Fostering Verbal and Play Interactions in Heritage Language: A Naturalistic Intervention Mediated by Siblings for Autistic Children

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Abstract

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Research on sibling-mediated interventions (SMIs) suggests that neurotypical siblings may help bolster language and play development in autistic children (Akers et al., 2018; Celiberti & Harris, 1993; Coe et al., 1991; Glugatch & Machalicek, 2021; Oppenheim-Leaf et al., 2012; Spector & Charlop, 2018), though consideration of culturally and linguistically diverse (CALD) populations is lacking. CALD autistic children often have a heritage language, or home language, other than English that is spoken at home with family members. Evidence suggests that bilingual exposure may be advantageous for language and play of autistic children (Dalmau et al., 2011; Lim & Charlop Seung et al., 2006; Vaughn, 2013). However, studies have not yet explored the role of neurotypical siblings in delivery of heritage language during intervention. The present study examined the effects of a naturalistic intervention mediated by siblings (NIMS) across four sibling dyads. Neurotypical siblings first received training through direct instruction, modeling, and role-play with a bilingual therapist. During intervention, visual prompts were used to encourage neurotypical siblings to deliver instructions, appropriate play phrases, and questions in heritage language during play with the autistic children. Results indicated that appropriate verbalizations of autistic children, social initiations of neurotypical siblings, and interactive play of the sibling dyad increased due to the intervention. Ancillary measures revealed that all dyads reported happiness during the intervention and two dyads improved the quality of the sibling relationship. The implications of the study suggest

researchers and practitioners alike should continue to explore neurotypical siblings as change agents for autistic children, particularly when delivering intervention in heritage language.

Key Words: autism spectrum disorder, sibling-mediated, heritage language, naturalistic, language, play, social initiation

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Table of Contents

Abstract …… iv

Chapter 1: Introduction and Literature Review……...1

Chapter 2: The Present Study……....40

Chapter 3: Method……..…42

Chapter 4: Results……..61

Chapter 5: Discussion……....……87

References……113

Appendix A: ……135

Appendix B: ……137

Appendix C: ……140

Appendix D: ……141

Appendix E: ……142

Appendix F: ……143

Appendix G: ……144

Appendix H: ……....145

Appendix I: ……146

CHAPTER 1

Introduction and Literature Review

Autism Spectrum Disorder

Autism spectrum disorder (ASD) is characterized by deficits in verbal and nonverbal social communication as well as restricted, repetitive behaviors and interests (American Psychological Association, 2013). Children on the spectrum display characteristics at varied levels, with some requiring minimal support and others requiring very substantial support. Verbal and nonverbal social communication and interaction deficits remain some of the most pervasive characteristics of ASD. Approximately 25-35% of autistic children are considered non-verbal or minimally verbal (i.e., having few expressive words) and will remain as such throughout their lifespan (National Research Council, 2001; Rose et al., 2016; Tager-Flusburg & Kasari, 2013). Deficits in nonverbal behavior include difficulties with eye contact, understanding gestures, integrating gestures to communicate with others, and understanding or use of facial expressions (American Psychological Association, 2013). Autistic children also face challenges with joint attention, body language, and social reciprocity (i.e., initiating or responding to social interactions; Leach & LaRocque, 2011; Murza et al., 2016).

Approximately 50-70% of autistic children exhibit challenging behaviors (e.g., tantrums, aggression, self-injury, elopement; Kanne & Mazurek, 2011; Lecavalier, 2006; Rosenbrock et al., 2021). These challenging behaviors negatively impact emotional functioning of caregivers and siblings (Davis & Carter, 2008; Rosenbrock et al., 2021; Walton, 2016; Yacoub et al., 2018), which may ultimately strain family relationships. Research indicates that these externalizing

behaviors may also be particularly detrimental to development of peer relationships, as they are associated with less social acceptance and more peer rejection (Sari et al., 2021).

Another core characteristic of ASD is restricted and/or repetitive behaviors (American Psychiatric Association, 2013). Stereotypy in the form of repetitive movements is often exhibited by these children, but may vary in topography (e.g., hand-flapping, body rocking, spinning objects; Cunningham & Schreibman, 2008). Stereotypic behaviors may also present through vocalizations. One of the first forms of repetitive speech to develop in some autistic children is echolalia (American Psychiatric Association, 2013). Echolalia may be immediate (i.e., repetition of verbalizations that were just heard) or delayed (i.e., repetition of verbalizations heard at some point in the past; Charlop, 1997). The function of echolalia remains inconclusive as some research indicates that echolalia may reflect intent to communicate (Charlop, 1983), while other studies suggest that it may interfere with learning (McEvoy et al., 1988; Schreibman & Carr, 1978). Lastly, verbal autistic children may demonstrate perseverative speech through contextually inappropriate fixation on a topic of interest (American Psychological Association, 2013).

To alleviate the challenges that autistic individuals face, various interventions based on Applied Behavior Analysis (ABA), have been developed and delivered by researchers and clinicians. ABA-based interventions have been determined to be the most empirically supported interventions for autistic individuals (Wong et al., 2013) and generally focus on improving socially significant behaviors. More specifically, these interventions are often created with the intention of decreasing challenging behaviors and teaching appropriate behaviors (e.g., language, communication, social skills) to improve functioning and quality of life of autistic individuals (Cooper et al., 2019).

Theoretical Framework

In the following sections, the study of autistic children and ABA-based interventions will be approached from the perspective of developmental contextualism (Lerner, 1991). Based on this perspective, the development of autistic children is examined within the constantly changing, bidirectional interactions between these children and their contexts (Lerner et al., 2011). In other words, autistic children are viewed as active participants in their development, as they are not only influenced by their context, but mutually influence the context in which they are situated.

Two specific theories, which are related to developmental contextualism, provide the overarching framework for the proposed study. These theories include Vygotsky's sociocultural theory and Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006; Miller, 2016). Lev Vygotsky's sociocultural theory assumes that each child's unique culture and context cannot be separated from their development (Miller, 2016). Bronfenbrenner's model extends Vygotsky's theory in that contexts are more clearly defined as a series of systems in which each child is nested (Bronfenbrenner & Morris, 2006). These systems are as broad as the child's macrosystem (i.e., culture or broader social context) and as specific as the microsystem (i.e., environments in which the child is directly involved, such as the home, school, or local community; Bronfenbrenner & Morris, 2006).

These theories are well suited to address the role of both culture and context when studying autistic children, particularly those that are culturally and linguistically diverse (CALD). For example, the beliefs, ideologies, and norms of a given culture inform the interactions that transpire within a CALD autistic child's microsystem. Thus, culture may have

ramifications for heritage language, or home language, practices within and beyond the home environment. Furthermore, these theories account for the role that change agents play in facilitating child-context interactions. Change agents that are actively involved in the lives of autistic children, such as neurotypical siblings, may facilitate heritage language development in home, school, or community contexts. One way this may be encouraged is by teaching contextually relevant play partners (i.e., neurotypical siblings) to implement social interaction interventions in heritage language for autistic children. Through these interactions, change agents may create increasingly complex opportunities over time to promote skills of autistic children while providing a foundation for autistic children to mutually influence the change agents they are interacting with and thus, influence their own developmental contexts.

Caregivers as Change Agents for Autistic Children

One way in which micro-level interactions may be assessed for autistic children is within context of ABA-interventions mediated by caregivers. Although most ABA interventions have been implemented by researchers and clinicians, research has demonstrated that caregivers also serve as effective change agents for their autistic children (Erturk et al., 2021; Gillet & LeBlanc, 2007; 2018; Koegel et al., 1982; Laski et al., 1988; Lovaas et al., 1973; Schultz et al., 2011). This research asserted that caregiver training was an integral component in the treatment of autistic children. Caregivers are typically taught ABA procedures through a combination of instructions, modeling, rehearsal, and/or feedback. For caregivers of autistic children, these procedures are specifically designed to address the core characteristics of ASD (i.e., social-communication, repetitive or restricted interests or behaviors; Bearrs et al., 2015; Schultz et al., 2011) and/or target skill acquisition.

Caregiver implementation of ABA-based interventions has demonstrated positive effects for autistic children across various developmental outcomes. Research illustrates that caregiver-mediated interventions have been advantageous for challenging behaviors, verbalizations, vocalizations, communication skills, play, social skills, motivation, and joint attention – all of which are impacted in autistic children (Althoff et al., 2019; Bradshaw et al., 2017; Eid et al., 2017; Erturk et al., 2021; Gillet & LeBlanc, 2007; Laski et al., 1988; Stadnick et al., 2015). There is some evidence to suggest that caregiver implementation may even help mitigate symptoms of ASD (Althoff et al., 2019; Bradshaw et al., 2017). This evidence is powerful in that it extends intervention possibilities for autistic children beyond clinicians and therapists alone. The success of caregiver-mediated interventions indicates that members of children's natural environments may serve as effective change agents.

Many caregiver-mediated interventions have also been implemented with high degrees of fidelity and/or social validity (Eid, 2017; Erturk et al., 2021; Gillet & LeBlanc, 2007; Hansen et al., 2018; Hardan et al., 2015). Interventions with fidelity are implemented as the procedure was intended, whereas interventions that are socially valid, were identified as acceptable and produced significant outcomes for the children involved (Cooper et al., 2019). Because caregiver interventions have been implemented with fidelity, there is evidence to suggest that other family members may also carry out intervention procedures when trained appropriately. These interventions may be more socially valid as they involve individuals that are naturally situated within the child's home environment and target behaviors of importance to the child's quality of life.

Furthermore, evidence suggests that caregiver involvement in behavioral interventions may be associated with positive post-intervention outcomes (Lovaas et al., 1973; Koegel et al.,

1982). Caregivers may be specifically advantageous for maintenance and generalization of skills taught during intervention (Jones & Feely, 2009; Koegel et al., 1982; Laski et al., 1988). Maintenance refers to the extent to which children continue to demonstrate behaviors and skills following intervention while generalization reflects the demonstration of behaviors and skills across, settings, situations, or individuals that were not specifically targeted during the intervention (Cooper et al., 2019). However, it is important to note that many caregiver studies focus on generalization of skills to other settings, situations, or adult therapists (Bass & Mulick, 2007). Thus, this may raise concerns regarding the extension of skills to interactions with similar-age social partners, such as peers or siblings.

Nonetheless, when assessed collectively, caregivers have the potential to implement intervention with efficacy while promoting skill acquisition, maintenance, and generalization across settings. Their effectiveness may be partially related to their relevancy within children's lives. Because caregivers are often prominent communication partners and models of behavior within the home environment, they may also be instrumental in providing opportunities to practice skills within the child's natural context and extending this practice to settings within the community at large. Caregiver implementation may thus contribute to longer-lasting, externally valid outcomes for autistic children and demonstrates how family members may serve as effective change agents for this population.

Neurotypical Peers as Change Agents for Autistic Children

Caregiver training often focuses on addressing challenging behaviors or adaptive skills with which caregivers require support (e.g., toileting, feeding, dressing; Lim et al., 2021; Scahill et al., 2016; Tonge et al., 2014; Turgeon et al., 2021). Although some caregiver-mediated studies have examined play or social skills (Althoff et al., 2019), researchers have also begun to explore

how natural social partners, such as neurotypical peers, may serve as effective change agents (Bass & Mulick, 2007; Chan et al., 2009; Garrison-Harrell et al., 1997; Kamps et al., 2002; Zhang & Wheeler, 2011). Neurotypical peers may serve as ideal change agents as they are naturally present within the social lives of autistic children and provide consistent opportunities for practicing such skills outside of the home.

In practice, peer-mediated interventions have been found to increase social interactions, initiations, and behaviors as well as verbal behavior, communication skills, play, and reduce challenging behavior in autistic children (Aldabas, 2020; Brock et al., 2018; Ganz et al., 2012; Garrison-Harrell et al., 1997; Kamps et al., 2002; Martinez et al., 2021; Simpson & Bui, 2016; Zhang & Wheeler, 2011). Research also indicates that training peers may promote maintenance and generalization (Kamps et al., 2002; Lory et al., 2018; Zhang & Wheeler, 2011). It has been argued that generalization of skills to other age-appropriate social partners may be easier to accomplish through peer-mediated interventions compared to caregiver-mediated interventions (Bass & Mulick, 2007). Neurotypical peers have also reported positive perceptions of autistic children following intervention implementation (Simpson & Bui, 2016). Overall, neurotypical peers may serve as successful interventionists due to their proximity in age to the autistic children they are teaching and the natural opportunities they cultivate for social skill development throughout childhood and adolescence in school and community contexts. The effectiveness of peer-mediated interventions provides evidence that neurotypical children can be trained to implement interventions for autistic children

However, research on peer-mediated interventions present some limitations for intervention fidelity and accessibility. In their meta-analyses, both Chan and colleagues (2009) as well as Lory and colleagues (2018) reported that fidelity of implementation was either lacking or

rarely assessed in peer-mediated studies. Lack of consideration of intervention fidelity may then raise questions regarding the true impact of these interventions. In Zhang and Wheeler's (2011) meta-analysis of peer-mediated interventions, they found that intervention was most beneficial when conducted within the home environment and when including various other potential change agents including clinicians, teachers, and family members. Training peers to conduct intervention within the home setting of an autistic child may be time-consuming and impractical. Additionally, the inclusion of other change agents raises questions regarding the effectiveness of peers alone.

A Review of the Literature on Sibling-Mediated Interventions for Autistic Children

Unlike caregivers or peers, neurotypical siblings both serve as accessible sources for social interaction within the home environment and are simultaneously age-similar social partners for autistic children. In neurotypical development, siblings are arguably more influential to the behavior of one another than peers (Azmitia & Hesser, 1993). In Azmitia and Hesser's (1993) study, the researchers observed older siblings and peers when teaching a building task to a younger child ($N = 64$ triads). Results indicated that following instruction, children achieved greater mastery of the tasks when taught by siblings compared to peers. The researchers found that older siblings also provided more positive feedback and allowed their younger siblings more control compared to peers. The authors posit that siblings may promote cognitive development.

Furthermore, sibling relationships are among the longest lasting and may lay the foundation for social-emotional development (Downey et al., 2004; Kim et al., 2007; McHale et al., 2012; Newman, 1994; Pike & Oliver, 2017; Shivers & Plavnick, 2015). Downey and colleagues (2004) studied the benefits of siblings on the development of kindergartners

(N = 20,649). The results suggested that children with one or two siblings demonstrated greater teacher-rated interpersonal skills than children with no siblings. The authors argue that children with siblings may be able to navigate social interactions more easily with peers based on their experiences with one another at home.

One longitudinal study examined social competence and depressive symptoms across middle childhood through adolescence in 197 families (Kim et al., 2007). Following parent and sibling interviews, the researchers found that intimate sibling relationships were associated with increased social competency in brothers and sisters and reduced depressive symptoms in sisters of autistic children (Kim et al., 2007). Pike and Oliver's (2017) also used data from a longitudinal study (N = 2,403) and conducted cross-lagged analysis on sibling relationships. The analysis indicated that sibling challenging, and prosocial behaviors were associated with overall sibling relationship quality. Thus, siblings appear to bidirectionally influence one another in terms of these behaviors. This influence may be even more pronounced for older siblings (Pike & Oliver, 2017).

Although sibling relationships are also marked by conflict, research suggests that sibling interactions may still create opportunities for social-emotional development in the face of negative interactions (McHale et al., 2012; Newman, 1994). For example, in Newman's (1994) review, the research indicated that interactions involving conflict may serve to promote skills related to reflection of one's behaviors, responsiveness to feedback, and communication. The author also suggested that siblings continue to serve as effective play partners and helpers for one another. In another review of neurotypical sibling relationships in childhood and adolescence, McHale and colleagues (2012) found that interactions and even conflicts between siblings facilitated skills including perspective taking, understanding of emotions, and problem-

solving. The review also indicated that siblings remained highly influential social partners, even when other relationships with family members and peers were accounted for.

Sibling Relationships with Autistic Children

Sibling relationships with autistic children may be uniquely complex considering that deficits in socialization and communication skills can potentially negatively impact behavior, psychosocial functioning, involvement, and feelings toward the autistic child (Guidotti et al., 2021; Verté, 2003; Walton & Ingersoll, 2015) In Verté's (2003) study, autistic sibling dyads (i.e., dyads in which one child was autistic; $N = 29$) were compared to neurotypical sibling dyads (i.e., dyads in which both siblings were typically developing; $N = 29$). Following parent and sibling questionnaires, analysis indicated that neurotypical siblings of autistic children exhibited more behavioral problems than those with neurotypical siblings. This finding is consistent with research on neurotypical sibling relationships, as both individuals may mutually influence one another, even in the display of challenging behavior (Pike & Oliver, 2017).

Walton and Ingersoll (2015) similarly compared autistic sibling dyads ($N = 69$) with neurotypical sibling dyads ($N = 93$). Parent-report measures indicated that autistic sibling dyad relationships were marked by higher rates of avoidance and lower levels of involvement than neurotypical sibling relationships. Avoidance and lack of involvement within relationships with an autistic sibling may be directly related to the deficits in social initiation that autistic children exhibit, leading to increased isolation. These findings may also reflect a lack of reciprocation within the sibling relationship, leading neurotypical siblings to also withdraw from attempts at interacting.

In Shivers and colleagues' (2019) review of the literature, the authors discovered that neurotypical siblings of autistic children experienced more negative outcomes compared to

siblings of children with other intellectual or developmental disabilities. Sixty-nine independent samples were included within the study. The cumulative results of these studies indicated that neurotypical siblings of autistic children fared worse on measures of internalizing behavior, psychological functioning, social functioning, sibling relationships, depressive symptoms, anxiety symptoms, and beliefs regarding disability. This research suggests that neurotypical siblings of autistic children may be particularly susceptible to psychological problems, which makes consideration of these children even more crucial.

Using an exploratory sequential design, Guidotti and colleagues (2021) examined warmth, rivalry, and conflict of sibling dyads ($N = 44$). Neurotypical siblings completed a questionnaire and drew pictures of situations in which they were 1) in harmony with their sibling and 2) in conflict with their sibling. Results indicated that adolescent siblings experienced higher levels of shame, annoyance, and/or embarrassment compared to child siblings (Guidotti et al., 2021). These negative appraisals may stem from the challenging or repetitive behaviors and interests that autistic individuals display, which may be seen as stigmatizing to neurotypical siblings in public or social situations.

Rixon and colleagues (2021) conducted a cluster analysis after separating autistic children ($N = 168$) into groups based on ASD symptoms, adaptive functioning, prosocial behavior, and behavior problems. Caregivers as well as siblings reported on sibling relationship quality and psychosocial functioning. Analysis revealed that neurotypical siblings with autistic children that displayed greater levels of internalizing and externalizing behaviors and were most at risk for behavior challenges and poor sibling relationship quality. This finding was noted even in autistic children with high adaptive skills and mild autistic symptoms. The results also showed that neurotypical siblings of autistic children with the greatest level of support needs reported

lower warmth and closeness within the relationship. Therefore, it appears that symptom severity is not necessarily predictive of relationship quality. However, internalizing, and externalizing behaviors (also known as challenging behaviors) of autistic children appear to have a spillover effect on both the behavior of the neurotypical sibling and the sibling relationship. This finding is consistent with the hypothesis that siblings bidirectionally influence one another (Pike & Oliver, 2017).

However, despite these challenges, research indicates that neurotypical siblings of autistic children continue to experience positive outcomes in terms of psychosocial development. They have been found to demonstrate high social competence, positive self-concept, and behavioral adjustment (Ferraioli et al., 2012). Notably, several studies have suggested that neurotypical siblings of autistic children may also display high levels of prosocial behavior (Orm et al., 2021; Rum et al., 2021; Walton & Ingersoll, 2015). Although Walton and Ingersoll (2015) found that avoidance and involvement were more frequent in relationships involving an autistic sibling, their relationships were also marked by greater levels of prosocial behavior as well as less aggression. The authors suggest that in the face of challenges, neurotypical siblings of autistic children do not appear to display increased risk for maladjustment compared to neurotypical sibling-dyads.

Similarly, Orm and colleagues (2021) compared prosocial behavior of neurotypical siblings with siblings of children with disabilities, including ASD ($N = 47$) via a multi-informant approach (i.e., reports from neurotypical siblings, mothers, and fathers). Results indicated that siblings of autistic children scored highest on mother-reported prosocial behavior. This research suggests that neurotypical siblings may be uniquely sensitive to the needs of autistic children.

Rum and colleagues (2021) also explored prosocial behavior in neurotypical sibling interactions with the autistic child. Video recordings were analyzed from 28 dyads while they played a game of their choice within the home environment. During play, older neurotypical siblings initiated more interactions overall compared to younger neurotypical siblings. A positive relationship was also found between frequency of prosocial behavior in neurotypical siblings and prosocial behavior in autistic children. Thus, neurotypical siblings not only exhibit prosocial behaviors themselves, but their behaviors may serve as potential models of prosocial behavior for autistic children.

The psychosocial strengths of neurotypical siblings of autistic children may be related to increased opportunities to cultivate such skills. Autistic children often experience deficits in various areas such as social skills, communication skills, and adaptive skills. These children, in turn, require more intensive support to function than neurotypical siblings, which may lead caregivers or other family members to rely on the neurotypical sibling for help in daily life. Neurotypical siblings may then be presented with consistent opportunities to practice prosocial behavior and develop social competency within the context of family interactions. In addition to the support needs of the autistic child, it is possible that neurotypical siblings with greater levels of social support themselves may be more likely to demonstrate high levels of prosocial behaviors among other social skills (Ferraioli & Harris, 2010). The evidence in support of neurotypical siblings as highly prosocial and socially competent models/play partners may be particularly valuable when considering intervention implementation, as neurotypical siblings of autistic children may be more intrinsically motivated to help create opportunities for their sibling to learn (Travis & Sigman, 1998).

Furthermore, research indicates that neurotypical siblings may provide opportunities for autistic children to learn social-emotional, cognitive, and communication skills (Banda et al., 2015; Bene & Lapina et al., 2020; Ben-Itzchak et al., 2019; de-Veld et al., 2021; El-Ghoroury & Romanczyk, 1999; Newman, 1994). Bronfenbrenner's ecological model may explain how neurotypical siblings may promote development of such skills (Bronfenbrenner & Morris, 2006). Neurotypical siblings are usually present in autistic children's microsystems, or immediate environments throughout most of their early lives. Over the course of childhood, neurotypical siblings provide daily opportunities for social interaction within the home environment. Many of the interactions between siblings, particularly siblings close in age, are likely to occur through play. Play involves activities that are pleasurable and intrinsically motivating (Wolfberg, 1995). These activities may ultimately provide the foundation by which children may develop cognitive, social-emotional, and communication skills (Freider et al., 2009; Holmes et al., 2019; Sahlberg & Doyle, 2019).

Although autistic children face challenges with play, resulting in rigidity or lack of imagination (Wolfberg, 1995), during play with neurotypical siblings, it is possible that neurotypical children may model and reinforce specific play behaviors, social behaviors, and communication skills. Over time, these repeated interactions may become increasingly complex, allowing for an increased level of challenge to cultivate opportunities for autistic children to develop a more expansive repertoire of skills. It is plausible that skills gained from interactions with neurotypical siblings may then extend to environments and situations within their microsystems, including those in school and the broader community.

Researchers have applied this theory in practice by assessing the effects of neurotypical siblings on autistic children. In El-Ghoroury and Romanczyk's (1999) study, the researchers

observed play between mothers, fathers, neurotypical siblings, and autistic children within the home environment. The results showed that although parents exhibited more play behaviors toward the autistic child compared to siblings, autistic children displayed more vocalizations and play behaviors toward their neurotypical sibling than toward parents. This finding may suggest that some autistic children display a preference for playing with their siblings. Because siblings did not display as many play behaviors as parents, this may have created increased opportunities for the autistic child to initiate social interactions. The authors suggest that sibling training may help further promote positive interactions between siblings.

Additionally, Ben-Itzchak and colleagues (2019) examined social-emotional skills of autistic children by assessing 150 families through parent-report measures of behavioral, adaptive, and social functioning. Correlational analyses showed that autistic children with older siblings demonstrated less severe deficits in social behaviors as well as repetitive and restricted behaviors. Having more than one neurotypical older sibling was also associated with increased social functioning of autistic children. The effects of younger siblings on greater social functioning of autistic children also received modest support, though the relationship was identified only in autistic children less cognitively impacted by ASD. The authors suggest older neurotypical siblings may serve as role models of appropriate social behaviors of autistic children. It was also proposed that the results may be related to family size, where larger families may be able to provide greater support to both the autistic child and neurotypical sibling.

In a randomized-control trial conducted by de-Veld and colleagues (2021), the researchers investigated the extent to which having siblings moderated outcomes related to theory of mind in autistic children (between the ages of 8 to 13). Theory of mind, which is impaired in many autistic children, is the ability to ascribe mental states or emotions to oneself

and others. Autistic children ($N = 141$) were randomized into a control group or intervention group. The results revealed that having an older sibling and more than one sibling were related to greater outcomes on theory of mind related behavior and social cognition. The authors propose that autistic children may benefit from neurotypical siblings as they may have increased opportunities to practice social-cognitive skills within the context of the home.

Considering that interactions with neurotypical siblings may provide opportunities for skill development of autistic children, involving them in the intervention process appears to be a logical extension. Strain and Danko (1995) involved three neurotypical siblings in a caregiver-mediated intervention targeting social interactions within the sibling dyad. Caregivers implemented a social skills intervention package within the home environment. This intervention required caregivers to model and reinforce positive interactions (e.g., sharing, offering help, complimenting) during play. Following intervention, all autistic children and neurotypical siblings demonstrated increased levels of positive social interactions with one another. The results of this study provided preliminary evidence that including neurotypical siblings in intervention of autistic children may help provide opportunities to enhance the sibling relationship.

In Baker's (2000) study, the researchers employed a multiple-baseline design when teaching three autistic children and neurotypical siblings how to play Bingo-based games that were individualized to capitalize on the perseverative interests of the autistic participants. Perseverative interests, which reflect a core characteristic of ASD involving repetitive behaviors and interests, may be displayed by a fixation on specific topics (e.g., Batman, basketball) during contextually inappropriate situations. During Baker's (2000) intervention, researchers initially taught the game and provided prompts to the sibling dyad and gradually faded their support

when the sibling dyads were able to play independently. While playing the games, the researchers discovered that sibling dyads engaged in more positive social behaviors and displayed more positive affect toward one another. Autistic children specifically demonstrated gains in joint attention and reductions in perseverative behaviors. Positive social behaviors and joint attention of the autistic children maintained at 1 and 3-month follow up as well as generalized to untrained games and untrained settings including the home and school. Postintervention, neurotypical siblings also delivered more positive comments toward the autistic child. Overall, the study provides support for involving neurotypical siblings in intervention to enhance the skills of autistic children and quality of interactions within the sibling dyad.

Jones and Schwartz (2004) employed neurotypical siblings, parents, and peers in a language intervention for three autistic children. Using a single-subject parallel-treatments design, neurotypical siblings, parents, and peers modeled appropriate responses on language tasks involving picture cards. Picture cards and reinforcement for appropriate responses were delivered by researchers. Appropriate responses during language tasks increased across all three models. However, the results demonstrated that neurotypical sibling models were as effective, and for some children, more effective than peer and parent models.

Dodd and colleagues (2008) involved siblings during play sessions following parent-implementation of a social story intervention for children diagnosed with Pervasive Developmental Disorder (now identified as ASD). The social stories focused on a challenging behavior (e.g., giving excessive directions) and an appropriate behavior (e.g., complimenting) during play with their neurotypical sibling. Following intervention, one autistic child exhibited a decrease in excessive directions and both children increased their frequency of complimenting during play sessions with their neurotypical sibling.

Reagon and colleagues' (2006) conducted a study in which an older neurotypical brother of an autistic boy acted as a video-model engaging in four pretend play scenarios. Using an AB design, the researchers first observed the siblings playing as the neurotypical sibling read his lines and performed his role from the video regardless of the autistic child's response. During intervention, the siblings were instructed to watch the video together and play was observed following the video. Though findings should be interpreted with caution as the AB design lacks demonstration of experimental control, the results demonstrated an increase in scripted statements and actions of the autistic child following sibling involvement in video-modeling. The autistic child also demonstrated generalization of pretend play as he performed a role learned from the video with their untrained sibling and mother. The sibling satisfaction survey revealed that the trained neurotypical sibling reported their involvement to be fun and informative of how to play with the autistic child.

Most recently, Watkins and colleagues (2021) used a reversal design across two sibling dyads in a play-based intervention implemented by adult researchers. During intervention, researchers provided instructions, modeling, and feedback to the sibling dyad during play interactions. Results indicated that following intervention, social interactions increased for both sibling dyads. Measures also suggested a high level of social validity of the intervention and generalization of social skills to another setting for one sibling dyad. Overall, the implications suggest that including neurotypical siblings could provide a method of improving socialization within the sibling dyad.

Sibling-Mediated Interventions

The research discussed clearly indicates that neurotypical sibling involvement in intervention may be advantageous for autistic children. However, many of these studies were

mediated by other individuals (e.g., therapists, caregivers) and involved neurotypical siblings more passively. However, researchers have also examined the effects of neurotypical siblings in a more active role through sibling-mediated interventions (SMIs). SMIs are interventions in which neurotypical siblings of autistic children receive training in ABA procedures and serve as the primary change agent in the direct delivery of intervention.

Behavioral Modification Interventions. Various intervention procedures have been successfully taught to and implemented by neurotypical siblings. Two of the earliest SMI studies, conducted by Colletti and Harris (1977) and Schreibman (1983), assessed sibling implementation of behavior modification strategies more generally. During Colletti and Harris' (1977) intervention, one neurotypical sibling delivered instructions to her autistic sibling and provided an edible reinforcer for successful string-beading when prompted via headset by a therapist. The results indicated that task engagement of the autistic child increased during the SMI.

Schreibman and colleagues (1983) trained 4 neurotypical siblings via video modeling and direct instruction on how to implement behavior modification strategies including reinforcement and discrete trial training (DTT). DTT involves reducing complex skills into small components and teaching skills systematically one by one. Neurotypicals siblings applied these strategies while providing instructions to autistic children on individualized tasks. The researchers found that correct responding of autistic children increased because of the SMI. Additionally, neurotypical siblings increased their percent of correct implementation of behavior modification procedures and generalized these skills to an untrained setting. A social validity measure also indicated that neurotypical siblings decreased their negative statements and increased their positive statements about the autistic child following training. Thus, these studies provided the

foundation for identifying neurotypical siblings as potentially effective teachers for autistic children.

Two other studies trained siblings to implement behavior modification techniques. However, unlike the prior studies, these techniques were implemented within the context of play. Coe and colleauges (1991) trained neurotypical siblings to provide reinforcement, verbal prompts, and physical prompts to autistic children during play at home. Following intervention, autistic children demonstrated increased functional manipulation of toys and increased verbalizations. Additionally, Celiberti and Harris' (1993) trained three neurotypical siblings to implement behavior modification techniques within the context of cooperative play. Prior to implementation, the neurotypical siblings watched the trainer model the intervention procedure, engaged in role-play with the trainer, and practiced the intervention with the autistic child. During the intervention, neurotypical siblings delivered instructions, modeled behavior, as well as provided reinforcement and/or prompts depending on the autistic child's responses. Following intervention, autistic children demonstrated increased interest in play, responses to social cues, and cooperation. Neurotypical siblings demonstrated increases in skills related to the behavior modification techniques as well as increased pleasure, confidence, and decreased frustration. Neurotypical siblings also demonstrated maintenance of the procedure over time and generalization across play partners. Therefore, these findings provided early support for neurotypical siblings' ability to implement behavior modification techniques within the context of play with autistic children.

Naturalistic Developmental Behavioral Interventions. Many recent studies have explored sibling implementation of well-established Naturalistic Developmental Behavioral Interventions (NDBI) for autistic children. NDBIs are implemented in natural contexts, involve

child-centered activities, capitalize on the motivation of the child by following their interests, focus on teaching functional skills, and promote generalization of skills across individuals, behaviors, and settings (Schreibman et al., 2015). NDBIs are informed by Piaget's cognitive stage theory and Vygotsky's sociocultural theory. More specifically, NDBIs generally follow developmental sequences when teaching skills and autistic children are viewed active participants in their development. For example, autistic children ultimately select the contexts and stimuli involved in learning by making choices and demonstrating interests for facilitators to follow. Additionally, Vygotsky's concept of the zone of proximal development is also incorporated into many NDBI's, as learning opportunities are individualized to allow for an appropriate balance between skill and challenge (Miller, 2016; Schreibman et al., 2015). This concept may be exemplified through strategies including the use of prompts (e.g., physical, verbal, gestural assistance) to support early skill acquisition and prompt fading (i.e., fading support) as autistic children become increasingly capable of independently demonstrating a skill.

Pivotal Response Training is one example of a NDBI that has been implemented by siblings in research (PRT; Allclair, 2020; Sullivan 1999). PRT is an intervention that mimics natural social interactions between children in their natural environment (Sullivan, 1999). This procedure aims to increase motivation, which is often impaired in autistic children, by providing choice, reinforcement, modeling behavior, and implementing natural consequences (Allclair, 2020; Sullivan, 1999). In Sullivan's (1999) study, neurotypical siblings were taught PRT via direct instruction, modeling, and role-play with in-vivo feedback before implementing the procedure at home during play with the autistic children. Increased interactions and decreased non-engagement were observed across all 7 participants. Increased object engagement, joint

attention, and verbal responses were observed in some participants. Neurotypical siblings increased their modeling and attempts to get their siblings' attention.

PRT was examined again by Allclair in 2020. Allclair's study, which involved 3 sibling dyads, neurotypical siblings implemented PRT during play sessions at home with the autistic children (Allclair, 2020; Sullivan, 1999). Following PRT, increased time the sibling dyad spent together increased, accompanied by increased mood of neurotypical siblings. Therefore, sibling-mediated PRT has been found to have potential benefits for autistic children and neurotypical siblings alike.

Stay-Play-Talk is another intervention that has been implemented by siblings (SPT; Kryzak & Jones, 2017; Tsao & Odom, 2006). SPT is a play-based intervention which contains various components of NDBIs. For example, SPT requires neurotypical siblings to stay close in physical proximity to the autistic child, obtain the autistic child's attention, cultivate natural opportunities for conversation and turn-taking, negotiate ideas regarding what to play, ask questions contextually related to play and the interests of the autistic child, and provide feedback (Goldstein & English, 1997; Tsao & Odom, 2006). In Tsao and Odom's (2006) study, 4 neurotypical siblings were first trained on the steps of SPT via direct instruction during social skills lessons. Neurotypical siblings then implemented the social interaction SPT intervention within the context of home-based play with autistic children. The sibling-mediated SPT intervention effectively increased joint attention and social behaviors of 3 of the 4 autistic children. Maintenance of social behaviors over time was also observed for 3 of the 4 participants. Three of the four neurotypical siblings also demonstrated increased social initiations. Overall, this study exemplifies how implementation of NDBIs may promote social skills for both autistic children and their neurotypical siblings.

Kryzak and Jones (2017) expanded on Tsao and Odom's (2006) SPT intervention by having 4 neurotypical siblings self-manage their implementation while playing with the autistic child. Neurotypical siblings first participated in behavior skills training, which involved instruction, modeling, rehearsal, and in-vivo feedback. The researchers then systematically increased the duration of time the neurotypical sibling spent staying near, playing with, and talking with their neurotypical sibling by one-minute intervals. The final goal for all participants was to implement SPT with 100% accuracy across three consecutive opportunities for 10 minutes while providing 10 comments to autistic children. The researchers found increased reciprocal interactions of autistic children, increased neurotypical self-management, and increased neurotypical SPT responses due to the sibling-mediated SPT intervention. It was also reported that the neurotypical siblings implemented the intervention with high degrees of fidelity and that the intervention was found socially valid. Thus, both Tsao and Odom's (2006) and Kryzak and Jones' (2017) studies further indicate that neurotypical siblings may help facilitate opportunities to practice social behaviors, joint attention, and play, which are all impacted in autistic children (American Psychiatric Association, 2013).

Furthermore, siblings also mediated reciprocal imitation training (RIT) during play with autistic children in Walton and Ingersoll's (2012) research. RIT is a NDBI an intervention aimed at increasing imitation skills of autistic children, which can facilitate social coordination between play partners within a natural, social context (Walton & Ingersoll, 2012). During this RIT intervention, six neurotypical siblings imitated the actions of the autistic children (e.g., gestures, movements, verbalizations), used simplified language to describe the activities, alternated between imitating the autistic children and providing attempts for the autistic children to engage in imitation, provided social praise for attempts at imitation, and provided prompting as needed.

The neurotypical siblings were taught to implement RIT in a home setting after receiving manualized training, engaging in role-play, and demonstrating the protocol with the autistic children. Following RIT implementation, autistic children experienced gains in imitation (which maintained over time) and joint attention. Neurotypical siblings also demonstrated increases in skills related to the RIT procedure and caregivers rated the intervention as socially valid. The results of the sibling-mediated RIT intervention suggest that neurotypical siblings can promote imitation skills of autistic children, which is critical for development of language and social behaviors.

The natural language paradigm is another NDBI that has been tested among siblings (NLP; Spector & Charlop, 2018). NLP is a naturalistic intervention which emphasizes turn-taking, task variation, and using highly motivating stimuli to facilitate functional language development (i.e., toys; Koegel et al., 1987; Spector & Charlop, 2018). Neurotypical siblings were first taught the NLP procedure via video-modeling, followed by role-play. The procedure itself required neurotypical siblings to provide autistic children with choices, model appropriate language, and provide positive reinforcement for imitation. Following sibling-mediated NLP, 3 of 4 autistic children demonstrated increases in appropriate speech. Speech gains maintained over time and generalized for 1 participant. The researchers also reported increased happiness behaviors across all 3 autistic children. This finding is particularly notable as it demonstrates that autistic children not only demonstrated language gains, but that they appeared to enjoy the SMI.

Combination Interventions. Various SMIs contain elements of both behavioral modification and NDBIs. For example, Ferraioli & Harris' study (2011), siblings implemented a joint attention (JA) intervention. JA is a social-communicative behavior that involves the ability to use gestures and eye contact to coordinate attention with another person (Ferraoili & Harris,

2011). Deficits in this skill are correlated with increased ASD severity (Ferraoili & Harris, 2011). In the study, four neurotypical siblings were trained via modeling and role-play with in-vivo feedback. This JA intervention systematically replicated a procedure created by Whalen and Schreibman (2003) and incorporated aspects of PRT and discrete trial training (DTT). Following sibling implementation, autistic children demonstrated increased initiations and neurotypical siblings reported satisfaction with the JA intervention.

Additionally, Oppenheim-Leaf and colleagues (2012) conducted a study in which three siblings implemented a social play intervention. During this social play intervention, neurotypical siblings were trained to provide clear instructions, initiated play interactions, reinforced appropriate play behavior, share toys, and model appropriate toy play via direct instruction, modeling, and role-play. Following implementation of the procedure, increased positive interactions, and decreased negative intercalations were observed in the sibling dyads. Neurotypical siblings also increased their social behaviors, play interactions, as well as quantity and quality play with the autistic children.

In Akers and colleagues' (2018) study, three neurotypical siblings delivered a script fading procedure with the three autistic children during play. Siblings were trained to deliver the script fading procedure via role-play with parents with feedback from researcher. During intervention, neurotypical siblings delivered an auditory script every 30 seconds and waited for their sibling to attempt to verbalize the script. If siblings did not imitate the phrase, they were physically guided to press a voice recorder button. If the prompt was ineffective, siblings provided a verbal prompt (e.g., "say, bounce the ball"). Once the autistic child independently verbalized 3 scripts with 100% accuracy, the script fading was initiated one word at a time. The last word was removed first, the second to last word was removed after, and so forth until the

entire script was removed. Results illustrated increases in contextually appropriate statements following the sibling-mediated script-fading procedure. These statements also maintained during follow-up sessions.

Most recently, neurotypical siblings in Glugatch and Machalicek's (2021) study participated in a play-based intervention augmented by a sibling-support program for the neurotypical sibling. The sibling-mediated play intervention focused on four strategies: 1) following the child's lead and providing choices, 2) ensuring the autistic sibling was paying attention before the sibling provided directions, 3) narrating play and providing prompts, and 4) providing social praise for appropriate play behaviors. Neurotypical siblings also participated in a weekly support group (limited to 3 weeks due to a global pandemic) that covered topics related to having an autistic sibling. The support group included group activities, opportunities for sharing experiences, and take-home activities. Due to a global pandemic, researchers monitored some of the intervention sessions via telehealth. The researchers found that the sibling-mediated intervention increased the percentage of reciprocal play within the sibling dyad and initiations made by neurotypical siblings. Neurotypical siblings were found to increase their use of play strategies and these strategies generalized with untrained toys. Results also demonstrated that the intervention was socially valid per sibling- and caregiver-report.

Taken together, the literature suggests that SMIs may have been successful at improving various skills for autistic children including those related to social skills, play, joint attention, language, task completion, imitation, and happiness. In all studies in which it was assessed, demonstrations of maintenance and/or generalization were observed which support the hypothesis that neurotypical siblings may also be highly influential in laying the foundation for skills to extend to other social partners, settings, and/or situations over time (Akers et al., 2018;

Colletti & Harris, 1977; Ferraioli & Harris, 2011; Glugatch & Machalicek, 2021; Kryzak & Jones, 2017; Schreibman et al., 1983; Spector & Charlop, 2018; Tsao & Odom, 2006). This may be partially related to the tendency for siblings to interact with one another in settings beyond the home such as school or public settings, allowing more opportunities for autistic children to practice skills across various contexts. Furthermore, sibling-mediated interventions had high socially validity across all the studies in which it was reported (Allclair, 2020; Glugatch & Machalicek, 2021; Ferraioli & Harris, 2011; Sullivan, 1999; Schreibman et al., 1983; Walton & Ingersoll, 2012), indicating that the interventions were both effective in their primary outcomes as well as meaningful to the lives of the neurotypical siblings and their families.

There are several reasons why these SMIs may have been effective. First and foremost, the interventions themselves largely involved play-based activities between siblings. Play is the primary process by which children learn and interact with one another. Research has consistently pointed to play as a facilitator of social-emotional, language, and cognitive skills in neurotypical children (Freider et al., 2009; Holmes et al., 2019; Sahlberg & Doyle, 2019). Play also provides children with opportunities to develop planning and self-regulation skills while turn-taking, sharing, and resolving conflict (Galinsky, 2010). This relationship may help explain why autistic children displayed fewer challenging behaviors during SMI interventions. Play also promotes concentration and engagement for extended periods of time (Wang & Barrett, 2013), which may have contributed to the observed increases in joint attention during SMIs.

During the SMIs, play interactions with neurotypical siblings often involved highly preferred toys or items. Neurotypical siblings often used these items to follow the interests of the autistic child to facilitate opportunities to practice skills. Following the interests of autistic children through play allows autistic children to adopt a more active role in their own

intervention. It is also possible that incorporating play maximized motivation of the autistic child, mimicked natural interactions between siblings, and facilitated enjoyment of both siblings (Charlop & Spector, 2018). This motivation and enjoyment may have enhanced learning and thus promoted skill development.

Additionally, the setting in which most of the interventions were conducted may have also contributed to overall effectiveness as most of studies involved SMIs were delivered in the home (Allclair, 2020; Celiberti & Harris, 1993; Coe et al., 1991; Colletti & Harris; 1977; Ferraioli & Harris, 2011; Kryzak & Jones, 2017; Oppenheim-Leaf et al., 2012; Schreibman et al., 1983; Sullivan, 1999; Tsao & Odom, 2006; Walton & Ingersoll, 2012). The home presents a non-threatening environment for autistic children that may be uniquely associated with play between siblings as most of their interactions occur in this context. This may have facilitated cooperation and opportunities for learning within a familiar setting. Thus, many of the play-based SMIs may have capitalized on history of interactions within the child's natural environment.

Moreover, the nature of sibling relationships themselves may have created opportunities for learning that were both highly motivating and enriching. Neurotypical siblings serve as familiar, age-appropriate, highly influential, and potentially reinforcing peers to teach skills (Azmitia & Hesser, 1993; Kim et al., 2007; McHale et al., 2012; Newman, 1994; Pike & Oliver, 2017). Neurotypical siblings are unique in that they display high levels of prosocial behavior toward autistic children (Orm et al., 2021; Walton & Ingersoll, 2015). These prosocial tendencies suggest that neurotypical siblings may be highly motivated to participate in the intervention of autistic children, perhaps influencing greater intervention fidelity and initiation of practice in situations beyond the initial intervention.

Lastly, many of these SMIs may have been effective because they capitalized on the bidirectionality of relationships between autistic children and neurotypical siblings (Allclair, 2020; Celiberti and Harris, 1993; Glugatch and Machalicek, 2021; Kryzak & Jones, 2017; Tsao & Odom, 2006). The relational developmental systems metatheory, which incorporates principles of Bronfenbrenner's bioecological model, highlights the bidirectionality of interactions between individuals and their contexts (Bronfenbrenner & Morris, 2006; Lerner, 2006). In the case of the SMIs, many autistic children gained developmental benefits, which may have consequently benefitted neurotypical siblings.

More specifically, when considering Bronfenbrenner's bioecological model (Bronfenbrenner and Morris, 2006), autistic children and neurotypical siblings engaged in bidirectional microsystem-level interactions during the SMIs. During these SMIs, neurotypical siblings facilitated repeated, play-based interactions within the home environment that continuously built upon the existing skills of the autistic children over the course of the intervention. Through these repeated interactions, autistic siblings were able to develop cognitive, social, and communication skills that likely paved the way for increased social initiations, play behaviors, and communication directed toward neurotypical siblings. In return, neurotypical siblings may have been reinforced by the social behaviors of the autistic children, leading to improved interest, pleasure, social interactions (Celiberti & Harris, 1993; Glugatch & Machalicek, 2021; Tsao & Odom, 2006), mood, confidence (Allclair, 2020), reciprocal interactions (Kryzak & Jones, 2017) and decreased frustration (Celiberti & Harris, 1993) of neurotypical siblings. One study demonstrated that despite concerns that neurotypical siblings may find intervention implementation demanding or challenging, there was no indication of detrimental effects to their well-being post-intervention (Allclair, 2020). Thus, these

bidirectional interactions may have enhanced positive outcomes for neurotypical siblings and provided a foundation for improving the sibling relationship. These findings replicate previous research that neurotypical siblings encounter developmental benefits from interacting with autistic children (Verté, 2003; Walton & Ingersoll, 2015, Guidotti et al., 2021) and support the theory that the bidirectionality of sibling interactions may endorse positive outcomes for both siblings via SMIs (Lerner, 2006).

However, despite the effectiveness of these SMIs, the current body of literature is lacking in its representation of culturally and linguistically diverse (CALD) children. To date, only one SMI (Glugatch & Machalicek, 2021) reported demographic information related to ethnicity and languages spoken by the sibling dyad. Only one of the participants in the study was identified as non-white and bilingually-exposed to English and Spanish, though this finding did not inform intervention delivery in any way. The lack of consideration of diversity raises concerns regarding the social validity and sensitivity of SMIs conducted thus far. Unfortunately, in research, White populations have historically received more attention than people of color (Durkin et al., 2015). For autistic children specifically, this discrepancy may particularly problematic as Black and Latinx autistic children are diagnosed later in development compared to white children (Maenner et al., 2018). Nonetheless, the dearth of SMI research for diverse populations of autistic children highlights a gap in the literature that demands further inquiry.

A Review of the Literature on Culturally and Linguistically Diverse Autistic Children

Worldwide, it is estimated that 1 in 100 children is affected by ASD (Zeidan et al., 2022). The prevalence of ASD has been difficult to ascertain in developing countries, though recent research suggests that previously under-represented groups are gaining more attention (World Health Organization, 2019; Zeidan et al., 2022). Although ASD appears to manifest in CALD

children and families across all racial, ethnic, and socioeconomic groups, recent estimates suggest that children of color tend to get diagnosed later in development and less often than their white counterparts (Maenner et al., 2020). More specifically, White children are 1.1 times more likely to be diagnosed than Black children and 1.2 times more than Latinx children (Maenner et al., 2020). These disparities are particularly pronounced for Latinx children as they are also 1.1 times less likely to be diagnosed than their black counterparts (Maenner et al., 2020). Cultural stigmas, lack of healthcare resources, and non-English primary language may explain why such gaps exist (Rosen-Reynoso et al., 2016).

Although black and Latinx children have been historically underdiagnosed, due to improvements in accessibility of health care and international policies, changes to the diagnostic criteria of ASD, and increased awareness of ASD, patterns suggest that diagnoses of these children have been catching up to White populations over time (Christensen, 2019; Maenner, 2020; Zeidan et al., 2022). However, despite improvements in the detectability and diagnosis of ASD, research on interventions for autistic children have focused primarily on White samples from Western cultures (Durkin et al., 2015). This discrepancy is particularly relevant because SMIs, which will be explored in the present study, appear to lack diversity in their participants. This lack of diversity is problematic considering that ASD impacts CALD groups and that the worldwide prevalence of ASD has increased over time (Maenner et al., 2020; Zeidan et al., 2022). Thus, research on interventions for CALD autistic children is needed.

Furthermore, lack of representation of CALD autistic children in research has resulted in limited scholarly understanding regarding the experiences of and best practices for this population, particularly related to heritage language(s), or home language(s). On a global scale, over 50% of children are exposed to more than one language (Grosjean, 2010). In the United

States, over 12 million children speak a language other than English in their home; a number that is projected to continue growing with the increasing diversity of the country's population (KIDS COUNT Data Center, 2020; Ortman & Shin, 2011). The prevalence of ASD combined with the growing diversity of language indicate that a large proportion of autistic children are raised in families with a heritage language other than English, suggesting that this language is worthy of exploration.

However, many caregivers have feared that bilingual exposure may exacerbate existing language delays in their autistic children (Hampton et al., 2017; Kremer-Sadlik, 2005; Lim et al., 2018; Yu, 2013). Caregivers of autistic children with lower levels of verbal ability appear to be most susceptible to these concerns (Hambly & Fombonne, 2012; Hampton et al., 2017). Although healthcare providers, therapists, and educators are the primary sources of information for caregivers, many of them have reinforced caregiver fears by advising them to avoid bilingual exposure so as not to cause confusion (Yu, 2013). This advice appears to have been informed by several factors: 1) language deficits as one of the core characteristics of ASD, 2) the need for bilingual-exposed children to understand that one concept may be represented by more than one word across languages, 3) autistic children face challenges with joint attention involved in mapping words to corresponding stimuli, which raises concerns regarding receptive language delays, 4) differences in grammatical structure across languages, and 5) English as the dominant language in certain cultures (Hambly & Fombonne, 2012; Lim et al., 2018; Yu, 2013; Yu, 2016).

On the other hand, research has consistently indicated that these fears may be unfounded as bilingual-exposed (BE; i.e., those exposed to two languages) and monolingual-exposed (ME; i.e., those exposed to one language) autistic children do not appear to differ in terms of their

language outcomes (Dai et al., 2018; Hambly & Fombonne, 2011; Ohashi et al., 2012; Peterson et al., 2012; Valicenti-McDermott et al., 2013; Zhou et al., 2019). These findings have been consistent across autistic children with low and high levels of verbal ability (Hambly & Fombonne, 2012; Hampton et al., 2017). BE autistic children's age of onset of first words, rates of English vocabulary, vocabulary production, and vocabulary comprehension have been identified as on par with their ME autistic counterparts (Ohashi et al., 2012; Peterson et al., 2012). BE autistic children have scored equally to ME autistic children on measures of receptive language, expressive language, and functional communication (Beauchamp et al., 2020; Dai et al., 2018; Gonzalez-Barrero & Nadig, 2019; Ohashi et al, 2012; Valicenti-McDermott et al., 2013). Onset of bilingual exposure (whether during infancy or post-infancy) does not appear to influence negatively influence language outcomes (Hambly & Fombonne, 2011).

Furthermore, Sendhilnathan & Chengappa's (2020) study demonstrated that BE autistic children do not appear do differ significantly from ME autistic children on measures of cognitive abilities, social-communication, or social skills. BE children in this study were exposed to heritage languages including Mandarin, Malay, or Indian. In the study, a 6-month language intervention was delivered exclusively in English. Following intervention, BE children exhibited developmental gains on par with the ME counterparts. Though the social-communication skills of the BE group were rated higher than those of ME children, this difference was not statistically significant. Nonetheless, this study indicates that BE autistic children fare equally as well as their ME autistic peers on measures related to characteristics of ASD.

Several studies have demonstrated that bilingual exposure may be advantageous for autistic children, particularly in relation to development of play and communication skills (Beauchamp et al., 2020; Valicenti-McDermott et al., 2013; Zhou et al., 2019). BE autistic

children appear more likely than their ME autistic peers to engage in pretend play as well as use vocalizations and gestures (e.g., pointing, leading an adult's hand to a desired object; Valicenti-McDermott et al., 2013; Zhou et al., 2019). School-aged BE autistic children have also displayed receptive vocabulary, receptive language, and expressive language skills that are equivalent to neurotypical ME and BE same-age peers (Beauchamp et al., 2020). In typically developing children, 40-70% of language input in heritage language is required for BE children to acquire language levels on par with ME peers. (Thordardottir, 2011). It is important to consider that despite this level of exposure, many autistic children experience lifelong language delays and may not necessarily achieve bilingual verbal ability equivalent to those of neurotypical children.

Research indicates that BE children may even prefer instruction in their heritage language, particularly during difficult tasks. In Aguilar and colleagues' (2017) study, five BE autistic children were taught to press colored buttons prior to presentation of tasks to request instruction and reinforcement delivered in English, Spanish (i.e., their heritage language), or no language (control condition with no instruction or reinforcement). Although analysis indicated that participants did not display a preference for either language during easy tasks, three children preferred instruction in their heritage language (Spanish) when difficult tasks were presented. The authors suggest that heritage language may be associated with long reinforcement histories and may be preferred when tasks appear challenging. Considering this preference for heritage language, particularly during challenging tasks, research is needed to determine how heritage language may help autistic children during interventions aimed at teaching new skills.

Vygotsky's sociocultural theory may help explain why heritage language may be particularly crucial for autistic children raised in a home with a non-English heritage language. According to Vygotsky's sociocultural theory, language is proposed as one of most important

tools for development (Gauvain, 1998; Miller, 2016). Language allows children to construct an understanding of themselves, others, and their environment. Through language, children are also able to engage in interactions with more knowledgeable individuals, including verbal, neurotypical siblings. These interactions must offer an appropriate balance between the existing skill-level of the child and potential skill-level obtained through challenge (Miller, 2016).

Although Vygotsky did not directly conduct research on heritage language acquisition of autistic children, his sociocultural theory emphasizes the role of culture in the development of language overall (Miller, 2016). According to this theory, culture determines what languages children learn and through what processes they acquire them. Therefore, autistic children essentially acquire heritage language through culturally-dictated interactions with more advanced social partners. Because the language used during intervention of autistic children often defaults to the dominant language of the culture (which in the United States is generally English), this may result in limited opportunities for autistic children to learn their heritage language. Thus, based on the assumptions of Vygotsky's sociocultural theory, it is predicted that heritage language acquisition of autistic children may be enhanced by adopting more culturally sensitive practices that incorporate such language during intervention.

Furthermore, heritage language is one way in which cultural practices are passed down to children and shared among a group of people (Beauchamp & MacLeod, 2017; Miller, 2016). For BE autistic children, interactions within the home are more likely to occur in this language. However, when autistic children are denied exposure their heritage language, they may be prevented from engaging in interactions that could otherwise promote development of language and social skills, which are often impacted in this population (American Psychological Association, 2013). Beyond the home, heritage language may also be valued by individuals who

share a common culture and engage in cultural practices with autistic children and their families (e.g., church, school, or social groups). Thus, exposure to heritage language may provide opportunities for autistic children to generalize social skills to other members of their local community.

This theory is supported by qualitative research of BE autistic children. In Hampton and colleagues' (2017) study, data were collected following parent interviews regarding language exposure. Parents of BE autistic children reported that restricting exposure to only one language could compromise warmth, emotional closeness, and high-quality social interactions within the family. Similarly, Chinese parents in Yu's (2013) study reported that heritage language was often reserved for social situations or daily life at home. Thus, it appears caregivers may feel more comfortable and confident in their ability to communicate effectively in their heritage language.

Despite the evidence suggesting that heritage language may be advantageous for the development of autistic children, only a few studies have included such language interventions with autistic children. The earliest study to do so was conducted by Seung and colleagues in 2006. Their study examined the efficacy of a speech-language intervention in Korean and English intervention for a 3-year-old BE autistic child. For the first 12 months, the child received biweekly intervention in his heritage language (Korean). For the following 12 months, the child was gradually introduced to English until the final 6 months, which were delivered in English. Throughout the intervention, the child's receptive and expressive skills improved in both languages, and he also exhibited reduced challenging behaviors. Follow-up measures indicated that the child was able to respond to testing delivered in English, suggesting that heritage language may be useful in promoting acquisition of another language.

In 2011, Lang and colleagues delivered discrete trial training (DTT) to a BE autistic child in both heritage language (Spanish) and English. Standardized measures indicated that the child exhibited equal delays in both languages prior to intervention. During intervention, data on challenging behaviors (i.e., persistent loud tongue clicks) and correct responses during DTT trials were collected. Results indicated that instruction in heritage language was associated with decreased challenging behaviors and increased correct responses. Thus, interventions delivered in heritage language may potentially help reduce challenging behaviors in autistic children, providing more opportunities to complete tasks and learn new skills.

Using an alternating treatments design, Vaughn (2013) assessed expressive language of three autistic children in English and their heritage language (Spanish) during a conversation training program. During training, therapists delivered sessions either exclusively in English or Spanish, though children were able to respond in either language. Results indicated that instruction in heritage language was as effective as English at facilitating expressive language.

Lastly, Lim and Charlop (2018) also used an alternating intervention design in which instruction, comments, and verbal praise were delivered in English and heritage language (Korean or Spanish) during play sessions with four BE autistic children. Results demonstrated that children displayed more functional play behaviors in the heritage language condition compared to the English condition. The study replicated the findings of Lang and colleagues (2011) as one child exhibited fewer challenging behaviors during the heritage language condition. Considering that many autistic children demonstrate challenges with appropriate play, instruction in heritage language may provide a foundation by which to teach play skills to these children.

A few studies have also successfully integrated heritage language in intervention of autistic children involving caregivers. In 2011, Dalmau and colleagues used a multielement design to compare the effects of parent-mediated functional communication training (FCT) in English and heritage language (Spanish) for two autistic children. FCT is a procedure which provides children with reinforcement for using language or communication to replace challenging behaviors that may interfere with learning. With training and coaching by primary investigators, mothers in the present study delivered FCT sessions in both languages in their home setting. Results indicated that across both language conditions, parent implementation of FCT effectively reduced destructive challenging behavior while increasing communication and task completion in both participants.

Additionally, Lim and colleagues' (2020) study used a multiple baseline design to teach five Spanish-speaking mothers with limited English proficiency how to facilitate dressing skills of their autistic children via a video prompting intervention. First, video prompting (delivered in Spanish) of each step of the procedure was facilitated by a monolingual English-speaking trainer. The mothers then role-played each step of the procedure with the trainer until they were able to do so with 100% accuracy across two consecutive opportunities. The mothers then implemented the procedure with their children. Results indicated that independent dressing skills increased for 4 of 5 children. All mothers mastered the procedure with a trainer, and skills taught via video prompting successfully generalized across people (i.e., from trainers to therapists) for 3 of the mothers. High social validity and intervention integrity were also reported.

Most recently, Gumaer and colleagues (in preparation) integrated heritage language through caregiver-mediated NLP. Using a non-concurrent multiple baseline design (n=4 dyads), NLP was taught in both English and heritage language (Spanish or Korean) using video-

modeling, role-play with a researcher, self-assessment, and in-vivo feedback from the researchers. Caregivers delivered NLP with their children following 100% accurate performance on all steps of the procedure across two consecutive sessions. During caregiver-mediated NLP and free-play sessions, appropriate verbalizations, and mean length of utterances in both English and Spanish increased for all four children. This study provides preliminary support that heritage language may be used to facilitate overall language skills of autistic children.

Therefore, the growing literature on heritage language indicates that contrary to the initial concerns presented by healthcare professionals and caregivers, BE autistic children do not appear to present additional development delays compared to their ME autistic counterparts. Interestingly, heritage language appears to be as effective, and in some cases more effective for promoting language, social, adaptive, and behavioral development (Dalmau et al., 2011; Gumaer et al., in preparation; Lang et al., 2011; Lim & Charlop, 2018; Lim et al., 2020; Seung et al., 2006; Vaughn, 2013). Integration of heritage language in caregiver-mediated interventions has demonstrated promising results for language, communication, and adaptive skills (Dalmau et al., 2011; Gumaer et al., in preparation; Lim et al., 2020). However, thus far, heritage language has only been assessed via therapist or caregiver delivery of intervention (Dalmau et al., 2011; Gumaer et al., in preparation; Lang et al., 2011; Lim & Charlop, 2018; Lim et al., 2020; Seung et al., 2006; Vaughn, 2013).

CHAPTER 2

The Present Study: A Naturalistic Intervention Mediated by Siblings for Autistic Children

Overall, the research on SMIs currently lacks consideration of CALD autistic children while research on heritage language lacks consideration of neurotypical siblings. In intervention, SMIs have provided crucial opportunities for development across various domains including language, social interactions, and play, which are impacted in autistic children (Akers et al., 2018; American Psychological Association, 2013; Celiberti & Harris, 1993; Coe et al., 1991; Glugatch & Machalicek, 2021; Oppenheim-Leaf et al., 2012; Spector & Charlop, 2018). Play specifically provides opportunities for engagement, turn-taking, resolving conflict, and concentration (Galinsky, 2010; Wang & Barrett, 2013). Play-based SMIs have demonstrated positive bidirectional effects on autistic children and their neurotypical siblings, yet these interventions have not been explored when conducted in heritage language (Allclair, 2020; Celiberti and Harris, 1993; Glugatch and Machalicek, 2021; Kryzak & Jones, 2017; Tsao & Odom, 2006).

Interestingly, autistic children receive most heritage language exposure at home (Lim, 2021), the primary environment in which sibling interactions occur. This language is often used as a cultural tool which facilitates communication, emotional closeness, and warmth within family relationships (Hampton et al., 2017; Yu, 2013). For autistic children specifically, heritage language appears to help facilitate language development overall (American Psychological Association, 2013; Dalmau et al., 2011; Seung et al., 2006; Vaughn, 2013). However, research has thus far has only assessed therapist and caregiver delivery of intervention (Lim & Charlop, 2018; Lim et al., 2020).

Incorporating heritage language into the context of a SMI may be a fruitful extension of current research. Considering that neurotypical siblings may be effective change agents for autistic children, it may be promising to train neurotypical siblings to deliver heritage language during intervention within the context of a play-based, Naturalistic Intervention Mediated by Siblings (NIMS). Therefore, the specific goals of the present study were to: 1) enhance the contextual appropriateness of intervention via the NIMS procedure 2) train neurotypical siblings to deliver intervention for autistic children in their heritage language, 3) examine the effects of NIMS on appropriate language of autistic children, social initiations of neurotypical siblings, and interactive play between siblings, 4) examine the effects of NIMS on happiness behaviors and sibling relationship quality overall, and 5) determine if outcomes maintain over time and generalize across languages and social partners.

CHAPTER 3
Method

Participants

Participants included four BE sibling dyads recruited from an afterschool intervention center for autistic children. Within each dyad, one child was autistic, and the other child was neurotypical. Three of the autistic siblings identified as male and one identified as female. All four of the neurotypical siblings identified as female. Autistic children received diagnoses based on the Diagnostic and Statistical Manual of Mental Disorders-Fifth edition (DSM-5; APA, 2013) by licensed psychologists from two independent agencies. Additional characteristics of the autistic children were assessed using the Childhood Autism Rating Scale-2 (CARS-2; Schopler et al., 2010) and the Vineland Adaptive Behavior Scales-Third Edition (VABS-3; Sparrow et al., 2016). All neurotypical siblings had previous exposure to the intervention center and/or participated in program activities along with autistic children. A summary of sibling dyads and their characteristics are presented in Table 1.

Table 1

Characteristics of Sibling Dyads

Autistic Child	Age	Gender	Ethnicity	Heritage Language	CARS-2 ASD Classification	VABS-3 Expressive Language	Neurotypical Sibling	Age	Gender
Scott	8	Male	Chinese American	Mandarin	Severe	Not available	Alison	5	Female
Alice	13	Female	Korean American	Korean	Moderate-Severe	Low	Samantha	10	Female
Luis	18	Male	Latinx	Spanish	Severe	Low	Katelyn	11	Female
Wesley	11	Male	Korean American	Korean	Moderate-Severe	Low	Audrey	10	Female

Sibling Dyad 1: Scott and Alison

The first sibling dyad consisted of Scott and Alison. Scott was an 8-year-old autistic male and his neurotypical sister Alison was 5 years old. Both were Chinese Americans, and their

first language was Mandarin. Scott's CARS-2 indicated severe ASD. Scott was considered minimally verbal as he spontaneously communicated using only 2 to 3-word phrases. He exhibited escape behaviors (i.e., elopement) when denied access to preferred activities/items or when demands were placed. He also exhibited vocal and visual stereotypy (i.e., gazing out of the corner of his eye). Parents communicated with one another and with both children in Mandarin and English at home and in the community.

Sibling Dyad 2: Alice and Samantha

The second sibling dyad consisted of Alice and Samantha. Alice was a 13-year-old autistic female and her neurotypical sister, Samantha was 10 years old. Both were Korean Americans. Alice's CARS-2 score indicated moderate-severe ASD and her VABS-3 score indicated low expressive language. Alice demonstrated conversational speech though she exhibited restricted and repetitive speech and interests when communicating with others (e.g., mentioning the same topic in conversation during inappropriate situations). Their mother reported that all family members communicate with one another in Korean at home.

Sibling Dyad 3: Luis and Katelyn

The third sibling dyad consisted of Luis and Katelyn. Luis was an 18-year-old autistic male and his neurotypical sister Katelyn was 11 years old. Both were Latinx. Luis' CARS-2 score indicated severe ASD and his VABS-3 score indicated low expressive language. Luis was minimally verbal and exhibited echolalia. He occasionally engaged in noncooperation when demands were placed (e.g., refusing to stand up or sit down when asked). Spanish as well as English were spoken in the home by all family members.

Sibling Dyad 4: Wesley and Audrey

The fourth sibling dyad consisted of Wesley and Audrey. Wesley was an 11--year-old autistic male, and his neurotypical sister Audrey was 9 years old. Both were Korean American. Although Wesley also had a younger brother, Audrey was selected for the study because she demonstrated more advanced mastery of Korean and was a more appropriate play partner as she was closer in age to Wesley. Wesley's CARS-2 score indicated moderate-severe ASD and his VABS-3 score indicated low expressive language. Wesley was conversational though his sentences were often grammatically incorrect. He demonstrated restricted play skills as he often engaged in scripted play scenes. Their mother reported that all family members speak in Korean to one another at home and in the community.

Setting and Materials

Informed consent was collected from caregivers of all children prior to their participation in the study. Assent was also obtained for all children participating in the study. All baseline, intervention and follow-up sessions took place on a tarp with a variety of preferred items. All sibling-report and caregiver-report measures were obtained at the intervention center. Materials for the study included an iPad to video record all sessions, an iPhone to deliver auditory prompts to siblings, visual prompt cards, the sibling training checklist, procedural fidelity data sheets, the sibling relationship questionnaire, a printed happiness scale, social validity questionnaires, and preferred items.

Research Design

The study used a multiple baseline design across four sibling dyads to assess the effectiveness of the NIMS procedure. A multiple baseline across sibling dyads was incorporated to demonstrate experimental control. Staggered baselines allowed intervention to be introduced at different points in time for each dyad, so the researcher was able to control for extraneous

variables and conclude that the NIMS was responsible for intervention (Cooper et al., 2019). The study consisted of five phases: (1) pre-intervention, (2) baseline, (3) probes (4) sibling training, (5) intervention, and (6) follow-up.

Procedure

Pre-intervention

One caregiver from each family completed the Home Heritage Language Use Questionnaire (see Appendix A) and Heritage Language Perspectives Questionnaire (see Appendix B). The Home Heritage Language Exposure Questionnaire was used to assess the extent to which both siblings were exposed to and communicated in their heritage language prior to their inclusion in the study. Regarding heritage language use in the home, each caregiver was asked how often they speak to each child in this language, how often each child speaks to them in this language, and how often and each child speaks to their sibling in this language. Table 2 displays caregiver responses to the Home Heritage Language Use Questionnaire. Responses were included within this chapter to provide the reader with evidence that the sibling dyads included in the study were BE and that heritage language was spoken in the home.

Table 2

Sibling Dyad Home Heritage Language Use

Autistic Child	Heritage Language	Exposure from Caregiver	Speak to Caregiver	Speak to Sibling	Neurotypical Child	Exposure from Caregiver	Speak to Caregiver	Speak to Sibling
Scott	Mandarin	Frequent	Frequent	Frequent	Alison	Frequent	Frequent	Frequent
Alice	Korean	Always	Frequent	Some	Samantha	Always	Some	Rare
Luis	Spanish	Always	Some	Always	Katelyn	Some	Some	Some
Wesley	Korean	Some	Rare	Rare	Audrey	Some	Some	Rare

Additionally, one caregiver from each dyad also completed the Heritage Language Perspectives Questionnaire, which included questions related to advice from professionals and reasons the caregiver chose to expose their autistic child to their heritage language. This questionnaire was informed by previous research which indicated that although caregivers may have been discouraged by healthcare professionals and educators from exposing autistic children to their heritage language, some still choose to bilingually expose their autistic children (Yu, 2013; Yu, 2016). See Figure 1 for the responses from this questionnaire.

Baseline

During baseline, autistic children and their neurotypical siblings engaged in 5-minute free play sessions on a tarp with a variety of available toys and stimuli. Sessions were conducted outdoors and occasionally indoors (when environmental factors prevented outdoor sessions), where a tarp marked the parameters for play. A bilingual therapist delivered the directive, "play and talk together" (in English) to both siblings, though no language was specified. No other demands or prompts were provided to children during baseline. In accordance with the multiple baseline across dyads design, each sibling dyad participated in a different number of baseline sessions to allow for behavior change to be attributed to the intervention.

Probes

After baseline, all sibling dyads underwent a phase during which they participated in one pre-intervention heritage language probe, one English generalization probe, and one heritage language generalization probe. During the pre-intervention heritage language probe, a bilingual therapist instructed the dyad to "play and talk together in (Korean, Spanish, or Mandarin)." This instruction was delivered in the language specified. This probe was included to assess for language and play in heritage language prior to sibling training and intervention. During the

English generalization probe, the autistic child engaged in a 5-minute free play session with a bilingual therapist. The bilingual therapist was instructed not to initiate conversation with the child, but to respond only in English if the child initiated. The heritage language generalization probe also involved a 5-minute free play session with a bilingual therapist. However, during this probe the bilingual therapist was instructed to respond only in the child's heritage language if the child initiated. The bilingual therapists that played with the autistic children did not deliver instructions during generalization probes in either language so that dependent variables could be assessed in the absence of prompting.

Sibling Training

Following completion of the probes, neurotypical sisters received training related to the Naturalistic Intervention Mediated by Siblings procedure. The neurotypical sisters, bilingual therapist, and the primary investigator were present during this phase of the study. Although the primary investigator was present to video record each session and monitor training implementation, sessions were delivered one-on-one in that only the bilingual therapist and the neurotypical sister engaged with one another during training. First, the bilingual therapist indicated to the neurotypical sister that they were going to learn about new ways to play and talk with their sibling in their heritage language (Korean, Spanish, or Mandarin). Each neurotypical sister was then trained to implement the procedure according to the training checklist (see Appendix C).

Training involved direct instruction, modeling, rehearsal via role-play, and in-vivo feedback. During training, neurotypical sisters were systematically introduced to the four phases of the NIMS procedure, ending with a final phase during which all skills were covered. A phase commenced with the bilingual therapist listing the skills that would be covered by a given phase

(see Table 3). The first skill was explained to the neurotypical sister, and the bilingual therapist then provided direct instruction on how to implement the skill. The therapist then engaged in modeling to demonstrate how to implement the skill. The bilingual therapist ensured that the neurotypical understood the skill by engaging in role-play while providing in-vivo feedback. The therapist then proceeded to teaching the second skill, until all skills in the phase were addressed. Training of each phase was completed until the neurotypical sister demonstrated 100% mastery of each skill within the phase during at least one role-play (in heritage language) opportunity with the bilingual therapist. The bilingual therapist then proceeded to the second and third phases of training. Once the neurotypical sister reached the fourth phase, they were required to implement the entire procedure during role play in heritage language with the bilingual therapist with at least 80% accuracy across two consecutive opportunities. All four neurotypical sisters mastered training within one 30-minute session.

Table 3

Four Phases of the Naturalistic Intervention Mediated by Siblings

Phase	Skill	Description
1	a) Physical Proximity	Stay close to sibling as they move around the play area
	b) Attention	Obtain autistic child's attention (e.g., call sibling by name, tap them on the shoulder, show object to child, establish eye contact, saying "look at me")
	c) Turn-taking	Create opportunities to share toys or take turns (e.g., saying "my turn," to request a toy the child is playing with or physically offering a toy to the autistic child)
2	a) "Time to Talk"	Introduce auditory prompt that will go off every 30 seconds to prompt neurotypical sister to socially initiate
	b) Visual Prompt Cards	Introduce visual prompt cards that will be displayed to encourage variation of neurotypical sibling social initiation (i.e., instruction, play, question)
3	a) Instructions	Deliver contextually appropriate instruction (e.g., "blow the bubbles," "throw the ball")
	b) Play	Deliver contextually appropriate phrase and model appropriate play with a toy (e.g., "drive the car") while demonstrating the action
	c) Questions	Ask question directed toward the autistic child (e.g., "what color is it?" "How many blocks do you have?")
	d) Praise	Provide social praise to the autistic child (e.g., "good job building the tower")
4	All Skills	Child implements all skills in practice during role play with the bilingual therapist

Phase 1: Physical Proximity, Attention, and Turn-Taking. The first skill covered was physical proximity. When teaching this skill, the bilingual therapist reviewed how to stay in close physical proximity to the autistic child as they move around the play area and explore their

surroundings. The second skill was related to getting the autistic child's attention. Sisters were instructed not to get discouraged if their sibling does not respond (Strain et al., 1985; Tsao & Odom, 2006). Lastly, each neurotypical sister was trained on how to provide opportunities to engage in turn-taking with the autistic child. The phase was completed once the neurotypical sister demonstrated 100% accurate demonstration of all 3 skills during role-play with the bilingual therapist.

Phase 2: "Time to Talk" and Visual Prompts. During the second phase of training, the child was introduced to the "Time to Talk" auditory prompt and visual prompts. First, the bilingual therapist instructed the neurotypical sister that a specific sound would be played every 30 seconds to prompt that it is "Time to Talk" (i.e., deliver an instruction, play phrase, or question). This resulted in a total of 10 opportunities throughout one 5-minute session.

First, the bilingual therapist set a 30 second timer and played the "Time to Talk" auditory prompt for the child. Once the sound was played, the neurotypical sister practiced locating the bilingual therapist, who held the visual prompt cards (see Appendix D). These prompts were included to encourage variation of speech of the neurotypical sisters. One of the cards displayed a photo of a character delivering an instruction. Another card displayed two children playing together to prompt a play-related comment and action. The last card displayed a question mark to prompt delivery of a question.

Phase 3: Instructions, Play, Questions, and Praise. Once the second phase was mastered, the bilingual therapist then taught the neurotypical sister the third phase which consisted of delivering instructions, modeling appropriate play phrases, asking questions, and delivering praise. First, the sisters were taught to deliver instructions that were relevant to play (e.g., "give me the car," "catch the ball"). Next, each sister was taught to model phrases and play

behaviors that were contextually appropriate (e.g., “bounce the ball” while bouncing the ball, “jump high” while jumping). Third, the bilingual sister was taught how to ask questions (e.g., “what color is the doll’s dress?” “Is the train big or little?”). Lastly, the neurotypical sister was taught to provide praise (e.g., saying “good job playing”) to the autistic child. The bilingual therapist emphasized that praise may be delivered at any point during the session and is not dependent upon the “Time to Talk” prompt. This phase was completed once the neurotypical sisters demonstrated all skills with 100% accuracy during role-play with the bilingual therapist.

Phase 4: Complete Checklist. Once the three phases were mastered, the bilingual therapist and each neurotypical sister engaged in role-play scenarios in which the bilingual therapist served as the autistic child and the neurotypical sister served as themselves. The bilingual therapist began each session by playing the “Time to Talk” prompt. Another researcher then rotated the presentation of the visual prompt cards every 30 seconds. Throughout the role-play scenarios, the bilingual therapist provided in-vivo feedback and each neurotypical sister was required to demonstrate their ability stay in close physical proximity to their play partner, get their play partner’s attention, and provide praise. They also demonstrated their ability to locate the visual prompt cards and deliver the corresponding social initiation. Each neurotypical sister mastered learning criterion when they met role-play criterion of 80% accuracy for the 4-phase checklist across two consecutive opportunities.

Intervention

Intervention sessions consisted of 5-minute play sessions involving the sibling dyad. During each 5-minute session, the neurotypical sister implemented the NIMS procedure with their autistic sibling. Each session commenced with a “Time to Talk” prompt which indicated that the neurotypical sister needed to locate the visual prompt cards and deliver a social initiation

in their heritage language (Korean, Spanish, or Mandarin). This process was repeated every 30 seconds until the 5-minute session was completed. If a neurotypical sister socially initiated in English after a prompt, the bilingual therapist reminded them to communicate only in heritage language. The intervention for each dyad consisted of no more than double the number of baseline sessions.

Training Checklist Probes. Throughout intervention, in-vivo procedural fidelity probes were conducted at random across a minimum of 50% of intervention sessions to assess for neurotypical sister accuracy of implementation. If siblings scored below 80% during a given probe, a booster training session was conducted. None of the sisters required booster sessions during the study.

Prompt Fading. Once learning criterion was met during intervention (i.e., at least double the baseline social initiation percentage across two consecutive sessions), all prompts were systematically faded. Levels of prompt fading for the NIMS procedure are displayed in Table 3. Level 1 fading consisted of removing the "Question" visual prompt from the rotation of cards. Instead, when this card would have otherwise been presented, neurotypical sisters were provided with only the "Time to Talk" auditory prompt. During this level of fading, the "Instruction" and "Play" cards were still presented to the neurotypical sisters. During level 2 fading, both the "Question" and "Instruction" cards were omitted from the rotation. Instead of presenting these cards, neurotypical sisters were provided with only the "Time to Talk" auditory prompt. However, the "Play" card was still presented to the sister within the rotation of opportunities. Level 3 fading consisted of removing all visual prompts and neurotypical sisters were provided only the auditory "Time to Talk" prompt every 30 seconds. Lastly, level 4 fading involved removal of all visual and auditory prompts.

To meet criterion to proceed to each phase of fading, social initiations of neurotypical sisters across all intervention sessions were required to remain at least double the baseline average percentage. If criterion was not met, the procedure was outlined to return to the previous level. However, none of the neurotypical sisters were required to return to a previous level of fading.

Alison's Prompt Fading. Due to the age and verbal ability of Scott's neurotypical sister Alison, it was determined a priori that full verbal prompts would be implemented from the onset of intervention. These verbal prompts were paired with the visual and auditory prompts and were systematically faded using a time delay procedure.

Table 4

Levels of NIMS Prompt Fading

Fading Level	Description
0	Full visual and auditory prompts
1	Question card removed
2	Question and instruction cards removed
3	Question, instruction, and play cards removed (i.e., auditory prompt only)
4	Auditory prompt removed

Follow-Up

During the follow-up phase of the study, sessions were conducted immediately following intervention and again within one week of completing intervention. Follow-up sessions were included to determine the extent to which behavior change maintained once the intervention was removed. Follow-up consisted of two sessions identical to baseline (i.e., children were instructed

to “play and talk together” with no language specified), two post-intervention heritage language probes (i.e., children were instructed to “talk and play together” in their heritage language), two generalization probes in English (discussed in the following section), and two generalization probes in heritage language (discussed in the following section). No other prompts were provided during these sessions.

Generalization Probes

Generalization probes were conducted with a bilingual therapist and each autistic child. Generalization probes were included to determine the extent to which autistic children exhibited target behaviors across persons and language conditions (Cooper et al., 2019). Following baseline and during follow-up, generalization probes consisted of 5-minute free-play sessions during which the therapist either communicated only in English or only in heritage language to the autistic child.

English NIMS Probe

Once each dyad achieved learning criterion during intervention, one five-minute English NIMS probe was conducted. This probe was conducted again for dyads who met full intervention criterion after prompt fading. These probes were included to assess the extent to which the intervention was effective when siblings were instructed to deliver the NIMS procedure in English. Prior to conducting an English play probe, the primary researcher instructed the neurotypical sibling to implement the NIMS procedure in English and delivered the directive for the dyad to “play and talk together in English.”

Dependent Measures

Appropriate Verbalizations

Average percentage of appropriate verbalizations of autistic children across intervals were measured across all sessions. Due to the limited expressive language of the participants per their VABS-3 scores and the likelihood that they would demonstrate low speech overall, both heritage language and English verbalizations were combined for this measure. Appropriate verbalizations were operationally defined as verbal approximations, imitations (i.e., verbal responses immediately following a model), answers (i.e., those that are contextually related to a preceding verbal discriminative stimulus), or spontaneous speech (i.e., verbalizations with no immediate verbal discriminative stimulus) that were contextually related to play. Verbalizations unrelated to the context of play were not scored as appropriate verbalizations

Appropriate verbalizations were measured using a 15-second partial interval scoring procedure (Cooper et al., 2019). Based on this procedure, an occurrence of an appropriate verbalization was recorded if the autistic child emitted verbal approximations, imitations, answers, or spontaneous speech at some point during the 15-second interval. Only one occurrence was necessary for a report per 15-second interval. Each language was coded separately. However, the data were collapsed during analysis. Criterion was met once autistic children exhibited appropriate verbalizations at least double the average of baseline across two consecutive sessions. Setting this criterion allowed the researchers to examine improvements in appropriate verbalizations that were socially significant for each individual autistic child.

Differential Language Use. Across all phases of the study, average percentage of appropriate verbalizations in heritage language and English were collected to assess changes in language use throughout the study.

MLU. Each child's mean length of utterance (MLU) was assessed to compare verbalizations from pre-intervention to post-intervention. MLU was calculated by collecting utterances (either imitative or spontaneous) spoken by the autistic child during each session and dividing the number of morphemes (i.e., smallest meaningful unit in a language) by the number of utterances. Each autistic child's total MLU involved a combination of utterances across both languages. These were calculated during each session and then averaged across the total number of sessions for that phase of the study. A paired samples t-test was also conducted to determine if a significant difference between pre-test to post-test MLU was observed.

Social Initiations

Average percentage of social initiations of neurotypical sisters were assessed across all phases of the study. Social initiations were operationally defined as any verbal or motor behaviors directed toward the autistic child to evoke a response (Tsao & Odom, 2006). A social initiation included delivering an instruction, asking, or answering a question, making a comment, sharing a toy or object, or helping the autistic child (Tsao & Odom, 2006). Simply looking at the autistic child was not considered an occurrence of social initiation. Criterion for this variable was met once the neurotypical sister exhibited social initiations least double the average of baseline across two consecutive sessions.

Interactive Play

A 15-second partial interval scoring procedure was also used to assess the percentage of intervals that autistic children and neurotypical siblings engaged in interactive play behaviors. Interactive play was operationally defined as any instance during which children engaged in play behaviors with and directed toward their sibling. These include instances in which siblings a) used toys as they were intended to be used (e.g., playing catch or building a tower), c) used toys

to represent something else (e.g., using a blanket as a cape), d) adopted an imaginary role (e.g., doctor or superhero), or e) used verbalizations, gestures, and/or motions to represent use of an imaginary object (e.g., holding a fist and moving hands back and forth to simulate holding a sword). Learning criterion was met once the sibling dyad exhibited interactive play at least double the average of baseline across two consecutive sessions.

Ancillary Measures

Happiness

Due to COVID-19, all sibling dyads were required to wear face masks throughout all phases of the study. Therefore, happiness measures for autistic children and neurotypical sisters were obtained via self-report. Happiness was assessed using a 3-item scale including a sad face, "okay" face, and happy face. All children had previous exposure to the happiness scale prior to the study as it was incorporated as a component of attendance at the clinical treatment center for autistic children. See Appendix E for the happiness scale used in this study. Children were asked "how do you feel?" and their responses were recorded. Children selected their choice by pointing to a specific face on the scale or verbalizing their choice (e.g., "I'm happy," "I'm okay," or "I'm sad"). This measure was included to assess the extent to which the sibling dyad enjoyed interacting with one another and happiness probes were interspersed randomly throughout the study.

Sibling Relationship Quality

The Sibling Relationship Questionnaire (see Appendix F) was incorporated to assess changes in the sibling relationship from the perspective of the neurotypical sisters. This questionnaire was informed by Furman and Buhrmester's (1985) Sibling Relationship Questionnaire. The questionnaire in the present study was adapted to be developmentally

appropriate for a wide range of ages, as the youngest child in the study was 5 years old. The original questionnaire involved 21 items which addressed both warmth/closeness and conflict within the sibling relationship. Questions included on the scale in this study were selected based on their relevance to both the objectives of the intervention and the literature base involving sibling relationships with autistic children. The wording of questions then was simplified to a level that a 5-year old child could understand. Furthermore, the Likert scale was also reduced from 5 options to 3 options.

To address the bidirectionality of the relationship, the questionnaire in the present study was adjusted to contain a total of 10 questions, 5 of which asked questions regarding the autistic child's behavior and another 5 which asked questions related to the neurotypical sister's behavior. The questions asked generally "how much" a child engages in a certain behavior with scale options including, "not at all," "a little," or "a lot." The questionnaire was implemented once following the final baseline session, once during the pre-intervention probes, interspersed randomly throughout intervention, and once during follow-up and generalization probes. This scale was conducted in English with only the primary investigator and the neurotypical sister.

Procedural Integrity

Procedural integrity was assessed to determine the extent to which the intervention was implemented as originally intended (Cooper et al., 2019). To assess for integrity of the application of the NIMS procedure, two independent coders were trained to score implementation of at least 50% of all intervention sessions. One coder completed the Sibling Implementation Checklist in-vivo during training checklist probes. The other coder separately observed the pre-recorded sessions and was provided with the Sibling Implementation Checklist (see Appendix G). Each coder then recorded the presence or absence of correct implementation

for each of the components of the procedure. Procedural integrity involved dividing correct implementation by the total number of opportunities and multiplying by 100. Results indicated that intervention integrity ranged from 80 to 100% for Alison, 80% for Samantha, 80 to 100% for Katelyn, and 80 to 100% for Audrey.

Interobserver Agreement

To assess for reliability of measurement, interobserver agreement (IOA) was obtained across one third (33%) of all phases of the study across all four dyads. IOA was conducted by independent, trained coders. These coders were provided with the operational definitions for dependent variables and watched prerecorded videos of sessions to score for instances of target behaviors using a 15-second interval scoring procedure. IOA percentages for each session were calculated first by adding the number of 15-second intervals during which two coders agreed on the occurrence or nonoccurrence of a behavior. This number was then divided by total observations (i.e., agreements plus disagreements) and multiplied by 100 for each session. IOA ranges collected for each sibling dyad are displayed in Table 4.

Table 5

Inter-observer Agreement Ranges

Dyad	Baseline	Probes	Intervention	Follow Up
Scott & Alison	83 - 100%	95 - 100%	84 - 100%	90 - 100%
Alice & Samantha	95 - 100%	94 – 100%	86 – 100%	80 – 100%
Luis & Katelyn	95 - 100%	100%	80 - 100%	80 - 100%
Wesley & Audrey	95 – 100%	95 – 100%	80 – 100%	80 – 100%

Social Validity

Social validity is a subjective measure of the extent to which intervention was identified as acceptable and produced significant outcomes for the individuals involved (Cooper et al., 2019). The present study incorporated neurotypical sister- and caregiver-reported social validity measures (see Appendices H and I). The social validity questionnaire for neurotypical sisters contained a 5-point Likert scale accompanied by a happy face scale. Questions were related to satisfaction with the intervention and their perception on its application with other children. The social validity questionnaire for caregivers involved questions related to perceived effects of sibling involvement and heritage language use in the intervention of autistic children.

CHAPTER 4
Results

Training Data

All four of the neurotypical sisters mastered learning criteria and individually completed the NIMS training within one 30-minute training session. Additionally, none of the sisters required booster sessions based on their performance during training checklist probes throughout intervention. For Alison, training checklist probes were conducted during intervention sessions 2, 3, 5, 7, and 9. Training checklists were completed for Samantha during intervention sessions 1, 2, 5, and 7. Probes for Katelyn were completed during intervention sessions 1, 3, 5, and 6. For Audrey, training checklist probes were conducted during sessions 2, 4, 5, and 8. Table 6 displays the average percentage of steps correctly performed by neurotypical sisters across opportunities during initial training and intervention training checklist probes.

Table 6

Average Percentage of Steps Correctly Performed

Neurotypical Sister	Training	Intervention
Alison	87%*	88%*
Samantha	86%	80%
Katelyn	95%	90%
Audrey	84%	90%

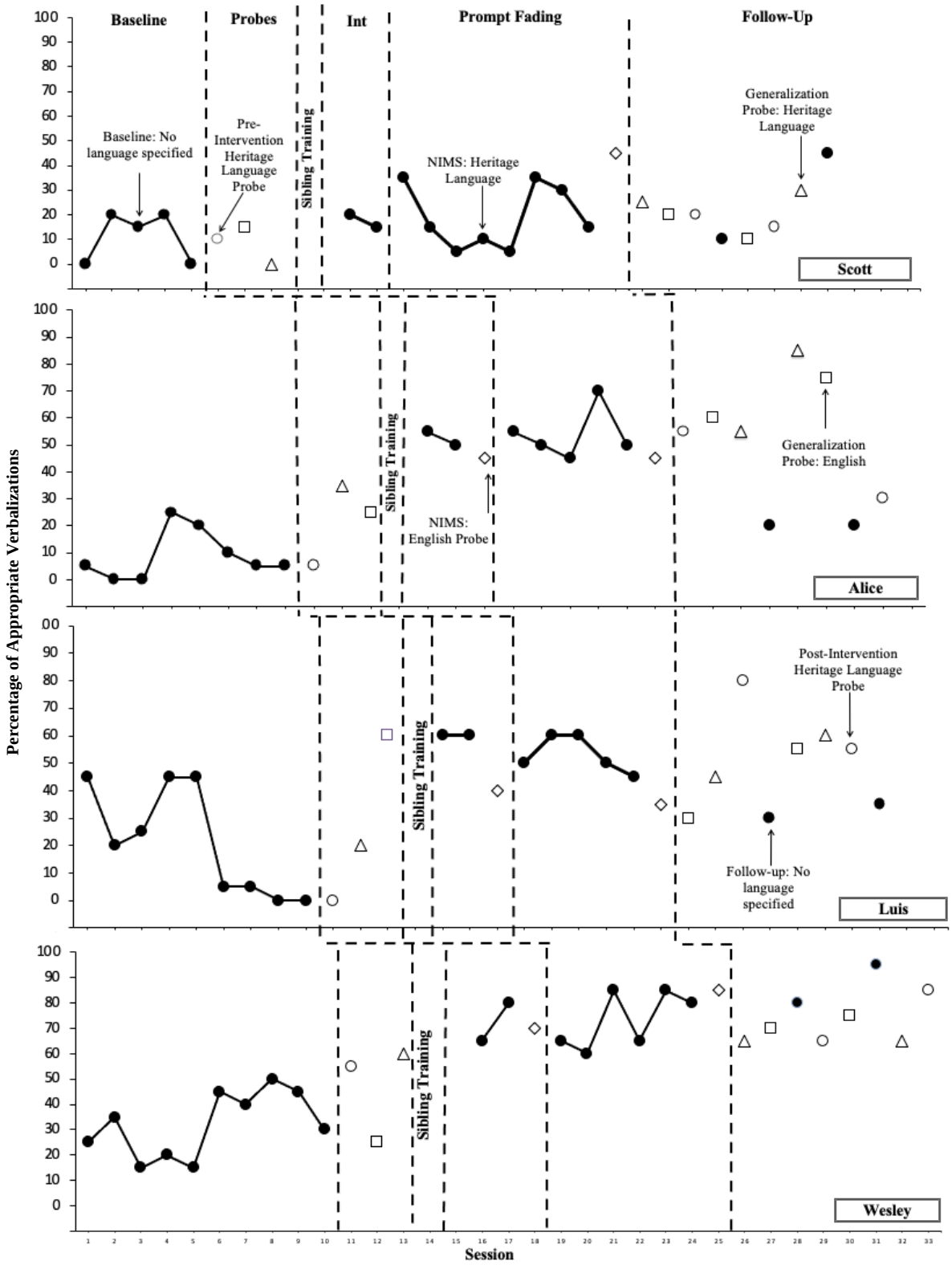
Note. * indicates that a sister was provided with full verbal prompts

Appropriate Verbalizations

All four autistic children achieved performance criterion (i.e., doubled their average of total baseline verbalizations). These children demonstrated increases in their average of total verbalizations (i.e., heritage language and English combined) from baseline levels during implementation of the NIMS procedure. Additionally, all four children generalized their appropriate verbalizations across persons and one child maintained their verbalizations during follow-up probes when no language was specified. Three of the autistic children demonstrated sustained improvements from the pre-intervention heritage language probes to post-intervention heritage language probes. Figure 1 depicts the average percentage of appropriate verbalizations across sessions.

Figure 1

Percentage of Appropriate Verbalizations Across Sessions



Note. Closed circles represent sessions when sibling dyads were instructed to play and talk together. Open circles represent heritage language probes when the sibling dyad was instructed to speak and play in their heritage language. Open squares represent generalization probes when a bilingual therapist responded to the autistic child only in English. Open triangles represent generalization probes when a bilingual therapist responded to the autistic child only in their heritage language. Open diamonds represent NIMS English probes when the neurotypical sisters implemented the intervention procedure in English.

Sibling Dyad 1: Scott and Alison

During baseline sessions with his sister Alison, Scott's level of appropriate verbalizations showed a variable pattern but remained consistently low (see panel 1, Figure 1). His verbalizations ranged from 0 to 20%. Verbalizations also remained low during the heritage language probes and generalization probes with the bilingual therapist in English and in Mandarin. During intervention, Scott achieved performance criterion at session 3. His appropriate verbalizations across all intervention sessions ranged from 5 to 35%. During follow-up as well as English post-intervention generalization probes, Scott's average percentage of appropriate verbalizations remained at a low level. Scott's average verbalizations during post-intervention heritage language probes and Mandarin generalization probes increased compared to pre-intervention.

Sibling Dyad 2: Alice and Samantha

During baseline with her sister Samantha, Alice's appropriate verbalizations demonstrated an initial increasing trend with a decreasing trend at the end of the phase (see panel 2, Figure 1). Her verbalizations remained at a low level across baseline sessions and her average appropriate verbalizations during baseline ranged from 0 to 25%. During the heritage language

probe and both generalization probes, Alice's verbalizations remained low. Upon implementation of the NIMS procedure in heritage language, Alice's appropriate verbalizations immediately increased. She mastered performance criterion at session 2. Her appropriate verbalizations across all intervention sessions ranged from 45 to 70%. Both English intervention probes remained at a high level. During follow-up sessions with her sister Samantha, Alice's level of appropriate verbalizations did not maintain over time. However, her verbalizations during the heritage language probes were higher post-intervention than pre-intervention. Her appropriate verbalizations generalized across persons during both language conditions.

Sibling Dyad 3: Luis and Katelyn

During baseline play sessions with his sister Katelyn, Luis' appropriate verbalizations demonstrated an initial increasing trend with a decreasing trend at the end of the phase (see panel 3, Figure 1). His appropriate verbalizations ranged from 0 to 45% across opportunities during baseline. Verbalizations were low during the heritage language probe and Spanish generalization probe with the bilingual therapist. During intervention, Luis' level of verbalizations increased, and he achieved learning criterion at session 2. Verbalizations ranged from 45 to 60% across all intervention sessions. His verbalizations during English NIMS probes were higher than baseline but lower than during NIMS in heritage language. During follow-up sessions with his sister Katelyn, Luis did not demonstrate intervention gains in terms of overall verbalizations. However, Luis' verbalizations during heritage language probes increased compared to pre-intervention. Luis also generalized his skills across persons during the Spanish language condition.

Sibling Dyad 4: Wesley and Audrey

During baseline sessions with his sister Audrey, Wesley's appropriate verbalizations indicated variable patterns of responding with a low level overall (see panel 4, Figure 1). His

average percentage of total verbalizations during baseline ranged from 15 to 50%. His total verbalizations during the heritage language probe in Korean were higher than baseline. During pre-intervention generalization probes with the bilingual therapist, Wesley's verbalizations were higher during the English probe than during the Korean probe. Upon implementation of the NIMS procedure in heritage language, Wesley's verbalizations immediately increased to a high level and learning criterion was met after 2 sessions. His average percentage of total verbalizations across all intervention sessions ranged from 65 to 80%. Verbalizations during English NIMS probes were also high. Wesley's average percentage of verbalizations maintained over time at follow-up. High levels of responding were also evident across post-intervention heritage language probes. Wesley's appropriate verbalizations generalized across persons during English and Korean sessions.

Differential Language Use

Regarding differential language use, all four autistic children increased their verbalizations in heritage language during the NIMS procedure in heritage language compared to baseline. Two of these children maintained their heritage language verbalizations during follow-up sessions and two demonstrated sustained heritage language use during post-intervention heritage language probes. See Figures 2 through 5 for each child's differential language use.

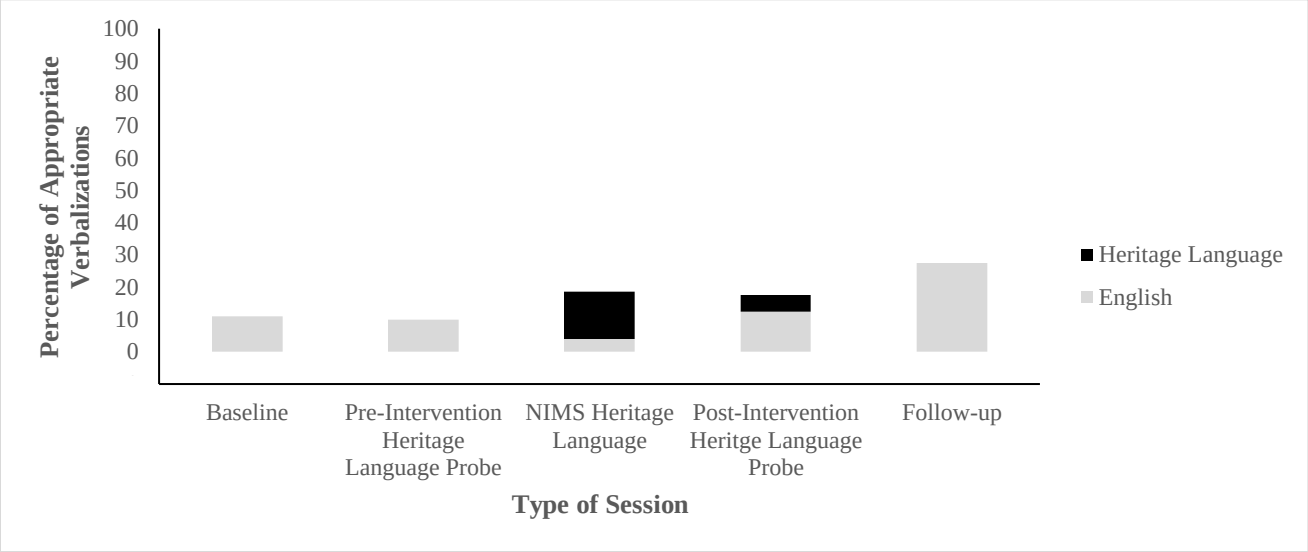
Sibling Dyad 1: Scott and Alison

Figure 2 depicts Scott's differential language use throughout the study. During baseline and the pre-intervention heritage language probe, Scott verbalized exclusively in English. Upon implementation of the NIMS procedure in Mandarin, Scott's appropriate verbalizations were greater in Mandarin than in English. During the post-intervention heritage language probes, Scott

demonstrated an improvement in his use of Mandarin compared to pre-intervention. Scott did not verbalize in Mandarin during follow-up.

Figure 2

Scott's Differential Language Use

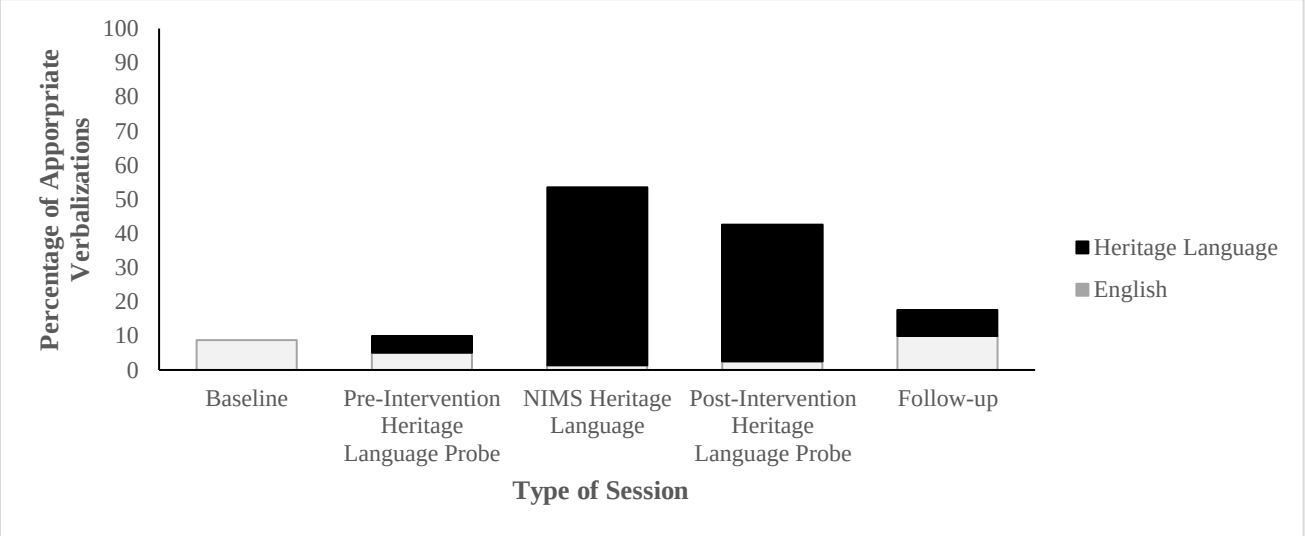


Sibling Dyad 2: Alice and Samantha

Figure 3 depicts Alice's differential language use across sessions. During baseline, Alice verbalized only in English and during the pre-intervention heritage language probes, her verbalizations in Korean increased. Once the NIMS procedure was implemented in heritage language, Alice's overall verbalizations increased and were primarily in Korean. During follow-up sessions and post-intervention heritage language probes with her sister, Alice's verbalizations in Korean were greater than baseline and the pre-intervention probes.

Figure 3

Alice's Differential Language Use

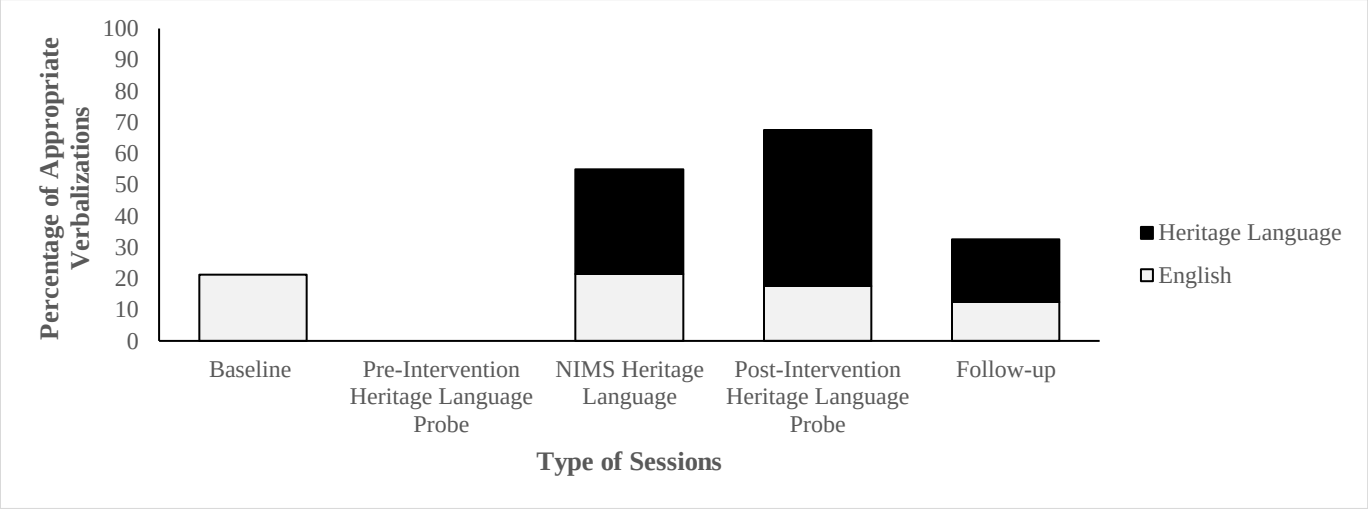


Sibling Dyad 3: Luis and Katelyn

Figure 4 depicts Luis' differential language use across sessions. During baseline, Luis verbalized only in English, and he did not offer any verbalizations during the heritage language probe. Upon implementation of NIMS in heritage language, Luis' verbalizations in Spanish increased. His verbalizations in heritage language maintained during follow-up as well as increased from the pre-intervention language probe to the post-intervention language probes.

Figure 4

Luis' Differential Language Use

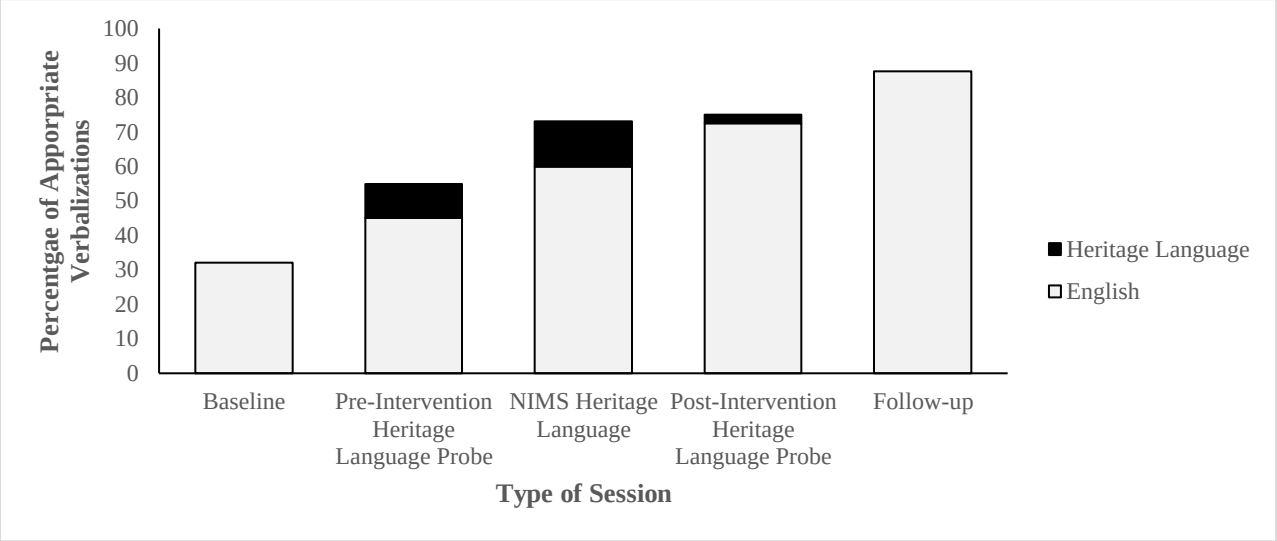


Sibling Dyad 4: Wesley and Audrey

Figure 5 depicts Wesley's differential language use throughout the study. During baseline, Wesley communicated exclusively in English. During the pre-intervention heritage language probe, his verbalizations in heritage language increased. Upon implementation of the NIMS procedure in Korean, appropriate verbalizations in heritage language increased compared to both baseline and the pre-intervention heritage language probe. Although Wesley's overall verbalizations increased during the post-intervention heritage language probes, he used less Korean during these sessions. Wesley did not verbalize in Korean during follow-up sessions when no language was specified.

Figure 5

Wesley's Differential Language Use



Mean Length of Utterance (MLU)

Lastly, all four autistic children demonstrated an increase in the overall MLU of their appropriate verbalizations during intervention and all children maintained increased MLU during follow-up. The smallest increase from baseline to follow-up was .43 morphemes, and the largest increase was 1.27 morphemes. Results from the paired samples t-test revealed a significant difference in MLU from pre-intervention (M = 1.83, SD = .72) to post-intervention (M = 2.77, SD = 1.09); t(3)= -5.23, p = .0136. See Table 7 for each child's MLU across baseline, intervention, and follow-up sessions and Figure 6 for each child's MLU from pre- to post-intervention.

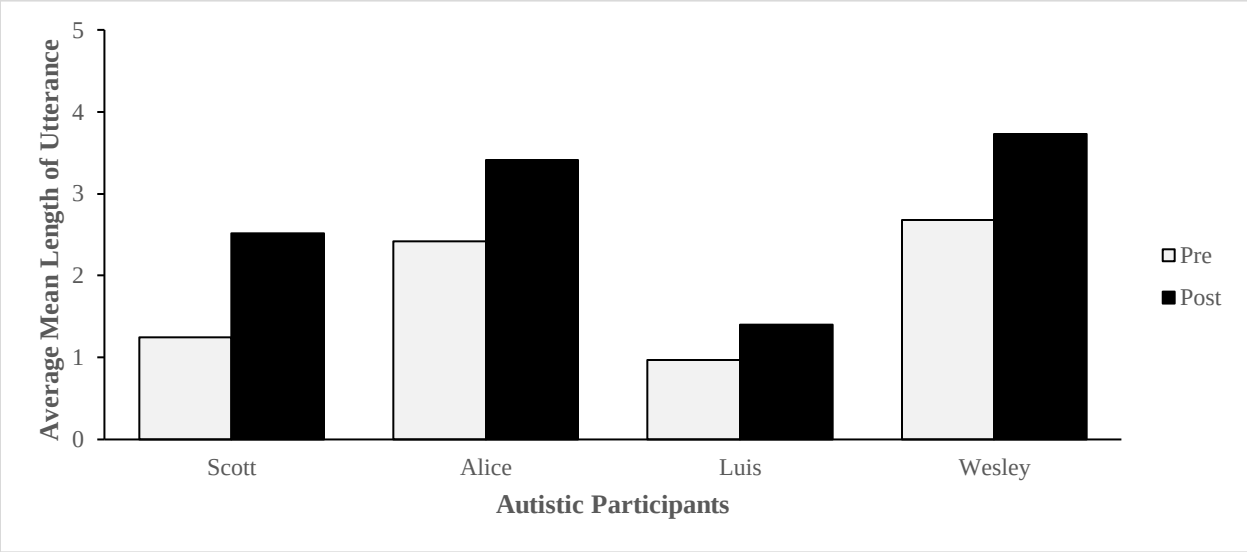
Table 7

Mean Length of Utterance (MLU) Across Sessions

Child	Baseline	Intervention	Follow-up
Scott	1.25	1.98	2.52
Alice	2.42	6.02	3.41
Luis	.97	1.34	1.40
Wesley	2.68	3.23	3.73

Figure 6

Mean Length of Utterance Pre/Post Comparison

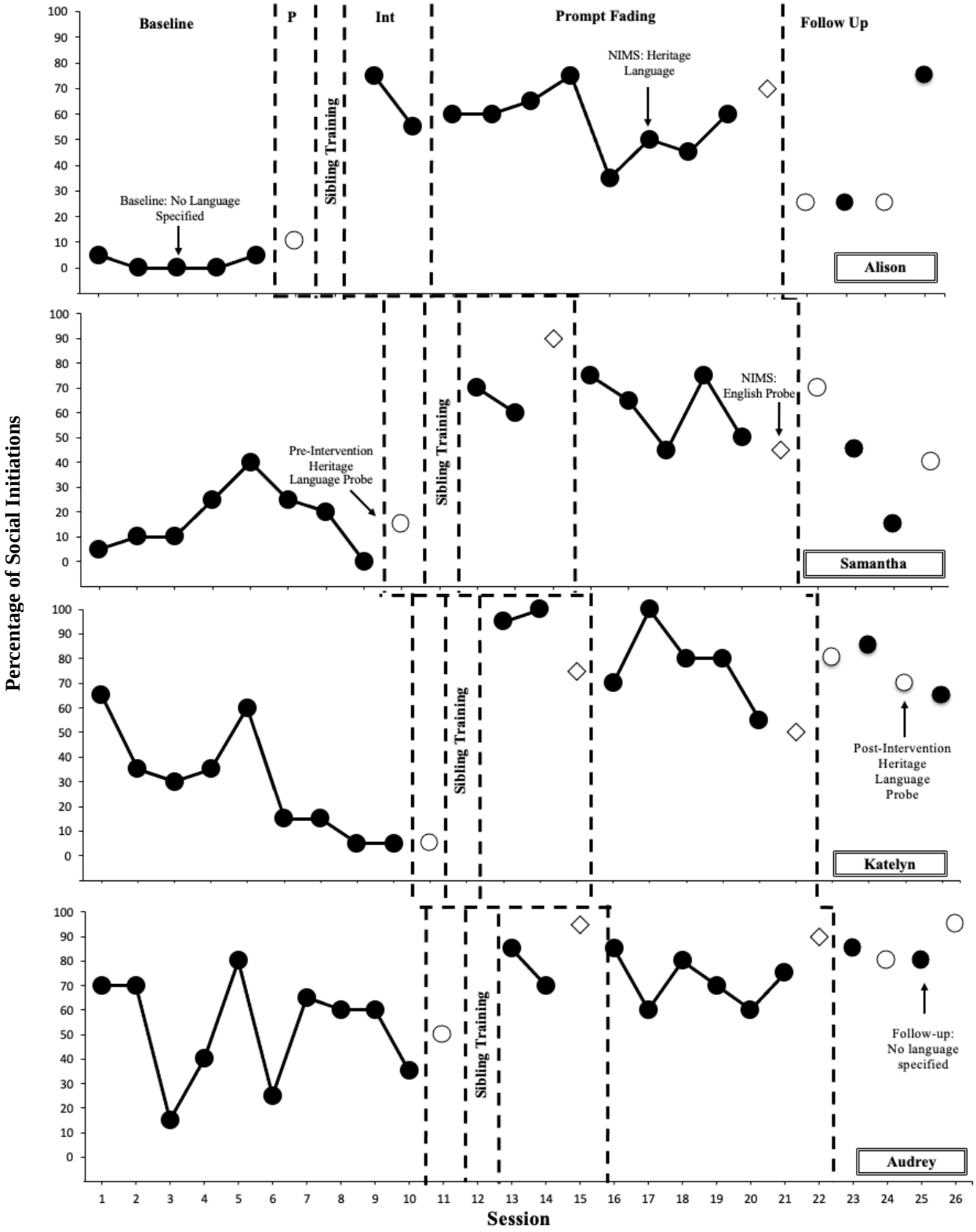


Social Initiations

All four of the neurotypical sisters mastered performance criterion (i.e., doubled their baseline average) and increased their social initiations following sibling training. Three of the sisters maintained their level of social initiations during follow-up sessions. Three of the siblings demonstrated an increase in social initiations from pre- to post-intervention heritage language probes. Figure 6 displays social initiations of neurotypical sisters across all phases of the study.

Figure 7

Percentage of Social Initiations Across Sessions



Note. Closed circles represent sessions when sibling dyads were instructed to play and talk together, but no language was specified. Open circles represent heritage language probes. Open diamonds represent NIMS English probes.

Sibling Dyad 1: Scott and Alison

In baseline, Alison's social initiations were very low in level (ranging from 0% to 5% across opportunities; see panel 1 Figure 7). Data indicated a zero trend. Alison's percentage of social initiations during the heritage language probe was also low. Following sibling training, Alison's percentage of social initiations immediately increased. Her percentage of social initiations remained higher than baseline (ranging from 35% to 75% across opportunities).

Due to her age and verbal abilities, Alison first met performance criterion with full verbal prompts provided by the bilingual therapist at intervention session 2. Verbal prompts were then faded using a time delay procedure and Alison independently reached performance criterion at session 10. Alison was the only neurotypical sister in the study who did not participate in the NIMS fading procedure due to the length of the intervention. Although Alison's social initiations did not maintain at intervention levels, they remained at a level higher than baseline during follow-up and post-intervention heritage language probes when no prompts were provided.

Sibling Dyad 2: Alice and Samantha

Samantha's baseline social initiations demonstrated an initial increasing with a decreasing trend toward the end of the phase (ranging from 5% to 40%). Her social initiations during the heritage language probe were also low. Following sibling training regarding the NIMS procedure in heritage language, her social initiations immediately increased, and she mastered learning criterion at intervention session 2. Following the prompt fading portion of the intervention, Samantha and her sister Alice met full intervention criteria at session 7. Her social

initiations across all intervention sessions ranged from 45% to 75%. Social initiations during English intervention probes remained higher than baseline. Samantha's level of social initiations maintained during the first follow-up session but not the second follow-up session. However, her social initiations during the post-intervention heritage language probes were greater than during the pre-intervention probe.

Sibling Dyad 3: Luis and Katelyn

Katelyn's social initiations during baseline showed variability (ranging from 5% to 65%) with a decreasing trend overall. Her social initiations during the pre-intervention heritage language probes were low. Following sibling training, Katelyn's social initiations increased to a high level and mastery was met at session 2. During the prompt fading portion of the intervention, social initiations remained at a high level. English NIMS probes were also higher than baseline levels. Katelyn's social initiations maintained over time during both follow-up sessions and post-intervention heritage language sessions.

Sibling Dyad 4: Wesley and Audrey

Audrey's social initiations during baseline showed variability (ranging from 15% to 70%) with a slight downward trend during her last baseline sessions. Her social initiations during the pre-intervention heritage language probe remained within this range. Following sibling training, Audrey's level of social initiations increased. Because Audrey's average percentage of social initiations during baseline was 52% and achieving double the average of baseline was not possible, her learning criterion during intervention was set to an average at least 20% higher than baseline. Audrey met learning criterion at session 2 with an average percentage of 77.5%. During the prompt fading portion of the study and during English NIMS probes, levels of social initiations remained high and indicated a zero trend across both types of sessions. During follow-

up as well as post-intervention heritage language probes, Audrey's social initiations maintained at a high level.

Interactive Play

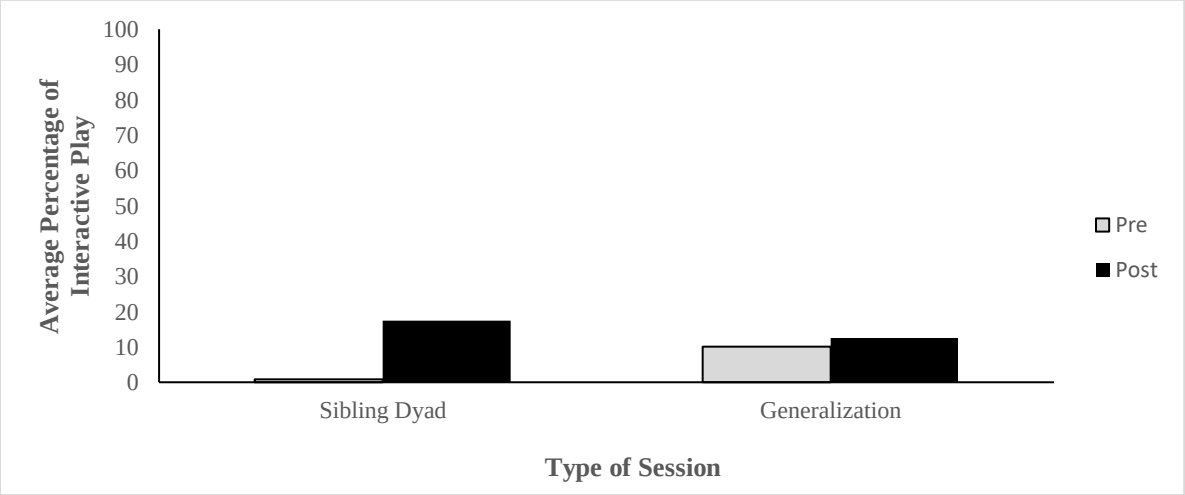
All four dyads achieved the performance criterion for interactive play during intervention. During sibling dyad sessions, four dyads demonstrated improvements in their average percentage of interactive play from pre- to post-intervention. Three of the autistic children also demonstrated generalization of interactive skills with a bilingual therapist during generalization probes. Figures 8 through 11 demonstrate average percentage of interactive play across pre-intervention and post-intervention sessions for each dyad.

Sibling Dyad 1: Scott and Alison

From pre- to post-intervention, Scott and Alison increased their average percentage of interactive play. Scott's interactive play skills during generalization sessions with the bilingual therapist only slightly increased.

Figure 8

Scott's Interactive Play Across Sibling and Generalization Sessions

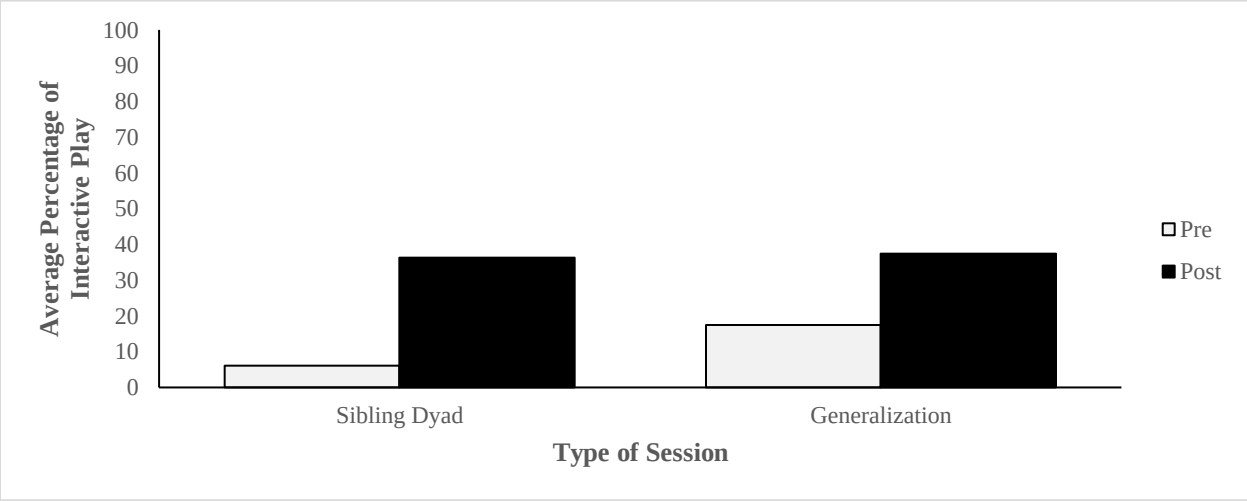


Sibling Dyad 2: Alice and Samantha

Alice and Samantha's average percentage of interactive play increased from pre-intervention to post-intervention. Alice's interactive play behaviors generalized across persons as gains were identified across English and Korean sessions with the bilingual therapist.

Figure 9

Alice's Interactive Play Across Sibling and Generalization Sessions

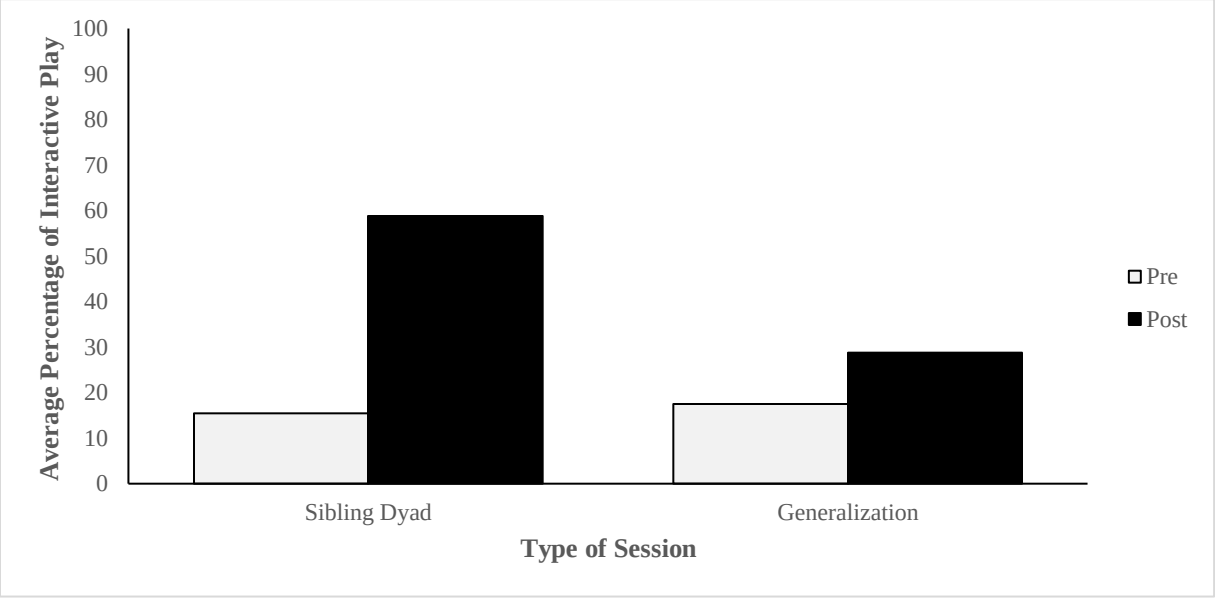


Sibling Dyad 3: Luis and Katelyn

Luis and Katelyn's average percentage of interactive play improved from pre- to post-intervention. Interactive play behaviors generalized across persons during generalization sessions.

Figure 10

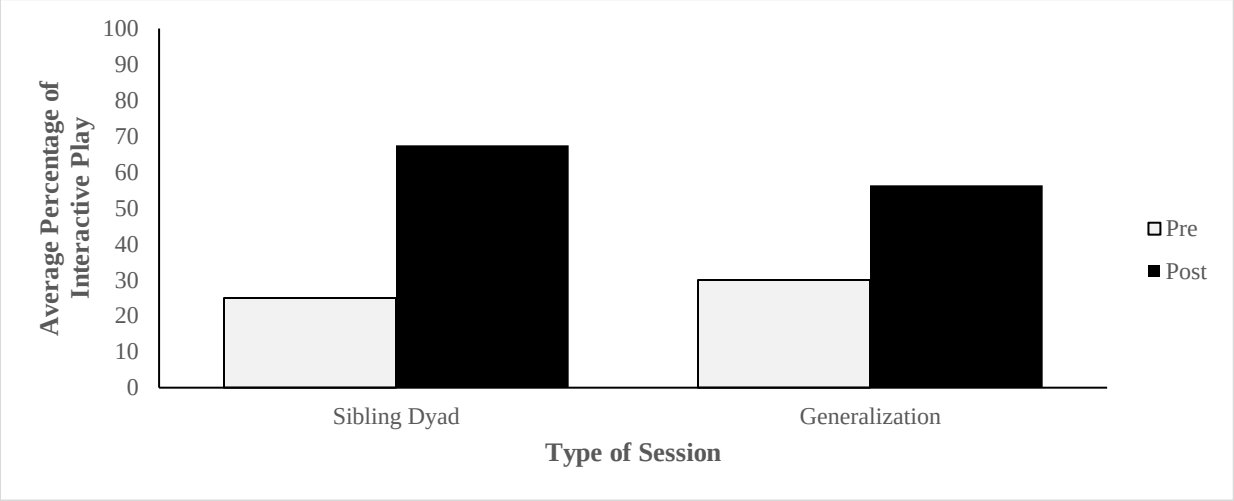
Luis' Interactive Play Across Sibling and Generalization Sessions



Sibling Dyad 4: Wesley and Audrey. Wesley and Audrey demonstrated gains in their average percentage of interactive play from pre-intervention to post-intervention. Wesley generalized interactive play behavior with the bilingual therapist across both language conditions.

Figure 11

Wesley's Interactive Play Across Sibling and Generalization Sessions



Ancillary Measures

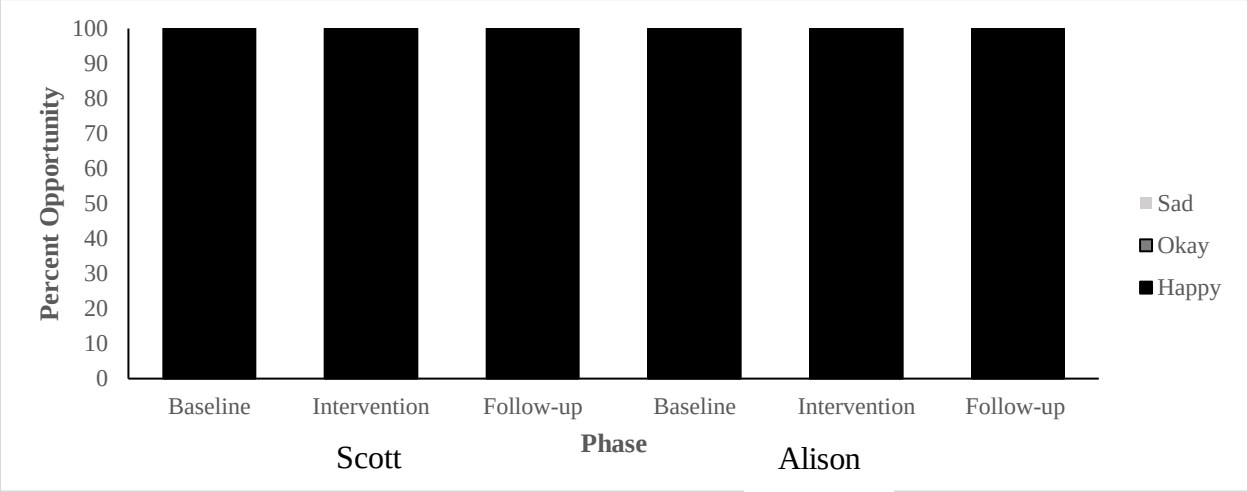
Happiness

Overall, all four sibling dyads reported happiness during the NIMS intervention and during follow-up. Three of the autistic children showed no change in happiness from baseline to intervention and follow-up. Three of the neurotypical sisters reported increased happiness from baseline to follow-up. Figures 11 through 14 display happiness ratings across all sibling dyads.

Sibling Dyad 1: Scott and Alison. Across all happiness probes during baseline, intervention, and follow-up phases of the study, both Scott and Alison reported themselves as "happy."

Figure 12

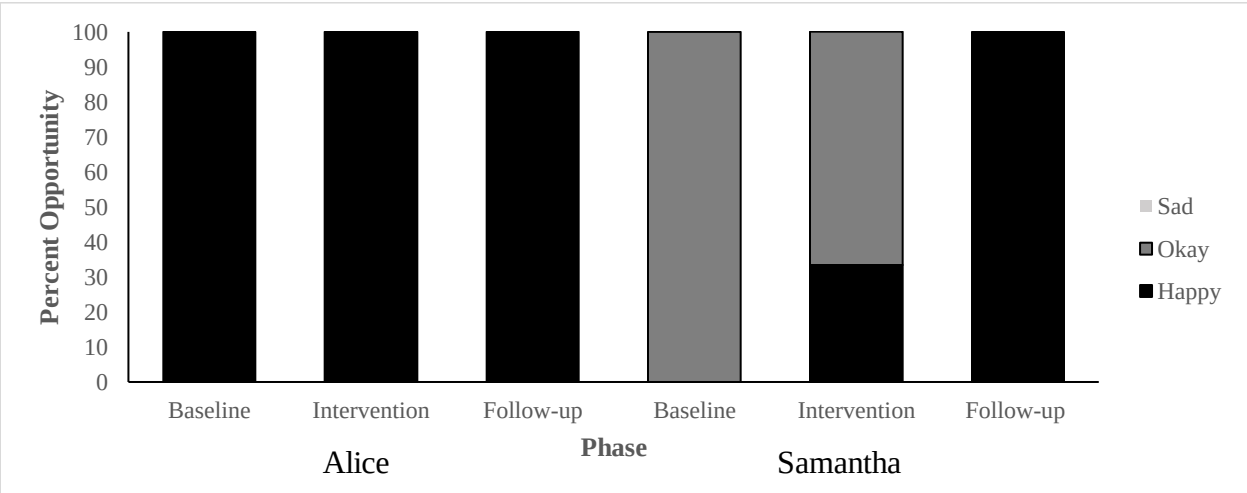
Scott and Alison's Self-Reported Happiness



Sibling Dyad 2: Alice and Samantha. Alice reported herself as "happy" across all baseline, intervention, and follow-up happiness probes. Samantha identified herself as "okay" during baseline. During intervention, Samantha reported herself as "okay" during two probes and "happy" during one probe. At follow-up, Samantha identified herself as "happy."

Figure 13

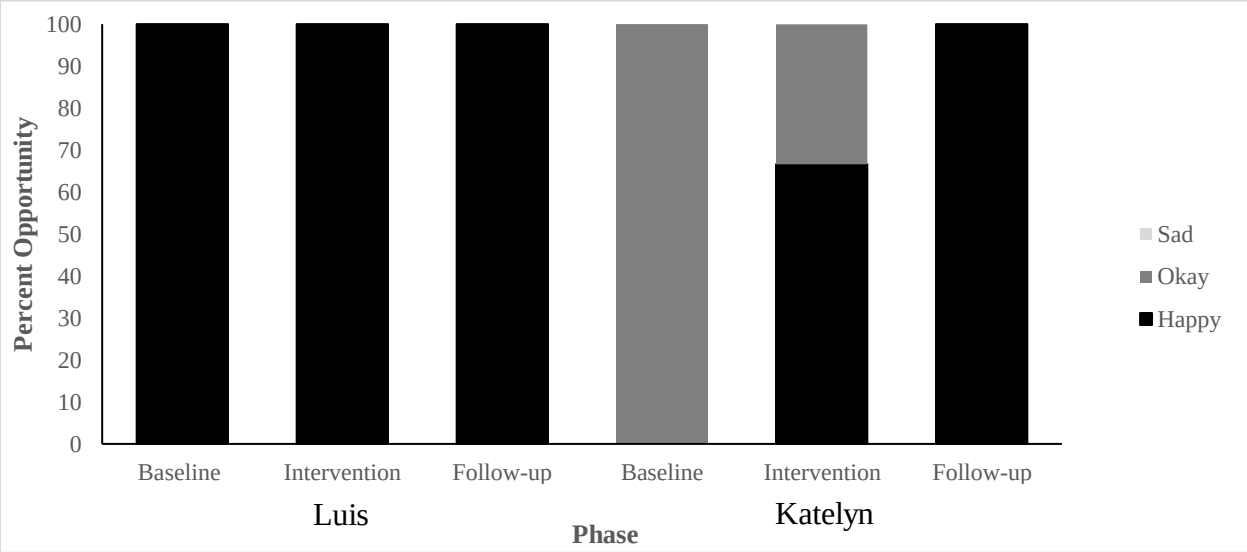
Alice and Samantha's Self-Reported Happiness



Sibling Dyad 3: Luis and Katelyn. Across all baseline, intervention, and follow-up happiness probes, Luis reported himself as "happy." During baseline, Katelyn selected the "okay" face on the happiness scale. During intervention, Katelyn reported herself as "okay" once and "happy" twice. During follow-up probes, Katelyn's reported happiness increased.

Figure 14

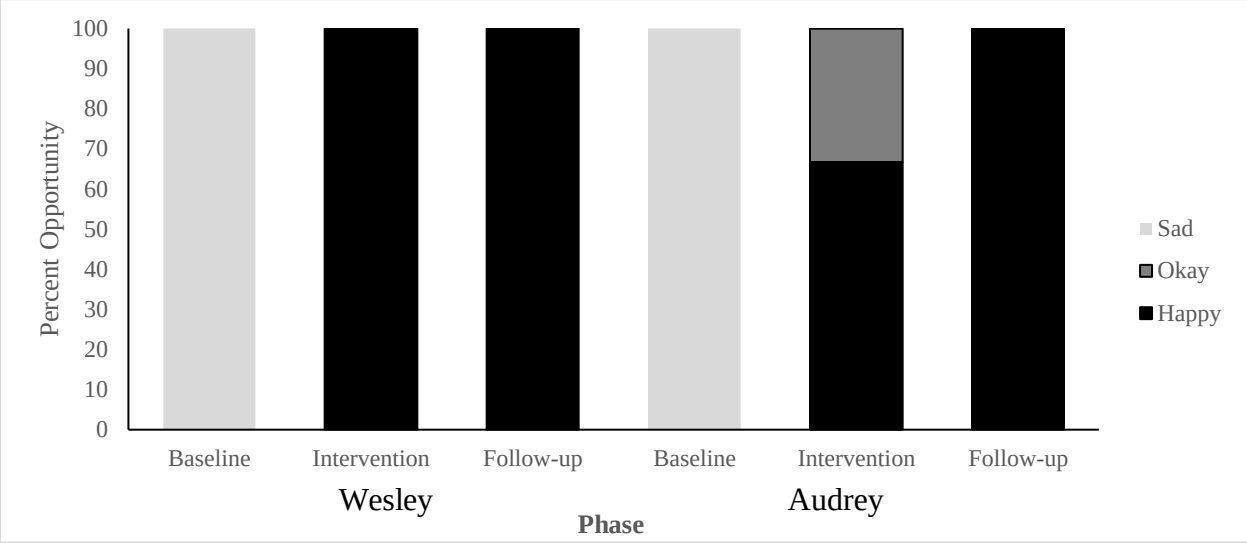
Luis and Katelyn's Self-Reported Happiness



Sibling Dyad 4: Wesley and Audrey. During baseline, Wesley reported himself as "sad." Wesley's happiness increased during intervention and follow-up probes. Audrey also reported herself as "sad" during baseline. During intervention she identified herself as "okay" once and "happy" twice. She reported herself as "happy" at follow-up.

Figure 15

Wesley and Audrey's Self-Reported Happiness



Sibling Relationship

Overall, the Sibling Relationship Questionnaire probes revealed that two of the four sibling dyads improved their relationship per report of the neurotypical sisters. The autistic children's challenging behavior and attempts to talk to their neurotypical sister improved for both dyads. Fun also improved for one sibling dyad. One neurotypical sister improved her self-reported attempts to talk to her brother. Three of the four neurotypical sisters reported that they helped their autistic brother/sister and had fun playing with them "a lot."

Sibling Dyad 1: Scott and Alison. Regarding questions related to Scott's behavior in the relationship, Alison's responses over the course of the study indicated an improvement in three areas. First, she indicated that Scott's hitting, grabbing, and hurting behaviors improved from occurring "a little" during baseline to " not at all" during intervention and follow-up. Additionally, Scott's yelling improved from "a little" during baseline and intervention to "not at all" during follow-up. Lastly, Alison reported an improvement in Scott's attempts to talk to her, changing from "a little" during baseline to "a lot" during intervention and follow-up. Throughout

baseline, intervention, and follow-up , Alison consistently reported that Scott had "a lot" of fun playing with her. No improvements were observed regarding Alison's perception of Scott's helping behaviors.

Regarding Alison's behavior in the relationship, an improvement was reported for one area of the sibling relationship. Her attempts to talk to Scott increased from "a little" during baseline to "a lot" during intervention and follow-up. Throughout baseline, intervention, and follow-up questionnaires, Alison consistently reported "not at all" regarding hitting, grabbing, pushing, or hurting Scott as well as yelling or saying mean things to him. Throughout all probes, she also reported that she helps him and has fun playing with him "a lot."

Sibling Dyad 2: Alice and Samantha. No improvements were reported from baseline to intervention or follow-up for Alice and Samantha's sibling relationship. Throughout the study, Samantha consistently reported that Alice hit, grabbed, pushed, or hurt her as well as yelled or said mean things to her "a lot." She also indicated throughout the study that Alice helped and had fun with Samantha "a little." She reported that Alice did not attempt to talk to her. Regarding her own behavior in the relationship, Samantha reported that she hit, grabbed, pushed, hurt, yelled, and said mean things to Alice "a little." She reported "a little" in response to her own helping behaviors and how much fun she had with Alice. Samantha indicated throughout the study that she did not attempt to talk to her sister.

Sibling Dyad 3: Luis and Katelyn. No improvements were reported for Luis and Katelyn throughout the study. Regarding Luis' behavior, Katelyn consistently reported that he never hit, grabbed, pushed, hurt, yelled, or said mean things to her. She also consistently reported that he helped her "a little." Katelyn repeatedly indicated that Luis tried to talk to her and had fun with her "a lot." Regarding her own behavior in the relationship, Katelyn consistently reported

that she never hit, grabbed, pushed, hurt, yelled at, or said mean things to Luis. She repeatedly indicated helping him, having fun with him, and trying to talk to him "a lot."

Sibling Dyad 4: Wesley and Audrey. Regarding questions related to Wesley's behavior in the relationship, improvements were identified in 3 areas. First, Audrey indicated that Wesley's hitting, grabbing, pushing, and hurting behavior improved from "a lot" during baseline to "a little" during intervention and follow-up. Additionally, when asked how much fun Wesley had with her, an improvement was noted from "not at all" during baseline to "a lot" during intervention and follow-up. An improvement was also noted for Wesley's attempts to talk to Audrey, which improved from "a little" during baseline to "a lot" during intervention and follow-up. No other changes were noted for Wesley's behavior in the relationship. However, Audrey consistently reported that Wesley yelled and said mean things to her "a little" as well as helped her "a lot."

Furthermore, regarding her own behavior in the relationship, Audrey reported an improvement in one area. During baseline, Audrey indicated "not at all" when asked how much fun she had with her brother. This improved during intervention and sustained during follow-up as she reported she had "a lot" of fun with her brother. No other changes were observed over the course of the study. However, Audrey consistently reported that she hit, grabbed, pushed, hurt, yelled at, or said mean things to Wesley "a little." She also repeatedly indicated that she helped and tried to talk to Wesley "a lot."

Social Validity

Neurotypical Sisters

All four neurotypical sisters rated the intervention as socially valid. Three of the sisters reported a "5" when asked how much they learned from the intervention. Two sisters reported a "4" and two sisters reported a "5" when asked how much they think other children would enjoy the intervention. Two of the sisters reported a "4" when asked how much fun they had during the intervention and three of the sisters reported a "5" when asked how much fun they think their sibling had during the intervention.

Table 8

Neurotypical Sister Social Validity Ratings

Question	Alison	Samantha	Katelyn	Audrey
1. How much did you learn about how to talk and play with your brother/sister in Korean, Mandarin, or Spanish?	5	3	5	5
2. How much do you think other brothers/sisters would like to learn how to talk and play with their siblings in Korean, Mandarin, or Spanish?	5	4	4	5
3. How much fun did you have talking and playing with your brother/sister in Korean, Mandarin, or Spanish?	4	3	4	5
4. How much fun do you think your brother/sister had talking and playing with you in Korean, Mandarin, or Spanish?	5	3	5	5

Note. Social validity questions were ranked on a Likert scale from 1 to 5, where 1 was the lowest possible rating and 5 was the highest possible rating.

Caregivers

All caregivers reported the elements of the intervention as having high social validity. Two caregivers responded "very much" in response to how important it is for their children to learn to communicate and play with one another in their heritage language. Three caregivers

responded “extremely much” in response to the extent to which their children benefit from their neurotypical child being involved in the intervention of their autistic child. Two of the caregivers responded, “extremely much” and the other two responded “very much” in response to how much their autistic child benefits from receiving intervention in their heritage language.

Table 9

Caregiver Social Validity Ratings

Question	Scott and Alison’s Parents	Alice and Samantha’s Mother	Luis and Katelyn’s Father	Wesley and Audrey’s Mother
1. How important is it for your children to learn to communicate and play with one another in their heritage language (i.e., Mandarin, Korean, Spanish)?	Very Much	A little	Extremely Much	Very Much
2. How much do you think your children benefit from your neurotypical child being involved in the intervention/therapy of your autistic child?	Extremely Much	Very Much	Extremely Much	Extremely Much
3. How much do you think your autistic child benefits from receiving intervention/therapy in their heritage language?	Very Much	Very Much	Extremely Much	Extremely Much

Note. Social validity questions were ranked on a scale from “Not at all” to “Extremely Much.”

Heritage Language Perspectives Questionnaire

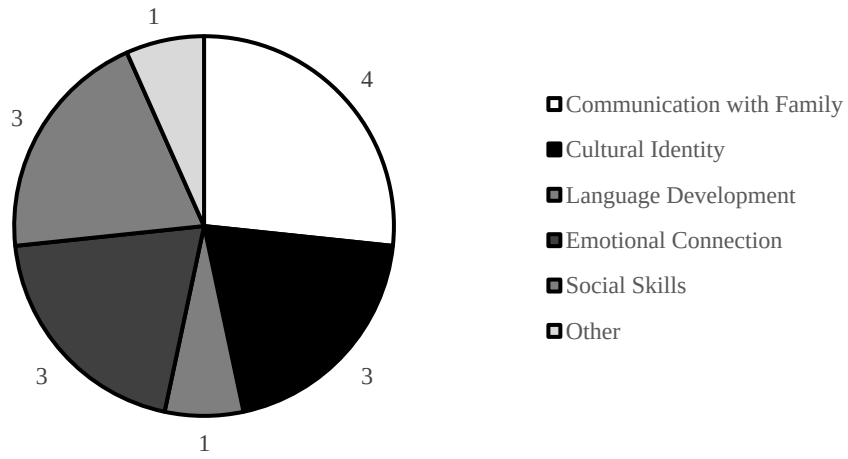
One caregiver for each dyad completed the Heritage Language Perspectives Questionnaire prior to intervention. Two of the caregivers reported feeling hesitant about exposing their autistic child to their heritage language and two of the caregivers reported that they did not feel hesitant about their decision. None of the caregivers reported that a doctor, psychologist, educator, or therapist advised against heritage language exposure for their autistic child. However, Scott and Alison’s father reported that when the family lived in China, a

psychologist advised the family to avoid speaking English to Scott because Mandarin was his first language.

Regarding reasons for exposing autistic children to their heritage language, all four caregivers reported that they chose to do so to improve communication with family members. Three of the caregivers also selected "help establish cultural identity", "improve emotional connection," and "practice social skills with people in the community." One caregiver also selected "facilitate language development." Scott's father selected the option "other" and noted that he chose to expose his children to Mandarin to "encourage them to be proud of who they are."

Figure 16

Caregiver Responses to Heritage Language Perspectives Questionnaire



Note. Four caregivers completed the questionnaire but were given the option to circle more than one answer.

CHAPTER 5

Discussion

Little research has addressed the incorporation of heritage language into the treatment of BE autistic children. Additionally, prior to this study, researchers had not investigated the effects of sibling delivery of treatment in heritage language. The purpose of the present study was to test a new procedure, a Naturalistic Intervention Mediated by Siblings, which was delivered in heritage language with four BE sibling dyads. The results suggested that neurotypical siblings were highly effective change agents and quickly learned to deliver the procedure after only one training session. In turn, these siblings effectively delivered the procedure throughout intervention with the autistic participants as evidenced by training checklist probes. None of the neurotypical sisters required booster sessions to enhance their performance, suggesting that skills taught during training remained salient over time. Upon implementation of the NIMS procedure, all four neurotypical sisters fostered the overall language of autistic children as evidenced by greater appropriate verbalizations across intervals, increased heritage language use, and improvements in MLU from pre- to post-intervention.

Generalization was mixed as all four children generalized their appropriate verbalizations across persons during the heritage language condition and two generalized during the English language condition. One child maintained their verbalizations during follow-up probes when no language was specified. Three of the autistic children demonstrated improvements in appropriate verbalizations from the pre-intervention heritage language probe to the post-intervention heritage language probes.

All four neurotypical sisters effectively improved their percentage of social initiations during intervention. Three of the sisters maintained their level of social initiations during follow-

up sessions where no language was specified and demonstrated increased social initiations from pre- to post-intervention heritage language probes. All four sibling dyads also demonstrated gains in interactive play.

Lastly, ancillary measures revealed that happiness was reported by all participants in the study during intervention, with increased happiness reported by one autistic child and three neurotypical sisters from baseline to follow-up. Improvements in sibling relationship quality were reported for two of the dyads. All neurotypical sisters and caregivers reported the study as socially valid.

Appropriate Verbalizations

Overall, NIMS in heritage language was an effective approach for fostering verbal behavior of the autistic children in this study. Considering that speech and language deficits are one of the hallmark features of ASD (American Psychological Association, 2013), this study extends upon the literature as it highlights the importance of SMIs when teaching language to autistic children. Although few SMIs have involved training neurotypical siblings to facilitate language of autistic children (Akers et al., 2018; Coe et al., 1991; Spector & Charlop, 2018), the current study presents promising results for this continuing this practice with children across the spectrum. Toward this end, because two of the autistic participants in the study were identified as severely autistic, the present study indicates that SMIs targeting heritage language may be effective even for autistic children with greater symptom severity. Furthermore, the present study is the first to address the needs of BE sibling dyads by training neurotypical siblings to deliver a heritage language intervention to target language skills of autistic children. This contribution may be especially meaningful when considering the previous lack of CALD representation in

SMI research alongside growing evidence in favor of heritage language interventions for BE autistic children.

During baseline, all four of the autistic children demonstrated low to moderate levels of appropriate speech and low MLU. This may be associated with how impacted the children were by their ASD. All four of the autistic children demonstrated low expressive language on the VABS-3 (Sparrow et al., 2016) as well as scored within the moderate to severe range on the CARS-2 (Schopler et al., 2010) prior to their inclusion in the study. The present study was conducted to address the speech and language deficits that autistic children face. Thus, it was predicted that lower levels of overall verbalizations would be observed during baseline sessions.

During intervention, all four autistic children demonstrated increases in their appropriate verbalizations, heritage language use, and MLU. All children met performance criterion, doubling their baseline average, within at least 3 intervention sessions. These findings support previous studies which assert that bilingual exposure is not detrimental for language outcomes for autistic children (Beauchamp et al., 2020; Dai et al., 2018; Hambly & Fombonne, 2011; Ohashi et al., 2012; Peterson et al., 2012; Valicenti-McDermott et al., 2013; Zhou et al., 2019). The present study demonstrates that heritage language may be advantageous when capitalized upon during intervention, even for moderately and severely autistic children. This study extends upon the existing literature base in that it is first to examine heritage language as a foundation for teaching neurotypical siblings to facilitate language skills in autistic children. Even a small quantity of sessions delivered by siblings in heritage language was effective enough to produce socially significant language gains for the autistic children. These gains were robust in that they were identified across percentage of overall language, increased use of heritage language, and

length of utterances overall, suggesting that the intervention may have cultivated opportunities to increase frequency, variety, and complexity of speech.

The success of the NIMS procedure in facilitating language use of autistic children may have been related to the improvement that was observed in percentage of social initiations of the neurotypical sisters (discussed later in this chapter). The increased social initiations of neurotypical sisters may have been associated with increased opportunities for interaction which were not present at baseline. Because prompts were provided to neurotypical sisters to increase the variety of their speech, they likely modeled more complex verbalizations for the autistic children. With these prompts, the neurotypical sisters were encouraged to ask questions, which ultimately created more opportunities for autistic children to verbalize in response. This hypothesis is consistent with previous research which has demonstrated an association between caregiver language input and language production of autistic children (Fusaroli et al., 2019).

The MLU improvement of all the autistic children may have been partially influenced by the languages spoken in baseline versus intervention. During baseline, all the autistic children verbalized only in English and during intervention, heritage language use increased for three of the four children. English verbalizations can differ in length compared to Mandarin, Korean, and Spanish utterances, which may have impacted overall MLU. Thus, MLU may have been potentially inflated or deflated by the word and sentence structure associated with the language each autistic child verbalized more in (Bedore, 2001; Gutiérrez-Clellen et al., 2000). Nonetheless, increased MLU was identified for all of the autistic participants regardless of which language was more prominent during intervention.

Although maintenance and generalization of skills were identified at follow-up, evidence was mixed among sibling dyads. Maintenance of appropriate verbalizations during follow-up

(where no language was specified) was only found for Wesley. However, three children maintained their appropriate verbalizations during post-intervention heritage language probes. A similar pattern was identified for generalization where all four children generalized their verbalizations with the bilingual therapist during heritage language probes, but only two of the children generalized across English probes. However, limited generalization may not be entirely problematic considering that the purpose of this study was to train neurotypical siblings to be change agents for autistic children and that generalization partners were adult therapists. Future studies may consider conducting generalization sessions with same-age neurotypical peers, which may help produce more socially significant results. Furthermore, the results from the follow-up phase of this study should be interpreted with caution as it is difficult to determine true maintenance and generalization of skills over time within one week of intervention. Further probing may be necessary at later points in time (i.e., 1 months or 6 months) to determine if sustained effects are evident.

The lack of maintenance and generalization in the study may be related to several factors. First, it is well documented that autistic children exhibit restricted patterns of learning which often result in challenges with generalization (Brown & Bebko, 2012; de Marchena et al., 2016; Rimland, 1964; Rincover & Koegel, 1975). That is, the autistic children in this study may have had difficulty transferring the skills they learned in heritage language to English situations with an individual that was not associated with learning during intervention. Another explanation is that autistic children may have become conditioned to verbalize in their heritage language when delivered with the SD to "play and talk" with either their sibling or the bilingual therapist in their heritage language. Moreover, previous researchers have found that autistic children may prefer instruction in their heritage language (Aguilar et al., 2017), which may explain their tendency to

verbalize more during heritage language specific probes and generalization probes. Thus, when these children were provided with a specific indication that the session would be delivered in heritage language, this may have resulted in greater verbalizations overall.

Potential Explanations for Limited Heritage Language Use

Although during intervention, heritage language verbalizations exceeded those in English for 3 of the 4 autistic children, all children continued to demonstrate English verbalizations. During this phase, social initiations from the neurotypical sisters were delivered exclusively in heritage language. However, many of the autistic children verbalized in both heritage language and English within any given session. This finding suggests that the autistic children may have engaged in a phenomenon called code-switching (Ponce-Lawler, 2017). Code-switching occurs when a BE child switches back and forth between communicating in two languages within a conversation (Ponce-Lawler, 2017). Previous research has primarily explored this phenomenon in neurotypical children while research on autistic children remains limited (Ponce-Lawler, 2017).

However, in the present study, code-switching may indicate that the autistic children receptively understood the social initiations delivered by their sisters but switched between responding in heritage language or English. It is possible that in doing so, the autistic children were attempting to maximize their linguistic resources (Ponce-Lawler, 2017). For autistic children who face pre-existing social challenges, any attempts at communication may be reinforced by parents, siblings, and extended family members regardless of the language used. Because many of their family members are bilingual themselves, autistic children may not be corrected when they code-switch at home. Thus, in these situations, autistic children may be

demonstrating their receptive understanding of heritage language and linguistic mastery of both languages.

Additionally, sociocultural theory may aid in explaining why the autistic children in this study demonstrated limited heritage language use. Vygotsky posited that children who learn two languages develop and internalize distinct systems that encompass the rules, meanings, and structures associated with each language. Development of these systems involves less conscious awareness in children exposed to two languages from infancy compared to children exposed later in childhood (Mahn & Fazalehaq, 2020). For the autistic children in this study, it is unclear at what age each of the sibling dyads in the study were first exposed to their heritage language. However, the autistic children exposed later in childhood may not have received substantial social opportunities to cultivate heritage language skills on par with English. This challenge may have been exacerbated by the deficits in language and social skills that autistic children experience. Thus, the autistic children in this study may have more highly developed English language systems compared to heritage language systems.

This hypothesis may also be explained from a behavioral perspective, where English language may have a strong reinforcement history that persists even when intervention is delivered in another language. The setting in which the study was conducted may have been specifically associated with English instruction and demands. Aside from the present study, no other past intervention or services at the intervention center were delivered to these children in heritage language. Additionally, within this setting sibling dyads were previously reinforced for communicating with each other in English and most of their heritage language communication occurred in the home environment. Home heritage language exposure may have exacerbated these differences for Wesley, who was the only autistic child who demonstrated more English

verbalizations than heritage language verbalizations during intervention. During the Home Heritage Language Questionnaire, Wesley's mom reported that he "rarely" spoke to his caregivers or to his sister in Korean at home. This may explain why his verbalizations in English over-shadowed those in his heritage language. Therefore, home exposure, combined with the intervention setting and researchers involved the study, may have resulted in a strong reinforcement history of English language use.

Furthermore, during follow-up sessions when no language was specified, English verbalizations were higher than heritage language for three of the children and during heritage language probes only two of the dyads continued to verbalize more in heritage language. These findings may be related to the instruction provided during follow-up sessions, which did not specify a language condition. Additionally, during post-intervention heritage language probes, only one directive was provided for the dyad to talk and play in heritage language. The sibling dyad was otherwise free to communicate with one another in the language they chose without outside prompting from the researchers.

These instructions may explain why Wesley's use of Korean did not maintain over time. During both follow-up and post-intervention heritage language probes, Wesley's sister Audrey socially initiated only English. During the Home Heritage Language Use Questionnaire, their mother reported that the dyad "rarely" communicated in Korean prior to the study. Anecdotally, Audrey was observed commenting that "sometimes it's hard" to communicate in Korean. This may lend insight into both Audrey's lack of Korean initiation and Wesley's lack of Korean verbalization during follow-up and heritage language probes. It appears that when minimal instructions were placed, Audrey relied on the language the dyad used most often. It is possible that some neurotypical siblings may feel apprehensive regarding their heritage language abilities

as they are still in the process of developing language themselves. They may also display preferences for which language they feel most comfortable communicating in, leading them to rely on the language with which they feel more confident.

Sibling Training

The neurotypical sisters in the study were able to learn the NIMS procedure and implement the intervention with fidelity in their heritage language during play with their autistic siblings. All neurotypical sisters mastered training within one 30-minute session and none of the sisters required booster sessions. These findings reaffirm that with effective training, neurotypical siblings can quickly learn complex intervention procedures (Akers et al., 2018; Ferraioli & Harris, 2011; Spector & Charlop, 2018). These findings also add to the current body of literature which suggests that the speed of sibling training does not necessarily compromise fidelity of implementation (Akers et al., 2018; Ferraioli & Harris, 2011; Glugatch & Machalicek, 2021; Kryzak & Jones, 2017; Schreibman et al., 1983; Spector & Charlop, 2018; Tsao & Odom, 2006).

Sibling training may have been effective due to the combination of teaching strategies that were applied. Instructions, examples, modeling, rehearsal, and in-vivo feedback were all incorporated when training the neurotypical sisters to implement the NIMS procedure. Previous sibling-mediated interventions have also incorporated these strategies when teaching neurotypical siblings to implement intervention for autistic children (Akers et al., 2018; Allclair, 2020; Coe et al., 1991; Ferraioli & Harris, 2011; Kryzak & Jones, 2017; Oppenheim-Leaf et al., 2012; Spector & Charlop, 2018; Sullivan, 1999; Tsao & Odom, 2012; Walton & Ingersoll, 2012). In the present study, skills were introduced to the neurotypical sisters through short lessons, which allowed the bilingual trainer to scaffold skills over time until full mastery was

achieved. Neurotypical siblings may have benefitted from receiving clear instructions and observing the behaviors of a trained, bilingual therapist. Role-play and in-vivo feedback may have allowed neurotypical siblings to practice their social initiations in heritage language with quick error correction so that areas for growth could be addressed to ensure that procedures would be implemented with accuracy when applied to the autistic children. Furthermore, all strategies were introduced using a combination of English and heritage language. This may have enhanced skill acquisition because the sisters were able to receive training in a language which they may feel more comfortable with. Thus, the training approach endorsed by this study may have allowed neurotypical sisters to adopt the NIMS procedure with ease and effectively implement it over time.

Additional supports were included to accommodate the developmental needs of the younger, less verbal neurotypical sister Alison. Individualized training practices have been reported in other SMIs with participants aged 5 and under (Akers et al., 2018; Tsao & Odom, 2006). Alison was eventually able implement the NIMS procedure without verbal prompting using a time delay procedure. Therefore, although the age of this neurotypical sibling required special considerations, this did not prevent her from learning to implement the NIMS procedure.

The training and intervention setting in which the study was conducted may also explain the success of sibling training. In the study, both training and intervention were implemented in the same setting. This aligns with previous research as other sibling-mediated interventions have also conducted training and intervention within the same environment (Akers et al., 2018; Celiberti & Harris, 1993; Coe et al., 1991; Ferraioli & Harris, 2011; Glugatch & Machalicek, 2021; Kryzak & Jones, 2017; Oppenheim et al., 2012; Spector & Charlop, 2018; Sullivan, 1999; Tsao & Odom, 2006; Walton & Ingersoll, 2012). Prior to the study, all neurotypical sisters

engaged in weekly participation alongside their autistic sibling at the clinical setting in which the training and intervention took place. Thus, they had previous exposure to both the setting and bilingual therapist that facilitated their training. Conducting training within this setting may have aided the neurotypical sister in their ability and willingness to learn NIMS procedure as they were familiar with the demands of the environment and the individual conducting their training.

Social Initiations

During baseline, all four of the neurotypical sisters demonstrated low to moderate levels of social initiation, with greater variability demonstrated by Audrey. Although no language was specified during this phase, all verbal social initiations that did transpire during baseline were delivered in English. As stated in the previous section, the intervention setting and reinforcement history of English at the intervention center likely played a role in the dominance of English language use during sibling social initiations at baseline.

During intervention, all four of the neurotypical sisters mastered performance criterion by doubling their baseline average of social initiations within at least two sessions. All social initiations delivered by siblings were delivered exclusively in each dyad's heritage language. Once the prompt fading phase of the intervention was introduced, the sisters continued to exhibit a level of social initiations higher than baseline across all intervention sessions. Improvements in social initiations in this study replicate the findings of Tsao and Odom (2006) and Glugatch and Machalicek's (2021) SMIs.

Teaching the neurotypical sisters in the study to socially initiate in their heritage language may have capitalized on their unique strengths as outlined by the literature. Researchers have proposed that neurotypical siblings of autistic children are more inclined to exhibit prosocial behaviors (Orm et al., 2021; Rum et al., 2021; Walton & Ingersoll, 2015). The requirement for

the sisters to initiate in their heritage language may have further enhanced these behaviors. Findings from the Sibling Relationship Questionnaire may help illustrate why social initiations improved within such a short span of time. Throughout all phases of the study, most of the sisters reported frequently helping the autistic children. Considering that autistic children often require substantial support across all areas of development, it is likely that these sisters had a history of engaging in helping behaviors for the autistic children. Thus, when taught to socially initiate during play, these sisters may have been intrinsically motivated to demonstrate such behaviors. Furthermore, heritage language may have been particularly associated with communication with family members, creating a natural pathway for the sisters to facilitate social interactions with their autistic siblings.

Maintenance was evident for three of the sisters as social initiations sustained during follow-up sessions when no language was specified and three of the siblings demonstrated increased social initiations from pre- to post-intervention heritage language probes. During the follow-up sessions, three sisters continued to initiate in heritage language though no language was specified. However, as stated earlier in this chapter, Audrey verbalized only in English during these sessions. It was hypothesized that her lack of heritage language use was likely related to individual preferences and language history prior to the study.

Furthermore, during the post-intervention heritage language probes, three of the sisters socially initiated in heritage language. Their social initiation in heritage language during these language-specific sessions demonstrated that the sisters likely became conditioned to demonstrate the specific skills learned during intervention upon the delivery of an instruction to talk and play in their heritage language. The systematic fading procedure may have also enabled the sisters to progressively become more independent in their initiations over the course of the

study, leading to sustained behaviors post-intervention. Three of the sisters were fully faded from the intervention, which meant that they were required to demonstrate a high level of social initiations without prompts prior to meeting full intervention criterion. Because they had practiced under these conditions at the end of intervention, the sisters were more likely to repeat these behaviors post-intervention.

As stated in Chapter 1 of this paper, Vygotsky emphasized the importance of individualizing learning opportunities. For example, the visual prompts used in the study were accompanied by written prompts that were provided exclusively in the heritage language of the sibling dyad. Additionally, learning criterions for social initiations were set to double the baseline average of the individual, which resulted in varied learning criterions for the sisters. This allowed for an appropriate balance between the existing skills of the neurotypical sister and opportunity for growth through challenge (Miller, 2016). Once learning criterion was achieved, the visual and auditory prompts were faded with consideration of each neurotypical sister's individual level of social initiation. Furthermore, an additional layer of scaffolding was provided to Alison through the inclusion of verbal prompts which were faded over time. The decision to implement and fade these verbal prompts was made to address Alison's unique developmental needs. These supports were provided and then systematically removed for all the neurotypical sisters until they were able to independently initiate with the autistic children in heritage language.

Interactive Play

During baseline, interactive play between sibling dyads was low and inconsistent across sessions. Although the children demonstrated play behaviors individually during this phase, most play was observed as parallel rather than interactive. Prior to this study, the neurotypical sisters

did not receive any formal training regarding how to initiate and facilitate play interactions with autistic children. Additionally, the autistic children themselves faced existing challenges with social communication and interaction which made them less likely to initiate interactive play.

However, following sibling training, all four dyads achieved the performance criterion for interactive play by doubling their baseline average during intervention. This finding was consistent with other SMIs which were found to improve play between sibling dyads (Glugatch & Machalicek, 2021; Oppenheim-Leaf et al., 2012). Once the neurotypical sisters implemented the NIMS procedure in heritage language, social initiations increased. Their social initiations often involved play with toys or stimuli preferred by the autistic child. The autistic children were then subsequently more likely to reciprocate play with their sisters. As interactive play increased, enjoyment and happiness likely also increased, which in turn, increased the likelihood of future engagement in interactive play. Therefore, as the intervention was implemented over time, it is possible that neurotypical sisters initiated a cycle of reciprocal interaction which continuously reinforced interactive play between the dyad.

The NIMS procedure in heritage language may have also been effective at facilitating play because it was based on the principles outlined by NDBIs (Schreibman et al., 2015). Play, which has been regarded by developmental theorists as "the work of childhood," (Miller, 2016) is a child-centered activity which allows children to freely select the stimuli with which they learn. The neurotypical sisters in the present study were trained to follow the interests of the autistic children to facilitate play interactions. One of the specific skills taught to the neurotypical sisters was the delivery of play-related statements and accompanying actions. This combination may have facilitated joint attention of the sibling dyads, which created opportunities for interactive play. Lim and Charlop (2018) found that heritage language instruction was

associated with greater play behaviors than English instruction. Considering that all dyads verbalized only in English during baseline and that they simultaneously demonstrated lower levels of interactive play, the results from the present study indicate that heritage language instruction may be partially responsible for these improvements.

Furthermore, all four dyads maintained interactive play over time during follow-up probes and three improved their interactive play during heritage language probes. Additionally, three of the autistic children generalized interactive play with a bilingual therapist across both language conditions. Maintenance and generalization may have been promoted by the NIMS procedure because the act of play is naturally reinforcing, increasing the likelihood that children will repeat such behaviors later in time or with new individuals. Generalization of these skills across both languages may be particularly meaningful considering that the intervention was conducted primarily in heritage language (aside from two English probes). Thus, developmental gains from intervention delivered in heritage language appear to transfer to English situations.

Happiness

All four sibling dyads reported happiness at some point during the NIMS intervention. Three of the neurotypical sisters reported increased happiness from baseline to follow-up. Although behavior interventions do not generally assess measures of emotional states, these findings provide further support that SMIs may facilitate qualitatively positive interactions for sibling dyads. These findings replicate those from SMIs which fostered happiness for autistic children (Spector & Charlop, 2018) as well as enjoyment (Allclair, 2020) and pleasure for neurotypical siblings (Celiberti & Harris, 1993).

Findings related to happiness ratings suggest that the dyads enjoyed talking and playing with their siblings (Spector & Charlop, 2018). This may be because the NIMS procedure

provided opportunities for the dyad to play together with a variety of preferred toys and stimuli. Reported happiness may have also been related to heritage language. This hypothesis is informed by prior studies which identified heritage language as a preferred language for autistic children (Aguilar, 2017). Although no change in happiness was observed for three of the autistic children, these children consistently reported the highest rating on the happiness scale throughout the study. This finding may suggest that the autistic children enjoyed interacting with their neurotypical sisters during the play-based interactions. However, all happiness findings should be interpreted with caution as self-report measures may be susceptible to response bias and social desirability.

Samantha's responses varied slightly from the other sisters in that she reported more "indifference" as opposed to happiness during intervention. These reports may be related to the quality of her relationship with Alice. Across all Sibling Relationship Questionnaire probes, Samantha reported that Alice hit, grabbed, pushed, or hurt her "a lot." Sibling relationships may be strained when autistic children demonstrate challenging behaviors (Walton, 2016). Samantha may have reported less happiness during baseline and intervention phases because of prior experiences during play with her sister Alice.

Sibling Relationship Quality

Relationship quality of two of the sibling dyads improved from baseline to follow-up. More specifically, Alison and Audrey reported reductions in challenging behavior and increased communication attempts of the autistic children. The demands of the NIMS procedure encouraged the sibling dyad to interact with one another within the context of play-based interactions. Research on neurotypical children indicates that self-regulation and conflict resolution skills are often learned through play (Galinsky, 2010). Based on happiness reported by

the dyads in this study, most of the children indicated that the intervention was enjoyable. Although the procedure entailed that neurotypical sisters placed more demands on the autistic child than were present during baseline, the positive context in which these interactions occurred may have helped buffer against challenging behavior. In fact, reduced challenging behavior has been associated with heritage language instruction in previous research (Lang et al., 2011). This combination of play-based sibling interactions in heritage language during the NIMS procedure may have enabled more positive interactions to occur between the sibling dyad, thus improving neurotypical sibling perceptions of these dimensions of the relationship.

Additionally, challenging behavior and attempts to communicate may have been related to one another. Autistic children often exhibit challenging behavior (Kanne & Mazurek, 2011; Lecavalier, 2006; Rosenbrock et al., 2021) and this behavior is often related to challenges in expressing wants and needs. The social initiations of the neurotypical sisters may have created more opportunities for the autistic children to engage in communication, resulting in reduced challenging behavior. The autistic children may have also been more motivated to play and/or communicate in their heritage language than in English.

Although no change was identified for some of the variables related to sibling relationship quality, the results may still be meaningful for understanding the experience of having an autistic sibling. For example, three of the four neurotypical sisters reported that they helped their autistic brother/sister "a lot." This finding is consistent with previous research which indicates that neurotypical siblings of autistic children demonstrate more prosocial behaviors than children with other neurotypical siblings or siblings with other developmental disabilities (Orm et al., 2021; Rum et al., 2021; Walton & Ingersoll, 2015). Simultaneously, these same three sisters also reported that they and their sibling had "a lot" of fun playing together. This pattern

suggests that although the neurotypical sisters reported frequently helping their autistic sibling, doing so did not negatively the sibling relationship in terms of their enjoyment during time spent together.

Social Validity

Consistent with previous SMIs, NIMS in heritage language received high social validity ratings from the majority of neurotypical sisters and the caregivers of the sibling dyad Allclair, 2020; Glugatch & Machalicek, 2021; Ferraioli & Harris, 2011; Sullivan, 1999). Of the neurotypical sisters, Samantha responded with the lowest ratings, reporting a "3" in response to how much she learned and how much fun the sibling dyad had during the study. Samantha's responses may reflect the quality of the sibling relationship overall. As previously mentioned, across Sibling Relationship Questionnaire probes, Samantha consistently reported that Alice demonstrated "a lot" of challenging behaviors. Her reported happiness during the intervention was also the lowest of all the neurotypical sisters. These factors may have been related to Samantha reporting that she learned less from the study and perceived the study as less fun than the other siblings. Alice and Samantha's mother also reported the lowest rating on one component of social validity: perceived importance of sibling communication in heritage language. Nonetheless, all other neurotypical sisters and caregivers of the sibling dyads reported the intervention and its components as socially valid.

Heritage Language Perspectives

Two of the caregivers in the present study reported feeling hesitant about their decision to bilingually expose their child, which aligns with previous research (Hampton et al., 2017; Kremer-Sadlik, 2005; Lim et al., 2018; Yu, 2013). Only one caregiver in the study was advised by a clinical professional to avoid bilingual exposure of their autistic child. This finding

contradicts previous research which claimed that caregivers are being advised by clinical professionals not to expose their autistic children to more than one language (Yu, 2013). This finding may either reflect the small sample used in this study, a shift in clinical perspectives regarding heritage language use, or an overestimation of the number of clinicians providing such advice. However, a more thorough analysis of this topic is needed to determine the true explanation.

Additionally, all caregivers in the study reported that they chose to expose their autistic child to their heritage language to improve communication with family members. Three of the caregivers also reported that they did so to help their child establish cultural identity, emotional connection, and social skills with people in the community. These findings replicate previous research regarding the association between heritage language with cultural identity of autistic children and emotional closeness within the family (Hampton et al., 2017; Yu, 2013). This study adds to the literature in that caregivers reported heritage language exposure as important for family communication and social opportunities within the community, indicating that based on the perspective of caregivers, heritage language may enable opportunities for autistic children to practice social-communication skills with others.

Overall, the findings from the Heritage Language Perspectives Questionnaire help provide a contextual basis for interpreting the results from this study. Current research practices involving SMIs do not provide readers with an understanding of the contextual variables that indirectly influence the interventions. With consideration of Bronfenbrenner's bioecological model (Bronfenbrenner & Morris, 2006) as part of the overarching framework of this study, it was assumed and subsequently confirmed that interactions within each dyad's mesosystem indirectly influenced heritage language perspectives of caregivers. Although only one of the

caregivers was advised by a clinical professional against bilingual exposure, 50% of the caregivers in this study reported hesitancy regarding their decision. Despite this hesitancy, all the caregivers in the present study reported that their decision was based upon the belief that bilingual exposure would benefit their autistic child in some form. These beliefs were likely informed by interactions with other family and community members who reinforced the importance of bilingual exposure. Although these mesosystem-level interactions did not directly involve the autistic children themselves, they likely impacted caregiver decision-making which in turn, may have influenced the degree to which autistic children were exposed to their heritage language.

Limitations

The NIMS study presents limitations regarding the sample of participants, results related to heritage language use, self-report measures, and timing of follow-up. Only sibling dyads were included in the study and all four of the neurotypical siblings were sisters. Given the sample, only three different languages were assessed using the NIMS procedure, which presents some limitations for the generalizability of findings to other BE children. Future research may aim to examine the procedure with dyads involving neurotypical brothers as well as languages not examined by this study.

As discussed earlier in this chapter, heritage language use increased for all the participants during intervention. However, their percentage of heritage language use may have been less notable due to the persistence of English verbalizations. Only two of the autistic children demonstrated heritage language verbalizations that maintained during the follow-up phase of the study. Since this is the first heritage language procedure that has been designed for sibling implementation, it is possible that more culturally-specific elements may be required to

facilitate greater improvements in heritage language. Thus, these findings may present limitations for specifically facilitating heritage language use (as opposed to English or overall language) in autistic children via the exact procedure outlined in this study.

Moreover, self-report measures were applied to assess measures of happiness and sibling relationship quality. Due to the COVID-19 pandemic, all sibling dyads were required to wear masks while at the intervention setting, presenting a challenge for determining whether children were smiling or demonstrating other happiness behaviors. If pandemic-related regulations impact future studies, it is recommended that the sibling dyads wear face shields to allow for a more objective measures of happiness.

Furthermore, the questions included on the Sibling Relationship Questionnaire were based on an empirically validated scale. However, results may be limited as reliability and validity testing were not conducted on the questionnaire prior to inclusion in the study. Another concern regarding this measure is that only the neurotypical sisters were asked their perceptions of the sibling relationship. This decision was made due to the limited verbal and cognitive abilities of some of the children in this study.

The timing of follow-up presents some concerns for maintenance. Follow-up was conducted immediately after the intervention and one week following intervention. This presents limitations for understanding how the treatment gains of both the autistic children and neurotypical siblings, sustain over time. To assess for maintenance, future researchers may consider conducting follow-up several weeks of months following the end of the intervention.

Lastly, although the overall findings from the study are promising, clear results were only identified for 3 of the 4 participants. Although Scott mastered performance criterion during intervention, once the prompt fading phase of the study was initiated, his appropriate

verbalizations did not sustain at double his baseline average. Alison also required full verbal prompts to socially initiate during intervention. By the end of the study, full verbal prompts were faded but visual and auditory prompts were still present. Thus, replication of the NIMS procedure with more dyads is necessary to truly capture its efficacy.

Future Directions and Conclusion

Given that this is the first study to investigate NIMS, the limitations identified from this study may provide opportunities for future researchers to improve upon the existing procedure. More specifically, the heritage language use of autistic children may be enhanced by applying a more extensive intervention, delivering reinforcement contingent upon heritage language verbalizations, providing culturally-relevant stimuli, individualizing intervention goals, as well as conducting sessions both in contextually-relevant environments and with contextually-relevant communication partners. First, the mixed results regarding maintenance in this study suggest that a more extensive intervention may be necessary. Conducting a longitudinal study may help researchers to determine if the NIMS procedure changes interaction patterns between siblings when implemented over a longer period of time. Researchers could also employ a longitudinal study of the NIMS procedure when complemented by other naturalistic sibling-mediated interventions (i.e., PRT, NLP, Stay Play Talk) to determine if a more robust treatment package may result in longer lasting impact.

The NIMS procedure outlined in the present study did not provide any reinforcement contingent upon autistic child verbalizations in heritage language. This decision was made to encourage the children to verbalize, regardless of language, and to avoid putting English verbalizations on extinction. Thus, autistic children were able to respond in either English or their heritage language. To target heritage language-specific verbalizations, future researchers

may consider reinforcing autistic children for responding in this language. Future research may also consider assessing the language preferences of the sibling dyad.

Additionally, future applications of the NIMS procedure should incorporate stimuli that are specifically associated with heritage language. Because the current intervention was conducted in a clinical setting, all dyads had previous exposure to the toys and stimuli provided during play sessions. It is possible that these items were associated with the setting and English language use. Thus, dyads did not have prior experience engaging with the stimuli in their heritage language prior to the study, which may have influenced lower levels of heritage language use. Considering that cultural knowledge can be passed down through interaction with tools and/or objects (Miller, 2016), researchers should consider providing dyads with preferred items that are tied to each dyads culture. This practice may also be extended to teaching neurotypical siblings of less impacted autistic children to facilitate conversation regarding culturally-relevant topics (e.g., Korean TV shows, Spanish songs). Consulting with neurotypical siblings and caregivers to determine preferred items and topics associated with each dyad's culture may aid in this process. Collectively, these adjustments may facilitate more natural opportunities for heritage language use.

Another way that researchers may improve the NIMS procedure is by creating more individualized intervention plans for the sibling dyads. Heritage language use was assessed through a questionnaire in the present study, which resulted in a wide range of responses. However, all neurotypical sisters received training on the same set of skills regardless of the dyad's exposure to and use of heritage language at home. Future researchers should consider using information related to heritage language exposure of each dyad to inform more specific intervention goals. For example, for autistic children with less verbal ability, neurotypical

siblings may be trained to provide more direct, trial-based opportunities for autistic children to imitate target phrases that are based on baseline MLU. For example, the neurotypical sibling of an autistic child with a baseline MLU of 1.5 would deliver target phrases in heritage language at a length of 2 to 3 words. By creating more individualized replications of the NIMS procedure, researchers may improve heritage language use of autistic children.

Future researchers should also consider conducting the procedure within the context that heritage language is most relevant – the home. Sibling dyads may associate their home environment with heritage language which could potentially result in greater developmental gains. Conducting the NIMS procedure in the home may facilitate better maintenance outcomes than were recorded in the present study. Considering that both sibling-mediated (Akers et al., 2018; American Psychological Association, 2013; Celiberti & Harris, 1993; Coe et al., 1991; Glugatch & Machalicek, 2021; Oppenheim-Leaf et al., 2012; Spector & Charlop, 2018) and caregiver-mediated interventions (Althoff et al., 2019; Bradshaw et al., 2017; Eid et al., 2017; Erturk et al., 2021; Gillet & LeBlanc, 2007; Laski et al., 1988; Stadnick et al., 2015) are effective for autistic children and that neurotypical siblings are likely to exhibit prosocial behaviors toward autistic children when provided substantial support at home (Ferraioli & Harris, 2010), researchers may consider involving caregivers in the process to optimize outcomes for both children.

Moreover, programming for generalization throughout intervention may result in greater heritage language verbalizations of autistic children. In their daily lives, BE autistic children are exposed to individuals (e.g., peers, or community members) who provide natural opportunities for heritage language exposure and communication. Future researchers should consider enhancing the contextual fit of the intervention by providing opportunities for autistic children to

generalize heritage language use with bilingual communication partners at school and in the community.

Furthermore, the present study may also have important implications for clinical practice. The present study highlights the need for incorporating neurotypical siblings and heritage language into the intervention programs designed for BE autistic children. Teaching neurotypical siblings may help promote skill development of autistic children and maintenance of those skills over time (Akers et al., 2018; Colletti & Harris, 1977; Ferraioli & Harris, 2011; Glugatch & Machalicek, 2021; Spector & Charlop, 2018; Tsao & Odom, 2006). Recent studies indicate that interventions in heritage language may promote language abilities and play of BE autistic children (Dalmau et al., 2011; Gumaer et al., in preparation). Additionally, caregivers in the present study reported that intervention delivery in heritage language as well as English may be highly beneficial for their children. Practitioners may consider integrating or encouraging opportunities for heritage language in the intervention of autistic children, particularly during home-based intervention where it is most pertinent to daily life.

Overall, the present study assessed the efficacy of the NIMS procedure implemented in heritage language for BE autistic children and their neurotypical sisters. This study is the first to teach neurotypical siblings to implement an intervention in heritage language with BE autistic children. All the neurotypical sisters quickly learned the procedure and implemented it with fidelity throughout the intervention. The intervention resulted in improved verbalizations, heritage language use, and MLU of autistic children, social initiations of neurotypical siblings, and interactive play within the sibling dyad. Analysis of ancillary measures suggest that this naturalistic, play-based procedure may also be associated with self-reported happiness and create

opportunities to enhance the quality of the sibling relationship. Both the neurotypical sisters and caregivers of the sibling dyads reported the intervention as socially meaningful.

Therefore, contrary to initial concerns noted in the literature regarding BE autistic children, this study provides further support that heritage language may be advantageous for this population when used as a foundation for learning. It appears that neurotypical siblings may serve as ideal change agents for delivering this language in intervention as they are age-appropriate play partners that may facilitate natural opportunities to learn. Ultimately, the success of NIMS suggests that the unique combination of sibling involvement, heritage language, and naturalistic teaching strategies warrants further exploration in both research and practice.

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Appendix A

Caregiver Pre-Intervention Home Heritage Language Use Questionnaire
Directions: Please carefully read the following questions about your autistic child.

1. Do you use a language other than English to communicate with this child?

   Yes No
   If yes, which language(s)?
   _____

2. How often do you speak to this child in your heritage language (Korean, Spanish, Mandarin)?

   Never Rarely Sometimes Frequently Always

3. How often does this child speak to you in your heritage language (Korean, Spanish, Mandarin)?

   Never Rarely Sometimes Frequently Always

4. How often does this child communicate with their sibling in your heritage language (Korean, Spanish, Mandarin)?

   Never Rarely Sometimes Frequently Always

Directions: Please carefully read the following questions about your neurotypical child.

1. Do you use a language other than English to communicate with this child?

   Yes No
   If yes, which language(s)?
   _____

2. How often do you speak to this child in your heritage language (Korean, Spanish, Mandarin)?

   Never Rarely Sometimes Frequently Always

3. How often does this child speak to you in your heritage language (Korean, Spanish, Mandarin)?

   Never Rarely Sometimes Frequently Always

4. How often does this child communicate with their sibling in your heritage language (Korean, Spanish, Mandarin)?

   Never Rarely Sometimes Frequently Always

Appendix B

Caregiver Pre-Intervention Heritage Language Perspectives Questionnaire
Directions: Please carefully read the following questions and circle your answer(s).

1. In the past, did you ever feel hesitant about exposing your autistic child to your heritage language?
   Yes No

2. Has a doctor, psychologist, educator, and/or therapist ever advised you to avoid exposing your autistic child to your heritage language (Korean, Spanish, Mandarin)?

   Yes No

3. What were your reasons for choosing to expose your child to your heritage language? Circle all that apply.

   a. Improve communication with family members

   b. Help establish cultural identity

   c. Facilitate language development

   d. Improve emotional connection

   e. Practice social skills with people in the community

   f. Other _____

Appendix C

Sibling Training Checklist

Step 1) Provide the sibling with an overview of the skills that will be covered by the corresponding phase (e.g., Phase 1: physical proximity, attention, and turn-taking).

Step 2) Name each skill and provide the sibling with a description of what it means. Write a check in the "Describe" box once completed.

Step 3) Provide verbal examples and/or model (if applicable) how to use this skill. Write a check in the "Examples" and "Model" boxes once completed. Ensure the child understands the skill before moving to the next skill.

Step 5) Role-play the skills covered by the given phase. Provide in-vivo feedback. Repeat role-play scenarios until the child demonstrates all the skills in the phase with 100% accuracy. Write a check under the rehearsal column once the sibling accurately implements the skills.

Step 6) Repeat process until first 3 phases have been mastered.

Step 7) Phase 4: Role-play until sibling achieves 80% accurate demonstration of all skills across 2 consecutive opportunities. Use procedural fidelity checklist to check off accurate implementation during Phase 4.

PHASE 1: PHYSICAL PROXIMITY, ATTENTION, & TURN-TAKING					
Topic	**Description**	**Describe**	**Example**	**Model**	**Rehearsal + / -**
a) Physical Proximity	Stay close to sibling as they move around the play area (e.g., sitting near child, following child to another side of the tarp)				
b) Attention	Obtain autistic child's attention (e.g., call sibling by name, tap them on the shoulder, show object to child, establish eye contact, saying "look at me")				
c) Turn-taking	Create opportunities to share toys or take turns (e.g., saying "my turn," to request a toy the child is playing with or physically offering a toy to the autistic child)				

PHASE 2: "TIME TO TALK" & VISUAL PROMPTS					
Topic	**Description**	**Describe**	**Examples**	**Model**	**Rehearsal** + / -
a) "Time to Talk"	Introduce auditory prompt that will go off every 30 seconds to prompt neurotypical sister to socially initiate				
b) Visual Prompt	Introduce visual prompt cards that will be displayed to encourage variation of neurotypical sibling social initiation (i.e., instruction, play, question) Practice locating cards once "Time to Talk" prompt is played				

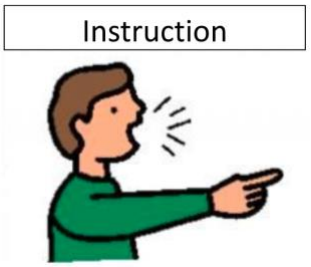
PHASE 3: INSTRUCTIONS, COMMENTS, QUESTIONS, PRAISE					
Topic	**Description**	**Describe**	**Examples**	**Model**	**Rehearsal** + / -
a) Instructions	Deliver contextually appropriate instruction (e.g., "blow the bubbles," "throw the ball") *Emphasize that autistic child does not need to follow instruction*				
b) Modeling Appropriate Phrases	Deliver contextually appropriate phrase and model appropriate play with a toy (e.g., "drive the car") while demonstrating the action *Emphasize that autistic child does not need to respond*				
c) Questions	Ask question directed toward the autistic child (e.g., "what color is it?" "How many blocks do you have?")				

	Emphasize that autistic child does not need to respond
d) Praise	Provide social praise to the autistic child (e.g., “good job building the tower”) *Emphasize that praise can be delivered at any time during the session*

Appendix D

Visual Prompt Cards

English



Korean

Mandarin

Spanish

Appendix E

Child Self-Reported Happiness Scale

Appendix F

Sibling Relationship Questionnaire

Brother/Sister

Directions: Please answer the questions thinking about what your brother/sister does.

1. How much does your brother/sister hit, grab, push, or hurt you?

   Not at all A little A lot

2. How much does your brother/sister help you?

   Not at all A little A lot

3. How much does your brother/sister yell or say mean things to you?

   Not at all A little A lot

4. How much does your brother/sister have fun with you?

   Not at all A little A lot

5. How much does your brother/sister try to talk to you?

   Not at all A little A lot

Self

Directions: Please answer these questions thinking about what you do.

1. How much do you hit, grab, push, or hurt your brother/sister?

   Not at all A little A lot

2. How much do you help your brother/sister?

   Not at all A little A lot

3. How much do you yell or say mean things to your brother/sister?

   Not at all A little A lot

4. How much do you have fun with your brother/sister?

   Not at all A little A lot

5. How much do you try to talk to your brother/sister?

   Not at all A little A lot

Appendix G

Sibling Procedural Fidelity Checklist

Sibling Dyad Code Names _____ Session _____

Date _____ Coder_____

1. Did the neurotypical sibling get in close physical proximity to the autistic child before or after at least one "Time to Talk" prompt?

   Yes No

2. Did the neurotypical sibling attempt to get the autistic child's attention before or after at least one "Time to Talk" prompt?

   Yes No

3. Did the neurotypical sibling attempt to engage in turn-taking with the autistic child before or after at least one "Time to Talk" prompt?

   Yes No

4. Did the neurotypical sibling provide praise before or after at least one "Time to Talk" prompt?

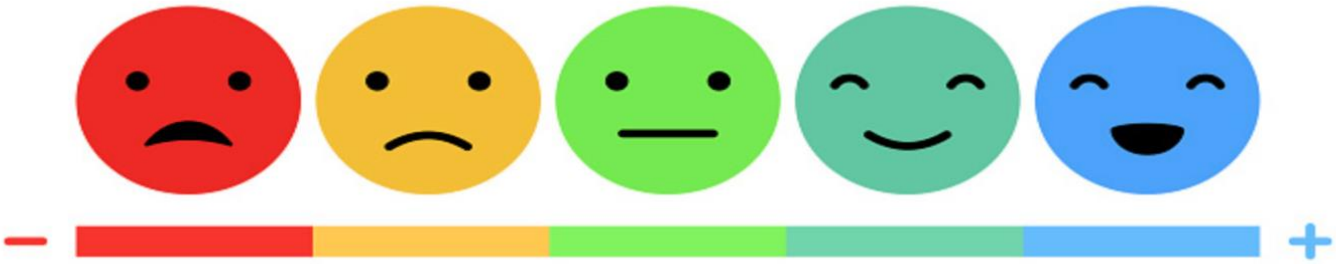
   Yes No

5. Did the neurotypical sister socially initiate in heritage language before or after at least one "Time to Talk" prompt?

Appendix H

Neurotypical Sibling Social Validity Questionnaire

On a scale of 1-5 rate the following questions:



1 2 3 4 5

1. How much did you learn about how to talk and play with your brother/sister in Korean, Mandarin, or Spanish?

2. How much do you think other brothers/sisters would like to learn how to talk and play with their siblings in Korean, Mandarin, or Spanish?

3. How much fun did you have talking and playing with your brother/sister in Korean, Mandarin, or Spanish?

4. How much fun do you think your brother/sister had talking and playing with you in Korean, Mandarin, or Spanish?

Appendix I

Caregiver Social Validity Questionnaire

Directions: Please carefully read the following questions and circle your answers.

1. In your opinion, how important is it for your children to learn to communicate and play with one another in their heritage language (i.e., Mandarin, Korean, Spanish)?

   Not at all A little Somewhat Very Much Extremely Much

2. In your opinion, how much do you think your children benefit from your neurotypical child being involved in the intervention/therapy of your autistic child?

   Not at all A little Somewhat Very Much Extremely Much

3. In your opinion, how much do you think your autistic child benefits from receiving intervention/therapy in their heritage language?

   Not at all A little Somewhat Very Much Extremely Much