VERBAL OUTCOMES AT SCHOOL ENTRY OF MONOLINGUAL AND BILINGUAL CHILDREN WITH ASD WHO WERE MINIMALLY VERBAL AT THE TIME OF DIAGNOSIS

by

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B.A., Carleton University, 2011

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES

(Special Education)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

April, 2016

ABSTRACT

Families of children with ASD raised in bilingual homes are often provided with mixed recommendations from professionals regarding language exposure. Many parents are advised to limit language exposure to the language of instruction, despite the familial, cultural, religious, or community challenges associated with forced monolingualism. Although previous research with verbal children with ASD has consistently shown that bilingual exposure does not have a negative impact on early language development, no study to date has examined this issue in minimally verbal (MV) children. Thus, the purpose of this study was to explore the extent to which home language exposure, in combination with other variables, predicted verbal outcome at the time of school entry (around age 6) in a sample of children with ASD who were MV (i.e., spoke five or fewer words) at the time of diagnosis. Participants were 34 MV children with ASD; of these, 24 monolingual-exposed (ME) children were exposed to only one language and 10 bilingual exposed (BE) children were exposed to a second language ≥ 20% of the time. Results of a logistic regression indicated that home language exposure was not a significant predictor of verbal status at the time of school entry, but nonverbal IQ (NVIQ) scores were. In the current sample, ME children were five times more likely to remain MV at age 6 after controlling for scores relating to NVIQ, imitation, responding to joint attention, and initiating joint attention. The results suggest that, in this sample, bilingual exposure did not negatively impact the verbal outcome of MV children with ASD, although this result cannot be generalized to the population at large. Limitations of the study are addressed, highlighting directions for future research and implications for clinical practice.

PREFACE

This study utilized data collected for the "Autism Spectrum Disorders: Pathways to Better Outcomes" research project that was approved by UBC's Behavioural Research Ethics Board (BREB) on June 26, 2009 under certificate H09-01085. Ms. Howse's name was added to the study team through BREB on April 12, 2015 (H09-01085-013) and the Pathways in ASD study team approved use of data for her thesis on January 28, 2016. Ms. Howse was responsible for all data analysis and is the sole author of this thesis.

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ACKNOWLEDGEMENTS

I would first like to thank Dr. Pat Mirenda for her continued guidance, support, and encouragement throughout my graduate studies. I would also like to thank Dr. Stefka Marinova-Todd, Dr. Cay Holbrook, and Dr. Eric Duku for sharing insight and expertise in their respective fields. I am grateful for my partner Stéphane who has provided ongoing patience, love, and support. Finally, I would like to thank my parents Linda and Dean, and brothers William and Martin, for supporting me from Ontario throughout my journey at UBC.

CHAPTER 1: INTRODUCTION

According to the 2011 Canadian Census, 14% of individuals living in Canada and 21% of those living in the metropolitan area of Vancouver, British Columbia speak more than one language regularly within the home (Statistics Canada, 2012a). Individuals who use more than one language are referred to as 'multilinguals,' a term that encompasses bilinguals (i.e., individuals who use two languages), trilinguals, quadrilinguals, and so forth (Goral & Conner, 2013). Multilingualism is rapidly becoming the standard in most countries worldwide, across all age groups and social classes (Grosjean, 2010). Canada prides itself on its rich multiculturalism and diversity in terms of ethnic origins, religions, and languages spoken. When the 1971 Multiculturalism Policy of Canada was adopted, Canada became the first country in the world to adopt multiculturalism as an official policy (Government of Canada, 2012).

As multilingualism is increasingly prominent worldwide, research on the language development of monolingual and multilingual children is on the rise. However, until recently, there has been limited research on the impact of multiple language exposure in special populations. Now, there is some research regarding the effect of multilingualism on language development in people with Down Syndrome (Feltman & Kay-Raining Bird, 2008; Kay-Raining Bird et al., 2005); specific language impairment (SLI; Crutchley, Botting, & Conti-Ramsden, 1997; Gutierrez-Clellen, Simon-Cereijido, & Wagner, 2008; Hakansson, Salameh, & Nettelbladt, 2003; Jacobson & Schwartz, 2002; Paradis, 2010; Restrepo & Kruth, 2000); and autism spectrum disorder (ASD; Hambly & Fombonne, 2012, 2014; Ohashi et al., 2012; Petersen, Marinova-Todd, & Mirenda, 2012; Valicenti-McDermott et al., 2012). Interest in research concerning ASD in particular has increased in recent years due to the increased prevalence of this disorder over the past decade. The U.S. Centers for Disease Control reported that, during the surveillance year of 2006, approximately 1 in 110 children had a diagnosis of ASD (Centers for Disease Control and Prevention, 2009); and in 2010, this same group reported a prevalence rate of 1 in 68 children (Centers for Disease Control and Prevention, 2014). With the growing number of children diagnosed with ASD, the need for research examining the effects of monolingual versus multilingual exposure on language development and other variables is becoming more critical. The next section provides an overview of ASD and the specific issues related to multilingualism reported in the literature.

Autism Spectrum Disorder and Bilingualism

Individuals diagnosed with autism spectrum disorder (ASD) are characterized by deficits in social-communicative development as well as restricted and repetitive behaviours (American Psychiatric Association, 2013). Social-communication symptoms include deficits in: (a) nonverbal communicative behaviours used for social interaction; (b) social-emotional reciprocity; and (c) the ability to develop and maintain developmentally-appropriate relationships. An individual must exhibit symptoms in each of these three socio-communicative domains to receive a diagnosis of ASD. Restricted and repetitive behaviour symptoms include: (a) ritualistic verbal or nonverbal behaviours, extreme adherence to routines, or extreme resistance to change; (b) stereotypic/repetitive speech, motor movements, or manipulation of objects; (c) unusual, hyper- or hypo-active reactions to sensory stimulation; and (d) interests that are highly restrictive, fixated, or abnormal in intensity and/or focus. To receive a diagnosis of ASD, an individual must exhibit symptoms in at least two of these behaviour domains. In addition, symptoms must be evident in early childhood and must impair an individual’s ability to function in daily life. ASD is now classified in the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V; American Psychiatric Association, 2013) to encompass all diagnostic categories from previous editions of the DSM, including Autistic Disorder, Asperger's Syndrome, Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), and Child Disintegrative Disorder.

Multi-/Bilingualism: The Debate

It has become common practice among many professionals, including physicians, psychologists, educators, speech-language pathologists, and behaviour analysts, to recommend multilingual families to expose their child with ASD to only one language (Jegatheeson, 2011; Kay-Raining Bird, Lamond, & Holden, 2012; Kremer-Sadlik, 2005; Yu 2013). For example, in a survey conducted by Kay-Raining Bird et al. (2012), 49 parents of children with ASD were interviewed about their experiences with raising children in a multilingual household. Of the parents who reported receiving advice about language exposure from professionals, 62.5% were consistently advised not to expose their child to more than one language, 25% received mixed advice, and only 12.5% were encouraged to continue exposing their child to more than one language. After a child is diagnosed with ASD, parents in North America are often advised to begin to speak English only (or another majority language, such as French in the Canadian province of Quebec), regardless of the parents' proficiency in that language (Jegatheeson, 2011). The reason often provided for this advice is that English is the primary language spoken in the country where the family lives and, therefore, the child's ability to become proficient in English will make his or her life less challenging in the future. In Yu (2013), for example, one mother stated "I am mindful now to only speak English with him . . . because the school he is going to now is an English-speaking environment, as well as the other settings he needs to be in. I think it's better to let him build a good foundation in English first (p. 15)." However, limiting non-English language exposure may result in considerable hardship by restricting the family's ability to attend cultural, religious, or community events in the non-dominant language. This may also prevent relatives or community members who are not proficient in English from communicating with the child (Jegatheeson, 2011).

Another reason for recommending single language exposure to parents of children with ASD is that some professionals believe that the linguistic input to which these children are exposed should be as simplistic as possible in order to facilitate language learning, given the social-communicative challenges inherent in ASD (Jegatheeson, 2011). The acquisition of a language requires an individual to successfully grasp a language's phonology, lexicon, morphology, syntax, semantics, and pragmatics (Fahim & Nedwick, 2014). Jegatheeson (2011) found that practitioners were advising parents to "stick with English" and "avoid speaking another language" because "your child will become terribly confused" or will "become more lost" (p. 195). In an interview study by Kremer-Sadlik (2005), one mother for whom English was a second language stated that "in order to help him [her son] move forward a little faster to make… him speech can catching up as same age kids… she [the clinician] suggested we need to use English more often" (p. 1225). However, the assumption that speaking only one language in the home will increase the success of therapy or intervention has not been corroborated. In fact, the only study to date that has specifically examined this issue (Seung, Siddiqi, & Elder, 2006) found that, when therapy was provided to a Korean/English bilingual boy with ASD in both languages, he was able to acquire both.

Notwithstanding the above concerns, there are some specific characteristics of individuals with ASD that might affect multiple language development. These will be examined briefly in the sections that follow.

Attention to voices. Children with ASD often prefer to attend to alternative auditory stimuli over human speech sounds, which may reduce their exposure to verbal vocal auditory input (Hambly & Fombonne, 2012). This deficit appears to be unique to children with ASD and does not occur in children with Down syndrome, SLI, or in typically developing children. Hambly and Fombonnne hypothesized that a deficit in attending to voices may result in fewer opportunities for children with ASD to analyze and sort the bilingual auditory input provided by family members. Hypothetically, this might result in later impairments for these children with regard to sentence comprehension and production. To date, however, no research has been conducted to examine this hypothesis in bilingual children with ASD.

Joint attention. A delay in the acquisition of joint attention skills is another impairment that is unique to children with ASD (Adamson, Bakeman, Deckner, & Romski, 2009; Hambly & Fombonne, 2012). Joint attention deficits include lack of eye gaze and difficulty following another person's line of regard (e.g., following a point), both of which hinder the ability of children with ASD to assign word labels to specific items or concepts. Bilingually exposed children with ASD may experience even greater difficulties than their monolingual peers in this regard, as they have to map twice the number of word labels to each item or concept (Hambly & Fombonne, 2012). For example, a monolingual-exposed child only needs to ascribe one word to the object "chair," but a child exposed to both English and French needs to learn at least two word labels, "chair" and "chaise."

The combination of difficulty with attention to voices, poor joint attention skills, and the social-communicative deficits inherent in ASD have led many parents and professionals to assume that children with ASD will experience additional language difficulty if they are raised in a multi-lingual environment. Is this assumption supported by research evidence? What exactly does the research say about the language development of children with ASD who are raised in bilingual or multilingual homes? In the next section, I review the research that has addressed this issue, thus far.

Multi-/Bilingualism: The Research

In recent years, there has been increased attention to the impact of bilingualism in children with ASD. There are three types of studies in this regard: qualitative, quantitative, and intervention studies. In the following sections, I review each of these, in turn.

Qualitative Research. Qualitative research has provided rich information about parents' opinions about the language outcomes of children with ASD who are raised in multilingual households, and the effects of parental decisions to restrict language use at home. In this section, I summarize four qualitative studies and one survey study that involved parental interviews.

In an early study by Kremer-Sadlik (2005), interviews were conducted with four sets of parents of children with ASD (i.e., both mothers and fathers of each child), all of whom spoke English as a second language (ESL). All four sets of parents spoke to their child with ASD in a native language prior to the child's diagnosis; however, after diagnosis, all parents began to speak English to the child to various degrees. All parents reported that this change in language exposure was due to recommendations by various professionals. As a result of first language exposure loss and parents' limited proficiency in the English language, the children were often excluded during family conversations at dinner time. They were also unable to attend cultural or religious events in which the family's native language was spoken. Although this study provides insight to the difficulties faced by ESL families, it does not provide parental views about children's language outcomes due to language exposure.

In an ethnographic study, Fernandez y Garcia, Breslau, Hansen, and Miller (2012) conducted narrative interviews with five bilingual mothers of children with ASD. Among the five families, eight children were diagnosed with ASD. Mothers were asked questions about their decisions regarding language exposure and how these choices influenced their daily lives. All families in this study were explicitly told by health care providers to speak only English and to avoid using their native language when communicating with their child with ASD. After making the sudden switch to English only, all five mothers reported great struggles, feelings of loss, and deep sadness. Mothers who were not fluent in the English language said they spoke to their child with ASD less often after they made the switch to English, because they did not feel comfortable speaking the second language. Mothers also reported that switching to English caused many social barriers within family, community, and cultural settings, including social isolation of the child with ASD and distancing from non-English-speaking family or community members. Some parents who later reintroduced their native language to their child with ASD described mixed feelings of apprehension, relief, and empowerment once they did so, as well as a better relationship with their child. This study provides insight into the personal experiences of families who decide to restrict use of a native language with their child with ASD.

In a study conducted by Jegatheeson (2011), three Muslim mothers of children with ASD provided information about their experiences raising children in a multilingual environment. The mothers all reported speaking at least four languages at home within their daily lives. All parents believed their children's verbal repertoire expanded due to their increased exposure to bilingual contexts within the home and community. Furthermore, they believed having their children immersed in multilingual contexts enriched their religious, cultural, and familial relationships. These parents also reported experiencing conflicts with professionals who did not support their use of native languages at home and even (in some cases) hiding the fact they continued to speak the native language with their children.

In contrast to these reports, a qualitative study by Yu (2013) yielded different results. Yu (2013) conducted in-depth, phenomenological interviews with 10 Chinese-English-speaking mothers of bilingual-exposed children with ASD. All of these mothers believed, to some degree, that bilingual exposure was detrimental to their child's language learning, largely because they had been told by professionals that this would be the case. Because the results of this study were based on parent reports, it is not possible to assess either the actual language practices within the family or the effect of multilingual exposure on the language abilities of the children.

Finally, in the previously mentioned survey by Kay-Raining Bird et al. (2012), 37 parents of children with ASD were identified as raising their child in multilingual homes. Of this population, 78% of parents reported their children were able to learn more than one language, albeit to varying degrees of language comprehension, verbal repertoires, and literacy across individuals. Parental reports suggested that children exposed to more than one language had no more difficulty acquiring language than their monolingual peers; however, there was no objective data to support this conclusion.

To summarize, parental reports regarding multilingual language exposure for children with ASD are somewhat mixed. Due to professional advice, some parents believed that exposing their child to a bilingual environment during early development resulted in language learning challenges (Yu, 2013), while other parents believed that bilingual exposure increased their child's verbal repertoire (Jegatheeson, 2011). Many parents reported familial, community, and cultural challenges when following the recommendation of professionals to restrict native language use when communicating with their child with ASD (Fernandez y Garcia et al., 2012; Kay-Raining Bird et al., 2012; Kremer-Sadlik, 2005). Although these parental reports provide important insights, it is also necessary to examine quantitative studies that have explored the language outcomes of children with ASD who are raised in multilingual homes.

Quantitative Research. In this section, I review six published, quantitative studies comparing bilingual and monolingual children with ASD with regard to various aspects of language development. All participants in these studies were young children, ranging in age from 20 months to 7 years. These studies will be reviewed in chronological order by publication date.

Hambly and Fombonne (2012) conducted the first study in this regard and compared the early language development of 45 bilingual-exposed children with ASD to 30 monolingual-exposed children with ASD, aged 36 to 78 months; only two of the 75 participants were identified as minimally verbal (MV). This study investigated potential differences in language development or social skills between these two language exposure populations. Bilingual-exposed children were divided into two categories: those were who bilingual-exposed before 12 months of age (i.e., simultaneous bilinguals) and those who were bilingual-exposed after 12 months of age (i.e., sequential bilinguals). Results indicated no significant differences between the monolingual and bilingual groups on measures of the age of first words, age of first phrases, social responsiveness, initiation of pointing, response to pointing, attention to voices, total conceptual vocabulary, and number of words spoken in the dominant language. Furthermore, no significant differences were found between simultaneous versus sequential bilingual children. These results suggest that children from bilingual environments are no more impaired in terms of expressive and receptive communication than children from monolingual environments.

In the work of Petersen et al. (2012), 14 bilingual English-Chinese speaking children were age-matched with 14 monolingual English-speaking children between 43 and 73 months of age. Inclusion criteria required that all children had vocal repertoires of at least 30 English words and that bilingual children also had spoken vocabularies of at least 30 Chinese words. The vocabulary skills and general language skills of the two groups were compared using the Preschool Language Scale 3rd ed. (PLS-3; Zimmerman, Steiner, & Pond, 1992) as well as both English and Chinese versions of the Peabody Picture Vocabulary Test—III (PPVT-III; Dunn & Dunn, 1997) and the MacArthur-Bates Communicative Development Inventories (MCDI; Fenson et al., 1993). No differences were found between the two groups in terms of their English vocabulary, conceptual vocabulary, vocabulary production, and overall language scores. However, the bilingual speaking children were found to have a larger total lexicon than the monolingual children. On the basis of these results, Petersen et al. (2012) suggested that parents should not restrict the use of a native language in home and community settings.

In a study conducted by Ohashi et al. (2012), 20 bilingual-exposed children with ASD were matched with 40 monolingual-exposed children with ASD (aged 24-52 months), based on nonverbal IQ scores and the chronological age at which language assessments were performed. All children spoke at least 30 words at the time of language assessment. Across the two matched groups, researchers compared functional communication scores, receptive language scores, expressive language scores, age of first words, age of first phrases, and severity of communication impairment. No significant differences were found for any of these variables. Again, the results suggest that early bilingual exposure does not negatively impact early language development in children with ASD.

Valicenti-McDermott et al. (2012) compared the language skills of 40 bilingual English-Spanish children with ASD and 40 monolingual English children with ASD ranging in age from 20 to 32 months. Inclusion criteria for participants required a diagnosis of ASD before the age of

3 and a recommendation to a university-affiliated centre. Of the 40 bilingual children, 14 participants (35%) were characterized as MV and, among the 40 monolingual children, 8 participants (20%) were categorized as MV. The difference between these two groups was not found to be significant. Children were tested on receptive language skills, expressive language skills, and communicative means (e.g., facial expression, pretend play). Bilingual children were found to be no more impaired in any of these areas than their monolingual counterparts. However, the bilingual children had a significantly higher probability of vocalizing and using gestures when communicating.

In another study, Hambly and Fombonne (2014) measured the expressive vocabularies of 33 monolingual and bilingually-exposed children with ASD, aged 3 to 7 years. To be considered for this study, children were required to have at least 50 spoken words in their vocabulary. Participants were grouped into one of three categories: (a) monolinguals, who had no second language vocabulary usage; (b) low bilinguals, who had second language vocabularies from 1 to 69 words; and (c) high bilinguals, who had second language vocabularies from 70 to 559 words. Children were assessed on the amount of recent direct language exposure, expressive language, receptive language, and various social measures. Expressive language and expressive vocabulary were both significantly higher for individuals in the high bilingual group. In addition, the amount of recent language exposure was positively correlated with the acquisition of a second language vocabulary. The results from Hambly and Fombonne (2014) suggest that bilingual exposure may increase the acquisition of a second language which may, in turn, promote relationships in the home and community settings.

The most recent study, from Guangzhou, China, examined the effects of bilingual exposure on children with ASD with a focus on the pragmatic aspects of language (Reetzke, Zou, Sheng, & Katsos, 2015). The bilingual-exposed participants (whose mean age was 61 months) had ongoing exposure to two mutually unintelligible Chinese languages, one of which was either Mandarin or Cantonese. The monolingual participants (whose mean age was 60 months) were all exposed to one Chinese language. The study assessed both structural and pragmatic abilities in the children's dominant language as well as the children's social functioning. Results indicated no significant differences in performance on any of the measures between the bilingual and monolingual Chinese participants. In addition to examining structural language competence, this study demonstrated that bilingual children with ASD are comparable to monolingual peers in terms of their level of pragmatic skills.

Although only a few quantitative studies have explored the language outcomes of bilingual versus monolingual exposed children with ASD, they have all reached similar conclusions. The general consensus is that exposure to a second language does not have a negative impact on the early language development of children with ASD. Although these studies are useful, none have included an intervention component. Only two studies, to date, have focused on this important element.

Intervention Studies. Very few studies have explored the impact of language intervention on bilingual-exposed children with ASD. In this section, I review two studies that examine the language outcomes of bilingual-exposed children after receiving intervention in more than one language. Both studies included only one participant whose language ability was assessed at multiple time points during intervention.

Seung et al. (2006) examined the effects of bilingual language intervention with a Korean/English bilingual boy with ASD. This study documented the child's abilities at four time points: Time 1 (after 6 months of treatment, age 3:6); Time 2 (after 12 months of treatment, age

4:0); Time 3 (after 18 months of treatment, age 4:6); and Time 4 (after 24 months of treatment, age 5:0). For the first 12 months, speech-language intervention was conducted in Korean only; during the following 6 months, English was gradually introduced during intervention; and for the final 6 months of the study, intervention was provided almost entirely in English. Researchers assessed the child's words and sentences, expressive vocabulary, receptive vocabulary, and developmental language, as well as the parents' level of stress, at each time point. Throughout treatment, the child made continuous gains in both expressive and receptive language development in both languages. In fact, the emergence of his native language (Korean) following six months of treatment seemed to be related to an increase in his English vocabulary. It is also important to note the child's mother reported lower ratings of parental stress the longer her child received intervention. These results suggest that bilingual intervention can be appropriate for children with ASD who come from multilingual families.

In a second study, a 4-year-old girl with ASD was provided with discrete trial teaching (DTT) in both English and Spanish (Lang, Rispoli, Sigafoos, Lancioni, Andrews, & Ortega, 2011). Prior to this, she was exposed regularly to both languages, primarily Spanish at home and English at school. Initial assessments found she was able to imitate 5-10 simple words in both English and Spanish; however, she produced little expressive language and was unable to follow simple commands beyond vocal imitations. Her overall expressive and receptive language levels were determined to be equally limited in both languages at baseline. Researchers used an alternating treatments design to determine whether the language of DTT instruction had an effect on the child's response accuracy and level of problem behaviour. Extraneous variables such as the instructor, materials, tasks, reinforcers, and schedules of reinforcement remained constant throughout sessions; thus, the only dependent variable was the language of instruction. Results demonstrated significant differences between the two languages of instruction, with a higher number of correct responses and a lower number of problem behaviours exhibited when instruction was provided in Spanish (the child's home language) compared to English (the language spoken most often at school). This study demonstrated that the language of instruction may have an effect on intervention success; it is also suggested that, if possible, family priorities should be accommodated in this regard. Of course, given that only two studies (involving one participant each) have examined the intervention issue, additional research in this area is required.

Summary. Interview studies with parents of children with ASD suggest that professionals often advise parents to restrict their language input at home to the minority language. As a result, parents have reported a number of social challenges arising in the family and community and have mixed opinions about this recommendation. Two intervention studies yielded mixed results on the effects of language of instruction for bilingual children with ASD. In contrast, studies examining the early language outcomes of children raised in monolingual versus bilingual home environments have uniformly failed to find significant differences between the two groups.

It is noteworthy that, with the exception of Valicenti-McDermott et al. (2012), none of the aforementioned studies included minimally verbal (MV) participants; rather, they all included preschool-aged participants who had at least some functional speech. Thus, we know very little about language outcomes of bilingual children who are minimally verbal at the time of diagnosis. What proportion of MV children with ASD become verbal later in life? What predicts verbal outcomes for children who are MV at the time of diagnosis? And, finally, is there a relationship between the verbal status of children who are MV at time of diagnosis and home language exposure? The next section will summarize the research on this topic to date.

Minimally Verbal Children with ASD: The Research

The verbal outcomes for children with ASD who are MV at the time of diagnosis have changed over the past few decades. Early estimates suggested that approximately 50% of children who were MV would never acquire a functional form of verbal communication (Prizant, 1996; Rutter, 1978; Volkmar et al., 1994). However, recent studies have found that a much lower percentage (14%-20%) of children remain MV at school entry (Anderson et al., 2007; Lord, Risi, & Pickles, 2004; Wodka, Mathy, & Kalb, 2013).

Research has also examined the factors that appear to predict speech development in this population. Table 1 summarizes the predictor studies to date that have explicitly targeted children with ASD who were MV at the time of diagnosis; thus, studies by authors such as Toth, Munson, Meltzoff, and Dawson (2006) and Stone and Yoder (2001) were excluded because participants were children with ASD regardless of spoken language ability. Table 1 includes a summary of the author and year, participants, definition used for minimally verbal, data analysis, and measures used in each study. The Participants column describes the sample size, age range or mean age of participants, and the percentage of participants who were male. The Definition column describes how the researchers in the study defined minimally verbal; some studies used data from assessments to establish clear criteria in this regard, while others used more general descriptions. The Analysis column describes the type of statistical analysis used to examine potential predictors of language development over time. Finally, the Measures columns lists all of the assessments that were used to evaluate participants throughout the study.

Table 1: Studies involving minimally verbal participants that examined the language outcomes of children with ASD

Authors, Year	Participants (N, age, sex)	Definition of Minimally Verbal	Analysis	Measures
Anderson, Lord, Risi, Delavore, Schulman, Thurm… Pickles, 2007	N = 206 (98 ASD, 58 PDD-NOS), *M* age 29 mo, 80% male	Nonverbal: <5 words/day on ADI-R at age 9	Growth curve analysis	ADI-R, ADOS, DAS, Infant MSEL, VABS, WISC-III
Smith, Mirenda, & Zaidman-Zait, 2007	N = 35, range 20-67 months, 80% male	Very delayed language: <60 words on MCDI during baseline	Cluster analysis, ANOVAs, ANCOVAs	CARS, MCDI, MSEL
Thurm, Lord, Lee, & Newschaffer, 2007	N = 118 (83 with ASD or PDD-NOS), *M* age 24 months, 78% male	No words: <5 words and/or speech not used on a daily basis at age 2	Bivariate ANOVAs, linear regression	ADI-R, DAS, MSEL, PL-ADOS, SICD, VABS
Wodka, Mathy, & Kalb, 2013	N = 535, range 8-17 years old (*M* 11.6), 85% male	Severe language delay: not putting words into meaningful phrases by age 4, includes nonverbal Nonverbal: single words or occasional basic phrases without a verb	Multivariate logistic regression	ADI-R, ADOS, CBCL, DAS-II, MSEL, WISC-IV, WASI

Authors, Year	Participants (N, age, sex)	Definition of Minimally Verbal	Analysis	Measures
Norrelgen, Fernell, Eriksson, Hedvall, Persson, Sjolin… Kjellmer, 2014	N = 165, range 4-6 years, 85% male	Nonverbal: <3 words and expressive age equivalent <15 months on VABS Minimally verbal: ≥3 words, and never or only sometimes 2-word phrases, and expressive age equivalent <24 months on VABS	ANOVAs, ANCOVAs, Logistic regression	ABC, DISCO-10, DSM-IV, Griffiths' developmental scales, VABS-II, WPPSI-III
Ellis Weismer & Kover, 2015	N = 129, *M* age 2.5 years, 87% male	Preverbal: uses minimal speech or does not consistently use phrase speech Minimal speech: no spoken words to simple two-word phrases	Hierarchical linear modeling	ADI-R, ADOS, Bayley-III, DSM-IV, ESCS, PLS-IV, PPVT-4, VABS
Thurm, Manwaring, Swineford, & Farmer, 2015	N = 70, 12-60 mo years (*M* 30), 81% male	Minimally verbal: Single words or less	Logistic regression, linear regression	ADI-R using DSM – IV-TR criteria, ADOS, MSEL

Key: ABC= Autism Behavior Checklist, ADI-R= Autism Diagnostic Interview- Revised, ADOS = Autism Diagnostic Observation Schedule, ANCOVA= Analysis of Covariance, ANOVA= Analysis of Variance, ASD= Autism Spectrum Disorder, Bayley= Bayley Scales of Infant and Toddler Development, CARS= Childhood Autism Rating Scale, CBCL= Child Behavior Checklist, DAS= Differential Ability Scales, DISCO= Diagnostic Interview of Social and Communication Disorders, DSM-IV-R= Diagnostic and Statistical Manual of Mental Disorders- Fourth Edition- Twice Revised, ESCS= Early Social Communication Scales, *M*= Mean, MCDI= MacArthur-Bates Communicative Development Inventory, MSEL= Mullen Scales of Early Learning: AGS Edition, N= Number of participants, PDD-NOS= Pervasive Developmental Disorder-Not Otherwise Specified, PL-ADOS= Pre-Linguistic Autism Diagnostic Observation Schedule, PLS-IV= Preschool Language Scale-Fourth Edition., PPVT-4= Peabody Picture Vocabulary Test-4, SICD= Sequenced Inventory of Communication Development, VABS= Vineland Adaptive Behavior Scales, WASI= Wechsler Abbreviated Intelligence Scale, WISC-III= Wechsler Intelligence Scale for Children-III, WPPSI= Wechsler Preschool and Primary Scale of Intelligence

Table 2 organizes the same studies listed in Table 1 by variables that were found to predict language outcomes. These variables include nonverbal intelligence quotient (NVIQ) scores, ASD severity, imitation, joint attention, toy play, and early verbal skills. A predictor was identified with “Yes” if the study found that, after controlling for confounding variables, the factor predicted language outcomes to a statistically significant degree. A predictor was identified with “No” if the factor did not predict language outcomes after controlling for confounding variables. Results indicated that NVIQ was the most commonly-identified predictor of language outcomes among studies, followed by joint attention and imitation skills. ASD severity was found to be an inconsistent factor for predicting language outcomes to a clinically significant degree.

Table 2: Factors predicting language development of children with ASD

Author, Year	NVIQ	ASD severity	Imitation	Joint attention	Toy Play	Early Verbal Skills
Anderson et al., 2007	Yes			Yes		
Smith et al., 2007		Yes	Yes	Yes	Yes	Yes
Thurm et al., 2007	Yes		Yes	Yes		Yes
Wodka et al., 2013	Yes	Social impairment: Yes RRSB: No				
Norrelgen et al., 2014	Yes					
Ellis Weismer & Kover, 2015	Yes	Yes		RJA: Yes IJA: No		
Thurm et al., 2015	Yes	No				

Key: ASD= Autism Spectrum Disorder, IJA= Initiating Joint Attention, NVIQ= Nonverbal Intelligence Quotient, RRSB= Restrictive, Repetitive, and Stereotyped Behaviour, RJA= Responding to Joint Attention

Statement of the Problem and Research Question

Currently, there is little research about the extent to which (if at all) the home language environment is associated with verbal outcomes of bilingual children who are MV at the time of diagnosis. Nonetheless, bilingual families whose children are MV will likely receive recommendations from professionals suggesting they limit exposure to their native language at home, (Jegatheeson, 2011; Kay-Raining Bird at al., 2012; Kremer-Sadlik, 2005; Yu 2013). To date, no study has examined whether early home language exposure (monolingual vs. bilingual) also predicts verbal status of children considered minimally verbal at time of diagnosis. The current study examined this issue in order to answer the following questions:

1. What are the verbal outcomes at school entry (age 6) for monolingual exposed versus bilingual exposed children with ASD who were MV at the time of diagnosis?
2. After controlling for other relevant variables (based on previous research), does bilingual exposure prior to school predict verbal status at the time of school entry (age 6)?

Because no previous study has examined the impact of language exposure on MV children with ASD, it was not possible to formulate a hypothesis related to the predictor variables. Thus, this study was exploratory in nature.

CHAPTER 2: METHOD

Participants

Participants in this study were drawn from a database created for the *Pathways in ASD* research project, a Canada-wide longitudinal study of children with ASD and their families (Szatmari et al., 2004). The *Pathways* team has collected data since 2004, through a research team located across five university sites: Dalhousie University in Halifax, Nova Scotia; McGill University in Montreal, Quebec; McMaster University in Hamilton, Ontario; the University of Alberta in Edmonton, Alberta; and the University of British Columbia in Vancouver, British Columbia. The following inclusion criteria were met by all of the *Pathways* participants: (a) an ASD diagnosis within 4 months of entering the study; (b) age 2 years to 4 years 11 months at the time of diagnosis; and (c) at least one parent whose English or French language proficiency allowed them to read and understand the information and consent form. All participants received a diagnosis of autism or ASD through a multidisciplinary diagnostic team in the province in which they lived, using assessments that were administered by research-reliable diagnosticians. Exclusion criteria from the *Pathways* database involved the presence of (a) cerebral palsy or other neuromotor disorder that might interfere with the study assessments; (b) a known genetic disorder or chromosomal abnormality; (c) a moderate to severe visual impairment (i.e., severe problem in one eye only, visual acuity 6/6-6/18 corrected in better eye); and/or (d) a moderate to severe hearing impairment (i.e., severe loss in one ear, hearing loss 20-40 dB).

A total of 34 participants (24 monolingual-exposed and 10 bilingual-exposed) were identified in the *Pathways* database for the current study. Children were selected because they had completed all of the test measures required for the current study and met the inclusion requirements for minimally verbal language status (defined in a forthcoming section) at the time of diagnosis. They also met the criteria for placement into either the monolingual-exposed (ME) or bilingual-exposed (BE) group (defined in a forthcoming section). Of the ME group, 96% were males, with a mean age at diagnosis of 33 months (range: 19-48 mo). Of the BE group, 90% were males, with a mean age at diagnosis of 33 months (range: 24-41 mo). Family demographics including location, marital status, and total household income are listed in Table 3. The highest level of education attained by parents is displayed for both the ME and BE groups in Table 4.

Table 3: Family demographic information

	ME Group		BE Group	
Descriptor	Frequency	Percent	Frequency	Percent
Location				
Montreal	9	37.5	8	80
Hamilton	6	25	1	10
Vancouver	4	16.7	1	10
Halifax	5	20.8	0	0
Marital status				
Married	16	66.7	8	80
Common law	6	25	0	0
Single	2	8.3	1	10
Separated	0	0	1	10
Total household income				
<$14,999	2	8.3	1	10
$15,000-$29,999	1	4.2	4	40
$30,000-$39,999	1	4.2	3	30
$40,000-$59,000	6	25	0	0
$60,000-$79,999	5	20.8	1	10
$80,000+	8	33.3	0	0
Unanswered	1	4.2	1	10

Families in the ME group were spread fairly evenly among all test sites across Canada, whereas families in the BE group were primarily from Montreal. Most caregivers from both language status groups identified as married. The majority of families in the ME group had a total household income of more than $40,000, while the majority of families in the BE group had a total household income of less than $40,000.

Table 4: Highest level of education attained in each family

	ME Group		BE Group	
Highest level of education	Frequency	Percent	Frequency	Percent
Completed high school	2	8.3	0	0
Some college	4	16.7	1	10
Completed college diploma/some university	6	25	3	30
Completed university undergraduate/Bachelor's degree	10	41.7	4	40
Completed Master's degree or higher	2	8.3	2	20

Both the ME and BE groups had approximately 70% of families whose highest level of education was a college diploma, some university, or a university undergraduate degree. Although education levels were comparable between groups, BE group had an overall slightly higher level of education. The fact that bilingual families in the current study had relatively higher education levels (Table 4) but proportionally lower income levels (Table 3) is consistent with immigrant labour force statistics data across Canada (Statistics Canada, 2012b) and suggests that underemployment is a common problem in this group.

Dependent (Outcome) Variable

Verbal status was the dependent (i.e., outcome) variable for this study. Participants were children with ASD in the *Pathways* database who were minimally verbal (MV) at the time of diagnosis (T1). For this study, MV was defined as speaking five or fewer words or approximations, in accordance with the information available on the Autism Diagnostic

Interview-Revised (ADI-R; (Lord, Rutter, & Le Couteur, 1994) and the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2003), which were both available for all participants. Children who were MV at T1 met two criteria: (a) a code of 2 ("Fewer than five words total or speech not used on a daily basis") on question 30 ("How much speech does the child have now?") of the ADI-R, as assessed by a research-reliable examiner within 4 months of diagnosis, and (b) code of 3 ("At least one word or word approximation, but fewer than five words used during session") or 8 (No words or word approximations") on Module 1 item A1 of the ADOS, as assessed by a research-reliable examiner within 4 months of diagnosis.

Verbal status at age 6 (T2) was also classified using ADI-R and/or ADOS criteria, as follows:

- ADI-R Q30 = missing or code of 2 PLUS ADOS Module 1 item A1 = 3 or 8 (same as at T1) – these are children who are still MV at age 6
- ADI-R Q30 = 0 or 1 PLUS ADOS Module 1 = 1 or 2 OR Module 2 = 2 or 3 – these are children who produce words but not phrases
- ADOS Module 1 = 0 OR Module 2 = 0 or 1 OR Module 3 = 2 or 3 – these are children with phrase speech
- ADOS Module 3 = 0 OR ADI-R Q30 = 0 and ADOS Module 3 = 1 – these are children with complex/fluent speech

Table 5 displays the codes relevant to these determinations, from the ADI-R and ADOS.

Table 5: ADI-R and ADOS codes used to determine verbal status at T1 and T2

Code	ADI-R, Q30: "How much speech does the child have now?"
0	Functional use of spontaneous, echoed, or stereotyped language that, on a daily basis, involves phrases of three words or more that at least sometimes include a verb and are comprehensible to other people.
1	No functional use of three-word phrases in spontaneous, echoed, or stereotyped speech, but uses speech on a daily basis with at least five different words in the last month.
2	Fewer than five words total or speech not used on a daily basis.
Code	ADOS Module 1, A.1
0	Regular use of utterances with two or more words.
1	Occasional phrases only; mostly single words.
2	Recognizable single words only; must use at least five different words during session.
3	At least one word or word approximation, but fewer than five words used during session.
8	No words or word approximations.
Code	ADOS Module 2, A.1
0	Non-echoed phrase speech of three or more words per utterance; some grammatical markings, such as plurals or tense.
1	Speech is primarily two- or three-word utterances, with minimal or no grammatical markings.
2	Occasional phrases; mostly single words.
3	Single words only, or no spoken language.
Code	ADOS Module 3, A.1
0	Uses sentences in a largely correct fashion (must use some complex utterances with two or more clauses)
1	Some relatively complex speech (occasional utterances with two or more clauses), but with recurrent grammatical errors.
2	Non-echoed speech is mostly utterances of at least three words, but non-elliptical simple phrases.
3	Non-echoed language is mostly simple phrases.

Independent (Predictor) Variables and Measurement

Five independent (i.e., predictor) variables were examined in this study: language exposure from birth to age 6, NVIQ scores, initiating joint attention scores, responding to joint attention scores, and imitation scores at the time of diagnosis. These variables were derived from a number of measures, as described in the sections that follow. Assessments used to diagnose ASD for participants in the current study are also described.

Language Exposure: Family Background Information Questionnaire

Two groups of MV children were included: bilingual-exposed (BE) children and monolingual-exposed (ME) children. The Family Background Information Questionnaire (FBIQ; Hambly & Fombonne, 2005), a parent report measure, was used to identify language exposure. The FBIQ is a 21-item caregiver report measure that provides information regarding family background. FBIQ questions are derived from those used in the Statistics Canada Census and include information regarding marital status, caregiver education, and total household income. In this study, questions regarding the number of languages to which a child was exposed between birth to age 1, age 1 to 2, and age 2 to 6, as well as the percentage of exposure to each language, were used to identify monolingual and bilingual children. FBIQ questions that were used in the current study regarding language exposure included: "What is the primary language spoken to your child at home?"; "What language did your family (primary caregiver, partner) speak to your child from birth to age 1, age 1 to age 2, and age 2 to present?"; "List the languages (primary and other) the primary caregiver and partner currently speak to the child"; and "During a typical week, what percent of time does your child hear the primary language, secondary language, and/or another language?"

Bilingual-exposed (BE) Group. Previous studies have used participant language exposure criteria ranging from a minimum of 20% for either language (Gutierrez-Clellen et al., 2008; Ohashi et al., 2012) to 30% (Fennell, Byers-Heinlein, & Werker, 2007) or higher. For this study, bilingual exposure was defined as (a) at least 20% exposure to two languages at home – one of which was either English or French – for at least one year prior to diagnosis, and (b) ongoing exposure to more than one language at home (with at least 20% exposure to the second language) from the time of diagnosis to age 6. All information was obtained by parent report on the FBIQ. It was important for children to have had reasonable exposure to English or French at the time of diagnosis, since all of the assessment measures were administered in one of these two languages. In this study, 50% of the BE children were exposed to two languages from birth to age 6; 20% were exposed from age 1 to age 6; and 30% were exposed from age 2 to age 6.

Monolingual-exposed (ME) Group. Children in the ME group were all exposed to English or French only from birth to age 6, according to parents' responses on the FBIQ. Table 6 summarizes the language exposure of children in the two groups.

Table 6: Language(s) exposed to monolingual and bilingual participants

Language(s) Exposed	Monolingual group		Bilingual group	
	Frequency	Percent	Frequency	Percent
English only	23	95.8	0	0
French only	1	4.2	0	0
English and French	0	0	1	10
English, French and another language (Italian, Yoruba)	0	0	2	20
English and another language (Korean, Bengali, Tamil, Spanish, Cantonese)	0	0	7	70

Only one child from the ME group was exposed only to French, and the remaining 96% of participants were exposed to English only. Of the BE group, most participants were exposed to English and one other language.

NVIQ: Merrill-Palmer-Revised Scales

In this study, cognitive subscale standard scores from the Merrill-Palmer-Revised Scales (M-P-R; Roid & Sampers, 2004) were used to estimate a nonverbal intelligence quotient (NVIQ) score. The M-P-R is a standardized developmental assessment measure for infants and children from birth to age 6 years 6 months. The M-P-R can be used to measure cognitive development and a variety of other domains. The cognitive assessment can be completed in about 45 minutes and involves having children engage in tasks that require interactions with the examiner and/or with various toys. For example, cognitive tasks include completion of puzzles, pegboard patterns, color matching, identifying items that "go together," etc. The mean and standard deviation for the cognitive subscale of the M-P-R are 100 and 15, respectively.

Reliability coefficients for most of the cognitive battery scales range from .91-.98 (Gregory, 1996, as cited in Roid & Sampers, 2004). Content validity has also been confirmed by various analyses (Roid & Sampers, 2004). Four participants (three from the ME group and one from the BE group) did not have cognitive subscale standard scores available. To calculate NVIQ scores for these participants, a ratio score was calculated using the age equivalent score for the cognitive subscale (M-P-R cognitive age equivalent multiplied by 100, then divided by M-P-R age in months).

Joint Attention: Early Social Communication Scales

The Early Social Communication Scales (ESCS; Mundy et al., 2003) is a videotaped, manualized, interactional assessment designed to measure the nonverbal communication skills of children with mental ages between 8 and 30 months. It is a 15 to 25 minute assessment comprised of 17 social communication tasks that involve turn taking, social interactions, gaze following, object spectacles, book presentation, and responding to invitations to play. Observers interpret joint attention behaviours as a child's use of nonverbal behaviours to share experiences of objects or events with others. Observers code joint attention in several categories, including (for the purpose of this study): (a) initiating joint attention (IJA); and (b) responding to joint attention (RJA). These behaviours may be classified as lower level behaviours (e.g., eye contact between the tester and an inactive mechanical toy, alternative eye contact between tester and an active object spectacle, and following a proximal point), higher level behaviours (e.g., pointing, showing objects, and following line of regard), or alternative behaviours (e.g., unprompted bids to caregiver). The ESCS has demonstrated good inter-rater reliability with generalizability coefficients of .93 for social interaction, .80 for initiating joint attention, and 1.0 for responding to joint attention (Mundy, Kasari, Sigman, & Ruskin, 1995). In this study, total IJA and RJA scores at T1 were used to determine if joint attention predicted later language development.

Imitation: Multidimensional Imitation Assessment

The Multidimensional Imitation Assessment (MIA; Lowe-Pearce & Smith, 2005) is an assessment measure developed by members of the *Pathways in ASD* study team to measure children's ability to copy actions and body movements performed by a live model. The MIA is videotaped and scored afterward, according to a manualized protocol. It is comprised of 48 examiner-elicited items that include actions without objects (29 items; for example, finger on cheek, touch toes, show teeth, stamp feet), actions with objects (4 items; for example, brush teeth with stick, knock over block, bang two sticks), and vocalizations (15 items; for example, "book," "deek," "vroom" with car, "ba ba ba") (Tan-MacNeill, 2015). The MIA's internal consistency is strong, with Cronbach's α= .99 across the 48 items. In this study, MIA total scores at T1 were used to determine if imitation was a predictor contributing to later language development.

Autism Diagnosis and Verbal Status: ADOS and ADI-R

Autism Diagnostic Observation Schedule. The Autism Diagnostic Observation Schedule is a semi-structured, standardized measure (Lord et al., 2003). The ADOS provides structured activities that create a standard context to observe an individual in terms of the following areas: (a) communication, (b) social interaction, and (c) play. During the 30 to 45 minute assessment, the administrator takes notes on a child's responses to structured activities. The information collected during the assessment is used to identify children who meet criteria for ASD. ADOS scores were used for diagnosis and, in this study, to classify the verbal status of participants at T1 and T2 (see Table 5).

Autism Diagnostic Interview-Revised. The Autism Diagnostic Interview-Revised is a standardized measure used to identify individuals with ASD (Lord et al., 1994). It is a semi-structured interview in which a caregiver responds to questions regarding a child's communication, social development and play, repetitive and restricted behaviors, and general behaviour problems. The ADI-R has acceptable internal reliability, with mean alpha coefficients of .95 for social items and .69 for restricted, repetitive behaviour items (Lord et al., 1994). In the present study, ADI-R scores were used for diagnosis, and ADI-R Question 30 ("Overall level of language: how much speech does [subject] have now?") was used to classify the verbal status of participants at T1 and T2 (see Table 5).

Procedure

Participant Identification

The *Pathways* database included the data for 423 participants at T1. A series of steps were used to identify children in the database who met the basic study criteria. First, the database was searched to identify all children who meet the ADOS and ADI-R criteria for MV at the time of diagnosis, as previously described (Table 5). Second, the database was searched to find which of these children also had ADOS and ADI scores available at age 6 (T2), in order to classify their verbal status at this time point. Next, the data for these children were examined to identify which of those met either the monolingual or bilingual criteria described previously, using the FBIQ. Following these procedures, data analysis commenced.

Data Analysis

Descriptive statistics were generated to characterize the ME and BE samples (e.g., age, gender, etc.) and their scores at T1 and T2 on all relevant measures. Logistic regression was used to determine whether the independent (predictor) variables predicted verbal status at T2.

Because of the small sample size, participants were coded into two groups for this analysis: participants who were still MV at T2 and participants who spoke more than five words.

CHAPTER 3: RESULTS

In this Chapter, I first present descriptive statistics related to the research questions. These are followed by the results of the logistic regression.

Descriptions of the ME and BE Groups at T1

Assessment scores for possible predictors of later language development (NVIQ, imitation, and joint attention) are displayed in Table 7 for both language status groups at T1. As previously described, the M-P-R cognitive standard score was used to measure NVIQ; MIA total scores measured imitation; ESCS IJA total scores measured initiating joint attention; and ESCS RJA total scores measured responding to joint attention.

Table 7: Descriptive statistics for assessment measures at T1 for ME and BE groups

	T1	
Measure	ME Group (Mean, SD)	BE Group (Mean, SD)
M-P-R cognitive standard score	40.97, 14.9	37.95, 18.6
MIA total score	22.96, 25.1	11.10, 9.7
ESCS IJA total score	10.83, 11.0	3.50, 6.6
ESCS RJA total score	38.00, 26.2	25.88, 16.2

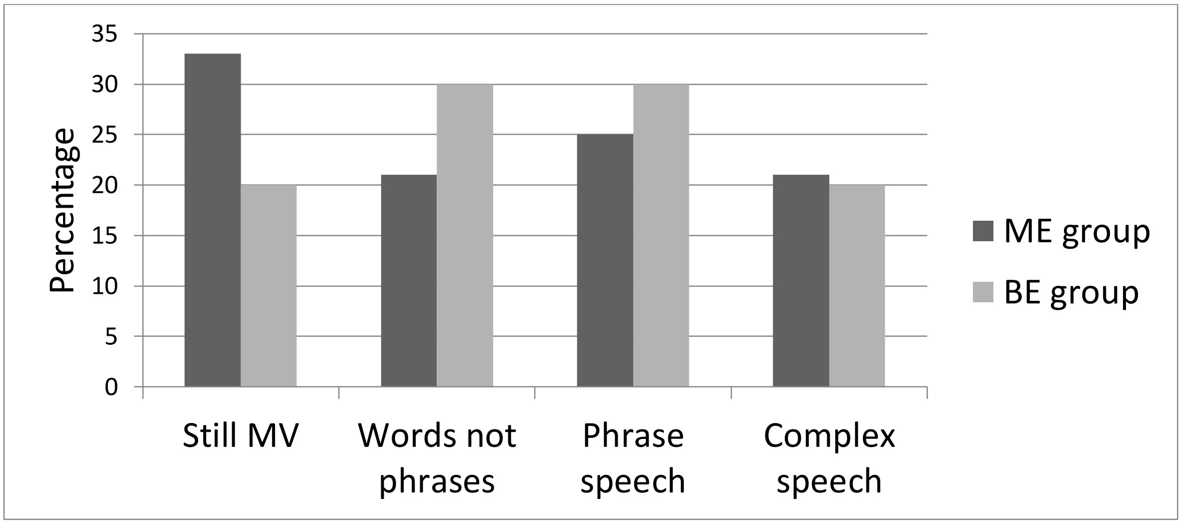
Key: ESCS= Early Social Communication Scales, IJA= Initiating Joint Attention, MIA= Multidimensional Imitation Assessment, M-P-R= Merrill Palmer Revised, RJA= Responding to Joint Attention, SD= Standard Deviation

At the time of diagnosis, the ME group displayed higher mean scores and standard deviations for all measures in comparison to the BE group. In addition, the mean MIA total score for the ME group was more than double that of the BE group at TI.

Verbal Status at Age 6 (T2)

Figure 1 summarizes the verbal status of participants in the ME and BE groups at age 6.

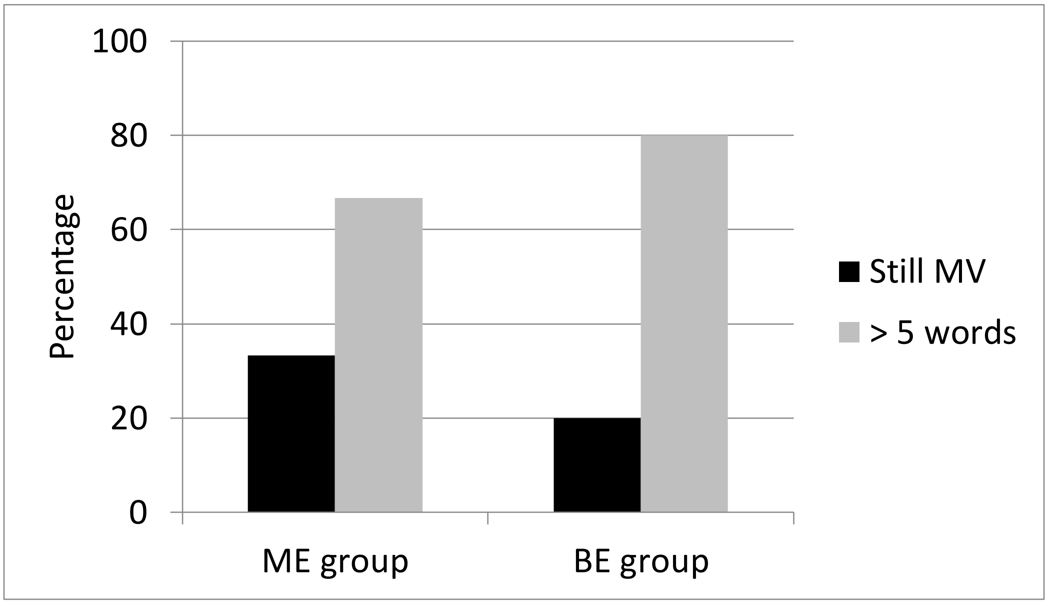
Figure 1: Verbal status of ME and BE participants at T2 (age 6)



Proportionally, fewer children in the BE group remained MV at age 6 (20% vs. 33% in the ME group). Conversely, higher proportions of BE children had words but not phrases (30% vs. 21%) or phrase speech (30% vs. 25%), compared to ME children. The proportion of children with complex speech was almost identical in the two groups (20% vs. 21%).

Due to the small sample size of the current study, participants were coded into two verbal outcome groups for the statistical analysis: participants who were still MV at T2 and participants who had at least some speech (> 5 words) at T2. Figure 2 displays the proportion of children in these two groups.

Figure 2: ME and BE group outcomes at T2 (age 6)



Proportionally, 33.3% of the ME group and 20% of the BE group remained MV at age 6.

Logistic Regression

Using the two groups described in Figure 2, scores for NVIQ, IJA, RJA, and MIA were entered into the model, in addition to language status (monolingual vs. bilingual). The Omnibus tests of model coefficients was significant, $\chi^2 = 12.22$ (df = 5), $p < .032$. The Hosmer and Lemeshow test was nonsignificant, - $\chi^2 = 7.17$ (df = 8), $p < .52$. Together, these two tests indicate that the model improved the prediction compared to the intercept alone (Omnibus tests) and that the data were a good fit to the model (Hosmer and Lemeshow test). Results of the logistic regression are summarized in Table 9.

Table 8: Logistic regression results

	β	S.E.	Wald	df	p	Exp (β)	95% C.I. for lower	95% C.I. for higher
Language status: ME vs. BE	1.595	1.240	1.656	1	**.198**	**4.931**	.434	55.984
RJA (ESCS)	-.011	.028	.157	1	.692	.989	.936	1.045
IJA (ESCS)	.029	.044	.425	1	.515	1.029	.944	1.122
Imitation (MIA)	-.030	.030	.992	1	.319	.970	.914	1.030
NVIQ (M-P-R)	**-.093**	.039	**5.792**	1	**.016**	**.911**	.845	.983
Constant	1.939	1.492	1.689	1	.194	6.952		

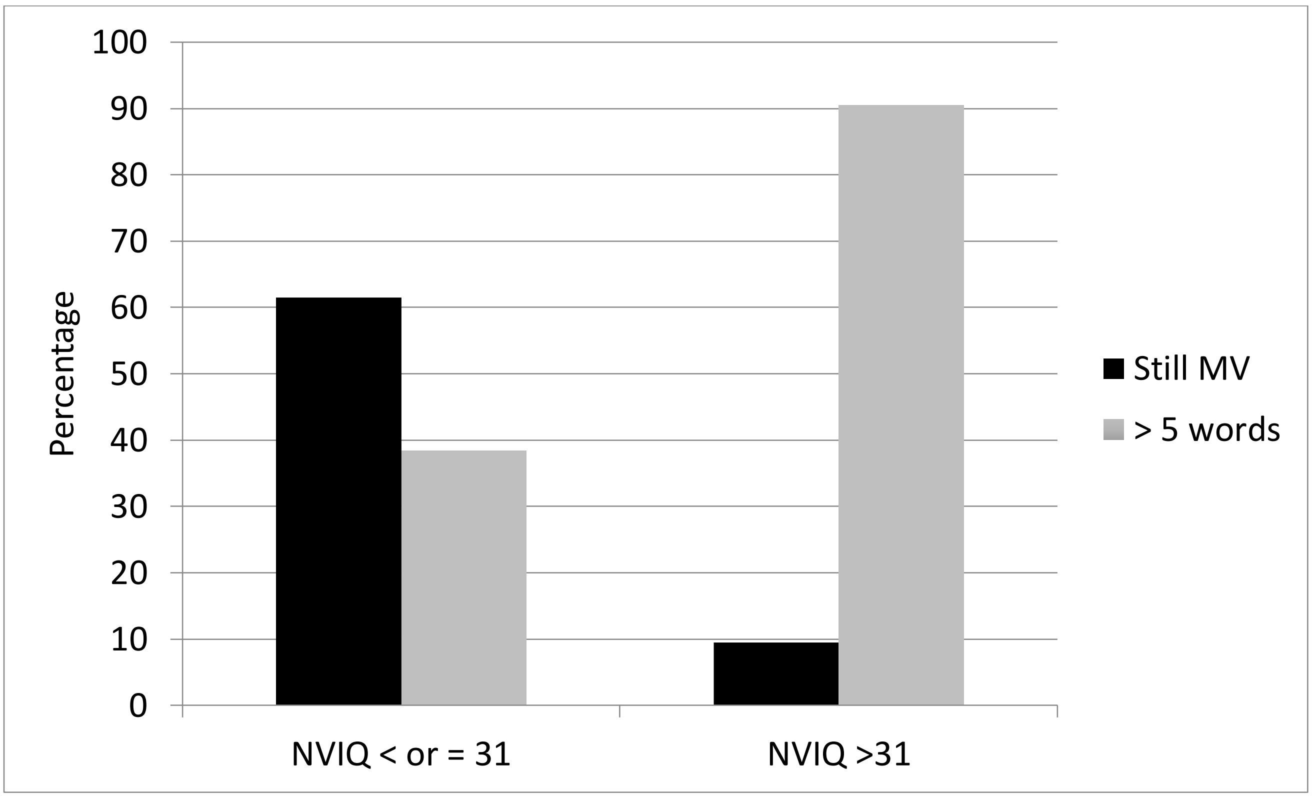
Key: β= Beta, BE= Bilingual Exposed, C.I.= Confidence Interval, df= Degrees of Freedom, ESCS= Early Social Communication Scales, IJA= Initiating Joint Attention, ME= Monolingual Exposed, MIA= Multidimensional Imitation Assessment, M-P-R= Merrill Palmer Revised, P= Probability, RJA= Responding to Joint Attention, S.E.= Standard Error

Results indicated the only variable that predicted verbal status at T2 was NVIQ at T1 (Wald = 5.792, df = 1, $p < .016$, odds ratio (Exp β) = .911. Because the beta weight (β) was negative for this variable, interpretation requires conversion by dividing 1.0 by .911 = 1.098. This means that the odds of being in the group with speech at T2 was predicted to increase by a factor of 1.1 for every one point increase in NVIQ. In addition, the odds ratio for language status was 4.931. This means that, when IJA, RJA, imitation, and NVIQ were considered in addition to language status, the odds of being MV at T2 (age 6) was five times greater for monolingual than for bilingual children. However, because this result was non-significant ($p = .198$), it pertains only to the sample of children included in this analysis, not to the population of mono- and bilingual children with ASD who are MV at the time of diagnosis.

NVIQ Groups at T2

To illustrate the logistic regression results, Figure 3 displays the verbal status at age 6 for the lower (≤31) and higher (>31) NVIQ groups. The graphs were split into NVIQ score groupings with a dividing score of 31 because, in the current sample, most children who remained MV at T2 had NVIQ scores of ≤31, with only two participants scoring above 50.

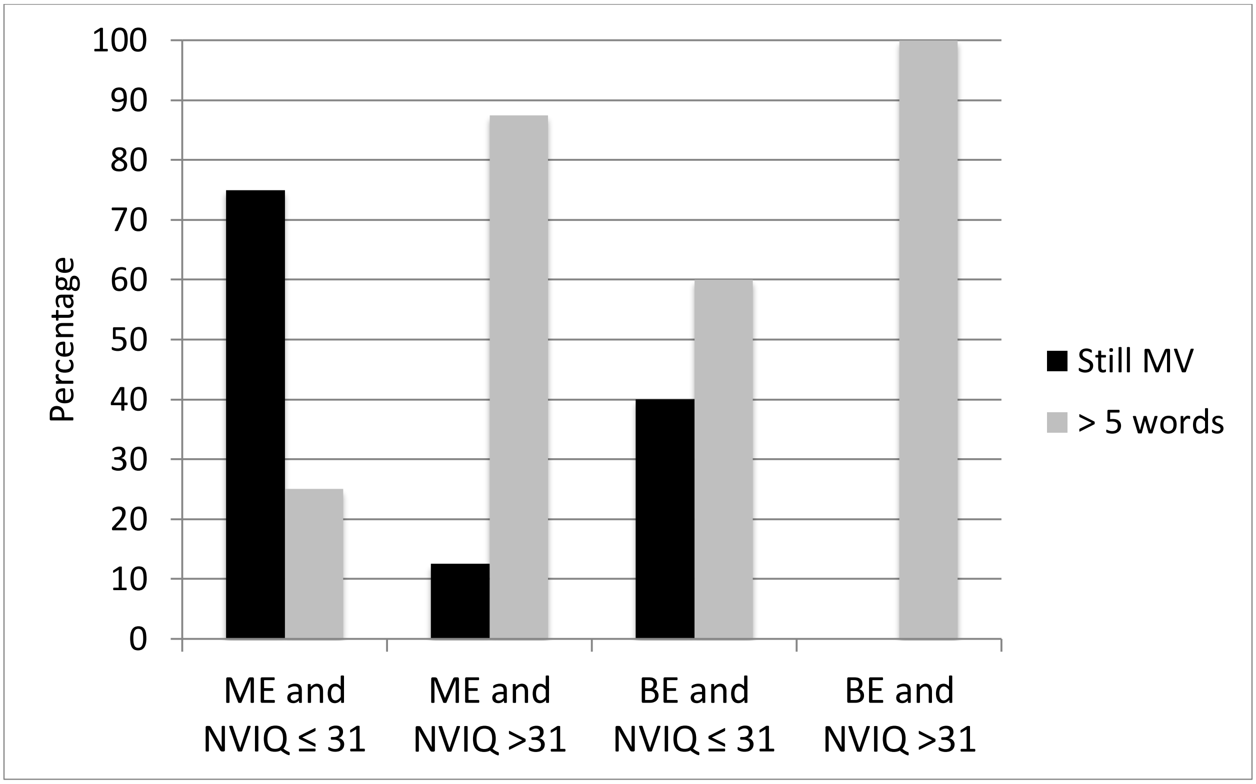
Figure 3: Verbal status of participants across NVIQ groups



Proportionally, 61.5% of participants with relatively low (≤31) NVIQ scores remained MV at T2, compared to 9.5% of those with relatively high NVIQ scores. In contrast 90.5% of participants in the higher NVIQ group had developed at least some speech (i.e., >5 words) at T2.

Figure 4 displays the results of the logistic regression in terms of both NVIQ scores (lower/higher) and language exposure (ME/BE).

Figure 4: Verbal status of ME and BE participants across NVIQ groups at T2 (age 6)



The majority (75%) of ME participants with lower NVIQ scores remained MV at T2. Conversely, a smaller proportion (40%) of BE participants with lower NVIQs remained MV, while 60% (n = 3) gained at least some speech (>5 words). In contrast, the majority of ME participants (87.5%) and 100% of BE participants (n = 5) with higher NVIQ scores had acquired at least some speech (>5 words) by age 6.

Summary

For the purposes of this study, the most notable result was that language exposure as a predictor variable was non-significant ($p = .198$). NVIQ was the only variable that predicted language outcome at age 6 for children who were MV at time of diagnosis. Proportionally, more BE participants with lower NVIQ scores (60%) gained at least some speech (>5 words) at T2, compared to ME participants with lower NVIQ scores (25%). Responding to joint attention, initiating joint attention, and imitation were not found to be significant in predict later language outcome for this sample. The results are confined to the current sample, which has a small sample size (24 in the ME group, 10 in the BE group).

CHAPTER 4: DISCUSSION

The goal of this exploratory study was to examine the impact of early language exposure on the speech development over time of children with ASD who were MV at the time of diagnosis; no published study to date has examined this issue. Results of the logistic regression indicated that, as was the case in previous research, NVIQ was the only variable that predicted speech development over time (Anderson et al., 2007; Ellis Weismer & Kover, 2015; Norrelgen et al., 2014; Thurm et al., 2007; 2015; Wodka et al., 2013). Most importantly, for the purpose of this study, home language exposure was not found to predict speech outcomes in the current sample.

ME vs BE Groups

The result of the logistic regression suggested that, when other relevant variables were considered, monolingual-exposed participants were five times more likely to remain minimally verbal at age 6, compared to their bilingual counterparts. Of course, these results must be interpreted cautiously because of the small sample size. Nonetheless, this is consistent with the results of previous studies that have also found no negative impact of bilingualism (Hambly and Fombonne, 2012; 2014; Ohashi et al., 2012; Petersen et al., 2012; Reetzke et al., 2015; Valicenti-McDermott et al., 2012). This study builds on the existing body of research on this topic in that all of the previous studies included either solely or primarily speaking children with ASD. Thus, there is no published study, to date, to examine the impact of bilingual exposure on verbal status for children who were MV at the time of diagnosis.

NVIQ as a Predictor

NVIQ was the only variable found to predict language status over time in the current sample. This is consistent with several previous studies that have examined NVIQ, all of which have found it to be a predictor of later verbal status. For example, Anderson et al. (2007) used growth curve analysis to assess the verbal skills of 206 children (98 with ASD, 58 with PDD-NOS) at ages 2, 3, 5, and 9 years of age. Participants were categorized into one of four outcome groups, from least to most improved verbal abilities over time. The strongest positive predictor of verbal outcome for this sample was NVIQ ($p < .001$) across all outcome groups. Joint attention also emerged as a strong predictor of verbal outcome in this study.

In another study, 129 children with ASD participated in language assessments at four time points, from a mean age 2.5 at first assessment to a mean age of 5.5 at last assessment (Ellis Weismer & Kover, 2015). Participants were categorized into two groups (preverbal or verbal) during the first visit and two groups (low language outcome or high language outcome) during the fourth visit. Hierarchical linear modeling was used to evaluate predictors of later language ability. NVIQ was found to be a strong predictor of expressive language abilities across the preschool period for this sample of participants. ASD severity and RJA were also found to predict development in language production in this sample; however, IJA was not.

Wodka et al. (2013) also found NVIQ to be a predictor of verbal status, with other variables yielding mixed results. This study examined the verbal status of 535 children with ASD (at least 8 years of age) who had not yet attained phrase speech by age 4. The strongest predictor of verbal outcome among the speech outcome groups was NVIQ (with p values ranging from <.01 to <.001). Higher NVIQ and lower social impairment were both associated with attainment of phrase and fluent speech. Repetitive interests/stereotyped behaviours were not found to be a significant predictor of later verbal outcome.

Norrelgen et al. (2014) conducted a study in which the only clear, consistently significant factor found to predict later verbal ability was NVIQ. This study involved 165 children with

ASD aged 4-6 years who were followed longitudinally for 2 years. Participants were classified into one of three groups based on NVIQ scores. Distribution of NVIQ scores across verbal status groups was found to be significant, with the highest NVIQ scores in the phrase speech group and the lowest NVIQ scores in the nonverbal group. Other variables examined as possible predictors were unclear and lacked consistency between and within groups.

Finally, two studies conducted by Thurm et al. (2007; 2015) both found NVIQ to predict later verbal skills. Thurm et al. (2007) followed 118 children (59 with ASD; 24 with PDD-NOS; and 35 with other, non-spectrum disabilities) from age 2 to age 5. For this sample, NVIQ at age 2 was the strongest variable to predict receptive and expressive language of children at age 5. Communication, joint attention, and imitation scores at age 3 were also found to predict age 5 language status. Thurm et al. (2015) explored the language development of 70 children with ASD. Participants were assessed at ages ranging from 1-5 and again, at least one year later. At both time points, they were classified into one of two categories, minimally verbal or phrase speech. NVIQ was the only variable that strongly predicted later language ability for this sample of participants.

When considering all of the previous studies that examined possible predictor variables of language outcome involving children with ASD who were MV at the time of diagnosis, NVIQ was the most commonly assessed factor. The consistent results of these previous studies support the results of the current study that also found NVIQ to predict later language outcome.

Limitations and Future Research

There are several limitations to the current study. In addition to descriptive statistics, a logistic regression was employed because it was the most appropriate statistical analysis for the small sample size and for the nature of the research question being addressed. However, results of the regression are confined to the current sample only and are not generalizable to all MV children with ASD. Future research is required with a larger sample size to improve statistical power and representation for a wider population of ME and BE children with ASD.

The data used in this study was drawn from an existing database, which did not include information that characterized the quality of language exposure that participants were receiving (i.e., richness/intensity of exposure, exposure type – direct communication or incidental exposure, etc.). Future research should seek to include the quality of language exposure as an potential variable in predicting later verbal status through the use of, for example, language diaries (Hambly & Fombonne, 2012, 2014) .

Bilingual exposed children in the current study exhibited a mixed amount of second language exposure, whereas monolingual exposure was consistent among ME participants. Monolingual children from the current study were 100% exposed to a single language from birth to age 6. In contrast, 50% of the BE children (n=5) were exposed to two languages from birth to age 6, 20% (n=2) were exposed from age 1 to age 6, and 30% (n=3) were exposed from age 2 to age 6. Although all of the BE participants had at least 20% exposure to a second language for at least one year prior to diagnosis, future research is required in which all BE children have been exposed to two languages from birth or shortly thereafter, in order to strengthen the validity of the results.

In addition, it is important to note that, of the ME group, 96% (n=23) of children were exposed to English only and 4% (n=1) were exposed to French only. Thus, the current sample of ME children is not representative of monolingual exposure for all languages; rather, it illustrates the results for predominately English-only language exposure. Future research may aim to include a ME group with participants who were exposed to range of languages, not exclusively English.

The degree to which treatment types (e.g., behavioural therapy, speech pathology, etc.) and/or intervention dosage (e.g., number of hours per week) may have influenced verbal outcomes was not addressed because detailed information regarding treatment exposure was not available from the *Pathways in ASD* research database for the current sample. This is one of the challenges the current study faced when using data obtained from a pre-existing database. Future research may involve treatment exposure and/or dosage as a possible predictor or covariate when examining whether or not language exposure predicts later verbal status for MV children with ASD.

Clinical Implications

The results of the current study contribute to the current body of research suggesting that bilingual language exposure does not negatively impact the verbal outcome of children with ASD (Hambly and Fombonne, 2012; 2014; Ohashi et al., 2012; Petersen et al., 2012; Reetzke et al., 2015; Valicenti-McDermott et al., 2012). Despite the growing body of research, many professionals continue to recommend restricted language exposure, with a focus on the dominant language of instruction (see Kay-Raining Bird et al., 2012). These recommendations are often made regardless of the familial, community, and cultural challenges reported by parents who were told to restrict their native language use when communicating with their child with ASD (see Jegatheesen, 2011 and Yu, 2013).

Professionals should consider the results of the current and previous studies when providing recommendations about language exposure to families of children with ASD. Parents of children who are MV at the time of diagnosis are especially vulnerable to professionals' advice because their child has not yet attained a spoken first language. When contemplating language exposure for a child with ASD, it is important for professionals to provide recommendations based on the best-fit for the individual family in each circumstance, while bearing in mind that exposure to a second language does not appear to hinder children's verbal outcome.

Conclusion

To date, no published study has examined the impact of home language exposure on children with ASD who were MV at the time of diagnosis, with regard to speech development over time. In this study, home language exposure (monolingual versus bilingual) was not found to be a significant predictor of children's verbal status at the time of school entry (age 6). However, consistent with previous research, NVIQ was found to predict verbal outcomes, suggesting a relationship between language development and cognitive ability. The results suggest that a bilingual environment does not impede the verbal language outcome of children with ASD, although the results from this small sample must be interpreted with caution. This is a positive finding for bilingual families, especially those who do not have access to services in their native language or do not have strong second language skills in their country's dominant language. Due to the small sample size and other limitations previously recognized, future research should be conducted to strengthen the results of the current study on verbal outcomes of BE and ME children who are MV at time of diagnosis.

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