positive interactions between the child and their microsystem provides the child with the opportunities or barriers that influence the child's development, including language acquisition. The relationships between the different parts of the microsystem are part of the mesosystem. For example, children benefit more from their relationships with their parents and health care providers if the relationships are positive, than they would if there is conflict or disagreement in the relationships. The exosystem includes indirect environmental variables that greatly influence the child's development even though the child may have limited or no direct contact with these variables. For example, the ASD resources available in the child's neighborhood or a therapist's access to professional development. The macrosystem includes the larger cultural and social influences on the child's development. For example, a society's perception of bilingualism. The chronosystem considers the changes that occur over time due to environmental events.

The factors within the ecological system are unique to each child so that the development of young children with ASD includes interactions between child-level factors (e.g., specific ASD symptoms) and their daily environments and interactions (e.g., linguistic interactions, health service access). The environmental variables that influence the development of young children with disabilities, such as ASD, may include access to health insurance and medical professionals, access to and quality of early intervention services, disability laws and policies, and added parental stress. Expanding upon Bronfenbrenner (1994), Vélez-Agosto et al. (2017) argue that the role of culture in child development begins at the micro level and extends to all levels. The Ecological Model of Human Development does not account for the socio-cultural factors that influence bilingual child development. Therefore, a socio-cultural theoretical framework encompassing theories of bilingual child development will be discussed next.

Sociocultural Framework for the Development of U.S. Bilingual Children

Castro, Garcia, and Markos (2013) present a framework for understanding the development of bilingual children in the United States Founded upon sociocultural learning theories (i.e., Rogoff, 2003; Vygotsky, 1991), Castro et al. (2013) posit that cultural factors and experiences unique to each bilingual child greatly influence their development, and so must be considered when working with bilingual children. These experiences and factors are usually different than the experiences that influence monolingual child development. Examples of socio-cultural factors that may influence the development of bilingual children may include, being an ethnic or linguistic minority, having immigrant parents with limited educational backgrounds, and being raised in two languages and cultures. The environmental context for the development of bilingual children may include immediate and extended family members, communities, schools, homes, early care programs, therapy and medical clinics, immigration policies and laws, language loss, cultural shame, separation from families due to deportation or work demands, and negative perceptions regarding bilingualism.

Summary

These theories and conceptual frameworks focus on the interactions between factors in the environment and the child. A child's characteristics, including DDs, influence his or her environment just as the factors in environment influence the child. For example, a talkative and friendly toddler is more likely to evoke positive attention and language interactions with adults, which in turn, may provide the child with greater opportunities for learning compared to a non-verbal or independent child. According to these theories, both external (e.g., language exposure) and internal (e.g., ASD symptoms) factors influence a child's development. Furthermore, limited opportunities for the bilingual language development of bilingual children may result in negative linguistic and social consequences (Castro et al., 2013). Guided by these theoretical frameworks, the present study examines the adaptive, social, communication, and cognitive development of bilingual and monolingual two-year-olds with ASD. Before reviewing the literature regarding the development of bilingual children with ASD, the following section describes ASD in culturally and linguistically diverse (CLD) children.

Autism Spectrum Disorder

ASD is a neurodevelopmental disorder characterized by significant delays in social communication and interaction, as well as patterns of restricted and repetitive behavior, interests, and or activities (*DSM-5*; American Psychiatric Association, 2013). ASD in a young child can be diagnosed by developmental pediatricians, child neurologists, child psychologists, and child psychiatrists. ASD is a neurological disorder that is diagnosed through observations of behavior patterns. While the average age of ASD diagnosis is 4 years and 4 months of age (National Center on Birth Defects and Developmental Disabilities, 2018), using gold standard assessment tools and procedures, clinicians can diagnose ASD reliably as early as 18 months (Woolfenden et al., 2012). According to the American Psychiatric Association (2013), ASD is diagnosed at three levels which indicate the level of support that the individual is likely to need: Level 1 (i.e., "requiring support"), Level 2 (i.e., "requiring substantial support"), and Level 3 (i.e., "requiring very substantial support"). According to the APA (2013), a child with Level 1 ASD has "deficits in social communication [that] cause noticeable impairments. Difficulty initiating social interactions, and clear examples of atypical or unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions... Inflexibility of behavior causes significant interference with functioning in one or more contexts. Difficulty switching between activities" (p. 52). An individual with ASD Level 2 has "Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. Inflexibility of behavior, difficulty coping with change, or other restricted/repetitive behaviors appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action" (p. 52). An individual with

ASD Level 3 experiences the most difficulties with social communication and restricted/repetitive behaviors. Specifically, an individual with ASD Level 3 experiences "Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. Inflexibility of behavior, extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action." (p. 52). These clinical distinctions guide clinicians when rendering an ASD diagnosis level; However, clinicians also use clinical judgement to decide which level of ASD supports the child will need. Research is needed to understand the biases and variables that influence a clinician's decision about ASD level diagnosis of CLD children with ASD.

The CDC estimates that one in every 59 children have ASD (Christenson et al., 2018). ASD can affect children in all racial and ethnic groups (Christensen et al., 2018). Male children are four times more likely than female children to be diagnosed with ASD (Baio et al., 2014). Theories for this gender discrepancy include: a protective effect of the X-chromosome, socio-cultural biases and expectations (e.g., belief that girls are more social results in greater social prompting for female children than for male children), and different symptoms for males and females with ASD (see Dilly & Hall, 2019). For example, some research has indicated that girls with ASD are more likely to engage in joint attention and gestures, and have fewer restricted and repetitive behaviors (e.g., hand flapping and spinning) compared to boys with ASD (see Dilly & Hall, 2019). Additionally, research has found that males with ASD experience significantly more externalizing behavior challenges (e.g., aggression) than their female peers do, while females with ASD experience significantly more internalizing behavior challenges (e.g., depression, anxiety) compared to their male peers, as reported by their parents (Werling & Geschwind, 2013).

The symptoms of ASD cause significant impairment in social and occupational functioning, including verbal and non-verbal communication. Given the social and communicative challenges that children with ASD experience, some believe that bilingual language development in children with ASD presents unique challenges. The research on ASD in CLD children is emerging. Screening for ASD in CLD children presents challenges for clinicians due to a limited knowledge and incorrect beliefs about normative development of CLD children (Wallis & Pinto-Marin, 2008). Research has indicated that bilingual children, ethno-racial minorities, children in poverty, and Latino children in the United States receive an ASD diagnosis at an older age compared to the age in which monolingual middle-class Caucasian children are diagnosed with ASD (Morrier & Hess, 2012; Mandell et al., 2010; Mandell et al., 2009; Morrier, Hess, & Heflin, 2008). Given that a delay in diagnosis limits the opportunities for early intervention services, understanding the developmental trajectories of bilingual children with ASD is imperative for earlier diagnosis and access to evidence-based services (Fahim & Nedwick, 2014).

The National Autism Center (2015) outlines six components of a high-quality comprehensive assessment for ASD: medical, psychological, and educational records review, parent/caregiver interview, cognitive or developmental assessment, direct play observation, adaptive functioning assessment, and comprehensive medical examination. In addition to standard evaluation procedures, a comprehensive assessment of ASD for bilingual children may include information on parent reported language exposure and use, and parent report of language developmental milestones reached in each language. Ideally, the ASD assessment would be completed in the parents' home language and or whichever language(s) to which the child is exposed to most often. In order to understand the unique individual and environmental context of early childhood development for bilingual children with ASD, the following sections provide background information regarding bilingualism in early childhood.

Bilingualism in Early Childhood

Bilingual children may be exposed to a second language simultaneously since infancy or sequentially (i.e., exposure to the first language [L1] since birth and a second language [L2] after three years of age). For example, a child born to bilingual Haitian American parents may be exposed to both Haitian and American English since birth (i.e., simultaneous bilingual) while a child born to monolingual speakers of Spanish may be exposed to Spanish since birth and then English when entering kindergarten (i.e., sequential bilingual). Most bilingual and multilingual children in the world are sequential bilinguals who were exposed to one language at first, and then acquired a second, third, and or fourth language successively (Grosjean, 2010, 2015). There is evidence that early childhood is a critical period for second language acquisition (e.g., Abrahamsson & Hyltenstam, 2009), but research has found that both types of bilingual children are able to acquire native-like proficiency if exposed to sufficient linguistic input in each language (Hammer et al., 2014). Research on behavioral and neuroanatomical differences between early versus late bilinguals provide support for a critical period for second language acquisition (Birdsong, 2018), which will be discussed in further detail later in this chapter. For the purposes of this literature review, the term bilingual child(ren) will be used to describe any child with constant exposure to two or more languages regardless if the child is a simultaneous or sequential bilingual, or whether the child has exhibited expressive language skills in any language.

Bilingualism in the United States and Florida

There are over 400 languages spoken by students in United States public schools (Office of English Language Acquisition [OELA], 2018). Although this number may seem large, there are over 7000 languages spoken across the 193 countries in the world today (Gordon, 2005). Thus, it is common for countries to have speakers of many different languages (Grosjean, 2015). The United States does not have an official language at the federal level (Crawford, 2000; Schildkraut, 2001), yet monolingual ideation in the United States has been documented since the Constitution was signed and has resulted in several State laws and educational policies that promote English as the national language (Crawford, 1989). For example, there have been several English-only movements in the United States since the 1700s (Crawford, 1989), including two recent bills introduced to the United States House of Representatives (H. R. 997) and Senate (S.678) that propose making English the official United States language (see "English Language Unity Act of 2017"). Despite these efforts, bilingualism in the United States continues to increase (Ryan, 2013) and is projected to continue to increase (Fernández Vítores, 2016). In fact, the United States is the second largest Spanish-speaking country in the world and has surpassed all other countries, except for Mexico, in number of Spanish-speaking residents (Fernández Vítores, 2016). According to the 2011 United States Census, approximately one in four United States children live in a home in which a language other than English is spoken (Ryan, 2013). Of those children, 58% live in a home in which English is spoken very well, 19% live in a home in which English is spoken well, 15% live in a home where English is not spoken well, and 7% live in a home where English is not spoken at all (Ryan, 2013). Approximately 40% of Floridian children under the age of eight years of age are bilingual (Park et al., 2017a). The majority of bilingual children in Florida speak Spanish

(67%), Haitian (8%), Portuguese (1.5%), Vietnamese (1.3%), and Arabic (1.3%) at home (Park et al., 2017a). Spanish in the United States is projected to continue to increase so that by 2050, the United States will be the largest Spanish-speaking country in the world, with most United States citizens and residents being English-Spanish bilinguals (Fernández Vítores, 2016).

The Bilingual Advantage

Research on bilingual individuals has found that compared to monolinguals, children who regularly use two languages demonstrate increased cognitive (e.g., heightened executive functioning abilities; Castro et al., 2013), and social and behavioral outcomes (e.g., stronger self-regulation skills; Espinosa, 2013). Regarding cognitive advantages, bilinguals demonstrate enhanced selective attention (Bialystok & Majumder, 1998), executive control (Barac, Moreno, & Bialystok, 2016), multitasking abilities (Poarch & Bialystok, 2015), inhibitory control (Bialystock & Martin, 2004; Salvatierra & Rosselli, 2016), working memory (Brito et al., 2014), and metalinguistic awareness (Bialystock & Barac, 2012). Furthermore, there is evidence that compared to monolingual adults, bilingual adults have an average of a four-year delayed onset of Alzheimer's Disease symptoms (Bialystok et al., 2007). While some studies have demonstrated a bilingual advantage in infancy and toddlerhood (e.g., Valicenti-McDermott et al., 2013), studies have usually documented a bilingual advantage in school-age children or adults. Many children in the U.S. are sequential bilinguals due to monolingual exposure to one language at home until the child goes to school and is exposed to English. Thus, a bilingual advantage would not be found until the child has acquired sufficient English.

Regarding social and behavioral outcomes, research has found that compared to their monolingual peers, bilingual children in preschool demonstrate stronger self-regulation skills (Espinosa, 2013), lower rates of problem behaviors (De Feyter & Winsler, 2009; Han, 2010), and a broader social-cultural awareness (Grosjean, 2015). Additionally, research also has demonstrated that young bilingual children outperform their monolingual peers in Theory of Mind tasks (Farhadian et al., 2010; Goetz, 2003). Given these findings, researchers recommend supporting the bilingual language development of United States children in bilingual homes or homes in which English is not the primary language. However, the impact of DD, including ASD, on bilingual advantages in toddlerhood is understudied. The following section reviews the research on the adaptive, social, communication, and cognitive development of bilingual children with ASD.

Young Bilingual Children with Autism Spectrum Disorder

Research has clearly established that early childhood (i.e., 0-8 years of age) is a critical time for human development (Center on the Developing Child, 2010). Children's developmental trajectories in early childhood predict future developmental processes and outcomes and are foundational for advancement across all five developmental domains (i.e., motor, cognitive, social, language, and adaptive development; Yoshikawa et al., 2013). Essentially, the knowledge and skill base that children, including bilingual children, develop before entering kindergarten influence their K-12 schooling (Camilli et al., 2010), as well as the academic, social, and economic opportunities these children will experience in the future (Reynolds et al., 2011). Early childhood also is a critical time for research-based early intervention as the positive effects tend to be large and long-lasting (Early Childhood Technical Assistance Center & Center for IDEA Early Childhood Data Systems, 2019). For example, research indicates that children with ASD enrolled in state programs that provide early intervention services for children with ASD through Part C of the Individuals with Disabilities Education Act (IDEA), experience a reduction in maladaptive behaviors and an increase in social and communication skills (Noyes-Grosser et al., 2018). Additionally, parents of children who participated in these state early intervention programs indicated that these services helped their children reach outcomes important for their family (Noyes-Grosser et al., 2018).

Although both public and professional perceptions still exist that bilingualism can contribute to a developmental delay, research has clearly established that the developmental trajectories of young children exposed to two or more languages are different than the trajectories of their monolingual peers, and that these variations do not indicate a developmental disability or delay (Barac et al., 2014; Halle et al., 2014; Hammer et al., 2014). These varying developmental trajectories are typical and include differences in the development of social-emotional, communication, and cognitive skills of young bilinguals compared to monolinguals. In fact, some of these developmental differences include statistically significant enhanced abilities of bilingual children compared to their monolingual peers. Regarding the effects of language exposure on the development of bilingual children with ASD, several studies have found no significant differences between the skills of monolingual and bilingual children with ASD, indicating that bilingual language exposure does not appear to increase the risk for developmental delays in children with ASD (e.g., Hambly & Fombonne, 2012; Reetzke et al., 2015). Other studies have found that when compared with their monolingual peers, bilingual children with ASD demonstrate enhanced social communication skills (e.g., Petersen et al., 2012; Valicenti-McDermott et al., 2013). However, despite research that supports the positive effects associated with bilingualism in children with

ASD, professionals may encourage parents of children with ASD to raise their children using English only (Kay-Raining Bird et al., 2012). Bilingual or non-English speaking parents of children with ASD report that they are advised to refrain from speaking the non-English language with their child(ren) with ASD (Drysdale et al., 2015; Jegatheesan, 2011; Kay-Raining Bird et al., 2012). These practices limit the opportunity for children with ASD to become bilingual, which may have a negative influence on the family dynamics and relationships of bicultural children with ASD (Fernandez y Garcia et al., 2012). The following section summarizes research on the adaptive, social, communication, and cognitive development of bilingual children with ASD or other DDs.

Adaptive Development

Adaptive skills, sometimes referred to as self-help skills, are, "skills or abilities that enable an individual to meet standards of personal independence and responsibility that would be expected of his or her age and social group" (Gerhardt & Crimmins, 2013, p. xv). In other words, adaptive skills are daily life skills or tasks that the average person uses in their everyday life in order to function with age-appropriate independence. Expectations and definitions of age-appropriate independence are highly influenced by culture and so adaptive skill norms vary across different cultures (Gerhardt et al., 2013). Adaptive skills for toddlers include activities of daily living such as personal care (e.g., removing shoes), self-feeding (e.g., drinking from a cup independently), and following simple schedules/routines (e.g., washing hands after toileting). Children with weak adaptive skills require assistance for meeting their basic needs. Adaptive skills are important for self-care (Anderson, 2013), quality of life (Felce & Emerson, 2001; Vine &

Hamilton, 2005), and opportunities for further learning (Heward et al., 2009). Children with ASD tend to have significant delays in adaptive skill development (Carteret al., 1996).

Similar to their typically developing peers (Sparrow et al., 2005), the adaptive skills of children with ASD tend to be strongly related to cognitive skills (Kanne et al., 2011; Perry et al., 2009; Pugliese et al., 201). Children with ASD with average cognitive skills, however, tend to perform significantly lower in adaptive skills compared to their typically developing peers with average cognitive skills (Kanne et al, 2011; Lee & Park, 2007). These delays in adaptive skills for children with ASD have been found in children as young as two years of age (Ray-Subramanian et al., 2012). Despite these challenges, there is a robust and growing empirical literature base that indicates that the adaptive skills of children with ASD can significantly increase with individualized adaptive skill training using applied behavior analysis (ABA) techniques to break down specific adaptive skills into smaller and more manageable tasks (see National Research Council, 2001). The following section reviews research on the influence of bilingual language exposure on the development of adaptive skills in young children with ASD.

Adaptive Skills of Bilingual Children with ASD

The research on the adaptive skills of bilingual children with ASD is limited. The small pool of studies that have compared the adaptive skills of monolingual and bilingual children with ASD have not found differences in the adaptive skills of both groups suggesting that bilingual language exposure does not result in increased vulnerability in the development of adaptive skills of children with ASD (Chaidez, et al., 2012; Hambly & Fombonne, 2012; Valicenti-McDermott et al., 2019). This section provides a chronological review of the literature on what is known about the adaptive skills of bilingual children with ASD.

In one study, Chaidez et al. (2012) investigated the adaptive and language skills of 1061 children (24–60 months old) who were categorized as either monolingual (English or Spanish) or bilingual (English-Spanish), as well as Latino or non-Latino. In this study, a monolingual was a child for which a parent reported only one language spoken in the home and a bilingual was a child for which a parent reported two languages spoken in the home. Approximately 25% of the non-Latino and 67% of the Latino children were bilingual and were compared to their monolingual Latino or non-Latino counterparts. The sample included a typically developing control group, as well as children with ASD or another DD. Adaptive skills were measured using the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II; Sparrow et al., 2005). The Vineland-II measures adaptive skills of individuals from birth to 90 years of age. It yields a composite score and 5 domain scores (i.e., Communication, Daily Living Skills, Socialization, Motor Skills, and Maladaptive Behavior). Although there were significant disadvantages in the Latino group compared to non-Latino children for academic, communication, and cognitive outcomes, multivariate regression analyses indicated that there were no significant differences in adaptive skill outcomes between the monolingual and bilingual language groups. These results suggest that bilingual language exposure is not a barrier in the adaptive skill development of young children with ASD. In addition, the findings suggest that being bilingual may be a protective factor for Latino children who may be facing greater challenges than their non-Latino peers (e.g., Latino mothers in this study were significantly younger and less educated than the non-Latino mothers).

In another study, Hamby and Fombonne (2012) examined the adaptive, social, and language skills of 75 children 36-78 months old with ASD. The participants were being reared in monolingual (*n* = 30) or bilingual (*n* = 45) language environments in Quebec. The children were exposed to at least one of the following languages: French, English, Chinese, Farsi, Hebrew, Italian, Romanian, Spanish and/or Tamil. In this study, a monolingual child was defined as a child exposed to the same language at home and other settings (e.g., daycare) and a bilingual child was defined as a child exposed to two or three languages in one or more settings. To measure their adaptive skills, the children were administered the Vineland Adaptive Behavior Scales—Second Edition (Vineland-II). The results of the one-way analysis of variance (ANOVA) indicated that there were no statistically significant adaptive skill differences between the monolingual and bilingual groups on any of the Vineland-II scale scores. This study provides further evidence that bilingual language exposure does not delay the acquisition of adaptive skills for young children with ASD. Given the sample size, this study may have homogeneity in the groups, as well as lower power.

In a recent study, Valicenti-McDermott et al. (2019) investigated the adaptive and social skills of monolingual English and bilingual English-Spanish children with ASD. The participants included children aged one to six years of age with ASD who were being reared in monolingual English ($n = 297$) or bilingual English-Spanish ($n = 165$) environments. The researchers conducted a review of multidisciplinary evaluations at a university-affiliated developmental center over 10 years. A multivariate logistic regression analysis indicated that there were no significant differences between the two groups on the Vineland-II Composite Score. These results provide evidence that bilingual language exposure is not a barrier for the development of adaptive skills of children with ASD. The results of the social outcomes that Valicenti-McDermott and colleagues (in press) examined will be discussed in the next section. In a previous review of multidisciplinary evaluations, Valicenti-McDermott and colleagues (2013) examined the language and adaptive skills of 40 monolingual and 40 bilingual children 1-3 years of age with ASD. Valicenti-McDermott et al. (2013) reported that English-Spanish bilingual toddlers scored significantly higher than monolingual English-speaking toddlers on the Vineland-II composite score ($p = .009$). Interpretation of this difference is limited as the authors did not discuss this finding or report the subdomain scores. Valicenti-McDermott et al. (2013) focused on language outcomes, which are discussed in further detail in the Language Development section below. In conclusion, the research on the relationship between bilingualism and adaptive skills of children with ASD is understudied, but the few studies that have been conducted do not provide evidence that bilingualism increases adaptive skill challenges that children with ASD face.

Social Development

Social skills are, "interpersonal responses with specific operational definitions that allow an individual to adapt to the environment through verbal and nonverbal communication" (Gerhardt & Crimmins, 2013, p. xv). Specific social skill definitions, expectations, and norms are highly influenced by culture (see Albert & Trommsdorff, 2014), but include appropriate ways of interacting with other individuals verbally (e.g., conversational content and rate) and nonverbally (e.g., facial affect and eye contact). Individuals with weak social skills might be described as odd, rude, or awkward relative to their cultural norms. Social skills are important for making and keeping friends (Denham et al., 2003), as well as positive academic and vocational outcomes as adults (Joshi et al., 2016; Goodman et al., 2015). Examples of social skills for most toddlers by the third birthday include imitation of other's speech and actions, awareness of and interest in other children, play and engagement with other children, and ability to find simple ways of resolving disagreements (CDC, n.d.).

Individuals with ASD demonstrate significant challenges in social communication and interaction (APA, 2013). So much so that some researchers argue that social impairments are the most defining aspects of ASD (e.g., Stella et al., 1999). Research has documented that individuals with ASD struggle with the appropriate use of several non-verbal social behaviors. For example, individuals with ASD tend to use inappropriate facial expressions (e.g., Faso et al., 2015), motor movements (e.g., Martin et al., 2018), and eye contact (e.g., Jones & Klin, 2013; Willemsen-Swinkels et al., 1998). Individuals with ASD also have difficulty with verbal social behaviors and tend to struggle with odd speech intonation, conversational content, and social interactions (see Matson, Matson, & Rivet, 2007). These atypical mannerisms and speech patterns persist into adulthood (Matson, Boisjoli, et al.., 2007) and tend to grow over time, multiplying the difficulties that individuals with ASD face throughout the lifespan (Howlin et al., 2000). In a review of 79 treatment studies, Matson, Matson, and Rivet (2007) found that the social skills of children with ASD can significantly increase using individualized ABA interventions for teaching social skills. However, despite the use of evidence-based social skills interventions, such as ABA techniques and procedures, children with ASD do not reach social skill levels comparable to their typically developing peers (Weiss, 2013). The following section reviews research on the influence of bilingual language exposure on the development of social skills in young bilingual children with ASD.

Social Skills of Bilingual Children with ASD

Although there is extensive research on the social skills of children with ASD, the research on the social skills of bilingual children with ASD is limited. Research on social skills of typically developing bilingual children has focused mainly on social-emotional skills, a subset of social skills that includes a child's experience, expression, and regulation of emotions (see Halle et al., 2014). For example, Han (2010) found that compared to their monolingual peers, Latino bilingual children scored higher on self-control and interpersonal skill measures. Han (2010) also found that Latino bilingual children have lower rates of internalizing behavior problems. Additionally, Halle and colleagues reviewed the literature and found that Latino bilingual children tend to have stronger socio-emotional skills compared to their English-speaking monolingual peers. However, the literature on the social skills of bilingual children with ASD is limited. The five studies that have compared the social skills of monolingual and bilingual children with ASD have not found differences between both groups suggesting that bilingual language exposure does not result in increased vulnerability in the development of social skills of children with ASD. These studies are reviewed in further detail below.

First, Hambly and Fombonne (2012) compared the adaptive, language, and social skills of children aged 36-78 months old who were living in monolingual (n = 30) or bilingual language environments (n = 45) with ASD. In this study, monolingual exposure was defined as a child's exposure to the same language at home and other settings (e.g., daycare) and bilingual exposure was defined as a child's exposure to two or three languages in one or more settings. The bilingual children were grouped into either a simultaneous (n = 24) or sequential (n = 21) bilingual exposure group. Social skills were measured by parent completion of the Vineland-II Interpersonal and Socialization Scales. The researchers found that simultaneous bilinguals scored significantly higher than sequential bilinguals on the Vineland-II Interpersonal Scale (p = .025). The study also found that there were no statistically significant social skills differences between the monolingual and bilingual groups. These findings indicate that simultaneous bilinguals with ASD may have stronger social skills than sequential bilinguals with ASD, but that bilingual and monolingual children with ASD do not differ from each other in social skill development. Thus, earlier exposure to two languages provided a social skill advantage. This study provides further evidence that bilingual language exposure does not further delay the acquisition of social skills for young children with ASD.

In another study, Hambly and Fombonne (2014) examined the language and social skills of 33 Canadian children with ASD between the ages of 3 and 7 years of age. All of the children had an expressive vocabulary size with a minimum of 50 words in at least one language and all were exposed to two or more languages on a daily basis. The children were categorized as non-bilingual (n = 10) if they had no L2 expressive vocabulary, low bilinguals (n = 11) if they had fewer than 69 words in an L2, and high bilinguals (n = 12) if they had 70 or more words in an L2. To measure their social skills, the children were administered the Vineland-II Interpersonal Scale and the Social Responsiveness Scale (SRS; Constantino, 2002). The results of the regression analyses indicated that there were no significant social skill differences between the three groups. This study suggests that the acquisition of social skills for young bilingual children with ASD is not influenced by their bilingual proficiency level.

In a recent study, Zhou, Munson, Greenson, Hou, Rogers, and Estes (2019) investigated the relationships between monolingual versus bilingual language exposure in the home, and the language and social skills of toddlers (i.e., 12-26 months old) with ASD. The participants were a small subset of a larger longitudinal randomized control trial on the effects of early intervention. To measure their social skills, the toddlers were administered the Vineland-II Socialization Scale. The children were living in bilingual (n = 13) or monolingual (n = 24) home environments and were matched for nonverbal IQ scores. An exploratory analysis indicated that there were no significant differences between the social skills of the two groups. This study provides further support that bilingual language exposure in early childhood does not increase the social skill challenges that children with ASD face. Zhou et al.'s (2019) language outcomes will be discussed in the next section.

In addition to the adaptive development outcomes described in the previous section, Valicenti-McDermott et al. (2019) also compared the social skills of monolingual English (n = 297) and bilingual English-Spanish (n = 165) children with ASD between the ages of 1 to 6 years of age. In this study, a monolingual child was defined as a child who was exposed to one language at home and a bilingual child was defined as a child who was exposed to Spanish and English in the home. The researchers reviewed neurodevelopmental evaluations conducted at a university-affiliated developmental center over 10 years. The data included information from a DSM-IV checklist completed at the time of the child's evaluation that measured ASD social characteristics, as well as stereotyped and repetitive motor mannerisms. Multivariate logistic regressions indicated that there were no significant differences between the two groups regarding peer relationships, social interaction, nonverbal behaviors, sharing, and social-emotional reciprocity. Regarding stereotyped and repetitive behaviors, the parents of bilingual children reported significantly higher amounts of stereotyped and repetitive language use than were reported by the parents of monolingual children (p = .002). These results suggest that bilingual language exposure does not present additional challenges for the social interactions of young children with ASD, but more research is needed to understand the differences in the reported amounts of stereotyped and repetitive language use of monolingual and bilingual children with ASD.

Finally, Sendhilnathan and Chengappa (2020b) compared the effects of a language intervention on cognitive, social communication, and social skills of 40 young children (i.e., 4 – 6 years of age) living in Singapore. All of the children had a diagnosis of ASD and were receiving speech and language therapy. The children were either monolingual English speakers (n = 20) or bilingual speakers of English and either Mandarin, Malay, or Tamil. Families completed background information forms that included a report on language usage. Based on parent report on the background information form, the authors defined a monolingual speaker as a child who used English over 80% of the time across settings and a bilingual speaker as a child who used at least one other language over 20% of the time across settings. The children were administered the Assessment, Evaluation and Programming System for Infant and children (AEPS) checklist (Bricker, 2002) to measure their social skills. In this pre-post design, the T-tests indicated that both groups made significant gains in their social skills over time but that there were not significant differences between the monolingual and bilingual groups in regard to their social skills, indicating the bilingualism did not impede the social skill development of children with ASD. In conclusion, the research on the relationship between bilingualism and social skills of children with ASD is understudied, but the few studies that have been conducted indicate that bilingualism does not intensify the social skill difficulties that children with ASD experience.

Communication Development

Communication skills include receptive and expressive language skills that begin to develop in utero (e.g., Minai et al, 2017) and are shaped by the environment in which a child is reared in (Golinkoff et al., 2019). Most humans reared in social environments acquire varying proficiencies in one or more languages (Hoff, 2015b). In brief, language development includes the comprehension and production of sounds (i.e., phonology), words (i.e., lexicon), and grammar (i.e., morphology and syntax) of any given language(s) that are used in a socially functional and competent manner when speaking with others (i.e., pragmatics). Before uttering their first words, infants develop several early social communication skills that they use to engage with their caregivers and learn about the formal properties of language. Examples of early social communication skills and abilities that are empirically established to be precursors of expressive language skills include joint attention (see Hoff, 2006) and gesturing (see Hoff, 2015b). Research has shown that the age of onset, along with, the quantity and quality of linguistic input significantly influence a bilingual child's overall development (e.g., Hammer et al., 2014).

The quantity and quality of linguistic input a young child is exposed to positively influences the linguistic, cognitive, and academic development of children throughout their development (see Golinkoff et al., 2019). Research has found that the greater amount of words a child with ASD is exposed to, the larger the child's expressive vocabulary size tends to be. For example, Gonzalez-Barrero and Nadig (2018) found that the amount of language exposure young school-age children with and without ASD were exposed to was the strongest predictor of vocabulary and grammar skills for both monolingual and bilingual Canadian children with and without ASD. These findings support other literature that has found that the quantity of linguistic exposure positively predicts expressive language skills of bilinguals with ASD (Hambly & Fombonne, 2014). A small study by Smith and colleagues (2020) found that monolingual and bilingual/trilingual parents of children 2 to 6 years of age with ASD had similar frequency and speed of responsiveness to their child’s verbal communication in recorded play sessions, which indicates that both monolingual and bilingual/trilingual parents of children with ASD respond similarly to their children in play situations. Unfortunately, bilingual or non-English speaking parents of children with ASD may be generally advised to refrain from speaking their home language(s) with their children with ASD (Drysdale et al., 2015), which may explain why bilingual children experience a sharp decrease in the amount of L1 input that they are exposed to immediately following a diagnosis of ASD (Fernandez y Garcia et al., 2012; Yu, 2013). This is especially concerning if the non-English speaking parent has limited or no English proficiency because the child with ASD will suffer from linguistic input deprivation of both languages (i.e., English and home language; Yu, 2013).

Children with ASD tend to have significant delays in receptive and expressive language development and these delays significantly impact their functioning (Tager-Flusberg et al., 2005). For example, children with ASD tend to reach language developmental milestones significantly later than their neurotypical peers, and some children with ASD may not reach some milestones at all (Lord et al., 2004). Despite these challenges, research suggests that bilingualism does not intensify the language difficulties of children with ASD (e.g., Dai et al., 2018; Petersen et al., 2012; Zhou et al., 2019). This section reviews research on the influence of bilingual language exposure on the development of communication skills in young children with ASD.

Communication Skills of Bilingual Children with ASD

The research on the communication skills of bilingual children with ASD and other DDs yields mixed results. These mixed results may be due to differences in the specific phenomena examined (e.g., expressive or receptive language skills; vocabulary or grammar) or methodological limitations. The studies have included both direct (e.g., observations and standardized assessments) and indirect (e.g., parent report surveys) measures of language skills. Several research studies have found no significant differences in language abilities of monolingual and bilingual children with developmental disorders (see Beauchamp & MacLeod, 2017), including the skills of children with ASD (e.g., Hambly & Fombonne, 2012; Zhou et al., 2019). Other studies have found that bilingual toddlers with ASD tend to outperform their peers in early social communication skills, such as, gesture production and vocalizations (e.g., Valicenti-McDermott et al., 2013). In addition, a systematic review of the language development children with ASD by Lund et al. (2017) analyzed the findings of 7 studies that compared that language skills of young monolingual and bilingual children with ASD. The researchers found that the receptive and expressive language skills of young children with ASD varied in the studies but that overall, there were no adverse outcomes associated with bilingualism in the early development of young children with ASD. This section provides a review of the 15 studies that have compared various language skills of bilingual and monolingual children with ASD. The sample sizes in these studies range from 15 (Sen & Geetha, 2011) to 1061 (Chaidez et al., 2012), with all but four (Dai et al., 2018; Iarocci et al., 2017; Chaidez et al., 2012) having sample sizes under 80. In this section, the studies comparing the language skills of monolingual and bilingual children with ASD are reviewed in chronological order. First, this section reviews studies that have found that bilingual children with ASD experience no additional challenges in language development, followed by studies that have found statistically significant advantages for bilingual children with ASD compared to their monolingual peers. Finally, this section reviews a study that found statistically significant disadvantages for bilingual children with ASD compared to their monolingual peers.

Research Suggesting No Communication Skill Differences between Monolinguals and Bilinguals with ASD. First, in a study set in India, Sen, and Geetha (2011) examined the semantic and morpho-syntactic skills of 15 children with ASD between the ages of four to ten years of age. The participants had average cognitive abilities, a diagnosis of mild-moderate ASD, and an expressive vocabulary size of at least one word. The monolingual participants were exposed to either Hindi (n = 5) or English (n = 5). The bilingual Hindi-English participants (n = 5) were reported as having exposure to both languages since 15 months of age or younger. To measure their language skills, the children were administered the Semantics and Syntax sections of the Linguistic Profile Test - Hindi (Suchithra & Karanth, 1990) and the English Language Testing for Indian Children (ELTIC; Bhuwaneshwari, 2009). The Linguistic Profile Test - Hindi is a standardized measurement of receptive Hindi phonology, syntax, and semantics in which the participant analyzes the morphophonemic structures, plural forms, tenses, case markers, transitive causatives, intra-transitive causatives, sentence types, predicates, conjunctions, comparatives, conditional clauses, and principal constructions of the Hindi language. The ELTIC is an assessment originally developed for use in a dissertation by Bhuwaneshwari (2009) that yields domain scores for English Expressive Language, English Comprehension, English Semantics, and English Syntax. The children were matched for socio-economic status (SES). The results of Wilcoxon Tests found that there were no statistically significant differences between the monolingual and bilingual groups in semantics and syntax skills. Although the sample size is small, this study provides initial evidence that bilingual language exposure does not magnify the language difficulties that children with ASD experience.

In another study, Hambly and Fombonne (2012) examined the adaptive, social, and language skills of 75 children with ASD who were living in monolingual (*n* = 30) or bilingual (*n* = 45) environments. In this study, a monolingual child was defined as a child exposed to one language at home and other settings (e.g., daycare) and a bilingual child was defined as a child exposed to two or three languages in various settings (e.g., home, daycare). The bilingual children were identified as having received simultaneous (*n* = 24) or sequential (*n* = 21) bilingual exposure. At the time of testing, the children were between 36-78 months old (*M* = 56 months). To measure their language skills, the children were administered the Vineland-II Communication Scale, which yields a total Communication domain score, as well as Receptive Language and Expressive Language subdomain scores. The researchers also interviewed the parents using the Language Environment Interview (Hambly & Fombonne, 2012). The researchers conducted one-way ANOVAs and found no significant language skill differences for children in any group. These findings suggest that simultaneous or sequential bilingual language exposure does not further delay the acquisition of language skills for young children with ASD.

In another study, Ohashi and colleagues (2012) compared the functional communication skills, and receptive and expressive language abilities of 20 bilingual children with ASD and 40 monolingual children with ASD. In this study, bilingual children lived in homes where they were exposed to two languages and monolingual children lived in homes where they were exposed to one language. The participants were matched for age and nonverbal IQ. Their ages ranged from 24 to 52 months Old. To measure their functional communication and receptive and expressive language skills, the children were administered the Words and Sentences scale of the MacArthur-Bates Communicative Development Inventory (MCDI; Fenson et al., 2007), Preschool Language

Scale (PLS; Zimmerman, Steiner, & Pond, 2002), and Vineland-II Communication Scale. Using the MCDI, parents report a young child's use of gestures and vocabulary over the past week. The researchers conducted a series of univariate ANOVAs and multivariate analyses of covariance (MANCOVAs) that controlled for the number of speech-language and applied behavior analysis intervention hours. The analyses found that the monolingual and bilingual groups were not statistically different from each other on any language measure, including age of first words and age of first phrases. These results provide support for the notion that bilingualism does not delay the language development of children with ASD.

In another study, Reetzke, Zou, Sheng, and Katsos (2015) indirectly examined the grammatical and pragmatic language skills of Chinese children with ASD exposed to one (*n* =31) or two (*n* = 23) languages. The children were exposed to at least one of the following languages: Mandarin, Cantonese, Yue, Hakka, Xiang, or Southern Min. Exposure to two languages was defined as having at least 20% of lifetime linguistic exposure in an L2. The participants were children 31 to 52 months old that were considered verbal (i.e., spoke using one-word phrases, at least). To measure the children's grammar and pragmatic language skills, the parents completed the SRS and the Children's Communication Checklist–Second Edition (CCC-2; Bishop, 2006). The parents also were interviewed using the Language Environment Interview (Hambly & Fombonne, 2012). The researchers conducted MANOVAs, which found that both the bilingual and monolingual groups performed similarly in all measures. Although both the monolingual and bilingual groups performed low on these measures, the findings indicate that compared to monolingual children with ASD, bilingual language exposure did not result in additional difficulties in a bilingual child's grammatical and pragmatic language skill development.

Dai, Burke, Naigles, Eigsti, and Fein (2018) investigated the effects of language exposure on the receptive and expressive language skills of 388 toddlers (74% male) with ASD ($n = 233$) or DD ($n = 155$). The children were grouped into either a monolingual ($n = 282$) or bilingual ($n = 106$) language exposure group. In this study, monolingual children were those who were only exposed to English in the home and bilingual children were regularly exposed to two languages in the home. There were over 25 non-English languages reported by the participants, but the majority of the bilingual children were exposed to English and Spanish. The children were part of a larger study on the early identification of developmental disorders. At the time of testing the children had a median age of 26 months. To measure their language skills, the children were administered the Receptive Language and Expressive Language domains of the MSEL. The authors conducted a series of chi-square tests of independence and linear regressions for each MSEL domain. The analyses found that children with ASD were significantly behind their peers with DD in language development, but did not find significant differences between monolingual and bilingual children in each disability group. The results indicate that the language challenges that children with ASD and DD were not intensified by bilingual language exposure.

One study that compared parent-reported language skills of monolinguals and bilinguals with ASD is Zhou et al. (2019). As part of a larger longitudinal randomized control trial on the effects of early behavioral intervention, Zhou et al. (2019) examined a small subset of the sample to investigate the relationships between monolingual ($n = 24$) versus bilingual language ($n = 13$) exposure in the home and language skills of infants and toddlers with ASD. The children were living in high-income homes that provided either monolingual English or bilingual language exposure in Chinese, English, German, Hindi, Japanese, Portuguese, Romanian, Spanish, Tigrinya, Ukrainian, or Vietnamese. The participants were assessed at three timepoints: baseline, one year after intervention start, and two years after intervention start. The participants were between eight and 30 months old at baseline. All participants in Zou et al. (2019) were matched for nonverbal IQ scores and randomly assigned to the intensive early intervention group. Throughout the study, they received individualized applied behavior analysis treatment plans delivered in English that targeted social communication skills, joint attention, social interaction, adaptive skills, play routines, and motor skills. To measure their language skills, the children were administered the Vineland-II Communication Scale and the MCDI at each timepoint. The researchers compared the groups using T-tests at the three timepoints. At baseline, there were no significant differences between the two groups on the Vineland-II Communication Scale. There were significant differences at baseline for total gestures ($p = .0413$) on the MCDI with children raised in bilingual environments demonstrating a disadvantage in the number of gestures used during testing compared to their monolingual peers. There were no significant differences between the two groups on either the Vineland-II or the MCDI at both intervention timepoints. The researchers also examined the effect of language exposure on social and communication outcomes using multivariate regression and found that the language skills of both groups greatly and equally benefited from the individualized interventions. The regressions also indicated that bilingual children exhibited a greater amount of gesture growth throughout the course of intervention as compared with the monolingual English group. Although it has a small sample size, this study suggests that quality early intervention for bilingual children produces significant language growth and that bilingual language exposure during early intervention does not negatively impact early intervention services nor does it increase the communication challenges that children with ASD face.

In addition, Sendhilnathan and Chengappa (2020a) compared the vocabulary and mean length of utterance (MLU) of monolingual (n=20) and bilingual (n=20) children with ASD aged between 4 and 6 years of age in Singapore after a 6-month language intervention. The monolingual children spoke English and the bilingual children spoke English and either Mandarin, Malay, or Tamil. The researchers used T-tests to compare the vocabulary and MLU of the two groups before and after the intervention. They found that both groups of children with ASD significantly increased their vocabulary after the intervention. There were no differences between the monolingual and bilingual children with ASD in regard to their vocabulary or MLUs indicating that bilingualism did not negatively influence the children's growth in language skills after intervention.

In addition to the social skills described in the section above, Sendhilnathan and Chengappa (2020b) investigated the effects of a language intervention on cognitive, social communication, and social skills of 40 young children (i.e., 4 – 6 years of age) with ASD living in Singapore. All children in the study spoke English and the bilingual children also spoke Mandarin, Malay, or Tamil. Using parent report on a background form, the authors defined a monolingual speaker as a child who uses English over 80% of the time across settings, and a bilingual speaker as a child who used at least one other language over 20% of the time across settings. In this pre-post design, the T-tests indicated that both groups made significant gains in their social communication skills, as measured by the AEPS, over time but that there were not significant differences between the monolingual and bilingual groups in regard to their social communication skills, indicating the bilingualism did not impede the social communication development of children with ASD.

Lastly, Meir and Novogrodsky (2020) examined the verbal memory and sentence structure (i.e., syntactic) abilities of 86 school-aged children between 4 and 9 years of age. The researchers evaluated the performance of monolingual Hebrew-speaking children and Hebrew-Russian speaking bilingual children with (n=28) and without (n=58) ASD on the Hebrew and Russian LITMUS Sentence Repetition task (Marinis & Armon-Lotem, 2015). The participants either had no parent-reported developmental disorders or were diagnosed with high-functioning ASD as assessed using the Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2000). Two-way ANOVAS indicated that overall, the children with ASD scored lower than their TD peers on the syntactic ability tasks, which is expected. The results also indicated that monolingual and bilingual children with ASD scored similarly on the sentence repetition tasks indicating that bilingualism did not negatively influence the syntactic abilities of children with ASD. The results of the memory tasks are described in the Cognitive Development section below.

Research Suggesting a Bilingual Advantage for Communication Skills. In one small-scale study, Petersen, Marinova-Todd, and Mirenda (2012) investigated the language skills, including lexical comprehension and production, of bilingual and monolingual children with ASD. The participants included preschoolers with ASD who were identified as either monolingual English speakers (*n* = 14) or English-Chinese bilinguals (*n* = 14) between the ages of 43 to 73 months old (*M* = 59 months). In this study, monolingual children were exposed to English and the bilingual children were exposed to a Chinese language and English simultaneously before the age of three years. The Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1997), PLS, Mullen Scales of Early Learning (MSEL; Mullen, 1995), and MCDI were used to measure the children's language skills. The PPVT is a standardized assessment of a child's receptive vocabulary in various languages, including English and Chinese. The assessments were conducted over two sessions in the children's homes within 3 weeks. The MSEL is a standardized developmental assessment of cognitive, language, and motor skills of children from birth to 5 years, 8 months old. The researchers conducted a MANCOVA that controlled for non-verbal IQ, as well as a series of pairwise t-tests to compare the two groups. The results indicated that there were no significant differences between the groups on all but one measure. When controlling for non-verbal IQ, the bilingual group had a significantly larger vocabulary size compared to the monolingual group. These results add to the body of literature that documents no significant differences in language skills between monolinguals and bilinguals with ASD. The results also indicate that bilinguals may demonstrate a bilingual advantage for vocabulary size. Additionally, these findings support the literature base that has found that bilingual language exposure does not delay the acquisition of language skills for young children with ASD.

In another study, Valicenti-McDermott and colleges (2013) examined the expressive and receptive language skills of 80 toddlers under three years of age with ASD, of which half were only exposed to English in the home (i.e., monolingual) and the other half were exposed to both Spanish and English in the home (i.e., bilingual). The researchers reviewed the multidisciplinary evaluations of children diagnosed with ASD at a university-affiliated center in the northeastern United States over seven years. To measure their language skills, the children were administered the Rossetti Infant-Toddler Language Scale (Rosetti, 2006) by a bilingual speech-language pathologist. The Rossetti Infant-Toddler Language Scale is a criterion-referenced assessment that has six subtests (i.e., Interaction Attachment, Pragmatics, Gesture, Play, Language

Comprehension, and Language Expression) and measures preverbal and verbal language skills through both direct observation and parent-report in Spanish or English. The chi-squared and independent *t*-test analyses found no significant differences between the monolingual and bilingual groups on any domain scores, or specific receptive language items. However, the analyses yielded statistically significant advantages for the bilingual toddlers compared to the monolingual toddlers with ASD for several item-level expressive language and early social communicative behaviors, including cooing (p = .002), babbling (p = .05), pointing to objects (p = .02), showing objects (p = .09), giving objects to caregiver (p = .07), leading caregiver to desired objects (p = .04), feeding others (p = .05), appropriately responding to a high-5 (p = .05), and pretending to pour from a container (p = .05). Although the authors state that the results should be interpreted with caution due to the small sample size, these findings indicate that bilingual toddlers with ASD may have an advantage compared to their monolingual peers in discrete early social communication and expressive language skills.

In another small-scale study, Hambly and Fombonne (2014) examined the language and social skills of three to seven year old children (*Mdn* = 60 months) with ASD exposed to at least two languages (n = 33). All of the children had a minimum vocabulary of 50 words in at least one language so that short phrases could be expected from the children. The children were identified as non-bilingual (n = 10) if they had no L2 expressive vocabulary, low bilinguals (n = 11) if they had fewer than 69 words in an L2, and high bilinguals (n = 12) if they had 70 or more words in an L2. To measure their language skills, the children were administered the MCDI and the Vineland-II Receptive Language and Expressive Language subdomains of the Communication Scale. Additionally, the parents completed a language diary that documented the child's direct and indirect language exposure and language usage, as well as the child's communication partners and location during these interactions throughout the week. The data analyses included Chi-square tests of independence and a series of one-way ANOVAs. The researchers found that there were significant associations between L2 exposure and L2 language skills. The children who were exposed to greater amounts of the L2 were more proficient in the L2 than those who were exposed to smaller amounts of the L2 throughout the week. These findings align with research that has found that a greater amount of linguistic input results in stronger language skills of typically developing children (e.g., Hammer et al., 2014). The researchers also found that, similar to their typically developing bilingual peers, bilingual children with ASD with a stronger L1 vocabulary had a significantly larger L2 vocabulary compared to low bilinguals or non-bilinguals with ASD. Additionally, highly bilingual children with ASD scored higher on the Vineland Expressive Language scale compared to low bilinguals or non-bilinguals with ASD. The results of Hambly and Fombonne (2014) add to the empirical literature that has found that young children with ASD are able to acquire bilingual language proficiencies without putting their overall language development at-risk. Additionally, these results provide evidence that despite the clearly documented language delays that children with ASD experience, bilingual children with ASD follow similar language acquisition patterns as their typically developing peers.

In another study, Iarocci and colleagues (2017) compared the functional communication and executive function (EF) skills of monolingual (n = 76) and bilingual children (n = 98) between 6 and 16 years of age with (n = 91) and without (n = 83) ASD. In this study, a monolingual child is defined as a child who is exposed to only one language in the home and a bilingual child is defined as a child who is exposed to two languages in the home. The researchers controlled for IQ by ensuring that the IQ scores of all participants were in the average range. To measure their functional communication skills, the parents completed the Functional Communication subscale of the Behavior Assessment System for Children-Second Edition Parent Report Scale (BASC-2 PRS; Reynolds & Kamphaus 2002). The BASC-2 PRS requires parents to rate 160 items using a 4-point scale and yields norm-referenced T-scores for each subscale. The Function Communication subscale measures how well a child uses expressive and receptive language skills in a socially functional manner (e.g., seek out new information, describe feelings, respond to questions). A low score on this subscale indicates that the child struggles with using language functionally in everyday situations. The analyses indicated that there were no significant differences in parent reported functional communication skills between the monolingual and bilingual groups with and without ASD. The researchers found that both groups of children with ASD had low functional communication scores, but that children in the bilingual group with ASD were less likely than children in the monolingual group with ASD to score in the clinically significant range for the Functional Communication subscale. These results provide further support that bilingualism in children with ASD does not intensify their struggles with language skills. Furthermore, the results suggest that monolingual children with ASD may have intensified functional communication difficulties compared to their bilingual peers with ASD.

Hoang, Gonzalez-Barrero, and Nadig (2018) compared the size and depth of vocabulary and expressive and receptive grammatical skills of 10 monolingual and 10 bilingual school-age children with average nonverbal IQ scores. In this study, monolingualism was defined has having less than 20% of L2 exposure in their life history and bilingualism was defined as having a history of at least 20% of language input in an L2 and demonstrating a high proficiency score in each language. Half of each group had ASD and the other half were considered typically developing. All of the children spoke Quebec French and were participants of a larger study examining the language skills of children with ASD. To measure their receptive language skills, the children were administered the *Échelle de vocabulaire en images Peabody* (EVIP; Dunn, Theriault-Whalen, & Dunn, 1993), which requires youth six to eighteen years of age to identify which of four pictures best represents the meaning of a word uttered by the examiner. To measure their expressive language skills, the children were tasked with sequencing sets of three picture cards and tell a story about the scenario that the cards depict (e.g., a child baking a pie, a child building a sandcastle). This narrative was used to analyze their language skills and the researchers recorded the number of utterances, number of words, correct sequencing of events, number of events described, coherence between the events, use of grammatical gender, use of connectives, character introductions, and maintenance of referential terms that the children produced. The researchers conducted a series of ANOVAS to compare the diagnostic and language proficiency groups for each outcome measure. They found that although children with ASD performed generally worse compared to typically developing children on the language measures, bilinguals with ASD performed more similarly to their bilingual peers without ASD (i.e., small effect size between both groups of bilinguals) than did the monolinguals with ASD compared to monolinguals without ASD (i.e., very large effect size between both groups of monolinguals) for microstructure aspects of their narratives (i.e., character introductions, maintenance of referential terms, grammatical gender, connectives). Overall, the analyses indicated that the bilingual children produced significantly more utterances than did monolingual children ($p = .03$). The researchers also found that bilinguals with ASD had a smaller French receptive vocabulary compared to French-speaking monolinguals with ASD ($p = .05$), which is not surprising given that French was the L2 for many of the bilingual children with ASD. Despite having a smaller receptive French vocabulary, the bilinguals with ASD did not score differently compared to their monolingual peers with ASD on any of the production measures. There were no other significant differences between the monolingual and bilingual groups with ASD, indicating that bilingualism did not negatively impact the vocabulary or grammatical language skills of children with ASD. These findings align with current empirical literature that has found benefits of bilingualism and research that has not documented adverse language outcomes for bilinguals with ASD.

Additionally, a study by Peristeri and collogues (2020) compared that the executive functioning and narrative story-telling skills of school-aged (i.e., 7 to 12 years of age) monolingual and bilingual children with (n=40) and without (no=40) ASD in Greece. The children were administered the Edmonton Narrative Norms Instrument (ENNI; Schneider et al., 2005) to measure their microstructural and macrostructural narrative production in a story-telling task. The ANOVAs, MANCOVAs, and post-hoc analyses performed indicated that bilingual children with ASD told significantly more complex stories with significantly more adverbial clauses and significantly fewer ambiguous references compared to the monolingual children with ASD. This study provides further evidence of a bilingual advantage in expressive language skills of children with ASD.

Research Suggesting a Bilingual Disadvantage in Communication Skills. Chaidez and colleagues (2012) investigated the adaptive and language skills of two- to five-year-old children (n = 1061) who were categorized as either monolingual or bilingual, as well as Latino or non-Latino. In this study, a monolingual child was defined as a child exposed to one language in the home and a bilingual child was defined as a child exposed to two languages in the home.

Approximately 25% of the non-Latino and 67% of the Latino children were bilinguals and were compared to the monolingual Latino or non-Latino children. The sample consisted of typically developing children, as well as children with ASD or a developmental delay (DD) in each language group. Expressive and receptive language skills were measured using the Receptive and Expressive Scales of the MSEL and the Vineland-II Communication scale. Multivariate regression analyses indicated that L2 exposure for 25–50% time for a typically developing child or child with ASD was significantly associated with lower expressive and receptive language subscale scores. Differences in the Vineland-II Communication scale scores between monolinguals and bilinguals were not reported. There were no significant differences in MSEL scores between monolinguals and bilinguals with DD, but there were differences between the monolingual and bilingual groups with ASD on receptive (p = 0.08) and expressive (p = .004) language skills. These findings contradict previous findings on the nonsignificant effects of bilingualism on language development and indicate that bilingualism may have negatively affected their language development. However, this study also found that bilingualism had negative effects on the receptive (p = .0002) and expressive ($p < 0.0001$) language skills of typically developing children. These findings have not been supported in the literature and may be due to methodological limitations in the data set. For example, the Latino group was more likely to have lower socio-economic resources and a larger number of bilingual children so the MSEL may be unintentionally measuring social factors related to socio-economic status or ethnicity instead of bilingualism.

Summary of Communication Development Research. In conclusion, research findings to date are mixed but most studies do not indicate that bilingualism has adverse effects on the language development of children with ASD. Given that individuals with ASD struggle with functional communication skills, it is especially important to note that research indicates that bilingual children with ASD do not have intensified functional communication challenges (Ohashi et al., 2012; Iarocci et al., 2017). Some studies have found a bilingual advantage for children with ASD, which reflects child development research for typically developing children. Studies that have found a bilingual advantage for children with ASD typically included preschool and school-age children so research is needed to examine if there is a bilingual advantage earlier in childhood. To the author's knowledge only one study has found adverse effects of bilingualism on the language development of children with ASD (i.e., Chaidez et al., 2012). Given that the Chaidez et al. findings do not align with previous research on bilingual development of typically developing children, these results should be interpreted in light of the methodological design of the study. However, it is important to note that Chaidez et al. (2012) had the largest sample size of all studies in the current literature review. More research is needed to understand the relationship between bilingualism and language development of children with ASD.

Cognitive Development

Cognitive skills include the thinking abilities needed for everyday functioning and goal-oriented problem solving (Gonzalez-Barrero & Nadig, 2017). Cognitive skills include inhibition, planning, cognitive flexibility (i.e., set-shifting), and working memory (Gioia et al., 2002). For older children and adults, cognitive skills are traditionally measured with standardized IQ tests. Cognitive skills in infants and toddlers are usually measured using standardized assessments in play situations. For infants and toddlers, cognitive skills are defined as learning, thinking, and problem-solving skills that children develop as they interact with their environments (CDC, n.d.). Measures of cognitive skills in early childhood focus on attention, memory, problem solving (i.e., reasoning), and conceptual knowledge. Examples of cognitive skills that children typically develop before their second birthday include locating objects hidden under two or three covers, sorting basic shapes and colors, reciting parts of sentences and rhymes in familiar books or songs (i.e., memory), playing simple imaginative games, building towers of 4 or more blocks, following two-step directions, and expressively identifying common items in a picture book (CDC, n.d.). Cognitive development occurs in response to and from environmental input in a child's everyday life. However, the severity of presenting ASD symptoms influences how children with ASD are able to process the learning opportunities in the environment around them (Vivanti et al., 2013). The less that the child takes in from the environment, the greater the risk of developing an Intellectual Disability (ID; Vivanti et al., 2013). Research has found that the cognitive skills of children with ASD tend to be significantly lower than the cognitive skills of typically developing children (Granader et al., 2014; Pellicano, 2010). By five years of age, children with ASD have been documented to be significantly behind their typically developing peers in their development of theory of mind, EF, central coherence, false-belief attribution, planning ability, and cognitive flexibility (Pellicano, 2010).

As many as 65% of individuals with ASD have significant cognitive skill delays that meet the diagnostic criteria for an ID (Dykens & Lense 2011). Children with ASD without significant cognitive delays are more likely to make positive social, language, and adaptive skill growth compared to their peers with ASD with ID (see Howlin, 2005). Furthermore, research has found that regardless of their cognitive skills at initial assessments, children with ASD with lower initial functioning scores were at greater risk for significant future cognitive delays compared to their peers with higher initial functioning scores (Vivanti et al., 2013). Understanding the cognitive development of bilingual children with ASD is important given that the presence or absence of ID for an individual with ASD is the strongest predictor of social and functional outcomes (Howlin et al., 2004). The following section reviews research on the development of cognitive skills in young bilingual children with ASD.

Cognitive Skills of Bilingual Children with ASD

Cognitive advantages for typically developing bilinguals compared to monolinguals have been documented in infants as young as 6 months (e.g., Brito & Barr, 2014; Singh et al., 2015;). Specifically, research has found that young bilinguals tend to outperform monolinguals in certain executive functioning tasks (Barac et al., 2014; Crespo et al., 2019). However, research comparing the cognitive skills of bilingual and monolingual children with ASD is limited and has yielded mixed results. Some research studies have found no significant differences in cognitive abilities of monolingual and bilingual children with ASD (e.g., parent report measure of EF; Gonzalez-Barrero & Nadig, 2017). Other findings indicate that bilingual children with ASD tend to outperform their peers in certain cognitive skills, such as, cognitive flexibility (e.g., card sorting task; Gonzalez-Barrero & Nadig, 2017) and executive functioning (Iarocci et al., 2017). In this section, five studies comparing the cognitive skills of monolingual and bilingual children with ASD are reviewed.

In one study, Gonzalez-Barrero and Nadig (2017) examined cognitive flexibility (i.e., set-shifting) and working memory skills of bilingual and monolingual children aged 6 to 9 years of age living in Canada (n = 40). In this study, a bilingual child was required to have an expressive vocabulary of at least 30 words in each language. Half of the children were typically developing, and the other half had a diagnosis of ASD. To measure their cognitive flexibility skills, the children completed a dimensional change card sort (DCCS) task on a computer. To measure their working memory, the children were administered the number repetition subtest of the 4th edition of the Clinical Evaluation of Language Fundamentals (CELF–IV; Semel, Wiig, & Secord, 2003), as well as the French (*Évaluation clinique des notions langagières fondamentales*; Wiig et al., 2009) or Spanish (CELF–IV Spanish Edition; Semel, Wiig, & Secord, 2006) version. Additionally, the parents reported on their child's set-shifting and working memory skills using the parent scale of the Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia et al., 2000) in English, French, or Spanish. The researchers conducted a series of two-way ANOVAS (i.e., Diagnostic group by language status) for each of the outcome variables (i.e., cognitive flexibility and working memory scores from the BRIEF, DCCS RTs, and CELF). The results indicated that the bilingual children with ASD performed significantly better than monolingual children with ASD on the DCCS set-shifting task, but not for the parent-reported cognitive flexibility skills. There were no differences in working memory for the bilingual and monolingual groups. These results are consistent with other research findings documenting enhanced sorting task skills for typically developing bilingual children compared to their monolingual peers (Barac et al., 2014). These findings indicate that bilingualism does not have adverse effects on the cognitive development of children with ASD and may be a promotive factor in the development of cognitive flexibility in children with ASD.

In another study, Iarocci et al. (2017) compared the functional communication and EF skills of school-aged (i.e., 6-16 years of age) monolingual (*n* = 76) and bilingual (*n* = 98) children with (*n* = 91) and without (*n* = 83) ASD. All of the participants had IQ scores that fell within the average range. In this study, a monolingual child is a child who is exposed to only one language in the home and a bilingual child is a child who is exposed to two languages in the home. The researchers controlled for IQ and SES. To measure their EF skills, the parents completed the Executive Function subscales of the BASC-2 PRS, which measures self-regulation skills, such as how well a child is able to control, plan, inhibit, or maintain their behavior, as well as how appropriately a child reacts to environmental feedback. The analyses indicated that the parents' reports of EF were not significantly different for the monolingual and bilingual groups. The researchers found that both groups of children with ASD had low Executive Functioning subscale scores, but that children in the bilingual group with ASD were less likely than children in the monolingual group with ASD to score in the clinically significant range for the Executive Functioning subscale. Compared to their monolingual peers with ASD, a lower percentage of bilingual children's Executive Functioning subscale scores fell within the clinically significant range. These results indicate that bilingualism in children with ASD does not intensify their cognitive skill challenges. Furthermore, the results of Iarocci et al. (2017) suggest that bilingual children with ASD may experience a lower intensity of EF difficulties compared to their monolingual peers with ASD.

In a recent study by Peristeri and collegues (2020), the executive functioning and narrative story-telling skills of school-aged monolingual and bilingual children 7 to 12 years of age with (n=40) and without (no=40) ASD were examined. The children were administered visual attention task and working memory tasks. A series of ANOVAs, MANCOVAs, and post-hoc analyses were completed and indicated that bilingual children with ASD outperformed their monolingual peers on the visual attention task and working memory tasks. On both tasks, bilingual children with ASD were significantly faster and more accurate, demonstrating a bilingual advantage in these executive functioning tasks.

In addition, Sendhilnathan and Chengappa's (2020b) study also investigated the difference in cognitive skills, as measured by the AEPS, between monolingual and bilingual young children (i.e., 4 – 6 years of age) with ASD living in Singapore. Half of the children were monolingual English-speakers (n=20) and the other half were bilingual (n = 20) speakers. The investigators defined a monolingual speaker as a child who used English over 80% of the time across settings and a bilingual speaker as a child who used at least one other language over 20% of the time across settings according to parent report. The children were administered the AEPS before and after the language intervention. In this pre-post design, the T-tests indicated that both groups made significant gains in their cognitive skills over time but that there were not significant differences in cognitive skills between the monolingual and bilingual groups, indicating the bilingualism had no effect on the measured cognitive skills of children with ASD.

Finally, Meir and Novogrodsky (2020) investigated the verbal memory and language of 86 school-aged children with and without ASD. The researchers compared the performance of monolingual Hebrew-speaking children and Hebrew-Russian speaking bilingual children on the Wechsler Intelligence Scale for Children (Wechsler, 1991) Hebrew Forward and Backward Digit Span. At the time of testing, the children were between 4 and 9 years of age. The typically developing children (n=58) had no parent-reported developmental delays or disorders and the children with ASD (n=28) were considered high-functioning as assessed using the Autism Diagnostic Observation Schedule (ADOS, Lord et al., 2000). Two-way ANOVAS indicated that overall the children with ASD scored lower than their TD peers on the verbal memory tasks. The results also indicated that monolingual and bilingual children with and without ASD scored similarly on the memory tasks indicating that bilingualism did not negatively influence the verbal memory of children with ASD.

In conclusion, the research on the relationship between bilingualism and cognitive skills of young children with ASD is not yet fully understood, but the studies that have been conducted indicate that bilingualism does not intensify the cognitive skill difficulties that children with ASD experience, and, in fact, may provide the bilingual child with ASD some cognitive advantages, similar to their typically developing bilingual peers.

Conclusion

In summary, as the rates of bilingualism and ASD increase in the United States, it is important for clinicians to understand the developmental trajectories of young bilingual children with ASD. Given the expected growth of bilingualism and the ASD population in the United States, research is needed to better understand how to help children with ASD. Research on the influence of language exposure on the adaptive, social, communication, and cognitive developmental trajectories of bilingual children with ASD is emerging and has yielded mixed results. Although some studies have found significantly lower skills in bilingual groups compared to monolingual groups, the results of most of the studies that have compared the development of monolingual and bilingual children with ASD have consistently indicated that simultaneous and sequential bilinguals with ASD develop adaptive, social, communication, and cognitive skills at the same rate that their monolingual peers do. In fact, there is emerging evidence that young bilingual children with ASD may have enhanced adaptive (e.g., Valicenti-McDermott et al., 2013), social (e.g., Hambly & Fombonne, 2012), language (e.g., Petersen et al., 2012), and cognitive (e.g., Iarocci et al., 2017) skills compared to their monolingual peers. Previous studies of the early development of bilinguals with ASD tend to have small sample sizes and focus only on one or two domains of early childhood development. Furthermore, the interpretation and generalization of these results is difficult due to the inconsistent definitions of bilingualism and lack of longitudinal data (Lim et al., 2018). Research on the global development of bilingual children with ASD is underrepresented in the ASD literature. There is a great need for understanding the influence of bilingual language exposure on the global development of children with ASD, as well as how to improve the outcomes of bilingual children with ASD who may face different challenges than monolingual children with ASD encounter in school, community, and therapy.

Chapter 3: Methods

This chapter presents the methods and procedures used in this study. First, the research questions are presented, followed by a description of setting and participants. Next, information regarding the ethical considerations, variables, and data collection procedures used are discussed. Finally, the study's design and statistical analyses are presented.

Research Questions

To examine the association between a child's language exposure (i.e., monolingual or bilingual) and the global development of toddlers with ASD, the following research questions were addressed using reviews of evaluations conducted for toddlers with ASD:

1. To what extent is language exposure (i.e., monolingual or bilingual) related to the **adaptive skills** of infants and toddlers with ASD as measured by the BDI-2 when controlling for sex (i.e., male or female)?
2. To what extent is language exposure (i.e., monolingual or bilingual) related to the **social skills** of infants and toddlers with ASD as measured by the Battelle Developmental Inventory-2nd Edition (BDI-2) when controlling for sex (i.e., male or female)?
3. To what extent is language exposure (i.e., monolingual or bilingual) related to the **communication skills** of infants and toddlers with ASD as measured by the BDI-2 when controlling for sex (i.e., male or female)?

4. To what extent is language exposure (i.e., monolingual or bilingual) related to the **cognitive skills** of infants and toddlers with ASD as measured by the BDI-2 when controlling for sex (i.e., male or female)?
5. To what extent is language exposure (i.e., monolingual or bilingual) related to the following **discrete early communication skills** of toddlers with ASD as measured by the BDI-2 when controlling for sex (i.e., male or female)?
    a) Attending to someone speaking to him or her for at least 10 seconds
    b) Babbling
    c) Vocalizing
    d) Producing monosyllabic sounds
    e) Imitating speech sounds
    f) Using communicative gestures (e.g., pointing to request an item)
    g) Using 10 or more words
    h) Using two-word phrases

Setting

Part C of the Individuals with Education Act (IDEA) is a federal program that provides states with grant funding for statewide early intervention (EI) services for infants and young children under 36 months of age with disabilities (U.S. Department of Education, 2021). In 2018, IDEA Part C programs served 406,582 children birth through age two years with disabilities in the 50 states and the District of Columbia (3.5% of the U.S. population in that age group; United States Department of Education, 2021). In Florida, IDEA Part C is provided through Early Steps. Early Steps provides early intervention services to Florida infants and toddlers from birth to thirty-six months of age with significant developmental delays or established medical conditions that put a child at risk for a significant developmental delay (Early Steps, n.d.). In 2017, 15,616 infants and toddlers in Florida received Early Steps services (2.29% of the Florida population; United States Department of Education, 2019). Data on bilingual or ASD populations served through IDEA Part C nationwide or in Florida are not available. Early Steps EI services are provided in home or childcare settings. At the initial Early Steps eligibility evaluations, trained evaluators administer the Battelle Developmental Inventory- 2nd Edition (BDI-2), a standardized developmental assessment. Along with the child's medical and developmental history, the information from the BDI-2 is used to determine if the child is eligible for EI services through Early Steps. A child is eligible for Early Steps services if the child is determined to be experiencing significant developmental delays in at least one major child development domain (i.e., motor, social, adaptive, language, or cognitive skills) or has an established medical condition that puts the child at risk for a significant developmental delay (Early Steps, n.d.). Once a child is enrolled in the EI program, the family completes a Registration Form that includes a list of languages that the child is exposed to in any setting (e.g., home, daycare, close family member's home). At enrollment, an Individualized Family Support Plan (IFSP) is developed with individualized short-term and long-term goals to help the child meet appropriate developmental milestones. Before exiting the program at 36 months of age, the children are re-evaluated with the BDI-2 at approximately 33 months of age to determine the child's progress and developmental functioning at that time.

One Early Steps program in a large urban area in Florida agreed to participate in this study. This program serves approximately 5,700 infants and toddlers per year across two counties. Of those children, 2,200 children are actively receiving evaluation and EI services at any given time.

The children served by this program are identified as predominantly Hispanic (41%), White (23%), Black (15%), and Asian (3%). Approximately 18% of children were identified as of unknown or mixed racial origin and less than 1% of children were identified as Native Alaskan or Pacific Islander. Approximately 78% of the families served by the program receive public healthcare coverage through Florida Medicaid. In addition, as part of this program's ASD evaluation, the caregiver is asked "What language(s) do you (and other family members) use when speaking with your child?" This language exposure information is documented in the child's ASD evaluation report. The Principal Investigator contacted another Early Steps program in a large urban area in Florida about participating in the study. However, that program documents the primary language indicated by the family as indicated on the IFSP, but does not document the child's language exposure information. Due to the nature of the study, language exposure data capture was essential. Thus, only data from one Florida Early Steps program were used in the current study.

The Florida Early Steps program uses a coaching model to equip caregivers to support the child's development. In order to help these children meet their goals, a child development specialist visits the child at home or daycare for one hour on a weekly or biweekly basis. During these EI sessions, an interventionist works directly with the child and the caregivers to coach caregivers on best practices for supporting the child's progress toward the goals outlined on the IFSP. The interventions are overseen by case managers who ensure that the child's intervention program is progressing, as well as support the interventionists and caregivers in the EI implementation. Case managers and interventionists also provide caregivers with additional information, support, and screening for developmental concerns that arise throughout services. Children whose screeners indicate that they are at-risk for a medical or developmental condition are referred to appropriate specialists for further evaluation. One screener that is given at this Early Steps program is the Modified Checklist for Autism in Toddlers (M-CHAT-R; Robins et al., 2009).

If a child's score on the M-CHAT-R indicates a risk for ASD, the child is referred for a full diagnostic ASD evaluation. In this Early Steps program, the ASD evaluation is conducted by a multidisciplinary team led by a child psychologist. Most of the children evaluated for ASD at this Early Steps program are at least 24 months of age at the time of the evaluation, an age at which an ASD diagnosis is very reliable using gold-standard measures (Lord et al., 2006). During the ASD evaluation, the Autism Diagnostic Observation Schedule- Second Edition (ADOS-2; Lord et al., 2012) is administered with the child and a caregiver interview is conducted to understand the child's social, behavioral, developmental, and medical history. The ADOS-2 is a standardized measure of social interaction, communication, and play or imagination as demonstrated in a semi-structured play context. One of five modules is administered depending on the examinee's developmental level and language proficiency. Either the Toddler Module or Module 1 were administered to the children in their ASD assessment through this Early Steps program. Both of these modules include 10 play activities that are conducted with the child, and later coded to yield a score that may support a diagnosis for ASD. This full diagnostic ASD evaluation takes approximately two hours to complete, including time for a discussion of the results with the parents. The caregivers of the children who are diagnosed with ASD are provided with information and resources regarding the diagnosis at the end of the ASD evaluation. The family is provided with a full report that documents the ASD evaluation results and provides individualized recommendations for each child. The participants of the current study are toddlers who were identified as having ASD through the Early Steps program and are described in detail below.

Participants

Children

The participants in the present study include 30 toddlers with ASD enrolled in a Florida Early Steps program in a large urban area (see Table 1). The sample included both male (N=19) and female (N=11) toddlers. The children were between 31-35 months of age (*Mdn*= 33 months) and were being raised either monolingually (N= 21) or bilingually (N = 9). The monolingual children were only exposed to either English (N=18) or Spanish (N=3), and the bilingual children were exposed to English and one of the following languages: Hindi (N= 2), Japanese (N= 1), or Spanish (N= 6). At two years of age (i.e., 24-35 months), licensed psychologists in the Early Steps program diagnosed the children with ASD using a gold-standard ASD measure, the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2). The children received a Level 1 (N=10) diagnosis if they required support for deficits in social communication and restricted and repetitive behavior or a Level 2 (N=20) diagnosis if they required substantial support for marked deficits in social communication and restricted and repetitive behaviors. Racially, the children were identified as Black (10%), White (76.7%), Black and White (3.3%), or Asian (10%). Regarding their ethnicity, 43.3% were identified as Hispanic and 56.7% were identified as Non-Hispanic.

Chi-square of independence tests were conducted to compare the difference between the demographic characteristics of the monolingual and bilingual groups (see Table 1). The tests indicated that there were no significant differences between the monolingual and bilingual groups in Sex, ASD Level, Types of Other Diagnoses, and Ethnicity. Due to the small sample size, the calculations related to children with ASD Level, Speakers of English, Spanish, Hindi, or Japanese, children with a language or speech Delay, and children without a Global Developmental Delay Race, and Ethnicity failed an assumption of the Chi-square test of independence because they had expected values of less than 5. The variable frequencies indicated that there was less than 20% difference between the language groups for Sex, ASD Level, and Language Exposure to English, Spanish, and Japanese, indicating that the groups were not statistically different for these variables. In contrast, there was a 22.2% difference between groups with regard to Hindi language exposure, with 0% of monolinguals exposed to Hindi compared to 22.2% of bilinguals. Additionally, there was a significant racial composition difference between the groups with 14.3% Black in the monolingual group and 0% Black in the bilingual group, and 0% Asian in the monolingual group compared to 33.3% in the bilingual group.

Inclusion and exclusion criteria. To be included in this study, the children with ASD Level 1 or 2 must have been evaluated using the BDI-2 through Early Steps when they were between 30-36 months of age. For the purpose of this study, data from children with ASD Level 1 or 2 who were evaluated for ASD between October 2019 and February 2021 were included. This study did not limit the sample to speakers of certain languages so that bilingual children with ASD who were exposed to any two languages were included. This study excluded children who received an ASD Level 3 diagnosis, did not have a diagnosis of ASD, did not have language exposure data, and were not evaluated using the BDI-2 by Early Steps. Although two children with ASD Level 3 were assessed through the Early Steps program during the given timeframe, they were excluded from the study because the sample size was too low to analyze statistically. Additionally, there was concern that BDI-2 may not be sensitive enough to measure the skills of children with ASD Level 3, who experience more significant delays than their typically developing peers. According to the DSM-5, a child with ASD level 3 requires very substantial support because "severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others…

extreme difficulty coping with change, or other restricted/repetitive behaviors markedly interfere with functioning in all spheres." (APA, 2013, p. 52). These symptoms make it difficult to use a standardized early childhood measures in structured settings to capture the true skills of these children.

Variables

Independent Variable

The independent variable in the present study was dichotomous, the child's language exposure (i.e., monolingual or bilingual). Language exposure data were collected from the child's Early Steps Registration Form and/or ASD evaluation reports completed by Early Steps between October 2019 to February 2021.

Dependent Variables

The dependent variables in the present study were the child's adaptive, social, communication, and cognitive skills as measured by the Adaptive, Personal-Social, Communication, and Cognition domains of the Battelle Developmental Inventory-2nd Edition (BDI-2; Newborg, 2005). The BDI-2 domain scores provided a norm-referenced estimate as to the child's current development in each of the skill areas. Each domain is comprised of subdomains (see Table 2); however; only the three subdomains within the Cognitive Domain were included in data analyses. The BDI-2 domain and subdomain scores are continuous variables. Given that previous research has found significant differences in discrete early communication skills and milestones for monolingual and bilingual toddlers with ASD (e.g., Valicenti-McDermott et al., 2013), 8 items from the BDI-2 Communication domain were further analyzed. These items are categorical variables as they are scored 0, 1, or 2.

Table 1. *Child Characteristics*

Descriptions	Total (N= 30)	Monolingual (N= 21)	Bilingual (N= 9)	Chi-squared statistic
Gender				0.34 NS
Male	63.3%	66.7%	55.6%	
Female	36.7%	33.3%	44.4%	
ASD Level[a]				0.00NS
Level 1: Requiring Support	33.3%	33.3%	33.3%	
Level 2: Requiring Substantial Support	66.7%	66.7%	66.7%	
Language(s) Spoken[b]				
English	90.0%	85.7%	100%[a]	1.43 NS
Non-English Language	10.3%	14.3%	100%	
Spanish	13.3%	14.3%	11.1%	0.06 NS
Non-Spanish Language	86.7%	85.7%	100%	
Hindi	6.7%	0%	22.2%	5.0*
Non-Hindi Language	93.3%	100%	100%	
Japanese	3.3%	0%	11.1%	2.41 NS
Non-Japanese Language	96.7%	100%	100%	
Other Diagnoses				
Global or Mixed Developmental Delay	86.7%	85.7%	88.9%	0.06 NS
No Global or Mixed Dev. Delay	13.3%	14.3%	11.1%	
Speech or Language Delay/ Disorder	50.0%	52.4%	44.4%	0.16 NS
No Speech or Language Delay/Disorder	50.0%	57.6%	55.6%	
Race				8.88*
Black	10.0%	14.3%	0%	
White	76.7%	81.0%	66.7%	
Black & White	3.3%	4.8%	0%	
Asian	10.0%	0%	33.3%	
Ethnicity				2.85 NS
Hispanic	43.3%	33.3%	66.7%	
Non-Hispanic	56.7%	66.7%	33.3%	

Note. NS = Not statistically significant (p > .05); $*p < .05$, $**p < .01$, $***p < .001$.
[a] ASD Level as reported in ASD evaluation report
[b] Percentages are greater than 100 because bilingual participants could report more than one language spoken.
[c] Percentages are greater than 100 because participants could report more than one additional diagnosis.

Measures

This section describes the measures and psychometric properties of the measures. BDI-2 reliability was calculated based on the sample of the current project. These measures were appropriate because they are designed for use with toddlers and have been used in other studies of young children.

Records Review

The child's ASD diagnosis level and sex were identified through a review of Early Steps ASD evaluation reports. Each ASD evaluation report specifies the diagnoses of the child, including the ASD level of support needed (i.e., Level 1: Requiring Support; Level 2: Requiring Substantial Support). As part of the Early Step program's ASD evaluation, the caregiver is asked "What language(s) do you and other family members use when speaking with your child?" This language exposure information is documented in the child's ASD evaluation report, along with any of the child's diagnoses. The Principal Investigator (PI) conducted record reviews of the ASD evaluation reports to gather language exposure information. In addition, a member of the Early Steps program reviewed the child's Early Steps Registration Form and provided the PI of this study with information about the languages listed on the form of children who did not have language information documented in their ASD evaluation report. To describe the sample, the PI also extracted the children's diagnoses, including ASD diagnosis level (i.e., Level 1 or Level 2), and child's age at the BDI-2 assessment from the ASD and BDI-2 evaluation reports, respectively.

Battelle Developmental Inventory-2nd Edition (BDI-2)

The children were administered the BDI-2 (Newborg, 2005) to measure their development of cognitive, adaptive, social, and communication skills using the BDI-2 Normative Update (BDI-2 NU; Newborg, 2016). The BDI-2 is a standardized assessment tool used to measure functional abilities of children from birth through 7 years, 11 months in five developmental domains: Adaptive, Personal-Social, Communication, Motor, and Cognitive (Newborg, 2016). Each domain is further divided into subdomains (see Table 2). For the purposes of this project, only scores from the BDI-2 Adaptive, Personal-Social, Communication, and Cognitive domains, as well as the Attention and Memory, Reasoning and Academic Skills, and Perception and Concepts subdomains were analyzed. The BDI-2 is available in English and Spanish; however, the BDI-2 is normed in English only. The BDI-2 Spanish translation is available for Spanish-speaking examiners to use when evaluating children dominant in the Spanish language. The Early Steps program made several accommodations in evaluations conducted for children with limited English proficiency. For example, for Spanish-dominant families and children, the BDI-2 was administered in Spanish. For families and children who are dominant in a non-English or non-Spanish language, a trained interpreter in the given language participated in the BDI-2 assessment.

These outcome data were collected by Early Steps as part of the routine evaluation process for young children referred to the Early Steps program. The children in the Early Steps program were administered the BDI-2 upon entry in the Early Steps program and again prior to exiting the program at 36 months of age. Using this tool, a trained examiner rates the items using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0; Newborg, 2016). The total raw scores for each subdomain are converted to scaled scores, age equivalents, and percentile ranks. Each domain score is obtained by adding the scaled scores for the respective subdomains. These domain scores are added to obtain the total score, which has a mean of 100 and a standard deviation of 15 (Newborg, 2016). An Early Steps staff member provided de-identified BDI-2 data to the Principal Investigator.

Table 2. *Summary of Relevant BDI-2 Domains and Subdomains*

Domain/Subdomains	Total Number of Items
Adaptive (ADP)	60
Self-Care (SC)	35
Personal Responsibility (PR)	25
Personal-Social (PS)	100
Adult Interaction (AI)	30
Peer Interaction (PrI)	25
Self-Concept and Social Role (SR)	45
Communication (COM)	85
Receptive Communication (RC)	40
Expressive Communication (EC)	45
Cognitive (COG)	105
Attention and Memory (AM)	30
Reasoning and Academic Skills (RA)	35
Perception and Concepts (PC)	40

The BDI-2 was originally normed in 2004 (Newborg, 2005) and underwent a normative update (Newborg, 2016), which was used for scoring in the current study. Regarding concurrent validity, selected domains of the BDI-2 NU were correlated with well-established measures of development. Correlations with the Bayley Scales of Infant Development Second Edition (Bayley, 1993) yielded coefficients of .61 for Cognitive and .67 for Communication domains. The BDI-2 NU also was correlated with the Preschool Language Scale 4th Edition (Zimmerman et al., 2002) with alphas between .57 and .72 for the Communication domain, as well as the Vineland Social Emotional Early Childhood Scales (Sparrow et al., 1998) with alphas at .62 for the Personal-Social domain and .66 for the Adaptive domain (Newborg, 2016).

Internal consistency reliability coefficients for children 24-36 months of age range from .89 to .97 for the domain scores and .76 to .96 for the subdomain scores, with the total score having an internal reliability coefficient of .99 (Newborg, 2016). Newborg (2016) published the BDI-2 NU with updated test-retest calculations based on a sample of 252 two and four-year olds. BDI-2 NU test-retest reliability for the 2-year-old group (n = 226; 60% female) was .93 for the total score, and ranged from .87 to .90 for the domain scores, and .77 to .90 for the subdomain scores (Newborg, 2016).

Procedures

This study involved secondary analyses of Early Steps data that were collected for administrative purposes. Toddlers from an Early Steps program in Florida were administered the BDI-2 by trained Early Steps test administrators as part of Early Step's initial qualification evaluation or exit evaluation. For children who spoke a language other than English at home, the BDI-2 was administered in Spanish or with a trained interpreter of the given language(s). Each BDI-2 assessment was approximately 90 minutes in length. All BDI-2 assessments were completed when the children were between 30-36 months of age (M = 33 months). The children were diagnosed with ASD through a diagnostic ASD evaluation conducted by a multidisciplinary Early Steps team led by a licensed child psychologist. The evaluation results are kept in a secure database. For the participants of the current study, the ASD evaluations occurred during October 2019 to February 2021. However, due to the COVID-19 pandemic, the Early Steps program was required to suspend all evaluations for several months in 2020 and resumed evaluations in a limited capacity in the fall of 2020. Therefore, due to the substantial decrease in the number of ASD evaluations conducted by the Early Steps program in 2020-2021 in response to the COVID-19 pandemic, the current sample size is smaller than was originally anticipated.

Upon receiving study approval from the USF IRB, the PI contacted the director of the Early Steps program to request the specific data needed to conduct this study. Two Early Steps staff uploaded the reports onto an encrypted folder. Specifically, the staff members shared the BDI-2 and ASD evaluation reports of children assessed for ASD during October 2019 and February 2021, as well as a basic demographic information documented on the child's Registration Form (e.g., list of languages the child is exposed to, child race/ethnicity). The PI used the child's medical record number (MRN) to match the data across the BDI-2 scores, demographic information, and ASD evaluation report data. The PI reviewed the ASD evaluations to screen the data for inclusion and exclusion criteria. Reports of ASD and BDI-2 evaluations for children who met exclusion criteria were deleted. Then, the PI removed all of identifying information from the remaining ASD and BDI-2 reports. The Principal Investigator reviewed the reports to save data on the child's BDI-2 scores, language exposure, age at the ASD evaluation, age at BDI-2 evaluation, and diagnoses, including ASD diagnosis level (i.e., Level 1 or Level 2). All de-identified data were saved on an Excel file. Two graduate students in the USF school psychology program volunteered as research assistants and reviewed 20% of the de-identified data to check for data entry errors and found no errors in the data used in the analyses.

Ethical Considerations

The data used for the present study were collected as part of normal operating procedures for an Early Steps program; thus, no new data were collected for the present study. Prior to data retrieval from Early Steps and before analyses, approval to conduct the research was obtained from the Institutional Review Board (IRB) at the University of South Florida (USF). Data were not analyzed until the study was approved by the IRB committee. The study uses archival BDI-2 and ASD evaluation data that are stored in a confidential electronic database. The IRB determined that the present study poses minimal risk to participants. Furthermore, the identity of participants is protected. Appendix A presents the study approval provided to the author of this dissertation from the USF IRB.

Several measures were taken throughout the project to ensure that ethical considerations were addressed. The present study conducted a secondary analyses of Early Steps data that were collected for administrative purposes. Thus, the toddlers were administered the BDI-2 and ADOS-2 assessments as part of standard Early Steps qualification and/or exit evaluation procedures. Participant privacy was protected by assigning an identification number for each participant that was used to identify the data without using the child's name or medical record number (MRN). All information gathered about the participants was de-identified and is kept in an encrypted and confidential electronic database.

Data Analysis

A correlational design was used to answer the research questions of the current study. Before the data were analyzed using SPSS software, the data were explored in order to identify outliers and ensure that outliers were correct data points. Data also were searched to identify data entry errors (e.g., duplicated data points) and ensure that only correct data points were used in the analysis. All participants had complete data so there were no missing values to account for in the analyses. Aggregate characteristics of the sample were analyzed (see Table 1) and are described in the following chapter. Scores from each of the outcome variables were analyzed using descriptive statistics and bivariate correlations. Next, multivariate analyses for categorical independent variables were conducted to compare the developmental domain scores of the toddlers with ASD. To answer the first four research questions, a multiple regression was conducted for each of the four BDI-2 domain scores with language exposure (i.e., monolingual or bilingual) as the independent variable, controlling for sex. First, the independence, normality, and homogeneity assumptions underlying regressions were examined. An alpha level of .05 was used to determine statistical significance for the analyses. The model equation was $Y_i = \beta_0 + \beta_1$language + $\beta_2$sex + e_i. In this model, i represented each of the four domain scores. Next, the models with significant results were further explored. Finally, the effect sizes were analyzed using Cohen's *d* to see determine if the differences between the groups were small, medium, or large.

For research question 5, a series of multiple regressions was conducted for the discrete early communication skills (i.e., 8 of the BDI-2 items). Given that all participants had complete data, there were no missing values to consider in the analyses. The independence, normality, and homogeneity assumptions underlying multiple regressions were examined. The model equation was $Y_i = \beta_0 + \beta_1$LanguageExposure + B_2Sex + e_i. Finally, the effect sizes were analyzed using Cohen's *d* to see if the differences between the groups were small, medium, or large.

Chapter 4: Results

Overview

Data from monolingual and bilingual two-year-old children with Autism Spectrum Disorder (ASD) enrolled in a large Florida Early Steps program were analyzed. The children were administered the Battelle Developmental Inventory-2nd Edition (BDI-2; Newborg, 2005) as part of standard evaluation procedures at the Early Steps program. The BDI-2 measured the children's development of cognitive, adaptive, social, and communication skills. The children were evaluated with the BDI-2 at approximately 33 months of age. Testing occurred in English for English-dominant children, Spanish for the Spanish-dominant children, or English with a trained interpreter for the speakers of other languages. The BDI-2 domain scores were calculated and analyzed for the two groups (i.e., monolingual and bilingual children with ASD). This chapter presents the results of the study.

The goal of this study was to better understand the extent to which language exposure (i.e., monolingual or bilingual) is related to the adaptive, social, communication, and cognitive development of young children with ASD. Thus, this study expanded upon previous research that examining the relationship between language exposure (i.e., monolingual or bilingual) and the developmental skills of toddlers with ASD by focusing on various developmental outcomes (i.e., adaptive, social, communication, and cognitive) for the sample and using direct standardized measures of the children's skills (i.e., BDI-2 domain and item-level data) and controlling for sex.

To begin, descriptive statistics were conducted to understand the distribution of the variables. Next, in order to analyze the relationship between all variables, correlations were conducted. Then, to test the relationship between the independent variable (i.e., language exposure) and the dependent variables (i.e., overall adaptive, social, communication, and cognitive skills; 8 discrete early communication skills), several multiple linear regressions were conducted, controlling for sex.

Preliminary Analyses

Descriptive Statistics of the Variables

The distribution of each variable was examined by identifying the frequency, mean, standard deviation, skewness, kurtosis, and minimum and maximum value of each variable. The results of the descriptive analyses are presented in Tables 3 through 5. The BDI-2 domains have a mean of 100 and standard deviation of 15 (Newborg, 2005). In regard to the mean and standard deviation of the overall developmental skill variables (i.e., BDI-2 Domains) of the sample (see Table 3), the Adaptive Domains (M = 71.43; SD = 10.39), Social Domain (M = 68.17; SD = 11.00), Language Domain (M = 60.80; SD = 9.35), Cognitive Domain (M = 70.57; SD = 8.32) scores were in the below average range, suggesting that the sample consisted of children with significant developmental delays across adaptive, social, communication, and cognitive developmental domains, as is expected in children with ASD. In regard to the sample distribution for the developmental domains, skewness values ranged from 0.35 to 2.42 and kurtosis values ranged from -1.58 to 5.93. Three subdomains within the Cognitive Domain were further analyzed (see Table 4): Attention and Memory (M = 4.27; SD = 1.48), Reasoning and Academic Skills (M = 5.50 SD = 2.10), and Perception and Concepts (M = 3.27; SD = 1.74). In the current sample, half (50%) of the children were diagnosed with a speech or language delay. However, the scores on the communication domain suggest that most of the children were experiencing significant language delays that may qualify for a diagnosis of a language delay or disorder.

Overall, the much lower range for the bilingual group, along with the negative kurtosis values suggest that there may be uncontrolled confounding variables related to sampling in the groups. For example, the identification of ASD in bilingually exposed children may be more difficult for clinicians who may attribute some delays to bilingual language exposure rather than ASD, and subsequently, make diagnostic decisions based on those judgments. Furthermore, given that CLD children with ASD are usually identified at a later age (Mandell et al., 2010; Mandell et al., 2009; Morrier & Hess, 2012; Morrier, Hess, & Heflin, 2008), it is possible that CLD children identified as a toddler have more intense symptoms of ASD, leading to an earlier referral for services compared to their peers.

The effect sizes are reported in Tables 3 through 5. First, the effect size for adaptive skills indicated that the adaptive skill difference between the groups was small (d = 0.26) and favored bilingual toddlers with ASD. Second, the effect size for social skills indicated that the difference between the groups was small (d = -0.37) and favored monolingual toddlers with ASD. Third, the effect size for communication skills indicated that the difference between the groups was medium (d = -0.45) favoring the monolingual group. For the fourth research question, the effect size for cognitive skills indicated that the difference between the groups was large (d = -0.95) and favored the monolingual group. A strong effect size (d = -0.84) for Attention and Memory skills favored the monolingual toddlers in the sample. Language exposure score had a *negative* effect on Reasoning and Academic skills with a strong effect size (d = -0.94). The effect size was medium (d = -0.49) for Perception and Concepts, favoring monolingual toddlers with ASD. For the fifth research question, the effect size for Attending to a Speaker was small (d = -0.18) and favored the monolingual group. The effect size for Communicative Gestures was small (*d* = -0.35) and favored the monolingual group. The effect size for Ten Word Utterances was small (*d* = -0.01) and favored the monolingual toddlers with ASD. The effect size for Two-Word Phrases was medium (*d* = -0.43) and favored the monolingual group. A summary of the effect sizes can also be found in Table 21.

Items in the BDI-2 are rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0; Newborg, 2016). The means and standard deviations of the discrete communication skills (i.e., 8 items from the BDI-2 Communication domain) for the sample are: Attends to speaker (*M* = 1.53; *SD* = 0.73), Babbles (*M* = 2.00; *SD* = 0), Vocalizes (*M* = 2.00; *SD* = 0), Produces Monosyllabic Sounds (*M* = 2; *SD* = 0), Imitates Speech Sounds (*M* = 1.60; *SD* = 0.72), Uses Communicative Gestures (*M* = 1.63; *SD* = 0.77), Speaks 10 or More Words (*M* = 0.90; *SD* = 0.96), and Uses Two-Word Phrases (*M* = 0.47; *SD* = 0.82). Analyses of the distribution of the discrete early communication skills of the current sample indicated that skewness values ranged from -1.72 to 1.32 and kurtosis values ranged from -1.97 to 1.15. Due to the lack of variability for the Babbles, Vocalizes, and Produces Monosyllabic Speech Sounds items, the skewness and kurtosis could not be analyzed. The BDI score data are presented in Table 5.

Table 3. *Descriptive Statistics of Domain Variables*

Scale	Total (N= 30)	Monolingual (N= 21)	Bilingual (N= 9)	Effect Sizes (*d*)
Adaptive Domain				0.26
M	71.43	70.62	73.33	
SD	10.39	11.03	9.01	
Min	55	55	58	
Max	100	100	85	
Skewness	0.58	0.90	-0.45	
Kurtosis	0.27	0.87	-0.79	
Social Domain				-0.37
M	68.17	69.38	65.33	
SD	11.00	11.96	8.23	
Min	55	55	55	
Max	102	102	78	
Skewness	1.30	1.31	0.19	
Kurtosis	1.93	1.52	-1.58	
Communication Domain				-0.45
M	60.80	62.05	57.89	
SD	9.35	10.73	3.92	
Min	55	55	55	
Max	93	93	65	
Skewness	2.42	2.05	1.02	
Kurtosis	5.93	3.69	-0.48	
Cognitive Domain				-0.95
M	70.57	72.76	65.44	
SD	8.32	8.11	6.69	
Min	55	58	55	
Max	91	91	75	
Skewness	0.35	0.37	-0.16	
Kurtosis	0.35	0.46	-1.22	

Note. Domain scores are standard scores. *d* = (mean for bilingual group – mean for the monolingual group)/pooled standard deviation

Table 4. *Descriptive Statistics of Cognitive Subdomain Standard Scores*

Scale	Total (N= 30)	Monolingual (N= 21)	Bilingual (N= 9)	Effect Size (*d*)
Attention and Memory				-0.84
M	2.47	4.62	3.44	
SD	1.48	1.40	1.42	
Min	1	1	1	
Max	8	8	5	
Skewness	-0.36	-0.09	-1.36	
Kurtosis	1.70	2.80	.50	
Reasoning and Academic Skills				-0.94
M	5.50	6.05	4.22	
SD	2.10	1.86	2.17	
Min	1	3	1	
Max	10	10	7	
Skewness	-0.17	0.34	-0.56	
Kurtosis	0.28	-0.30	-0.95	
Perception and Concepts				-0.49
M	3.27	3.52	2.67	
SD	1.74	1.89	1.23	
Min	1	1	1	
Max	8	8	5	
Skewness	0.78	0.63	0.29	
Kurtosis	0.74	0.28	.83	

Note. Subdomain scores are scaled scores.; *d* = (mean for bilingual group – mean for the monolingual group)/pooled standard deviation.

Table 5. *Descriptive Statistics of the Discrete Early Communication Skills Variables*

Scale	Total (N= 30)	Monolingual (N= 21)	Bilingual (N= 9)	Effect Size (*d*)
Attends to speaker				
M	1.53	1.57	1.44	-0.18
SD	0.73	0.68	0.8	
Min	0	0	0	
Max	2	2	2	
Skewness	-1.26	-1.36	-1.19	
Kurtosis	0.17	0.76	-0.45	
Imitates speech sounds				
M	1.60	1.67	1.44	-0.32
SD	0.72	0.73	0.73	
Min	0	0	0	
Max	2	2	2	
Skewness	-1.54	-1.92	-1.01	
Kurtosis	0.88	2.09	0.19	
Uses communicative gestures				-0.35
M	1.63	1.71	1.44	
SD	0.77	0.72	0.89	
Min	0	0	0	
Max	2	2	2	
Skewness	-1.72	-2.20	-1.19	
Kurtosis	1.15	3.14	-0.45	
Speaks 10 or more words				-0.01
M	0.90	0.90	0.89	
SD	0.96	1.00	0.93	
Min	0	0	0	
Max	2	2	2	
Skewness	0.21	0.21	0.26	
Kurtosis	-1.97	-2.11	-2.02	
Uses two-word phrases				-0.43
M	0.47	0.57	0.22	
SD	0.82	0.87	0.67	
Min	0	0	0	
Max	2	2	2	
Skewness	1.32	1.02	3.00	
Kurtosis	-0.10	-0.87	9.00	

Note: These were rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0); *d* = (mean for bilingual group – mean for the monolingual group)/pooled standard deviation

Correlational Analyses

To determine whether there were significant bivariate relationships between any of the variables, bivariate correlations were conducted between all of the variables (see Tables 6-7). The correlation matrix for the overall developmental domains included the Adaptive, Social, Communication, and Cognitive Skill domains. The results of the developmental domain correlational analyses are presented in Table 6 and demonstrate that the developmental domains are positively correlated with one another. The correlation matrix for the developmental domains indicated that Adaptive Skills are significantly associated with Social (r = .71), Communication (r = .45), and Cognitive skills (r = .56). In addition, Social Skills are significantly associated with Communication (r = .69) and Cognitive Skills (r = .67), and Communication Skills also are correlated with Cognitive Skills (r = .67).

Table 6. *Correlations Between the Developmental Domains*

Variable	1	2	3	4
1. Adaptive Skills Domain	--			
2. Social Skills Domain	.71**	--		
3. Communication Skills Domain	.45*	.69**	--	
4. Cognitive Domain	.56*	.77**	.67**	--

Note: N = 30; *p < .05, **p < .01, ***p < .001.

The correlational analyses for the Cognitive Skills subdomains are presented in Table 7. The Attention and Memory subdomain is significantly associated with the Reasoning and Academic Skills (r = .73) and Perception and Concepts subdomains (r = .56). In addition, the

Reasoning and Academic Skills subdomain is significantly associated with Perception and Concepts (r = .78).

Table 7. *Correlations Between the Cognitive Skills Subdomains*

Variable	1	2	3
1. Attention and Memory	--		
2. Reasoning and Academic Skills	.73***	--	
3. Perception and Concepts	.56***	.78***	--

Note: *N* = 30. **p* < .05, ***p* < .01, ****p* < .001.

The correlation matrix for the discrete early communication skills included the scores from the eight Communication domain items. The results of the discrete early communication skills correlational analyses are presented in Table 8. In terms of discrete communication skills, the correlation matrix indicated that Attending to the Speaker was significantly associated with Imitating Speech Sounds (*r* = .48), Using Communicative Gestures (*r* = .55), and Speaking 10 or More Words (*r* = .42). No other significant associations between the developmental domains were found. In addition, Imitating Speech Sounds was significantly correlated with Using Communicative Gestures (*r* = .60) and Speaking 10 or More Words (*r* = .44). Furthermore, Speaking 10 or More Words was significantly associated with Using Two-Word Phrases (*r* = .68). No other significant associations were identified.

Table 8. *Correlations Between the Discrete Early Communication Skills*

Variable	1	2	3	4	5	6	7	8
1. Attends to Speaker	--							
2. Babbles	A	--						
3. Vocalizes	A	A	--					
4. Produces Monosyllabic Sounds	A	A	A	--				
5. Imitates Speech Sounds	.48*	A	A	A	--			
6. Uses Communicative Gestures	.55**	A	A	A	.60**	--		
7. Speaks 10 or More Words	.42*	A	A	A	.44*	.23	--	
8. Uses Two-Word Phrases	.26	A	A	A	.21	.06	.68**	--

Note: N = 30. **p* < .05, ***p* < .01, ****p* < .001. A= cannot be computed because the data are constant for the entire sample for the Babbles, Vocalizing, and Produces Monosyllabic Sounds variables.

Analyses of Developmental Skills

To answer the first four research questions, a total of seven multiple regressions were analyzed to compare the developmental domains of monolingual and bilingual toddlers with ASD while controlling for sex (i.e., male or female). To answer the fifth research question, a total of five multiple regressions were analyzed, controlling for sex, to compare the discrete early communication skills of monolingual and bilingual toddlers with ASD. Dummy variables were created for the independent variables in order to represent the dichotomous subgroups (i.e., monolingual or bilingual; male or female) within the language exposure and sex variables, respectively. Each regression had two models. Model 1 included main effects and Model 2 includes the main effects and the interaction between language exposure and sex. Multicollinearity was not a concern for any of the models and the assumptions of linear regressions are discussed below for each model. Given the limited sample size and lack of power for analyses, these findings should be interpreted with caution.

Research Question 1: Adaptive Skills

The first research question is: To what extent is language exposure (i.e., monolingual or bilingual) related to the adaptive skills of infants and toddlers with ASD when controlling for sex (i.e., male or female)? A multiple regression was conducted to answer the first research question, with language exposure (i.e., monolingual or bilingual) as the independent variable, the BDI-2 Adaptive domain score as the dependent variable, and sex (i.e., male or female) as the covariate. The model equation predicting Adaptive Skills was $Y_i = \beta_0 + \beta_1 \text{language} + \beta_2 \text{sex} + e_i$ with i representing the Adaptive Domain scores.

Assumptions

The assumptions underlying multiple regressions (i.e., linearity, normality, multicollinearity, and homoscedasticity) were assessed. Visual analyses of the scatterplots and histograms of the residuals indicated that there were no substantial violations of the homoscedasticity, linearity, and normality assumptions underlying multiple linear regressions for the Adaptive Skills Models.

Adaptive Skills Models

Results of the Adaptive Skills Models are presented in Table 9. In this model, a statistically significant interaction effect was not found (b = -8.63, p = .33) in Model 2 with an R^2 of .07. Additionally, the Adaptive Skills Domain model did not yield any statistically significant main effects for Language Exposure (b = 3.03, p = .48) or Sex (b = -2.86, p = .49) in Model 1 with an R^2 of .03. This finding suggests that neither language exposure nor sex independently predicted the Adaptive Skills Domain.

Table 9. *Linear Models for Adaptive Skills Domain*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	3.03	4.24	.48	.6.56	5.51	.25
Sex	-2.86	4.03	.49	-0.07	4.90	.99
Interaction Effect						
Language Exposure X Sex				-8.63	8.63	.33
R^2		.03			.07	

Note: N= 30; *p<.05, **p<.01, ***p<.001; Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Research Question 2: Social Skills

The second research question is: To what extent is language exposure (i.e., monolingual or bilingual) related to the social skills of infants and toddlers with ASD when controlling for sex (i.e., male or female)? In order to answer this question, a multiple regression was conducted. The model for Research Question 1 includes language exposure (i.e., monolingual or bilingual) as the independent variable, the BDI-2 Personal-Social domain score as the dependent variable, and sex (i.e., male or female) as the covariate. The Social Skills model equation was $Y_i = \beta_0 + \beta_1$language + $\beta_2$sex + e_i with i representing the Personal-Social Domain scores.

Assumptions

The assumptions underlying multiple regressions (i.e., linearity, normality, multicollinearity, and homoscedasticity) were assessed. Visual analyses of the scatterplots of the residuals indicated that there were no substantial violations of the homoscedasticity and linearity assumptions underlying multiple linear regressions. However, the distribution of the residuals based on the histogram and skewness and kurtosis results indicates that there appears to be some violations of normality due to the large skewness and kurtosis values.

Social Skills Models

Results of the Social Skills Domain models are presented in Table 10. The Social Skills model did not yield a statistically significant interaction effect (b = -2.81, p = .77) on Model 2, with an R^2 of .36. Additionally, it did not yield significant effects for Language Exposure (b = -4.19, p = .36) or Sex (b = 1.31 p = .76) on Model 1 with an R^2 of .33. These findings suggesting that neither language exposure nor sex independently predicted the social skills.

Table 10. *Linear Models for Social Skills Domain*

	Model 1				Model 2		
Variable	Estimate	SE	*p*-value	R^2	Estimate	SE	*p*-value
Main Effects							
Language Exposure	-4.19	4.49	.36		-3.04	5.94	.61
Sex	1.31	4.27	.76		2.21	5.28	.68
Interaction Effect							
Language Exposure X Sex					-2.81	9.30	.77
R^2		.33				.36	

Note: N= 30; **p*<.05, ***p*<.01, ****p*<.001; Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Research Question 3: Communication Skills

The third research question is: To what extent is language exposure (i.e., monolingual or bilingual) related to the communication skills of infants and toddlers with ASD when controlling for sex (i.e., male or female)? The model for Research Question 3 includes language exposure (i.e., monolingual or bilingual) as the independent variable, the BDI-2 Communication domain score as the dependent variable, and sex (i.e., male or female) as the covariate. The Communication Domain model equation is $Y_i = \beta_0 + \beta_1 \text{language} + \beta_2 \text{sex} + e_i$ with i representing the Communication Domain scores.

Assumptions

The assumptions underlying multiple regressions (i.e., linearity, normality, multicollinearity, and homoscedasticity) were assessed for the communication skills model. Visual analyses of the scatterplots of the residuals indicated that there were no substantial violations of the homoscedasticity and linearity assumptions underlying multiple linear regressions. However, the distribution of the variables on the histogram, along with the large skewness and kurtosis values indicate that there appear to be some violations of normality.

Communication Skills Models

Results of the Communication Skills models presented in Table 11 indicated that a statistically significant interaction effect was not found (*b* = 3.66, *p* = .64, R^2 = .78). The Communication Skills model did not yield significant effects for Language Exposure (*b* = -3.81, *p* = .32) or Sex (*b* = -3.18, *p* = .38) with an R^2 of .70, suggesting that neither Language Exposure or Sex independently predicted the children's communication skills.

Table 11. *Linear Models for Communication Skills Domain*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-3.81	3.74	.32	-5.30	4.94	.29
Sex	-3.18	3.56	.38	-4.36	4.39	.33
Interaction Effect						
Language Exposure X Sex				3.66	7.72	.64
R^2		.70			.78	

Note: N= 30; **p*<.05, ***p*<.01, ****p*<.001; Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Research Question 4: Cognitive Skills

The fourth research question is: To what extent is language exposure (i.e., monolingual or bilingual) related to the cognitive skills of infants and toddlers with ASD when controlling for sex (i.e., male or female)? The Cognitive Skills model includes language exposure (i.e., monolingual or bilingual) as the independent variable, the BDI-2 Cognitive domain score as the dependent variable, and sex (i.e., male or female) as the covariate. The regression model equation is $Y_i = \beta_0 + \beta_1\text{language} + \beta_2\text{sex} + e_i$ with i representing the Cognitive Domain scores.

Assumptions

The assumptions underlying multiple regressions (i.e., linearity, normality, multicollinearity, and homoscedasticity) were assessed. Visual analyses of the scatterplots and histograms of the residuals indicated that there were no substantial violations of the homoscedasticity, linearity, and normality assumptions underlying multiple linear regressions for any of the Cognitive Models discussed in this section.

Cognitive Models

Results of the Cognitive Domain model is presented in Table 12. A statistically significant interaction effect was not found (b = -5.61, p = .39) with an R^2 of .193. The Cognitive Skill model yielded a statistically significant main effect for Language Exposure (b = -7.25, p = .03) but not for Sex (b = -0.60, p = .84) with an R^2 of .17. These findings suggest that language exposure (i.e., monolingual or bilingual) may have independently predicted cognitive skills of toddlers with ASD in the sample. Bilingual language exposure score had a *negative* effect on cognitive skills in the current sample.

Table 12. *Linear Models for Cognitive Skills Domain*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-7.25	3.15	.03*	-4.96	4.12	.24
Sex	-0.60	3.00	.84	1.21	3.66	.74
Interaction Effect						
Language Exposure X Sex				-5.61	6.43	.39
R^2		.17			.19	

Note: N= 30; *p<.05, **p<.01, ***p<.001; Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

To further explore the significant main effects of language exposure on cognitive skills, post-hoc analyses were conducted for the three subdomains within the Cognitive Skill domain (i.e., Attention and Memory, Reasoning and Academic Skills, and Perception and Concepts). Results of the Attention and Memory, Reasoning and Academic Skills, and Perception and Concepts models are presented in Tables 13 to 15, respectively.

Attention and Memory Model. The Attention and Memory model (see Table 13) indicated there was no interaction effect (*b* = -0.64, *p* = .96), with an R^2 of .146. Furthermore, the models did not yield any significant effects for Sex (*b* = -0.31, *p* = .58) or Language Exposure (*b* = -1.14, *p* = .06), with an R^2 of .146. The data trend in the model indicates that neither language exposure and sex independently predicted Attention and Memory.

Table 13. *Linear Models for Attention and Memory*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-1.14	.57	.06	-1.11	.75	.15
Sex	-0.31	.54	.58	-0.29	.67	.67
Interaction Effect						
Language Exposure X Sex				-0.64	1.18	.96
R^2		.146			.146	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These scores are scaled scores. Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Reasoning and Academic Skill Model. The Reasoning and Academic Skills model (see Table 14) indicated that there was no interaction effect (*b*= -1.01, p = .54; R^2 = .20). Additionally, the Model 1 revealed a statistically significant effect for Language Exposure (*b* = -1.76, p =.03). This finding indicates that a child's exposure may independently predict Reasoning and Academic Skills. Bilingual language exposure had a *negative* effect on Reasoning and Academic skills. The Reasoning and Academic Skills Model 1 did not indicate statistically significant results for Sex (*b* = -0.61, p = .42). The R^2 for Model 1 is .19.

Table 14. *Linear Models for Reasoning and Academic Skills*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-1.76	.79	.03*	-1.34	1.03	.21
Sex	-0.61	.75	.42	-0.29	.92	.76
Interaction Effect						
Language Exposure X Sex				-1.01	1.62	.54
R^2		.19			.20	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These scores are scaled scores. Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Perception and Concepts Model. There were no significant main or interaction effects in the Perception and Concepts model (see Table 15). Overall, no significant interaction effect (*b* = -1.49) was identified in Model 2 with an R^2 of .093. Additionally, the results indicated that neither Sex (*b* = -0.19, *p* =.774) nor Language Exposure (*b*= -0.84, *p* = .245) independently predicted Perception and Concept skills.

Table 15. *Linear Models for Perception and Concepts*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-0.84	.70	.25	-0.23	.91	.80
Sex	-0.19	.67	.77	0.29	.81	.73
Interaction Effect						
Language Exposure X Sex				-1.49	1.43	.31
R^2		.06			.09	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These scores are scaled scores. Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex as coded 0=male and 1=female.

Research Question 5: Discrete Early Communication Skills

The fifth research question is: To what extent is language exposure (i.e., monolingual or bilingual) related to the following discrete early communication skills of toddlers with ASD when controlling for sex (i.e., male or female)?

1. Attending to someone speaking to him or her for at least 10 seconds
2. Babbling
3. Vocalizing
4. Producing monosyllabic sounds
5. Imitating speech sounds
6. Using communicative gestures (e.g., pointing to request an item)
7. Using 10 or more words
8. Using two-word phrases

The sample's scores on three of the discrete early communication items (i.e., Babbling, Vocalizing, and Producing Monosyllabic Sounds) were constant, indicating that all children in the sample scored the same on those items. All children scored a 2 ("Demonstrated Regularly") on each of those items; thus, there were no differences between the groups. Because of this lack of variability, regression analyses were not possible. The lack of variability is likely due to the small sample size of the current study. To explore the remaining discrete early communication skills (i.e., Attending, Imitating Speech, Communicative Gestures, Ten Words, and Two-Word Phrases), a total of five linear regression models were analyzed, one for each of the remaining discrete early communication skills. For each dependent variable, the model equation was $Y_i = \beta_0 + \beta_1 LanguageExposure + B_2 Sex + e_i$. This section describes the results of the models for the fifth research question.

Assumptions

Visual analyses of the scatterplots and histograms of the residuals indicated that there were no substantial violations of the homoscedasticity and linearity assumptions underlying multilevel regressions. However, the distribution of the variables on the histogram, along with the large skewness and kurtosis values indicate that there appear to be some violations of normality on all of the Discrete Early Communication Skills Models.

Discrete Early Communication Skills Models

Results from the Discrete Early Communication Skills models are presented in Tables 16 to 20. The conditional models predicting discrete early communication skills (i.e., attending to speaker for at least 10 seconds, babbling, vocalizing, producing monosyllabic sounds, imitating speech sounds, using 10 or more words, and using two-word phrases) included the child's language exposure (i.e., monolingual or bilingual) and sex (i.e., male or female).

Attending to a Speaker Model. The Attending to a Speaker model did not reveal an interaction effect for Model 2 (b = -0.14, p = .827) with an R^2 .04. Furthermore, results indicated that there were no statistically significant main effects for Language Exposure (b = -0.10, p =.744) or Sex (b = -.26, p = .370) with an R^2 of .04, which means that language exposure and sex did not independently predict if a child attends to a speaker for 10 seconds or more.

Table 16. *Linear Models for Attending to Speaker*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-0.10	.30	.74	-.0.04	.39	.91
Sex	-0.26	.28	.37	-.0.21	.35	.55
Interaction Effect						
Language Exposure X Sex				-0.14	.62	.83
R^2		.04			.04	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These were rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0). Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Imitating Speech Model. The Imitating Speech model indicated that there was not an interaction effect for this model (*b* = -.42, *p* = .15) with an R^2 of .12. Furthermore, Model 1 did not indicate statistically significant results for Language Exposure (*b* = -0.20, *p* = .51) or Sex (*b* = -0.02 *p* = .46) with san R^2 of .04, which means that language exposure or sex did not independently predict the speech imitation skills of a child with ASD.

Table 17. *Linear Models for Imitating Speech Sounds*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-0.20	.29	.51	0.16	.38	.68
Sex	-0.21	.28	.46	0.07	.33	.83
Interaction Effect						
Language Exposure X Sex				-.41	.59	.15
R^2		.04			.12	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These were rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0). Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Communicative Gestures Model. The Communicative Gestures model found no interaction effects for this model (*b* = 0.08, *p* = .90) with an R^2 of .09, suggesting that language exposure did not predict communicative gestures when controlling for sex. Furthermore, the model did not indicate statistically significant results for Language Exposure (*b* = -0.23, *p* = .46) or Sex (*b* = -0.40 *p* = .17) with an R^2 of .09, which means that a child's language exposure or sex did not independently predict the use of communicative gestures of a child with ASD.

Table 18. *Linear Models for Using Communicative Gestures*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-0.23	.30	.46	-0.26	.40	.53
Sex	-0.40	.29	.17	-0.43	.36	.24
Interaction Effect						
Language Exposure X Sex				-0.08	.63	.90
R^2		.09			.09	

Note: N= 30; **p*<.05, ***p*<.01, ****p*<.001; These were rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0). Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female

Ten Words Model. An interaction effect was not identified in the Ten Words Model 2 ($b = -0.61$, $p = .46$), with an R^2 of .03. Furthermore, the model did not indicate statistically significant results for Language Exposure ($b = -0.03$, $p = .93$) or Sex ($b = 0.16$, $p = .67$) with an R^2 of .01. This finding suggests that a child's language exposure did not independently predict a child's usage of at least 10 words.

Table 19. *Linear Models for Using 10 or More Words*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-0.03	.40	.93	0.21	.52	.68
Sex	0.16	.38	.67	0.36	.46	.45
Interaction Effect						
Language Exposure X Sex				-0.61	.81	.46
R^2		.01			.03	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These were rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0). Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Two-Word Phrases Model. The Two-Word Phrases model did not indicate a significant interaction effect (*b* = 0.50, *p* = .47) with an R^2 of .26. Additionally, there were no statistically significant Language Exposure (*b* = -0.38, *p* = .28) or Sex (*b* = 0.16, *p* = .62) effects, with an R^2 of .22.

Table 20. *Linear Models for Using Two-Word Phrases*

	Model 1			Model 2		
Variable	Estimate	SE	*p*-value	Estimate	SE	*p*-value
Main Effects						
Language Exposure	-0.38	.33	.27	-0.57	-.33	.435
Sex	0.16	.32	.62	0.00	.00	1.00
Interaction Effect						
Language Exposure X Sex				0.50	.21	.47
R^2		.22			.26	

Note: N= 30; *p<.05, **p<.01, ***p<.001; These were rated using a 3-point Likert scale that indicates whether the skill is regularly demonstrated (score = 2), emerging (score = 1) or absent (score = 0). Model 1 is the model without the interaction and Model 2 includes the interaction between Language Exposure and Sex. Language Exposure was coded 0=monolingual and 1=bilingual. Sex was coded 0=male and 1=female.

Summary of Results

A summary of the effect sizes for the outcome variables is presented in Table 21. The first four research questions addressed the extent to which bilingual language exposure is related to four major early childhood developmental domains (i.e., Adaptive, Social, Communication, and Cognitive Skills) while controlling for sex (i.e., male or female). The results indicated that there were no statistically significant differences between monolingual and bilingual groups in Adaptive, Social, and Communication skills. However, although there were no statistically significant differences between the Communication skills and Attention and Memory skills of both groups, there was a medium effect size for Communication skills and a large effect size for Attention and Memory. A medium or large effect size in an underpowered study indicates that there are differences between the groups that should be considered. These differences could be due extraneous or confounding variables that the current study is unable to measure or statistically control. Specifically, it is important to consider the uneven groups in the current sample. Most of the participants were monolingual toddlers and due to the limited descriptions of the sample in the current study, it is not possible to fully understand or control for extraneous or confounding variables that may be influencing this finding. It appears that the bilingual group in the current study scored lower overall compared to the monolingual group; thus, comparing the two groups statistically introduces the potential for several variables that could influence the outcomes in an underpowered study.

Furthermore, there was a negative association between the language exposure and overall cognitive skills of toddlers with ASD enrolled in the Florida Early Steps program, but no differences between the groups when controlling for the child's sex. Post-doc analyses were completed for the Cognitive Skills Domain subdomains (Attention and Memory, Reasoning and Academic Skills, and Perception and Concepts) and did not reveal significant effects when controlling for sex. The fifth research question examined the extent to which bilingual or monolingual language exposure was related to eight discrete early communication skills of toddlers with ASD enrolled in a Florida Early Steps program. Importantly, the Babbling, Vocalizing, and Producing Monosyllabic Sounds discrete early communication skills could not be analyzed because there was no variability in the sample data for these items due to the small sample size. In response to the fifth research question, the results indicated that there was no association between language exposure and Attending, Imitating Speech, using Communicative Gestures, saying Ten Words, and using Two-Word Phrases independently or when controlling for the child's sex. Furthermore, the current study found that there were no main effects for sex (i.e., male or female) nor were any of the associations between language exposure (i.e., male or female) and various developmental skills significant when controlling for the child's sex. The interpretation of the findings from the present study are discussed in Chapter 5.

Table 20. *Summary of Effects Sizes Favoring Monolingual or Bilingual Groups*

Outcome	Monolingual	Bilingual
Adaptive Skills Domain		0.26
Social Skills Domain	-0.37	
Communication Skills Domain	-0.45	
Cognitive Skills Domain	-0.95	
Attention and Memory	-0.84	
Reasoning and Academic Skill	-0.94	
Perception and Conceptions	-0.49	
Attends to Speaker	-0.18	
Imitates Speech Sounds	-0.32	
Uses Communicative Gestures	-0.35	
Uses 10 or more words	-0.01	
Uses Two-Word Phrases	-0.43	

Note: Cohen's *d* = (mean for bilingual group – mean for the monolingual group)/pooled standard deviation; Language Exposure was coded 0=monolingual and 1=bilingual.

Chapter 5: Discussion

Overview

Bilingualism is a common human experience worldwide and is becoming more common in the U.S. (Goldstein, 2011). The social, economic, and cognitive benefits of bilingualism across the lifespan have been clearly documented in scientific literature (e.g., Barac et al., 2016; Bialystoket al., 2012; Hans, 2010); however, the influence of bilingualism on the development of individuals with social communication disorders, such as Autism Spectrum Disorder (ASD), is not yet fully understood. The rates of ASD are increasing in the United States (CDC, 2019) making it more likely that many individuals with ASD are being raised bilingually. Therefore, clinicians and educators are likely to work with bilingual children who have ASD (Dilly & Hall, 2019). Yet, research on the global development of bilingual children with ASD is limited and there are mixed findings in the research regarding the effect of bilingual exposure on the development of adaptive, social, communication, and cognitive skills of children with ASD (e.g., Hambly & Fombonne, 2012; Valicenti-McDermott et al., 2012). Although a bilingual advantage usually occurs in school-age children, the advantages of bilingualism in toddlerhood are not yet understood. This study aimed to fill this knowledge gap and better understand the association between bilingual language exposure and early childhood development by comparing the adaptive, social, communication, and cognitive skills of monolingual and simultaneous bilingual toddlers with ASD. This chapter provides an interpretation of the study results as they relate to each research question and discusses study limitations, implications, and directions for future research.

Research Question 1

To what extent is language exposure (i.e., monolingual or bilingual) related to the **adaptive skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?

The current study found that adaptive skills were not associated with a child's language exposure. Specifically, there were no significant differences in adaptive skill functioning between the monolingual and bilingual children with ASD. In other words, both monolingual and bilingual toddlers in the present study have similarly developed adaptive skills, which suggests that bilingual language exposure does not increase the adaptive skill challenges that children with ASD face. These findings are not surprising given other studies that have found that there are no significant adaptive skill differences between monolingual and bilingual children (i.e., infants, toddlers, and preschoolers) with ASD (Chaidez et al., 2012; Hambley & Fombonne, 2012). Although one study has found a bilingual advantage for the adaptive skills of children with ASD (Valicenti-McDermott et al., 2013), the sample size was small and the finding has not been replicated. Because adaptive behaviors and expectations are culture-specific (e.g., Taverna et al., 2011), it may be that the children in the monolingual and bilingual groups in the Valicenti-McDermott and colleagues (2013) study were each from similar cultural backgrounds. Overall, the current study findings are similar to previous research that has not found statistically significant differences between the adaptive skills of monolingual and bilingual toddlers with ASD bilingualism. However, given that the study was underpowered these results should be interpreted with caution.

Research Question 2

To what extent is language exposure (i.e., monolingual or bilingual) related to the **social skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?

Given the significant social skill difficulties that children with ASD face, it is important to understand the social skills of monolingual and bilingual toddlers with ASD. The current study found that social skills were not associated with a child's language exposure. Specifically, results from the present study indicated that there were no significant differences in social skills between monolingual and bilingual toddlers with ASD. Unlike research that has identified a social skill advantage for simultaneous bilingual children with ASD (Hambly & Fombonne, 2012), the present study results suggest that monolingual and bilingual toddlers with ASD develop similar levels of social skills, as measured by the BDI-2. These findings suggest that bilingual language exposure does not increase the social challenges that children with ASD experience. The present findings add to the research base that has documented similar social skills between monolingual and bilingual children with ASD (Hambly & Fombonne, 2012; Hambley & Fombonne, 2014; Sendhilnathan & Chengappa, 2020b; Valicenti-McDermott et al., 2019; Zhou et al., 2019). Similar to previous studies, the present study findings suggest that bilingualism does not negatively influence the social skills of toddler with ASD. The current study findings are similar to research demonstrating that bilingual language exposure in early childhood does not increase the social skill difficulties that children with ASD experience.

Research Questions 3:

To what extent is language exposure (i.e., monolingual or bilingual) related to the **communication skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?

Children with ASD tend to experience significant communication delays. In the U.S., families who speak non-English languages at home report that they are advised to speak English language with their child(ren) with ASD (Drysdale et al., 2015; Jegatheesan, 2011; Kay-Raining Bird et al., 2012). Although this advice may be well-meaning, it may unintentionally restrict the amount of rich linguistic input that children with ASD need to develop language (Gonzalez-Barrero & Nadig. 2018). Importantly, this advice does not appear to have a conceptual foundation in research. In fact, some research has actually found that bilingual children with ASD outperform their monolingual peers with ASD on certain language skills (e.g., Hambly & Fombonne, 2014; Hoang et al., 2018; Iarocci et al., 2017; Peristeri et al., 2020); Petersen et al., 2012; Valicenti-McDermott et al., 2013). In contrast, one study found a disadvantage in the language development of bilingual children with ASD compared to the language skills of monolingual children with ASD (Chaidez et al., 2012). Other researchers have found no differences in the communication skills of monolingual and bilingual toddlers with ASD (e.g., Dai et al., 2019; Reetzke et al., 2015; Zhou et al., 2019).

Findings from the current study revealed no differences in the overall communication skills between monolingual and bilingual toddlers with ASD. Thus, findings from the present study do not support the research findings that bilingualism provides an advantage (e.g., Iarocci et al., 2017; Peristeri et al., 2020) or disadvantage (Chaidez et al., 2012) for children with ASD. The present study results are similar to literature that monolingual and bilingual infants and toddlers with ASD perform similarly on language and communication tasks (Dai et al., 2018; Hambly & Fombonne, 2012; Hambley & Fombonne, 2014; Meir & Novogrodsky, 2020; Ohashi et al., 2012; Reetzke et al., 2015; Sendhilnathan & Chengappa, 2020a; Sendhilnathan & Chengappa, 2020b; Zhou et al., 2019). The similarities in the language development of the two groups, as measured by the BDI-2, suggests that bilingualism does not increase the communication challenges that children with ASD encounter. However, evidence from the effect sizes indicates that monolingual toddlers performed better on the BDI-2 than did the bilingual toddlers in the current sample. Although investigating the reasons for the different effect sizes between the groups is beyond the scope of this study, it is important to consider that there are likely extraneous variables influencing the results of a study with such a small sample size. Possible reasons for which the monolingual toddlers outperformed their bilingual peers in the current study include differences in SES, parental education level, and access to early childhood educational settings. However, these variables were not controlled for in the current study so the results should be interpreted with caution,

Research Question 4

To what extent is language exposure (i.e., monolingual or bilingual) related to the **cognitive skills** of infants and toddlers with ASD when controlling for sex (i.e., male or female)?

Overall, the present study found that there were no significant cognitive differences between monolingual and bilingual toddlers with ASD when controlling for sex; however, there were two significant main effects identified in the relationship between language exposure and cognitive skills. Although these two findings do not align with the fourth research question, this section discusses the findings within the context of the current literature about the cognitive skills of bilingual children with ASD. First, a child's language exposure independently predicted a child's overall cognitive skills. Specifically, bilingual children in the current sample had significantly lower cognitive skills than their monolingual peers. To the PI's knowledge, research to date on the effects of bilingualism on the cognitive development of young children with ASD has focused on school-age children. Similarly, no studies that have examined the cognitive skills of children three years old or younger; therefore, comparison of the current findings with previous literature of the cognitive skills of toddlers with ASD is not possible. However, the current main effect findings do not support previous literature on the cognitive skills of bilingual preschool and school-age children (i.e., 4-12 years of age) with ASD. Contrary to the negative cognitive effects of bilingualism observed in the current study, previous research on the cognitive skills of children with ASD has indicated that monolingual and bilingual children with ASD perform similarly or better on working memory (Gonzalez-Barrero & Nadig, 2017), verbal memory (Meir & Novogrodsky, 2020), and overall cognitive (Sendhilnathan & Chengappa, 2020b) tasks. Once controlling for sex, the results of the present study align with the current literature base documenting no differences in cognitive skills for monolingual and bilingual children with ASD. This suggests that the current sample may have confounding variables that influenced the male and female groups. Previous studies that have found cognitive advantages for bilingual children with ASD have not controlled for sex (Gonzalez-Barrero & Nadig, 2017; Meir & Novogrodsky, 2020; Sendhilnathan & Chengappa, 2020b) or have used studied male participants (Peristeri et al., 2020). In contrast to the current findings, previous research has found an advantage in the performance of bilingual children with ASD compared to their monolingual peers on certain executive functioning tasks, including set-shifting (Gonzalez-Barrero & Nadig, 2017), visual attention (Peristeri et al., 2020), computerized working-memory (Peristeri et al., 2020), and parent-reported overall executive functioning skills (Iarocci et al., 2017). Given the small sample size of the current study, it is important to interpret these findings in the context of the current empirical literature. Additionally, traditional measures of cognitive functioning (i.e., IQ) are not utilized to measure the cognitive processes of infants and toddlers so it is possible that differences in these findings are due to the measures used for each age group. For example, in early childhood, academic skills are usually measured as a cognitive outcome; however, traditional measures of cognitive functioning in older children and adults do not consider academic skills. Thus, in early childhood the measurement of cognition may tap into skills that research has established can be temporarily difficult for certain groups of bilingual children due to the nature of dual language development and cultural influences. Eventually, the gap between dual language learners and proficient English-speaking peers closes when young bilinguals are provided with sufficient support.

Further exploration of the sample's cognitive skills examined the toddlers' attention and memory, reasoning and academic skills, and perception and concepts. The current study found that there were no significant differences between the monolingual and bilingual groups in their attention and memory or perception and concepts skills. Although these specific cognitive skills have not previously been compared for monolingual and bilingual toddlers with ASD, these findings are consistent with previous research on cognitive skills of school-aged children with ASD. Specifically, Gonzalez-Barrero and Nadig (2017) and Meir and Novogrodsky (2020) found that both monolingual and bilingual children with ASD scored similarly on memory tasks. Overall, it appears that bilingualism does not place burden upon or enhance the attention, memory, and conceptual skills of bilingual toddlers with ASD, as measured by the BDI-2. The current findings add to the knowledge base that demonstrates that bilingual language exposure does not harm the memory development of young children with ASD. The findings also support the research that has found that the perception and concept cognitive skills of toddlers with ASD are not harmed through bilingual language exposure.

The second significant finding in the current study is that language exposure (i.e., monolingual or bilingual) independently predicted a subset of cognitive skills: reasoning and academic skills. The findings indicate that the bilingual group had lower reasoning and academic skills than did the monolingual group. These findings are consistent with previous research that has found that some bilingual children in the U.S. are behind their monolingual peers in early academic skills (e.g., Espinosa, 2010). Given that the majority of the bilingual group was of Hispanic origin and Hispanic families are less likely to emphasize academic skills at home (Zarate, 2007), it is likely that unidentified cultural factors played a role in this finding. For typically developing children, early academic skills before kindergarten entry are the strongest predictors of academic outcomes (Duncan et al., 2007) and are associated with socio-emotional skills (Jeon et al., 2018) and risk of grade retention in elementary school (Davoudzadeh et al., 2015). The academic difficulties of DLLs may be augmented by social stressors (e.g., living in poverty, immigration status), as well as early childhood education (ECE) environments (Burchinal et al., 2015; Phillips et al., 2017). However, once controlling for sex, the difference between the two groups became insignificant, suggesting that there are no differences in the reasoning and academic skills of monolingual and bilingual toddlers with ASD. Given the limitations of the current sample, these findings could be due to unidentified differences between the male and female children in the current sample. When controlling for sex, the present study is similar to previous literature reporting that bilingual language exposure in early childhood does not harm the cognitive skills of young children with ASD. It is also important to note that research documenting a cognitive bilingual advantage for children with ASD has identified the advantage in school-age children (Gonzalez-Barrero & Nadig, 2017; Iarocci et al. (2017); Peristeri et al., 2020); thus, it may be that in toddlerhood the bilingual advantage is not yet measurable or present.

Research Question 5

To what extent is language exposure (i.e., monolingual or bilingual) related to the following **discrete early communication skills** of toddlers with ASD when controlling for sex (i.e., male or female)?

9. Attending to someone speaking to him or her for at least 10 seconds
10. Babbling
11. Vocalizing
12. Producing monosyllabic sounds
13. Imitating speech sounds
14. Using communicative gestures (e.g., pointing to request an item)
15. Using 10 or more words
16. Using two-word phrases

Previous research has found a bilingual advantage in several discrete early communication skills (e.g., Pons et al., 2015; Valicenti-McDermott et al., 2013). Thus, the present study examined a toddler's ability to attend to someone speaking to him or her for at least 10 seconds, babble, vocalize, produce monosyllabic sounds, imitate speech sounds, use communicative gestures (e.g., pointing to request a toy), speak 10 or more words, and use two-word phrases. The sample's BDI-2 scores on three of the discrete early communication items (i.e., Babbling, Vocalizing, and Producing Monosyllabic Sounds) were constant, with all children in the sample scoring a 2 ("Demonstrated Regularly") on each of those items. The analyses comparing the differences between the groups was not possible for these three skills due to the lack of variability for these items in the sample. It is likely that a larger sample size would provide sufficient variability in the data to examine the babbling, vocalizing, and producing monosyllabic sounds skills of toddlers with ASD. This section discusses the present study results in the context of the current literature base.

Attending to a Speaker. The item related to attending to a speaker measured a child's ability to pay attention to a speaker for at least 10 seconds. This receptive language skill is a prerequisite for expressive language skills because it provides the child with an opportunity to gain important linguistic and social information from the speaker, even if the child does not yet understand what the speaker is saying. Research has found that attending to a speaker is associated with the future receptive and expressive vocabulary of preschoolers with ASD (McDaniel et al., 2018). Results indicated that there were no significant differences in the monolingual and bilingual participants' ability to attend to what a speaker is saying to them for 10 or more seconds. However, due to the limited power of the current study these results may not indicate that both bilingual and monolingual children with ASD attend to speakers similarly. Furthermore, the effect sizes indicate that monolinguals outperformed their bilingual peers. Non-significant differences between the groups are consistent with previous research that has found that monolingual and bilingual toddlers with ASD engage in similar rates of discrete receptive language skills (Valicenti-McDermott et al., 2013). However, the current results are unlike previous research that has found differences in how typically developing bilingual and monolingual infants attend to a speaker (Pons et al., 2015). Pons et al. (2015) found that bilingual infants tend to attend to a speaker's mouth more than monolingual children do. Overall, bilingual language exposure does not appear to negatively influence a child's ability to attend to a speaker for 10 or more seconds. Given that typically developing infants who are bilingually exposed tend to shift their attention to a speaker sooner than their monolingual peers do (Atagi & Johnson, 2020), it is important to further explore this skill in young children with ASD.

Babbling, Vocalizing, and Producing Monosyllabic Sounds. All of the participants in the current study were babbling, vocalizing, and producing monosyllabic sounds; therefore, analyses comparing these discrete early communication skills between the monolingual and bilingual groups were not possible. Contrary to the current study, previous research has found that bilingual toddlers with ASD engage in significantly more cooing and babbling compared to their monolingual peers (e.g., Valicenti-McDermott et al., 2013). A larger sample size may provide sufficient variability to examine these variables.

Imitating Speech. The imitating speech item measured the child's ability to imitate the phonemes or prosody of the speech produced by caregivers or adults, such as the vocalizations made by infants and toddlers directed toward a caregiver. Imitating speech is an important expressive language skill that develops early in infancy (Gratier & Devouche, 2011). It allows for communicative back and forth interactions between the child and caregiver (Kugiumutzakis, 1999) and helps infants store and organize speech sounds that they hear in their environment as part of the language acquisition process (Kuhl & Meltzoff, 1996). The current study found that monolingual and bilingual toddlers with ASD both imitate speech at similar rates. These results suggest that bilingual language exposure does not inhibit the speech imitation of a child with ASD, which is important because speech imitation is an important steppingstone for language development. Imitating speech sounds may elicit more interactions from a child's caregivers. Research has found that mothers are more likely to respond verbally to an infant's speech sounds than non-speech sounds (e.g., Kuhl & Meltzoff, 1982). Back and forth communicative interactions between young children and their caregivers positively promote language and learning outcomes and allow for the child to be exposed to rich linguistic input necessary for language development (Masek et al., 2021). Speech imitation is not only beneficial for expressive language skills, but it is a crucial step in pragmatic language development (Stephens & Mathews, 2014). The present study did not find significant differences in the imitation of speech sounds of monolingual and bilingual toddlers with ASD. These findings indicate that bilingual language exposure does not increase the expressive language skill challenges that children with ASD face. These findings support previous literature that has found no differences between the expressive language skills of monolingual and bilingual children with ASD (e.g., Dai et al., 2018; Hambley & Fombonne, 2014; Meir & Novogrodsky, 2020; Ohashi et al., 2012; Reetzke et al., 2015; Zhou et al., 2019

Communicative Gestures. Gesture usage in early childhood is culture-specific (e.g., Kwon et al, 2017) and strongly related to later language development (e.g., Bates & Dick, 2002; Iverson, 2010). Similar to their typically developing peers, gesture usage is a reliable predictor of the language development of children with ASD (Ramos-Cabo et al., 2019). The results of the current study indicated that there were no differences in how often monolingual and bilingual toddlers with ASD produced communicative gestures. One common gesture in the U.S. culture is pointing. Research has found that pointing is an important precursor to verbal skills (Colonnesi et al., 2010; Lüke et al., 2017) and children with ASD tend to engage in less pointing (Leekam & Ramsden, 2006). Nonsignificant differences in the communicative gestures of monolingual and bilingual toddlers with ASD in this study suggests that both groups developed communicative gestures at similar rates. Therefore, exposure to two or more languages does not appear to hinder this important steppingstone in language development for children with ASD in the current study. Unlike the current findings, previous research has found that bilingual toddlers with ASD engage in more gestures compared to their monolingual peers (Valicenti-McDermott et al., 2013), similar to how their typically developing bilingual peers produce more gestures compared to typically developing monolingual children (Nicoladis et al., 2009). The limited sample size of the current study may not have provided enough power to replicate these findings. Therefore, there is a need to further understand the possible promotive benefits of bilingualism on gesture production of young children with ASD.

Says Ten Words. Saying 10 words is an early expressive language milestone that is usually achieved shortly after the first year of age. By one year of age, a typically developing child will have spoken their first word and will continue to build their expressive vocabulary to approximately 50-300 words by their second birthday (Kliegman et al., 2016). Vocabulary size at 24 months is a strong predictor of academic and behavioral outcomes (Morgan et al, 2015); however, children with ASD tend to begin speaking their first words later than their typically developing peers, at an average age of 36 months (Howlin, 2003). The current study found that bilingual language exposure did not influence the expression of at least 10 words by 30-36 months of age. These findings highlight that bilingualism does not appear to place a burden on the expressive vocabulary of children with ASD. In fact, previous research has found that bilingual children with ASD tend to have larger expressive vocabulary sizes compared to their monolingual peers with ASD (Peterson et al., 2011). Research is needed to understand the possible promotive effect of bilingualism on the initial 10-word vocabularies of children with ASD.

Uses Two-Word Phrases. Once children use approximately 50 words expressively, they begin to form short two-word utterances (Capone Singleton & Shulman, 2020). Given the significant expressive language difficulties that children with ASD tend to experience, some individuals with ASD do not develop the skill of forming two-word utterances (Baghdadli et al., 2012; Lord et al., 2004; Sigman & McGovern, 2005). Other individuals with ASD require intensive therapy to reach this and other expressive language milestones (Medavarapu et al., 2019). Results from the present study indicated there were no differences between the production of two-word phrases of monolingual and bilingual toddlers with ASD. This finding indicates that bilingual language exposure does not further delay the usage of two-word phrases by toddlers with ASD. These findings are consistent with previous research indicating that monolingual and bilingual toddlers with ASD use two-word phrases at similar rates (e.g., Valicenti-McDermott et al., 2013). At this time, there is no evidence to indicate that bilingual language exposure further delays or negatively influences the ability for a toddler with ASD to use two-word phrases.

Limitations

Overall, the analysis of secondary data has several benefits, but restricts the flexibility in the type of measures used and data captured. For example, socio-economic status (SES) was not available and thus the SES of the current sample cannot be described, limiting the interpretation of the findings. Additionally, the language exposure data were received from one of two sources (i.e., ASD evaluation report or Early Steps Registration form); thus, the amount of exposure in each language was not measured. Further, the use of the BDI-2 is a limitation because although it is available in English and Spanish, it is only normed in English. Additionally, the use of an interpreter with the bilingual children may have impacted their scores and the validity of the findings. The present study has a limited sample size due to the participation of only one Early Steps program and a substantial decrease in the number of ASD evaluations conducted by the Early Steps program in 2020-2021 in response to the COVID-19 pandemic. It is possible that significant associations between language exposure and developmental skills were not identified because of underpowered analyses. Thus, a larger sample size may be able to identify statistically significant differences in the outcome variables. Furthermore, the limited sample size restricted the amount of potentially confounding variables that could be controlled for in the present study.

The generalizability of this study's findings is limited by the sample method used and the overall sample size. The PI contacted the Early Steps program for participation in this study because of the PI's prior involvement with the program (i.e., PI was a psychology trainee at the program) and the program's density of culturally and linguistically diverse families enrolled. Thus, the Early Steps program was not randomly selected. However, the leadership of this program was interested in learning about the development of the monolingual and bilingual children with ASD enrolled in the program. The various demographic characteristics of this program would allow for the study of diverse populations of young children with ASD with a larger sample size and power to control for confounding and extraneous variables; however, the diversity in the current underpowered study included several variables that could not be controlled. Therefore, the current sample may not be representative of other Early Steps programs or other young children with ASD. Given that the sample was recruited from one Early Steps program consisting of two counties in Florida, the findings may not be representative of all bilingual toddlers with ASD enrolled in Florida Early Steps programs. Despite the study limitations, there are several implications of the current study for clinicians and researchers to consider.

Implications and Future Directions

Implications for Clinicians

The results of the current study are relevant for clinicians who work with culturally and linguistically diverse (CLD) toddlers with ASD. Given that the present study results do not indicate that bilingual exposure is harmful for the development of young children with ASD and most previous research has found either a bilingual advantage or no differences between the overall development monolingual and bilingual children with ASD, there is currently no empirical foundation to discourage the dual language development of young children with ASD. Research on bilingual children with ASD has grown substantially over the past 5 years; thus, clinicians will need to be informed about the latest advancements in the field in order to support CLD children and counter myths that may harm the early development of bilingual children with developmental delays. This section describes some implications for practice based on the results of the current study that clinicians working with young children with ASD can implement when working with CLD children with ASD.

Overall, the current literature suggests that clinicians working with children with ASD should support the dual language development of children who live in bilingual homes or in monolingual homes of non-majority language speakers (e.g., non-English speakers in the U.S.). Given that the current study results align with previous findings indicating that bilingual children with ASD do not experience increased challenges in their adaptive, social, communication, and cognitive skills, there is currently no conceptual foundation to discourage the dual language development of young children with ASD. On the contrary, research has identified several benefits to bilingualism across the lifespan.

In order to increase their language skills, children with ASD must be exposed to high quantity and quality of language input, as this is associated with increased language skills (Gonzalez-Barrero & Nadig, 2018). In order to do so, parents with limited English proficiency should be encouraged to speak whichever language(s) they feel most comfortable using with their child; thus, increasing the child's access to rich linguistic input in the home. Clinicians should explicitly explain to families the benefits of their child's rich exposure to the home language. One way to explicitly encourage and affirm home language usage with the child is to teach parents how to use intervention skills in their given languages. Having a bilingual interventionist would be ideal to ensure that both languages are being used in the child's early intervention programming.

However, it is not always possible to have bilingual clinician on the case. To encourage families to speak to their children in the language(s) they are most proficient in, therapists working with a CLD toddler with ASD could incorporate basic words from the child's home language into their intervention programing (e.g., mom, dad, thank you, come here, more, eat, drink). In addition, caregivers should be encouraged to watch and participate in therapy sessions so that they can implement the same strategies throughout the week in the home language outside of allotted therapy times. Given that many bilingual families in the U.S. emphasize interactions with extended family members, clinicians can support the participation of extended family members (e.g., grandparents, aunts/uncles, etc.) in intervention programming to increase family buy-in, social support for the intervention, and opportunities for generalization of skills across different settings. Importantly, doing so may increase the child's opportunity for rich linguistic input in the home language(s), as well as provide the clinician with opportunities to learn about the cultural values and beliefs of their client's/patient's family. Additionally, clinicians working on communication goals with CLD toddlers with ASD should engage in culturally responsive practices to build rapport with the child and family, as well as adapt the intervention to the needs of the child.

Implications for Researchers

The current study findings are relevant for researchers who examine the development of children with ASD and other developmental disabilities. Much research on bilingualism in early childhood has focused on the deficits and challenges that this group faces in U.S. educational settings. However, there are many social, financial, academic, cognitive, and linguistic benefits to bilingualism across the lifespan. Although underpowered, the current study does not provide evidence that bilingualism taxes the development of young children with ASD, who already experience significant developmental challenges. Future research is needed to examine the adaptive, social, communication, and cognitive skills of infants, toddlers, and preschoolers. Most research to date in the field has analyzed small sample sizes; thus, large scale studies that examine these variables in detail with many participants will provide greater insight and confidence in generalizability. A replication of the current study with a larger and diversified sample of participants is recommended, as well as more information about the sample in order to control for possible extraneous variables. Additionally, confounding variables, as well as mediating and moderating variables for these relationships should also be studied in order to better understand the relationship between language exposure and developmental outcomes of children with ASD. For example, Goodrich et al. (in press) found that by controlling for confounding variables, monolingual and bilingual children had similar executive functioning abilities despite a bilingual advantage having been identified for the same group when not controlling for confounding variables. In addition to advantages in developmental skills, future research should explore the possible social, financial, and quality of life advantages of bilingualism for individuals with ASD. Furthermore, longitudinal studies of a child's developmental trajectory over time are needed to better understand the development of adaptive, social, communication, and cognitive skills of young bilingual children with ASD. Specifically, longitudinal studies using psychometrically sound measures of global development from infancy to puberty may be beneficial to understand the ages or developmental stages during which bilingual advantages are present for children.

Although the current study did not aim to explore the main effects of sex (i.e., male or female) on the developmental domain skills of toddlers with ASD, no main effects for sex were identified. However, the cognitive skills model was significant for a bilingual disadvantage before controlling for sex, when the significant cognitive skills models were no longer significant. Research on main effects of sex on the social, adaptive, communication, and cognitive skills of young children with ASD is limited. Although sex differences in adults with ASD have found no differences in adaptive skills (e.g., Ben-Itzchak et al., 2013), research on sex differences in young children with ASD has yielded mixed results. For example, some research has found an advantage for females in social and communication skills (e.g., Lai et al., 2012) and other research has indicated a disadvantage in social and communication skills for females as they grow older (Mahendiran et al., 2019). Therefore, research on sex differences in early childhood is needed.

Conclusion

In order to provide high quality services to children with ASD during a critical period of human development, it is important for clinicians and educators to understand the development of young bilingual children with ASD. Previous research has identified benefits to bilingualism across the lifespan, including bilingual benefits for children with ASD. This study aimed to contribute to the body of knowledge on the adaptive, social, communication, and cognitive skills of monolingual and bilingual toddlers with ASD. Using data from a single site, this study compared the adaptive, social, communication, and cognitive skills of monolingual and bilingual toddlers with Level 1 or Level 2 ASD, controlling for sex. A series of multiple regressions indicated that there were no significant differences in the social, adaptive, communication, and cognitive skills of monolingual and bilingual toddlers with ASD when controlling for sex. Although there were limitations to this study in terms of sample size, power, and methods, the results align with previous research that has found that bilingualism does not intensify the challenges that young children with ASD experience. However, the limitations of the study indicate that caution should be taken when interpreting the findings from the current study. It also is important to consider that a bilingual advantage usually develops later in childhood so it is not surprising to find non-significant differences between the groups at this age. The results of the study should inform the research agendas of pediatric and educational stakeholders who serve bilingual children with ASD and their families during a critical period of language development. As the rates of bilingualism and ASD increase in the U.S., educational and clinical stakeholders need to better understand the developmental trajectories of young children with ASD. Research with a larger sample size is needed to better understand the development of bilingual children with ASD. In addition, research focused on the influence of sex (i.e., male or female) in the development of adaptive, social, communication, and cognitive skills is also needed.

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Appendix A

University of South Florida IRB Study Approval Letter

UNIVERSITY of
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APPROVAL

September 25, 2020

Marcela Galicia
[redacted]

Dear Ms.Galicia:

On 9/24/2020, the IRB reviewed and approved the following protocol:

Application Type:	Initial Study
IRB ID:	STUDY001310
Review Type:	Expedited 5
Title:	The Adaptive, Social, Language, and Cognitive Skills of Monolingual and Bilingual Toddlers with Autism Spectrum Disorder
Funding:	None
IND, IDE, or HDE:	None
Approved Protocol and Consent(s)/Assent(s):	• 1310 Protocol Version #1 September_21_2020_HIPAA Edits.docx;

Within 30 days of the anniversary date of study approval, confirm your research is ongoing by clicking Confirm Ongoing Research in BullsIRB, or if your research is complete, submit a study closure request in BullsIRB by clicking Create Modification/CR.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Your study qualifies for a waiver of the requirements for the informed consent process for this record review as outlined in the federal regulations at 45 CFR 46.116(f).

Your study qualifies for a waiver of the requirement for signed authorization as outlined in the HIPAA Privacy Rule regulations at 45 CFR 164.512(i). A waiver of HIPAA authorization is granted for this retrospective record review of children with ASD who were evaluated by Early Steps within the date range in the protocol. This waiver allows the study team and/or its honest

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broker to obtain PHI of children in this cohort from the Tampa Bay Area Early Steps Program records.

This research involving children as participants was approved under 45 CFR 46.404: Research not involving greater than minimal risk to children is presented.

Sincerely,

Various Menzel
IRB Research Compliance Administrator