INFANTS AT ELEVATED LIKELIHOOD OF AUTISM SPECTRUM DISORDER: LANGUAGE DEVELOPMENT PATTERNS AND CAREGIVER COACHING STRATEGIES

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ABSTRACT

Jonet Artis: Infants at Elevated Likelihood of Autism Spectrum Disorder: Language Development Patterns and Caregiver Coaching Strategies
(Under the direction of Linda R. Watson)

This dissertation is composed of two manuscripts that study the early development of infants at an elevated likelihood of an autism spectrum disorder diagnosis (EL-ASD). In the first manuscript, the language profiles (i.e., receptive dominant, expressive dominant, balanced) and the predictors of the language profiles are examined in infants at EL-ASD. Results indicated that there were no differences in the frequencies of the profiles demonstrated by children at EL-ASD when compared to children at lower likelihood of an ASD diagnosis. Neither response to joint attention nor parent responsiveness were predictors of the difference between receptive and expressive language scores within this sample. Similarly, ASD-related social communication features and restrictive and repetitive behavior features were also not significantly correlated with the language difference scores. However, the language scores themselves were significantly associated with these variables. The results suggest that while the language difference scores may not relate to response to joint attention, parent responsiveness, or ASD features (social communication or restricted and repetitive behaviors) in infants at EL-ASD, there is a relationship between these skills and features and the language scores of infants within this sample.

The second manuscript is focused on coaching behaviors demonstrated by interventionists in a parent-mediated intervention for infants at EL-ASD. In this study, we investigated the frequency of the coaching behaviors used by the interventionists, the

relationship between the use of coaching behaviors and parent education levels, and the relationship between the use of coaching behaviors and the change in parent responsiveness to their infants' attentional and communication cues. Results indicated that the joint interaction and child-focused behaviors were demonstrated most frequently by interventionists. Guided practice, caregiver practice, and problem solving were implemented less frequently. The use of the joint interaction coaching behavior was positively associated with parent education levels, whereas the use of the child-focused behavior was negatively associated with parent education levels. More information sharing by the interventionist predicted a greater change in parent responsiveness, whereas more child-focused behaviors predicted less change in parent responsiveness. These results suggest the need for professional development that facilitates the implementation of coaching behaviors often used less frequently.

In memory of my dad, Jonathan Artis, whose words of wisdom continue to encourage me.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ASD	Autism spectrum disorder
EL- ASD	Elevated likelihood of a later diagnosis of ASD
FYI	First Years Inventory
IDEA	Individuals with Disabilities Education Act
LL- ASD	Lower likelihood of a later diagnosis of ASD
RJA	Response to joint attention
RRB	Restrictive and repetitive behavior
SC	Social communication

CHAPTER 1: INTRODUCTION TO EARLY LANGUAGE DEVELOPMENT AND LANGUAGE INTERVENTIONS FOR CHILDREN AT ELEVATED LIKELIHOOD FOR AUTISM SPECTRUM DISORDER

This dissertation includes two manuscripts that describe empirical studies focused on infants at elevated likelihood of a later diagnosis of autism spectrum disorder (EL-ASD). Both of these studies include children who were identified from a parent-report screening tool that was developed to identify children at EL-ASD based on social communication and sensory regulatory symptoms (Reznick et al., 2007). This approach to studying infants at EL-ASD is less common than studying children who are infant siblings of children diagnosed with ASD (Bradshaw et al., 2015). In a study conducted by Ozonoff et al. (2011), approximately 19% of infants at elevated familial-likelihood for ASD were later diagnosed with ASD. Thus, it is evident that infant siblings are at a greater risk for a later diagnosis of ASD than the general population in which the prevalence is estimated to be approximately 2% (Kim et al., 2011; Zablotsky et al., 2015). However, most infants who eventually will be diagnosed with ASD do not have siblings diagnosed with ASD. Constantino et al. (2010), for example, documented that approximately 11% of children with ASD in families with at least two children had siblings also diagnosed with ASD. This finding implies that the vast majority of infants who will later be diagnosed with ASD will not be identified based on familial likelihood of ASD. Therefore, it is essential to study the development of infants at EL-ASD who are not identified based on familial likelihood of ASD, to further our understanding of the full population of infants at EL-ASD and determine if findings from studies of infant siblings at identified familial likelihood for a later ASD diagnosis generalize to infants identified based only on early behavioral symptoms. Therefore, the first

manuscript in this dissertation explores the early language development, specifically the language patterns, of infants at EL-ASD who were identified by screening.

The early language development of children diagnosed with ASD, specifically spoken language, has been identified as a significant predictor of later social and adaptive functioning within this population (Tager-Flusberg & Kasari, 2013). However, our knowledge of the language development of children with ASD during infancy and early toddlerhood is limited. Based on the studies exploring the language development of infant siblings of children with ASD, there is evidence that language delays are apparent in some of these infants as early as 12 months of age (Ozonoff et al., 2010). Other studies have explored the language trajectories of infant siblings and characterized the trajectories by final diagnoses (e.g., non-ASD, ASD, language delay) (Iverson et al., 2018; Landa et al., 2013; Swanson et al., 2017). Within these studies, there are differences in the trajectories of infant siblings based on their final diagnoses. These results help us to see the early patterns of language development across time and recognize patterns of language development that may be red flags for a later ASD diagnosis in infant siblings. While this information is valuable, it is unclear whether or not these results can be generalized to infants at EL-ASD who are not identified by familial risk. Therefore, further investigation of the early language development of a community sample of infants at EL-ASD identified based on a screening for early behavioral predictors of ASD is warranted. An investigation of the early language development of infants identified by screening can help us to determine if there are similarities and differences in language development within this population when compared to previous findings from infant siblings.

Previous research exploring early interventions of infants at EL-ASD identified by screening has provided us with information about their early language development (Baranek et

al., 2015; Watson et al., 2017). Within these studies, infants at EL-ASD, on average, demonstrated language scores that were at least one standard deviation below the mean at baseline. Therefore, similar to the infant sibling literature, we see that infants at EL-ASD who were identified via screening often demonstrate lower than average language scores. However, because these studies of community-screened infants were designed as intervention studies (Baranek et al., 2015; Watson et al., 2017), they did not include a comparison group of infants at a lower likelihood of a later ASD diagnosis (LL-ASD), as has commonly been done in developmental studies of infant siblings of children with ASD. Therefore, adding a comparison group for the first study reported in this dissertation allowed us to further explore how the early language skills of children at EL-ASD differ from the language skills of children at LL-ASD.

In addition to providing information on the relationship between early language skills and later outcomes, there are many other benefits to further investigating the early language development of this population. First, it can potentially lead to the earlier identification of children at EL-ASD. The average age of diagnosis for children with ASD is four years old (Baio et al., 2018). However, children who are at EL-ASD and later diagnosed with ASD often show significant delays in areas such as language development as early as 12 months of age (Lazenby et al., 2016; Swanson et al., 2017). Therefore, it should not be a surprise that, as indicated by Monteiro et al. (2016), some children access speech and language services before the diagnosis of ASD. Consequently, better knowledge of the early language development of children at EL-ASD could help professionals identify the unique language or communication features that are often demonstrated in this population. Subsequently, this can aid in the early identification of ASD or referral for additional services.

Secondly, a better understanding of the early language development of children can help us to refine interventions to meet the needs of infants at EL-ASD or diagnosed with ASD who demonstrate delays in language development. Typically, within a child's first two years of life, their language skills are developing rapidly (Bradshaw et al., 2015). However, many infants at greater likelihood for ASD and later diagnosed with ASD, not only demonstrate lower language scores, but also show different language trajectories within these first two years of life (Swanson et al., 2017). Therefore, it is important to understand which aspects of early communication and language development in infants at EL-ASD are most strongly associated with parent behaviors and child outcomes. Knowledge of these child-related skills and parent behaviors that are associated with language development can assist us in designing preemptive interventions for this population.

In addition to the skills targeted within early interventions, it is also important to know how to best deliver the intervention to families. Thus, the implementation of a parent-mediated intervention is the focus of the second manuscript, which explores the coaching behaviors that the interventionists used with the parents. Based on the Part C guidelines of the Individuals with Disabilities Education Act (IDEA; 2004), family-centered practices are recommended for children ages birth to three. Parent mediated interventions are designed to encourage family-centered practices (Woods et al., 2011). Consequently, the most common interventions for children with or at elevated likelihood for ASD under the age of 24 months are parent-mediated interventions (Bradshaw et al., 2015). There is also evidence that supports the use of parent-mediated interventions for targeting language development. For example, in a review of parent-implemented language interventions, Roberts and Kaiser (2011) indicated that these interventions were effective in improving the language skills of children. Therefore, parent-

mediated interventions are an appropriate type of intervention to investigate with the goal of improving outcomes for children at EL-ASD, including their language development.

Successful implementation of parent-mediated interventions requires interventionists who are skilled in coaching parents, which is a different set of skills from those used to provide direct services to the child. However, often studies provide limited information on how the interventionists train the parents to implement the interventions (Roberts & Kaiser, 2011). Yet, Peterson et al. (2007) emphasized the importance of understanding the process of delivering interventions. While the recommendations provided by the Part C guidelines of IDEA (2004) indicate that parents should play an integral role in the intervention and that services should not only be provided directly to the child, it appears that this has been difficult to implement within early intervention studies (Woods et al., 2011).

This difficulty with delivering family-centered practices may be due to the components of the parent and interventionist interactions that are focused on. For example, within the larger study of family-centered practices, Dunst and Trivette (1996) noted that there are two types of practices that describe how clinicians engage with parents. First, there are relational practices in which clinicians are encouraged to demonstrate a warm attitude and be responsive to the families. Second, there are participatory practices in which clinicians are asked to engage parents in a way that empowers them to seek out other resources. While Dunst and Trivette (1996) explained these concepts in the context of general family services, these practices can also be applied to intervention services. Thus, participatory practices can apply to how well interventionists empower parents within the context of the intervention session to implement strategies. From the meta-analysis conducted by Dunst et al. (2007), it is evident that often interventionists have no difficulties with relational practices; however, participatory practices are

more challenging to implement. Dunst and colleagues (2007) indicated that both practices are essential for family-centered services, yet, participatory practices have more of a long term impact on outcomes. Therefore, studies are warranted that investigate how interventionists empower and build the capacity of families within parent-implemented interventions.

In summary, the overall goal is for these two studies to contribute to our understanding of the early language development of children at EL-ASD and the active ingredients of effective coaching interventions developed for this population. The first project will investigate one component of the language development of infants at EL-ASD, their language profiles. Knowledge of the profiles demonstrated by infants and the skills that predict these profiles can potentially assist in early identification of children at EL-ASD and help to individualize interventions to meet their needs. The second project will explore the coaching behaviors that interventionists demonstrate during a parent-mediated intervention. This will add to the literature on how interventionists interact with parents within intervention sessions and the relationship between those behaviors and parent outcomes. Ultimately, the results of this dissertation are intended to assist with creating individualized interventions for infants at EL-ASD, with specific emphasis on language and communication development.

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CHAPTER 2: THE EARLY LANGUAGE PATTERNS OF INFANTS AT ELEVATED LIKELIHOOD OF LATER AUTISM SPECTRUM DISORDER DIAGNOSIS

Introduction

Speech and language concerns are the most frequent type of first concerns expressed by parents of children later diagnosed with ASD (Coonrod & Stone, 2004; Yimgang et al., 2017). In addition, children later diagnosed with ASD, on average, show significantly lower expressive and receptive language scores on standardized assessments than their peers, not diagnosed with ASD, beginning as early as 12 months of age (Ozonoff et al., 2010). However, delays in language development are not solely linked to ASD, as they are also demonstrated by children diagnosed with a language-specific impairment or with another developmental disorder such as Down syndrome (Polišenská & Kapalková, 2014). While significantly lower language assessment scores alone may not be able to distinguish children with ASD from children with other disorders, the language profiles (i.e., the differences between the receptive and expressive language scores) could serve as an indicator of a higher likelihood for a later ASD diagnosis in infants. Thus, knowledge about these language profiles in infancy may further explain the language development of children with ASD.

This study is focused on three different language profiles described in previous literature: balanced, expressive dominant, and receptive dominant (Reinhartsen et al., 2019; Seol et al., 2014). In a balanced profile, expressive and receptive language scores are not significantly different. In an expressive dominant profile, expressive language scores are significantly higher than receptive language scores, whereas the opposite pattern is seen in a receptive dominant

profile. Toddlers who are 20-40 months old and have been diagnosed with ASD are more likely to demonstrate an expressive dominant language profile compared to toddlers diagnosed with other disorders or those who are typically developing (Ellis Weismer et al., 2010). In contrast, the receptive dominant language profile is more often observed in toddlers who are late talkers or diagnosed with other neurodevelopmental disorders such as Down syndrome (Davidson & Ellis Weismer, 2017; Seol et al., 2014); and balanced profiles are more characteristic of typically developing children. Thus, an expressive dominant profile in a toddler may be a red flag for a greater likelihood for a later ASD diagnosis.

The prevalence of the expressive dominant pattern in children diagnosed with ASD has been reported to vary based on the age of the child (Reinhartsen et al., 2019). The earliest age range in which the expressive dominant profile has been reported to be highly prevalent in children with ASD is 20-29 months (Seol et al., 2014). Seol et al. (2014) indicated that, within their sample, approximately 56% of the children with ASD presented with an expressive dominant language profile compared to 26% of children with developmental language delay (Seol et al., 2014). Similarly, Swanson et al. (2017) explored the early language development of infants siblings of children with ASD from the ages of 6-24 months. Those infants who eventually were diagnosed with ASD were more likely to show an expressive advantage at 24 months, when compared to infants diagnosed with a language delay, infants not diagnosed with a disorder, and infant siblings of children who were typically developing. Within the 30-39-month age range, Seol et al. (2014) reported that 54.1% of children diagnosed with ASD showing an expressive dominant profile compared to 5.9% of the group with developmental language delays. Thus, a larger percentage of children diagnosed with ASD presented with an expressive dominant pattern between the ages of 30-39 months when compared to children between the ages

of 20-29 months. Similarly, Davidson et al. (2017) indicated that a large percentage, 62%, of their sample of children diagnosed with ASD, had an expressive dominant profile at 30 months. At older ages (>40 months), most children with ASD do not present with expressive dominant profiles; instead, they show balanced or receptive dominant profiles (Seol et al., 2014). Thus, based on cross-sectional research, the proportion of children with ASD who demonstrate an expressive dominant pattern appears to change with age. Nevertheless, the average language scores of older children with ASD continue to fall significantly below average (Hudry et al., 2010; Seol et al., 2014), raising the possibility that different early language profiles reflect variable learning processes that continue to impact language acquisition.

While there has been an increase in research on language profiles of children older than 20 months, we know little about language profiles before the age of 20 months, or about factors associated with an expressive dominant profile. Swanson and colleagues (2017) conducted a study in which they examined the relationship between receptive and expressive language skills. They specifically focused on how the relationship between the receptive and expressive language skills of the infants at an elevated familial likelihood of ASD who were later diagnosed with ASD differed from children who were at an elevated familial likelihood of ASD but not diagnosed with ASD and children at a lower familial likelihood for ASD. The children participated in assessments at 6, 12, and 24 months. Their results indicated that there was evidence for a lower "receptive advantage" in the group of infants at EL-ASD who were later diagnosed with ASD. Thus, the research investigating the language profiles of infants is limited, and, currently, no evidence identifies the expressive dominant profile as the most prevalent profile demonstrated by infants at EL-ASD.

Knowledge about the early social communication skills that impact the receptive and expressive language development of typically developing children can provide insight into how deficits in these skills may affect the language development of children diagnosed with ASD. It is possible that some social communication skills associated with receptive and expressive language, such as joint attention, develop differently, implying that challenges in specific social communication skills commonly seen in infants later diagnosed with ASD may play a role in the development of an expressive dominant profile. In addition, infants with early impairments in social-communication skills may provide their caregivers with fewer and/or less clear opportunities for parents to respond to their emerging communication cues. The current study specifically examines infant joint attention skills and parent responsiveness as possible contributors to the expressive dominant profile demonstrated by some children who are diagnosed with ASD. Examining associations between these variables and the relative difference between receptive and expressive language scores could further increase our understanding of variables that may be contributing to the receptive-expressive language discrepancy observed in some children diagnosed with ASD.

Response to joint attention and language development

Joint attention has been identified as a "starter set skill," and through this skill, infants and parents have opportunities for social communication exchanges (Toth et al., 2006). According to Tomasello's (2000) social-pragmatic theory, social communication exchanges are made up of multiple joint attention interactions. It is through these social communication exchanges that children develop both their receptive and expressive language skills. Response to joint attention (RJA) is described as being the ability of the child to follow the bid for attention (e.g., gaze, point, head turn) of a social partner (Morales et al., 2000). When children respond to

the joint attention bids of others, there are many aspects of language learning at work. The child must attend to the spoken and/or visual prompt for attention (Paul et al., 2007). Then, the child must also recognize that the speaker is intentionally communicating to them about an object or an event in the environment and respond to the cue to look toward the object or event (Tomasello, 2000). They also must recognize that the language provided by the speaker is related to the object within the environment. Therefore, they are demonstrating a readiness for interaction and they are learning that they are able to gain information about the language associated with actions and events through interactions with others (Adamson et al., 2017; Bottema-Beutel, 2016). The speaker, also involved in this interaction, is learning that the child is following his/her gaze or gesture and is recognizing that this is an opportunity to provide language input. Thus, the actions of both parties are encouraging social interaction and language development.

Skills in responding to joint attention appear to develop early in typically developing children. Morales et al. (1998) noted that RJA skills may begin to emerge as early as 6 months of age in typically developing children. However, the critical period for the development of joint attention skills appears to be when children are between the ages of 9 and 15 months (Beuker et al., 2013). In agreement with the idea of a critical period for the development of RJA skills, Morales et al. (2000) documented that for typically developing children, RJA skills appear to stabilize around 18 months. As a result, the impact of RJA on language skills may differ based on the age of the child.

The relationship between RJA and language skills seems to differ for infants and younger toddlers when compared to older toddlers. For example, the ability of 11-17- month-old children to respond to RJA bids has been associated with their receptive language development but not

their expressive language development (Beuker et al., 2013). In contrast, Morales et al. (2000) noted that the RJA skills of children aged between 6 to 24 months predicted both the receptive and expressive vocabulary of the children at 24 months and 30 months. Mundy and Gomes (1998) similarly reported a significant relationship between RJA and both expressive and receptive language scores. The differences in the association between RJA and receptive and expressive skills within these studies may be due to the age in which receptive and expressive skills were assessed. Beuker et al. (2013) reported that the ability of children to follow the attention of others at 10, 11, and 14 months related to their receptive vocabulary skills at 18 months. However, the language skills of the children who participated in the Morales et al. (2000) study were assessed at 24 months. Mundy and Gomes (1998), did not provide the mean chronological age of the children at follow up; however, they did note that the children were at least 18 months old at that time point. Therefore, the significant association solely between RJA and receptive language skills may only occur within a narrow period (e.g., when children are aged between 11-18 months). One possible explanation for this pattern of findings is that, typically, young children demonstrate that they understand more words than they produce (Caselli et al., 2012). Therefore, the relationship between RJA and receptive vocabulary may be more readily detected than a relationship between RJA and expressive vocabulary within infancy and early toddlerhood based on the greater variability in receptive vocabulary in this developmental period. Thus, these social interactions involving RJA are building receptive language skills first, and as the child ages, both RJA skills and receptive language skills are useful in developing expressive language skills.

For children diagnosed with ASD, the age ranges in which there are specific associations between RJA and language skills may differ from that of typically developing children.

According to Charwarska et al. (2012), toddlers diagnosed with ASD often present with reduced RJA skills. While RJA has been linked to the receptive language development of typically developing children less than two years old, there is not a significant amount of information available that explores the relationship between RJA and the receptive language of children who are less than two years old and are diagnosed with ASD (Adamson et al., 2017). This limitation likely has occurred because diagnosis of ASD rarely occurs before the age of two (Maenner et al., 2020). Therefore, previously published studies on infants at EL-ASD have not examined this question. Nevertheless, in studies with older children diagnosed with ASD between the ages of three to five years old, RJA was linked to initial language skills and was considered a foundational skill that was necessary for language development (Murray et al., 2008). However, Murray et al. (2008) did not report RJA as solely related to receptive language development but instead related to both receptive and expressive language skills. Similarly, Yoder et al. (2015) indicated that RJA was a value-added predictor of both receptive and expressive language skills for children initially aged between 24 and 48 months, and followed for 16 months. The potential impact of RJA on both receptive and expressive language skills in these studies may be due to the fact that children are older than the critical age range of 9-15 months in which RJA was found to be solely related to later language comprehension skills among typically developing infants. In addition, if children with ASD are showing delays in the development of RJA skills, then the age range in which there is a significant relationship between RJA and later language development may extend beyond the age at which RJA ceases to be significantly related to language development in typically developing children. Therefore, RJA may play a different role in the language development of children diagnosed with ASD who are older than 24 months old than it does in typically developing children who are older than 24 months.

Difficulties with RJA that are demonstrated by some children with ASD may be related to their challenges in engaging with social stimuli. Children diagnosed with ASD have demonstrated deficits in attending to social-auditory stimuli (Dawson et al., 1998). Similarly, toddlers diagnosed with ASD have shown difficulties orienting to child-directed speech when compared to typically developing children and children diagnosed with a developmental disorder (Paul et al., 2007). Likewise, another study reported that toddlers diagnosed with ASD demonstrated less attention to live child-directed speech than typically developing peers matched by language age (Watson et al., 2012). Of pertinence to this study, McDaniel et al. (2018) noted that children who showed less attention toward a speaker were more likely to demonstrate atypical receptive-expressive vocabulary discrepancies. This decreased response to social-auditory stimuli may be impacting responses to verbal bids for attention demonstrated by children with ASD as well as their attention to the language presented if they respond to the bid. Therefore, it is possible that, from an early age, children diagnosed with ASD are not attending to the speech provided by others and are not actively participating in social interactions. According to the social-pragmatic theory (Tomasello, 2000), these factors would limit their opportunities to learn language.

The severity of their difficulties with RJA further differentiates children with ASD from children with other developmental disorders. Difficulties with RJA may significantly impact the receptive language skills of children diagnosed with ASD and, therefore, could contribute to the expressive dominant profile that occurs in some children diagnosed with ASD. Both typically developing children and children with Down syndrome show better RJA than children diagnosed with ASD (Adamson et al., 2009). These differences in RJA skills may help explain differences in the prevalence of different language profiles among children with ASD versus children who

are typically developing or diagnosed with other developmental disorders. For most children, RJA is a sign that children are ready to engage in an interaction. Therefore, children who do not attend to joint attention bids may be signaling that they are not ready to engage in interactions with others. Typically developing children respond to bids for attention frequently, even at an early age (Morales et al., 1998). As a result, they are participating in social interactions that provide them with opportunities to learn the names, functions, and characteristics of objects and activities. The ability to participate in social interactions may be different for children with ASD who generally develop RJA skills later than their typically developing peers. As children with ASD age, they may be able to respond to bids for joint attention but the early underlying comprehension skills that typically developing children develop may not occur in the same sequence for children with ASD. A study conducted by Norbury et al. (2010) supports this idea that the underlying comprehension skills in children with ASD may differ from the comprehension skills of typically developing children and that attention to social information may relate to these differences. Their participants included children diagnosed with ASD and typically developing children who were between the ages of 6 to 8 years old. They analyzed the word learning skills of the participants and noted that children with ASD initially performed better on naming tasks than the typically developing children. However, the typically developing children demonstrated stronger skills on a task that required them to define words. The authors suggested that, perhaps, typically developing children were relying on social cues to develop a better understanding of the word, and focusing relatively less on the phonological form. Thus, they initially did not perform as well on naming task. In contrast, children with ASD may have focused more on the phonological form of the word when learning a new word. These

differences in performance on specific tasks suggests that early differences in attention to social stimuli play a role in how children learn language, and may persist as children age.

Parent responsiveness and language development

Along with child-related factors that may impact language development, parent verbal input and parent responsiveness are widely assumed to play a significant role in child language development (Haebig et al., 2013a; McDuffie & Yoder, 2010; Siller & Sigman, 2008). Parent input that is related to the child's focus of attention also aids in the language development of the child (Siller & Sigman, 2008). Perryman et al. (2013) defined parent verbal responsiveness as a parent providing verbal input that is related to the child's focus of attention. When parents respond to the attention of their child, they are creating social interactions that are important for language development (Tomasello, 2000). Siller and Sigman (2008) proposed that the critical period for parent responsiveness in typically developing children is between the ages of 9 to 15 months. This corresponds to the critical development period for joint attention skills. In relation to this hypothesis, Wu & Gros-Louis (2014) noted that parents who were sensitive to their 10-13-month-old child's actions and provided related responses to those actions had children who had better expressive and receptive language scores at the 15-month-old follow-up. In addition, they also reported that parents who provided more responses that were not related to the child's visual focus had children with lower comprehension scores (but not lower expressive scores) at follow-up (Wu & Gros-Louis, 2014). Together, these results support the assumption that parent responsive input assists in the development of both receptive and expressive language skills for typically developing children, starting at a young age. In contrast, parent input that is not responsive may be more predictive of receptive language skills than expressive language skills.

While parent responsiveness has been associated with both expressive and receptive language development (Wu & Gros-Louis, 2014), different types of parent responsiveness have been shown to be more closely related to later receptive language skills than expressive language skills. For example, follow-in comments are a type of response that parents can provide that follow into the attention of the child but do not require any response from the child. Tomasello (1986) reported that for 14-month-old typically developing children, the frequency of follow-in comments provided by parents during joint attention activities had an impact on later language comprehension skills but not expressive language skills. Therefore, children less than two years old may benefit from follow-in comments provided by their parents in order to develop an understanding of an object or event.

Researchers have investigated the responsiveness of parents of children at EL-ASD and children diagnosed with ASD (Wan et al., 2019). As indicated within a review of joint attention skills, children with ASD often present with difficulties following the attention of others or orienting their attention to social stimuli (Bottema-Beutel, 2016). Parents may be able to partially compensate for their children's difficulties by increasing their responses that follow in with comments about the object or event within the child's focus. This parental strategy would provide language that is relevant to the child's focus of attention and reduce the cognitive demands of the interaction, as the child would not have to coordinate their visual attention between the parent and the object (McDuffie & Yoder, 2010). One study reported that for children who were diagnosed with ASD and ranged in age from 15-24 months (mean age= 21 months), follow-in comments were predictive of the raw receptive language scores approximately nine months later (Perryman et al., 2013). However, Perryman et al. (2013) did not assess the association between follow-in comments and expressive language. Thus, follow-in

comments appear to be predictive of the receptive language skills of young children with ASD. However, the predictive relationship between follow-in comments and expressive language skills is not as clear in children less than three years old who are diagnosed with ASD.

Parent responsiveness in the form of follow-in comments is deemed important for the language development of both typically developing children and children with ASD who are younger than three years old (Perryman et al., 2013; Tomasello & Farrar, 1986). As children with ASD become closer to three years old, their current language skills seem to determine the extent to which parent responsiveness impacts later language development. For example, Haebig, et al. (2013b) indicated that for children diagnosed with ASD (mean age = 31.15 months at Time 1), the relationship between follow-in comments and language skills was only significant for children who were initially minimally verbal, meaning they spoke less than five words. When the minimally verbal children were assessed at Time 2, on average 12 months later, parent follow-in comments from the initial time point positively correlated with expressive and receptive language scores (Haebig et al., 2013b). Therefore, it seems that for children with ASD who are less than 24 months old chronologically, follow-in comments may predict later receptive language skills. As these children age, if they present with limited language abilities, then the follow-in comments may be impacting both their receptive and expressive language skills.

In contrast to the likely benefits of the follow-in comments, Haebig et al., (2013a) indicated that parents' descriptions of their own actions at the first time point related to less of a gain in receptive language scores in children diagnosed with ASD. This finding is similar to that of Wu and Gros-Luis (2014), in which input to young typically developing children that did not pertain to the child's attention did not account for significant variance in gains in receptive language scores. Thus, the relationship between parent follow-in comments and language scores

appears to vary based on the child's age and whether or not the parent's input is responsive to the child's focus of attention.

Language development and ASD symptomatology

In addition to understanding potential causes of atypical language profiles, we also seek to understand the predictive ability of early language profiles to account for variability in ASD symptomatology. ASD is diagnosed based on symptoms related to restrictive and repetitive behaviors (RRB) and social communication skills (American Psychiatric Association, 2013). Within the literature focused on ASD symptomatology and language skills, the majority of studies either examine their relationship concurrently or the predictive association between early ASD symptomatology and later language skills (Thurm et al., 2015). For example, Larkin et al. (2017) documented a negative relationship between sensory and motor repetitive behaviors and expressive and receptive language skills concurrently and also between sensory and motor repetitive behaviors and receptive language skills predictively. Within their community-based sample, the average age of the children at Time 1 was 26 months, and at Time 2 was 61 months. However, only one child within this sample was later diagnosed with ASD. Thurm et al. (2015) assessed preschoolers diagnosed with ASD. They discovered that an increase in the social affect calibrated severity scores at a mean age of approximately 3.5 years was significantly related to lower expressive language scores at a mean age of approximately 5.5 years, when nonverbal cognitive scores were not included in the model. Recently, in a cross-sectional study, Reinhartsen et al. (2019) reported that social affect symptoms of children diagnosed with ASD between the ages of 30-68 months were related to their expressive and receptive language difference scores. They noted that children who presented with more of an expressive advantage (i.e., stronger expressive language skills relative to receptive language skills) presented with

more severe social affect symptoms. Together, these studies indicate that often there is a relationship between ASD symptomology and language skills. It is possible that more severe restrictive and repetitive behaviors may interfere with children's opportunities to learn language (Ray-Subramanian & Ellis Weismer, 2012). In addition, children who demonstrate more severe social affect symptoms may be showing difficulties with social communication skills that serve as prerequisites for language learning (Toth et al., 2006). Therefore, this predictive relationship between ASD symptomology and later language skills is not unexpected. However, we know less about how very early language skills or receptive-expressive profiles may relate to later ASD symptomology.

The limited available examinations of the association between early language skills and later ASD symptomatology have yielded promising results. For example, an increase in language skills was noted to be predictive of a decrease in RRBs in children with ASD between the ages of two to three years old (Ray-Subramanian & Ellis Weismer, 2012). One potential explanation provided by Ray-Subramanian and Ellis Weismer was that as the language and communication skills of the children grow, they demonstrate more abilities to access their environment and therefore, spend less time engaging in restrictive and repetitive behaviors. Thus, early language skills may be able to provide insight into later ASD symptomology. In addition, since parents and professionals often note language concerns first (Yimyang et al., 2017), as opposed to concerns about specific ASD symptoms, more research on the relationship between early language skills and later ASD symptoms is warranted.

The purpose of this study is to gain further understanding of the language profiles of infants at EL-ASD and the factors contributing to atypical language profiles. The aims of this study are to:

(1) Determine if infants who screen at EL-ASD are more likely than infants who screen at LL-ASD to demonstrate an expressive language dominant profile. Hypothesis 1: More infants at EL-ASD will demonstrate an expressive dominant profile than infants at LL-ASD.

(2) Determine whether RJA and parent responsiveness are associated with language difference scores (receptive language score minus expressive language score) in infants at EL-ASD. Hypothesis 2: Infants who present with stronger receptive language skills when compared to their expressive language skills will demonstrate stronger RJA skills and have parents who demonstrate more responsiveness.

(3) Determine if receptive-expressive language differences in infants at EL-ASD are associated with ASD symptom features, specifically social communication skills and restrictive and repetitive behaviors. Hypothesis 3: Infants whose language difference scores indicate a greater receptive advantage (i.e., higher receptive language scores than expressive language scores) will demonstrate less severe ASD symptom features in both the social communication and restrictive and repetitive behavior domains.

Method

Study Design

This study included data collected in two larger studies. The first study was a proof-of-concept intervention study investigating a parent-mediated intervention focused on promoting parent-infant engagement. The current study includes a subset of infants at EL-ASD who met the eligibility requirement for, and participated in, the intervention study. The data collected from this sample of EL-ASD infants were the only data used to address Aims 2 and 3, which addressed questions requiring longitudinal within-group analyses.

The second study through which data were collected for the current study was implemented as an extension of the intervention study. The "extension study" included infants who were identified as EL-ASD and who either did not meet full inclusion criteria for the intervention study or whose parents did not agree to participate in the intervention, but instead agreed to participate in assessments. The extension study also included children who were at LL-ASD (see below for criteria). The participants of the extension study only participated in the assessments and did not participate in the intervention. The data used to address Aim 1 for the current study included all of the EL-ASD participants in the intervention study and the extension study, as well as the LL-ASD participants in extension study. This allowed for a comparative analysis across groups at a single time point (study entry) for Aim 1.

Participants

We recruited participants for this study through mailings and emails to the parents of infants aged 11-16 months who were registered in the NC birth registry, posts in Facebook groups for parents of young children, booths at local family-oriented fairs, and flyers at public health clinics as well as pediatricians' and family medical practice offices. Participants completed the First Years Inventory-Lite v. 3.1b (FYI-Lite; Baranek et al., 2014). At the time of recruitment, the FYI-Lite was only available in English, with norms for English-speaking children only. Therefore, one inclusion criterion was that families indicated that they spoke English in the home more than 50% of the time. Children with identified conditions such as uncorrected hearing and vision impairments or genetic disorders were excluded from both studies. The FYI-Lite is a screening tool used to identify children who are at EL-ASD. The items on the FYI-Lite fall into one of two domains, social-communication or sensory-regulation. Risk point assignments were made separately for 11- to 13-month-olds and 14- to 16-month-olds

(based on distributions of responses in the normative sample for children in each respective age range). Participants who met criteria based on highly extreme risk scores in one domain (i.e., social communication or sensory regulation) or who met dual cutoff criteria for elevated risk scores in both domains were identified as being at EL-ASD. They were then invited to participate in an initial assessment. Participants who scored at least one standard deviation below the mean on one of the Mullen Scales of Early Learning (Mullen, 1995) language subtests and who were classified as hyporesponsive or hyperresponsive on the Sensory Processing Assessment (Baranek, 1999) using clinically determined cutoff scores at their first assessment were invited to participate in the intervention study. Parents of infants at EL-ASD who did not meet full inclusion criteria for the intervention study were invited to participate in the extension study, as were parents of infants at EL-ASD who did not wish to participate in the intervention study. The LL-ASD group for the extension study was recruited by contacting families with infants who did not meet the risk criteria on the FYI-Lite, thereby not qualifying as at EL-ASD. These families of infants with subthreshold scores on the FYI-Lite were stratified based on infant sex, and twice as many families of boys were randomly selected to be contacted as families of girls. This decision was based on previous data on the sex distribution of the infants at EL-ASD identified by earlier versions of the FYI.

We recruited 45 infants who screened at EL-ASD, whose families reported speaking English at least 50% of the time at home, and who did not present with any exclusionary conditions; 36 of these infants qualified for the intervention based on the infants' scores on language and sensory measures at the initial assessment and their parents agreed to participate in the intervention. Two families elected to discontinue the intervention study, but agreed to participate in the assessments and one family discontinued all study participation. An additional

three families were unable to complete the intervention study due to the COVID-19 pandemic. Therefore, a total of 30 infants completed the intervention and participated in posttest assessments. We also recruited 37 infants who screened at LL-ASD. For this study, data collected at the first assessment from the 45 infants who screened at EL-ASD and the 37 infants at LL-ASD were used to address the first aim. We used the longitudinal data collected for the 30 infants who participated in the intervention and in posttesting for the second and third aims. Participant demographic information is provided in Table 2.1.

Table 2.1: Sample demographics

	EL-ASD- PIE intervention (n=30)	**EL-ASD- extension study (n=15)**	**LL-ASD (n=37)**
Adjusted age in months (SD)-Time 1	14.0 (1.72)	14.6 (1.68)	14.7 (1.61)
Sex- Female (%)	9 (30%)	5 (33%)	13 (35%)
Race- Not White (%)	10 (33%)	3 (20%)	3 (8%)
Ethnicity- Hispanic (%)	5 (17%)	3 (20%)	2 (5%)
Adjusted age in months (SD)- Time 2	18.3 (1.99)	--	--

Procedures, data collection methods, and instruments

For the purposes of this study, data from two assessment time points were used. The first time point occurred when children were aged between 11-18 months old; data from the initial time point were included in the analyses for all three study aims. Data from a second time point also were used for the analyses for Aims 2 and 3, which were restricted to the 30 infants at EL-ASD who also completed the intervention study. In the intervention study, all families completed the full intervention, but were randomly assigned to the order in which they participated in its two primary content components. For the current study, the data for the second time point were drawn from the assessment following each family's completion of the full intervention. This time

point occurred at approximately 4.5 months (183 days) after the first time point. The children who participated in the intervention were between the ages of 15-24 months old at the second time point. Participants were tested in a child-friendly assessment suite in the research project offices.

The assessment tools used at each time point relevant to the current study included:

The Mullen Scales of Early Learning (MSEL; Mullen, 1995)

The MSEL is a developmental assessment that can be used to assess children aged birth to 68 months. Four subscales are included in this measure: Visual Reception, Fine Motor, and Receptive and Expressive language. The receptive and expressive subscales were used in this study to assess a broad range of language skills. For example, the receptive subscale of the MSEL assesses behaviors such the child's response to his/her name, and understanding of gestures, vocabulary words, and simple verbal commands. The expressive subtest assesses behaviors such as the different consonant-vowel productions occurring in the child's babbling, gestures used by the child, and spoken words and phrases. In general, as the child ages, the skills assessed become more complex. The standard T-scores are used within the analyses for this study. The mean T-score for each subtest is 50 with a standard deviation of 10.

The Brief Observation of Social Communication Change (BOSCC; Grzadzinski et al., 2016)

The BOSCC is based on the Autism Diagnostic Observation Scale-2 (Lord et al., 2012), but designed to be more sensitive to change over time; subscores for social communication (SC) and RRB were used as continuous measures of ASD features for the purposes of the current study. Items on the BOSCC are not representative of all the items on the ADOS-2. Instead, the items were chosen based on evidence that they change with development and/or intervention (Grzadzinksi et al., 2016). Therefore, scores from the BOSCC provide us with results regarding

the severity of selected ASD features rather than the severity of comprehensive ASD symptomology. Higher scores on the BOSCC indicate more impaired features.

A response to joint attention (RJA) protocol adapted from the Attention-Following and Initiating Joint Attention Protocol (Watson, Baranek, & Poston, 2003)

The infants also participated in response to joint attention (RJA) probes interspersed within the assessment session. Three items were placed on the left side of the room and three items were placed on the right side of the room. Infants were directed to follow the gaze of the examiner toward an object with an increasing level of cues. There were a total of six RJA probes, broken into three sets. For each set, the examiner used specified cues to direct the infant's attention to an object on the right side of the room and an object on the left side of the room. Each probe was initiated by the examiner calling the infant's name, then providing the appropriate attention-directing cues for the probe, and last glancing back at the infant to see if the infant had followed the examiner's cues. For the first set of RJA probes, the examiner glanced at an object located on the right or left side of the room. For the second set of probes, the examiner looked and pointed to the objects. For the final set of RJA probes, the examiner looked, pointed, and verbalized "look." After the examiner completed one set of RJAs, he/she exchanged those objects for another set of objects. This protocol has demonstrated strong psychometric properties for young children diagnosed with ASD (Nowell et al., 2018). The summary score for this variable was the total number of RJA probes to which the child responded by looking at the object directed by the examiner.

Parent responsiveness rating scale

This rating scale was a project-specific measure used in the larger study to assess each parent's responses to his/her child's prelinguistic intentional and nonintentional communicative

acts from videos recorded during four parent-child interaction activities. The parent-child interaction activities included free-play, a "What's in the box?" activity in which the parent was instructed to take items out of a box one at a time and share them with the child, a snack that included a variety of food choices of different textures, tastes, and temperatures, and a caregiving routine (e.g., changing the child's diaper or wiping off the child's hands). A one- to seven-point-rating- scale was used to rate parents from unresponsive to extremely responsive to the child's prelinguistic communication cues during each activity. The summary score for this variable was the average rating across all of the parent-child interaction activities. Reliability for this tool was calculated for 20% of the videos. The intraclass correlation coefficients (ICCs) were 0.68 for single measures and 0.81 for average measures.

Analyses

We used StataSE 16 (StataCorp, 2019) and R version 3.5.1 (R Core Team, 2018) to conduct the analyses for this study. For the first aim, language dominance profiles were established by subtracting MSEL standardized expressive language scores from receptive language scores. Based on the criteria used by Davidson and Ellis Weismer (2017), meaningful standardized differences are defined as, "receptive-expressive difference scores that are beyond the standard error of measurement at the 95% confidence interval of the MSEL for the child's chronological age" (p. 2170). Language difference scores greater than or equal to a meaningful standardized difference on the MSEL were characterized as expressive dominant if the expressive language scores were significantly greater than the receptive language scores. The profile was characterized as receptive dominant if the receptive language scores were significantly greater than the expressive language scores. Children who presented with receptive-expressive difference scores that were within the standard error of measurement at the 95%

confidence interval were classified as having a balanced profile. A chi-square analysis was used to determine if the proportion of children demonstrating each language profile (i.e., expressive dominant, receptive dominant, balanced) was significantly different based on group risk status.

For the second aim, preliminary analyses were conducted to obtain descriptive statistics for the variables explored in Aims 2 and 3. The language variable used for analyses for Aims 2 and 3 was the receptive-expressive difference score. As described above, each child's MSEL expressive language T-score was subtracted from the MSEL receptive language T-scores to derive the child's language difference score (as the first step in determining their language profile for Aim 1). Therefore, positive language difference numbers indicated a receptive advantage (i.e., higher receptive than expressive language scores) and negative numbers indicated an expressive advantage (i.e., higher expressive language skills than receptive language scores). Thus, the language difference scores provide us with a continuous score that relates to the language profiles.

After the language difference score was obtained, we then analyzed the relationship between language difference scores and each predictor variable (i.e., RJA and parent responsiveness) using cross-lagged panel models. The cross-lagged panel models control for the correlations between the variables at the same time points and also for the stability of these variables across time (Kearney, 2018). The cross-lagged panel model was selected since it can be used to characterize the change in scores from one time point to the next. For example, we examined the association between RJA from Time 1 and RJA at Time 2. The cross-lagged panel model also was also used to assess the degree to which earlier RJA predicts later receptive-expressive difference scores as well as the extent to which earlier language difference scores predict RJA. A similar model was used to examine the longitudinal associations between

receptive-expressive difference scores and parent responsiveness. The associations of RJA and parent responsiveness with the receptive-expressive difference scores were of primary interest for testing the hypothesis for Aim 2.

For the third aim, cross-lagged panel models were used to determine the predictive power of the receptive-expressive difference scores in accounting for later ASD symptom features measured on the BOSCC. We conducted two different cross-lagged panel models: one with social communication (SC) features and one with restrictive and repetitive behavior (RRB) features.

Finally, post-hoc first-order correlations were computed to further examine the associations among receptive and expressive language scores, RJA, BOSCC scores, and parent responsiveness ratings.

Results

Aim 1

To determine if infants at EL-ASD are more likely than infants at LL-ASD to demonstrate an expressive dominant language profile.

Based on the data shown in Figure 2.1, there was not a significant difference in the profiles demonstrated by infants at EL-ASD when compared to infants at LL-ASD (X^2= 0.20, p-value = 0.90) when assessed between the ages of 11-18 months. The balanced profile was the most prevalent profile in both groups. This indicates that infants tended to demonstrate similar profiles despite varying levels of likelihood for ASD.

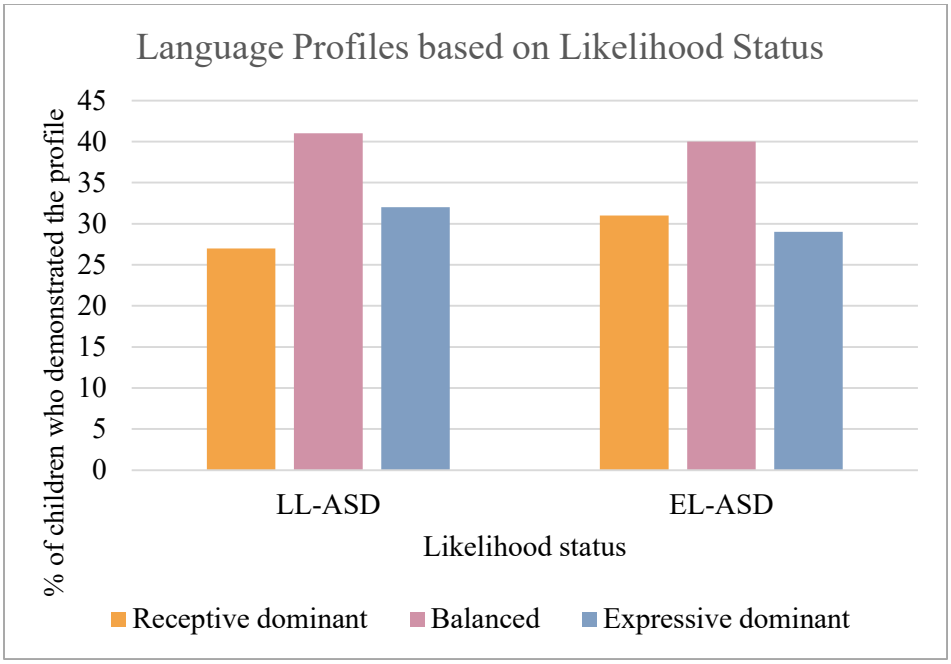

Figure 2.1: Language profiles of children at LL-ASD and children at EL-ASD

Aim 2

To develop an understanding of the variables (e.g., RJA, parent responsiveness) that are related to an expressive dominant profile

The preliminary analyses which include the descriptive statistics for the variables analyzed for this aim and Aim 3 are included in Table 2.2.

Table 2.2: Descriptive statistics for study variables

Variables	Time point	n	Mean	Std. Dev.	Min	Max
Receptive t-scores	1	30	33.23	10.91	20	60
Receptive t-scores	2	30	34.80	14.03	20	70
Expressive t-scores	1	30	32.80	10.08	20	51
Expressive t-scores	2	30	37.06	11.31	20	54
Difference scores	1	30	0.43	12.89	-15	36
Difference scores	2	30	-2.27	11.88	-20	21
RJA	1	30	2.57	2.3	0	6
RJA	2	30	3.80	2.31	0	6
Parent responsiveness	1	30	4.31	1.08	2.25	6.25
Parent responsiveness	2	30	4.38	1.02	2	6
BOSCC - SC	1	24	31.92	4.84	22	37.5
BOSCC - SC	2	24	29.85	6.71	17.5	37.5
BOSCC - RRB	1	24	5.72	1.89	3	9.5
BOSCC - RRB	2	24	4.77	1.45	3	8.5

For Aim 2, we first conducted a cross-lagged panel analysis in order to examine the relationship between difference scores and RJA (Figure 2.2). There were significant associations between the language difference scores at Time 1 and Time 2 as well as between RJA at Time 1 and Time 2. This means that the language difference scores at Time 1 were predictive of the language scores at Time 2. Similarly, RJA at Time 1 was predictive of RJA at Time 2. The associations between RJA and language difference scores across time points were not significant.

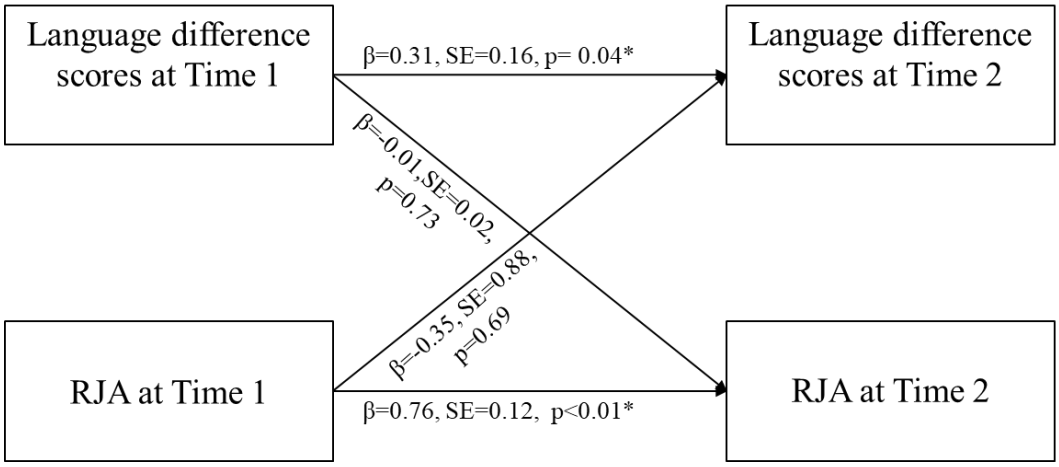

Figure 2.2: Cross-lagged panel model for RJA and language difference scores
Note: n = 30, SE= standard error, * = p <0.05

Similarly, with the cross lagged panel model that included the parent responsiveness ratings and the language difference scores, there was a relationship between the language difference scores at Time 1 and Time 2 (Figure 2.3). There was also a significant relationship between the parent responsiveness scores at Time 1 and Time 2. The relationship between parent responsiveness and language difference scores across time points was not significant.

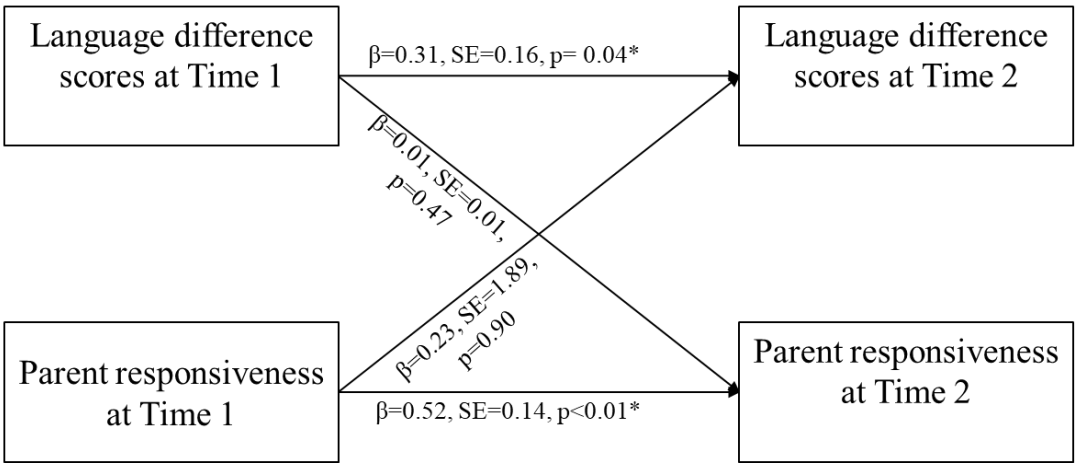

Figure 2.3: Cross-lagged panel model for parent responsiveness and language difference scores
Note: n = 30, SE= standard error, * = p <0.05

Aim 3

To determine if language profiles are associated with ASD symptom features, specifically social communication skills and restrictive and repetitive behaviors.

Results of the cross-lagged panel analysis with the social communication features from the BOSCC and language difference scores revealed that there were no significant associations between these variables, across time points (Figure 2.4). In contrast, the cross-lagged panel analysis that included both the RRBs and language difference scores revealed that there was a significant relationship between the language difference scores, with the time 1 language difference scores predicting the time 2 difference scores in the cross-lagged panel (Figure 2.5).

All of the cross-lagged panel models were saturated (X^2= 0) due to the small sample size. Therefore, these results should be interpreted with caution.

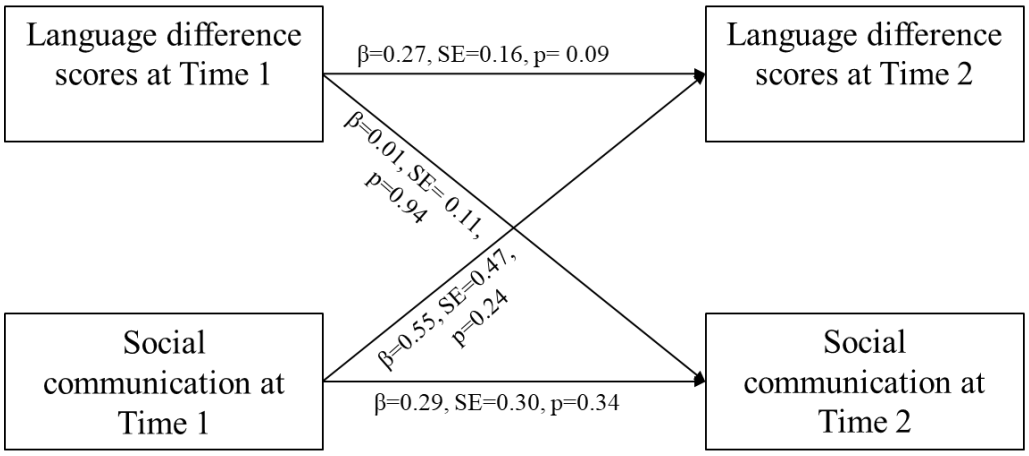

Figure 2.4: Cross-lagged panel model for SC features and language difference scores
Note: n = 19, SE= standard error, * = p <0.05

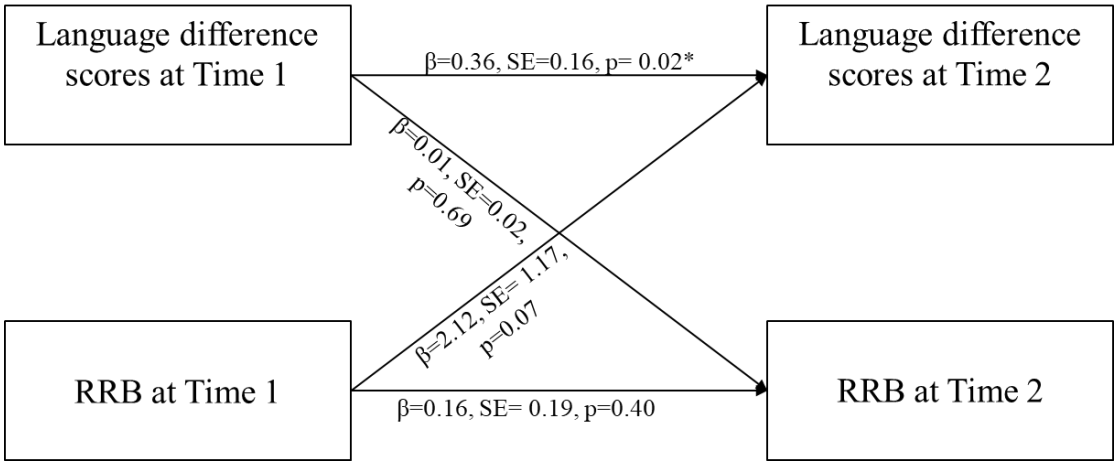

Figure 2.5: Cross-lagged panel model for RRB features and language difference scores
Note: n = 19, SE= standard error, * = p <0.05

Post hoc analyses

Given the absence of hypothesized associations between the language difference scores and other study variables, the first order correlations between receptive and expressive language standard scores and the other variables of interest in this study (i.e., RJA, parent responsiveness, RRB features and SC features) were examined as information that could contribute to a revised conceptual framework for understanding the patterns of language development in infants at EL-ASD (Table 2.3). The first order correlations between RJA and the language scores indicated that there were significant concurrent correlations of RJA with both receptive and expressive

language at Time 1 and Time 2. Also, there were significant relationships between both receptive and expressive language scores at Time 1 and RJA at Time 2. There were also significant correlations between language scores and social communication features within time points. There were no significant correlations between parent responsiveness and language scores or between language scores and RRB features at any of the time points.

Table 2.3: First-order correlations between study variables and language scores

Measures	n	r	p-value
Receptive scores at T1 and RJA at T1	30	0.55	<0.01*
Expressive scores at T1 and RJA at T1	30	0.54	<0.01*
Receptive scores at T1 and RJA at T2	30	0.48	<0.01*
Expressive scores at T1 and RJA at T2	30	0.52	<0.01*
RJA at T1 and Receptive scores at T2	30	0.22	0.23
RJA at T1 and Expressive scores at T2	30	0.33	0.07
Receptive scores at T2 and RJA at T2	30	0.41	0.02*
Expressive scores at T2 and RJA at T2	30	0.64	<0.01*
Receptive scores at T1 and PR at T1	30	0.22	0.23
Expressive scores at T1 and PR at T1	30	0.20	0.29
Receptive scores at T1 and PR at T2	30	0.15	0.42
Expressive scores at T1 and PR at T2	30	0.00	0.99
Receptive scores at T2 and PR at T1	30	-0.14	0.46
Expressive scores at T2 and PR at T1	30	-0.21	0.27
Receptive scores at T2 and PR at T2	30	-0.21	0.27
Expressive scores at T2 and PR at T2	30	-0.18	0.34
Receptive scores at T1 and SC at T1	24	-0.40	0.05*
Expressive scores at T1 and SC at T1	24	-0.61	<0.01*
Receptive scores at T1 and SC at T2	24	-0.21	0.33
Expressive scores at T1 and SC at T2	24	-0.28	0.18
SC at T1 and Receptive scores at T2	24	-0.23	0.27
SC at T1 and Expressive scores at T2	24	-0.39	0.06
Receptive scores at T2 and SC at T2	24	-0.10	0.66
Expressive scores at T2 and SC at T2	24	-0.43	0.04*
Receptive scores at T1 and RRB at T1	24	-0.21	0.32
Expressive scores at T1 and RRB at T1	24	-0.01	0.96
Receptive scores at T1 and RRB at T2	24	-0.28	0.18
Expressive scores at T1 and RRB at T2	24	-0.33	0.11
RRB at T1 and Receptive scores at T2	24	-0.08	0.72
RRB at T1 and Expressive scores at T2	24	0.14	0.51
Receptive scores at T2 and RRB at T2	24	-0.04	0.86

Expressive scores at T2 and RRB at T2	24	-0.35	0.10

*p ≤ 0.05

Discussion

In the current study, the language profiles of infants who screened at EL-ASD and infants who screened at LL-ASD were first investigated. Infants who screened at EL-ASD presented with a variety of language profiles between the ages of 11-17 months. The frequency of these profiles was not significantly different from the profiles demonstrated by infants at LL-ASD. Therefore, the hypothesis that the expressive dominant profile would be more prevalent for infants at EL-ASD than for infants at LL-ASD was not supported by these results. The results from this study are different from the results of other studies examining the language profiles of young children diagnosed with ASD (Reinhartsen, 2019, Seol 2014). As noted by Reinhartsen et al. (2019), the expressive dominant profile is not necessarily the most prevalent profile in young children with ASD; however, when examining its occurrence across diagnostic groups, it is noticed to be most prevalent in children diagnosed with ASD. Within the current study, this was not the case when comparing children at EL-ASD and children at LL-ASD. There are a few potential explanations for the lack of significant differences in the profiles demonstrated by the two groups.

First, a previous version of the FYI had a positive predictive value (PPV) of 0.31 for an ASD diagnosis (Turner-Brown et al., 2013). While a different version of the FYI was used in this study, unpublished psychometric findings for the FYI-Lite indicate that it has a similar PPV for an ASD diagnosis for the age range of infants in this study. Therefore, approximately one third of the infants at EL-ASD in this study will be later be diagnosed with ASD. Turner-Brown et al. (2013) also noted that 85% of their sample, identified with an earlier version of the FYI, were either diagnosed with developmental disorder (including ASD as well as other developmental

disorders) by age 3 years, 6 months, or their parents expressed concerns about their development. Anticipating that infants identified by the FYI-Lite used in this study will have similar outcomes, then we would expect variability in the profiles demonstrated by our sample of infants at EL-ASD. This variability would occur in part because not all of the children are expected to present with the same disorder and a smaller proportion of the children will potentially not present with any developmental concerns at follow up.

Differences in language profiles based on final diagnosis of infants at EL-ASD has been explored in infant sibling studies (Lazenby et al., 2016; Swanson et al., 2017). For example, Swanson et al. (2017) indicated that the language advantage of children differed based on their diagnosis at age two years. Children who were at EL-ASD and later diagnosed with ASD showed a balanced profile or expressive advantage. In contrast, children who were diagnosed with another disorder or who were typically developing demonstrated, on average, a receptive advantage. This suggests that final diagnoses provide more insight into profiles that are more likely to occur within infancy and toddlerhood. Nevertheless, contrary to the hypothesis for Aim 1, the proportion of infants at EL-ASD and at LL-ASD who demonstrated expressive dominant profiles did not significantly differ, with about one-third of the infants in each group showing this profile. This finding suggests that for the infants included in this study, the presence of an expressive dominant profile between 11 to 18 months is unlikely to be predictive of a later ASD diagnosis.

Second, different types of language skills are being assessed at different age ranges, and therefore, the age of the children may play a role in the presence of the expressive dominant profile. For example, Swanson et al. (2017) assessed the language skills of children at 6, 12, and 24 months; however, they noted that the expressive advantage did not differentiate among groups

of children until 24 months of age. Reinhartsen et al. (2019), studying children with ASD who ranged in age from 30 to 68 months old, reported that as children aged, they were less likely to demonstrate the expressive dominant profile. The present study adds to the literature on language profiles because other researchers have not investigated the language profiles of infants at EL-ASD identified via screening. These results suggest that the expressive dominant profile may not be more prevalent in children at EL-ASD or diagnosed with ASD than in children diagnosed with other developmental disorders or typically developing children below the age of two. Thus, these results are similar to those of Swanson et al. (2017), who also did not find a higher prevalence of the expressive advantage in toddlers at EL-ASD until the age of two. However, unlike the Swanson et al. (2017) study, this study cannot specify at which age the expressive dominant profile is most likely to be most prevalent in infants at EL-ASD because there is no evidence in this study that the expressive dominant profile has a specific association with ASD likelihood or ASD symptom severity in the age range studied.

The prevalence of profiles at specific ages may be influenced by the skills assessed during these age ranges. For example, the MSEL initially assesses children's understanding of common words, gestures, and commands. As the child ages, the areas of understanding become more complex. Children are asked to demonstrate their understanding of words by manipulating objects or selecting pictures, beginning with nouns, then verbs, adjectives, and spatial terms. It could be that children with ASD do not have as much difficulty with the initial concepts assessed, but as the concepts become more complex, their receptive language skills are no longer continuing to develop in the same way. Therefore, a better understanding of what types of receptive language skills are difficult for toddler and preschool-aged children who present with an expressive dominant profile, and whether they have relatively more difficulty learning some

receptive language concepts than children with receptive dominant or balanced profiles, is warranted.

A final factor possibly influencing the prevalence of the expressive dominant profiles in both infants at EL-ASD and infants at LL-ASD is the language domains measured in different language assessments. In addition to different language domains being assessed at different ages, often there are differences in the language domains tested within standardized assessments. For example, the MSEL includes items that test a variety of language domains such as semantics, phonology, and syntax, as the child ages. In contrast, the MacArthur-Bates CDI Words and Gestures (MCDI; Fenson et al., 2007) is focused more on semantics as represented by vocabulary knowledge. However, studies using both the MCDI and the MSEL have produced evidence supporting a high prevalence of expressive dominant profiles in young children between the ages of 30-68 months old with ASD (McDaniel, 2019; Reinhartsen, 2019). Similarly, Nevill et al. (2017) indicated that within their sample of children aged 19-46 months old, children were more likely to demonstrate an expressive dominant profile when assessed with the MSEL, but were more likely to demonstrate a receptive dominant profile on the Preschool Language Scale, Fifth Edition and a balanced profile on the Vineland Adaptive Behavior Scales, Second Edition (Sparrow et al., 2005). Davidson and Ellis Weismer (2017), however, had a large percentage of children who demonstrated an expressive dominant profile when assessed with the Preschool Language Scale, Fourth Edition (Zimmerman et al. 2002).

In addition to the different domains targeted within some language measures, Luyster et al. (2008) noted that developmental measures differ in their structure. For instance, they noted that measures differ in the number of items within each language subtest. They further explained that the expectations for the age at which different milestones are met might vary across

assessments. Therefore, to better understand why the expressive dominant profile is more prevalent for children with ASD within the toddler and preschool years, further investigation into which skills these various instruments are capturing during that time period is needed. For example, if the expressive dominant profile is primarily based on vocabulary knowledge or semantics, we would expect more variability in language skills and language profiles between the toddler and preschool years when, typically, there is a large growth in vocabulary. Therefore, examining the language domains captured by assessment instruments used across different studies examining language profiles in children at EL-ASD or diagnosed with ASD may also provide insight into why there were no significant differences in the profiles demonstrated by the EL-ASD and LL-ASD groups within this study who were, on average, younger than the participants of most other studies.

For the second aim, we analyzed the relationship between RJA and language difference scores. RJA was not identified as a predictor of language difference scores. Therefore, the hypothesis that higher RJA skills would be predictive of a receptive advantage was not supported by the results of this study. As a result, the performance of the children on the RJA probes cannot be used to explain the language profiles within this sample. However, these results may differ within a larger sample in which there would be more power to detect significant associations between RJA and language difference scores within a cross-lagged panel model.

While RJA was not significantly associated with the language difference scores, posthoc analyses indicated this skill was moderately correlated with the receptive and expressive language scores within this sample. Specifically, RJA and the receptive and expressive language scores were moderately correlated with one another within each time point, and receptive and expressive language scores at Time 1 were moderately correlated with RJA scores at Time 2.

However, RJA at Time 1 did not correlate significantly with the language scores at Time 2. This may be due to the age at which the children were assessed. Previous research investigated the relationship between RJA in typically developing infants who were six months and their language skills at 24 months and 30 months (Morales et al., 2000). Perhaps, this means that variability in the RJA skills at an even earlier age is important for determining the predictive relationship between RJA and language skills. It could also mean that the language skills measured at 24 months are more closely associated with earlier RJA skills versus language assessed at 18 months. In summary, the results of this study do not support a causal argument, but they do demonstrate that there is a relationship between language skills and RJA, as also indicated in other studies (Toth et al., 2006; Yoder et al., 2015). In addition, these results provide no evidence that RJA is more associated with receptive language versus expressive language. RJA skills may relate to the attention skills needed to develop receptive and expressive skills at various ages. Further exploration into how these skills relate to language development of infants at EL-ASD is warranted.

The association between parent responsiveness and language difference scores was also explored within Aim 2. Similarly, parent responsiveness was not predictive of language difference scores within this study. Therefore, the hypothesis that an expressive language advantage would be associated with lower parent responsiveness skills was rejected.

Further investigation through posthoc analyses into the correlations between parent responsiveness and receptive and expressive scores revealed that there were also no significant associations between these variables, and all correlations were small in magnitude. These results could be due to the measure used to assess parent responsiveness within this study. We used a project-developed rating scale to measure both the nonverbal and verbal responsivity of the

parent to the child's cues. The reliability statistics for the parent responsiveness measure indicated that the amount of measurement error in this tool could have impeded our ability to detect associations of parent responsiveness with other variables. Findings from prior research investigating the relationship between parent responsiveness and language development also are informative regarding potential limitations in our tool. For example, previous studies have documented that follow-in comments, a specific type of parent responsiveness, were correlated with later language skills (Haebig et al., 2013; Perryman et al., 2013). Therefore, a focus on specific types of parent responsiveness may have provided us with different results. Edmunds et al. (2019) arrived at a similar conclusion in their systematic review and meta-analysis of parent responsiveness and child communication. Their results indicated that coding for specific types of parent responsiveness behaviors provided more insight into the relationship between these behaviors and the outcome variables. They also noted that studies that coded parent responsiveness behaviors were more likely to have significant findings than studies that used global rating scales. Therefore, while there were no significant relationships between parent responsiveness and language scores within this study, further examination of specific types of parent responsiveness behaviors may produce different results.

Finally, there were no significant relationships between language difference scores and ASD features within this sample. Therefore, the results did not support our hypothesis for Aim 3 in which we believed proposed that an expressive dominant profile would be predictive of more severe SC features and RRB features. While there were no significant associations between the SC features and the language difference scores, the posthoc analyses demonstrated that significant first order correlations between these features and both receptive and expressive language scores at Time 1, as well as between SC features and expressive language at Time 2.

These associations are unsurprising since the BOSCC includes items like social response and engagement (Grzadzinski et al., 2016). Therefore, similar to a suggested interpretation of the RJA probes, items on the BOSCC may reflect in part the child's ability to attend to others. Since our results indicate that there is a relationship between infants' RJA skills and language, it is unsurprising that there also is a relationship between their SC features and language. However, the BOSCC assesses a wide range of skills within the SC domain, whereas the RJA probes assess only one specific skill; therefore, the patterns of correlations between RJA and language scores may not be fully aligned with the patterns of correlations between SC features and language scores. Overall, these results continue to highlight that the standard language scores appear to provide us with more insight into the relationship between these variables within infants at EL-ASD than the language difference scores.

In contrast to the significant associations between social communication features and language scores obtained in the posthoc analyses, there were no significant correlations between RRBs and language scores. This may be due to the limited number of RRBs demonstrated by the infants during the assessments. Possibly, as the children age, the RRBs will become more apparent in some of them. Then there may be a significant concurrent or predictive relationship between RRBs and language scores. Previous studies that reported significant associations between RRBs and language development assessed children who were older than the children in this sample (Larkin et al., 2017; Ray-Subramanian & Ellis Weismer, 2012). Therefore, there may be correlations between language scores and RRB features in late toddlerhood.

Limitations

The sample size in this study was small. Therefore, the results obtained from the cross-lagged panel analyses, in particular, should be interpreted with caution. The reliability of the

parent responsiveness rating scale used for this study was lower than desired. Also, diagnostic outcomes for these children are not yet available, so we do not know how many children will be diagnosed with ASD or other disabilities that may impact their patterns of language learning. In addition, analyses for Aims 2 and 3 involved a group of infants at EL-ASD who participated in a parent-mediated intervention between Time 1 and Time 2; thus, the intervention may have disrupted associations across the timepoints that would have been observed in a sample of infants at EL-ASD and their parents in the absence of any intervention.

Conclusion and Future directions

The early language development of infants at EL-ASD is more likely to be delayed when compared to the early language development of infants at LL-ASD (Ozonoff et al., 2010; Swanson et al., 2017). However, in this study, in looking at the language profiles demonstrated within these two groups, there were no significant differences in the language profiles demonstrated within these two groups. Future studies should continue to investigate the specific aspects of language development that are often delayed in children at EL-ASD. A recent study conducted by the Autism and Developmental Disabilities Monitoring (ADDM) Network indicated that, within their sample of four-year-old children, the percentage of children who had the first evaluation before 36 months of age was higher in 2016 than the results from two years earlier (Shaw et al., 2020). Their finding may reflect an increase in awareness of early ASD symptoms and/or increased rates of early screening for ASD, and suggests that we may have opportunities to learn more about the patterns of early language development specific to children with ASD if the age of first evaluation continues to decrease. In addition, we should continue to explore the relationships between social communication skills and language development within this population so that we can develop and refine interventions that are individualized to their

needs. Finally, further investigation about the relationship between language development patterns and ASD symptomology is warranted. Perhaps, paralleling findings in the literature about RJA and parent responsiveness, the relationship between the severity of ASD symptoms and language may differ based on the age of the child. Therefore, this should also be investigated in future research.

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CHAPTER 3: AN INVESTIGATION OF THE COACHING STRATEGIES USED WITHIN A PARENT MEDIATED INTERVENTION

Introduction

Over the last ten years, there has been an increase in the number of parent-mediated interventions and studies of those interventions for children diagnosed with autism spectrum disorder (ASD) (Oono et al., 2013). Parent-mediated interventions are interventions in which parents are trained to implement strategies with their child. These interventions are the most commonly used interventions among children at an elevated likelihood of a later diagnosis of ASD (EL-ASD) or diagnosed with ASD who are under the age of two years old (Bradshaw et al., 2015). They are designed to support parents (or other family caregivers), who typically spend more time with their child than other adults, by helping them to learn about strategies designed to meet the needs of their child and practice these strategies within their daily routines. In addition, this type of intervention follows the recommended practices of the Division for Early Childhood of the Council for Exceptional Children (DEC) and the guidelines of Part C of the Individual with Disabilities Education Act (IDEA), which encourage and require family-centered and family capacity-building practices (DEC, 2004; IDEA, 2004). Many studies of interventions for infants and toddlers at EL-ASD or diagnosed with ASD focus solely on the parent and child skills targeted within the intervention (e.g., parent responsiveness, child adaptive behavior or social communication) (Bradshaw et al., 2015; Kasari et al., 2014; Oono et al., 2013). However, many professional guidelines related to interventions for children within the birth-to-three age range include a focus on another critical aspect of the intervention process, how interventionists

interact with parents (American Speech-Language-Hearing Association, 2008; DEC, 2004). Therefore, an examination of the interactions between parents and interventionists and the impact that these interactions have on the outcomes of the intervention is warranted.

Coaching within parent mediated interventions

One way to investigate the strategies that interventionists use to empower and build the capacity of parents is by exploring the ways in which interventionists work with parents within parent-mediated interventions. One common service delivery approach used in parent mediated interventions is coaching. Rush and Shelden (2011) defined coaching as, "An adult learning strategy in which the coach promotes the learner's ability to reflect on his or her actions as a means to determine the effectiveness of an action or practice and develop a plan for refinement and use of the action in immediate and future situations" (p. 8). Therefore, the role of the coach in coaching is to support the parent in implementing the intervention. As noted by Woods et al. (2011), within the coaching model, parents have the opportunity to create strategies with their interventionist and practice those strategies within the intervention session. Thus, interventionists are expected to facilitate active participation from the parents within coaching interventions. This is not only important for creating family-centered services, but also because active participation has been identified as a significant component of adult learning methods (Trivette et al., 2009). As stated by Trivette et al. (2009), the more opportunities adult learners have to engage within the learning process, the easier it is for them to acquire new knowledge. Therefore, there are many benefits to using the coaching service delivery approach. However, there are many different types of coaching models, and consequently, the definitions of coaching often vary across studies (Kemp & Turnbull, 2014; Lorio et al., 2020). As a result, the frequency in which different coaching behaviors occur within these interventions may also vary.

There are a variety of coaching behaviors that can be used within intervention sessions. Some coaching behaviors examined in prior research are information sharing, observation, joint interaction, direct teaching, demonstration with narration, guided practice, caregiver practice, feedback, problem solving, and reflection (Brown & Woods, 2015; Friedman et al., 2012). The frequency in which these behaviors are used within intervention sessions varies. For example, Kemp and Turnbull (2014) reported that the coaching models tended to fall on a continuum with an intervener-derived protocol being on one end and a relationship-derived process being on the other end. Within the intervener-derived protocol, Kemp and Turnbull (2014) noted that interventionists often delivered an intervention with an established curriculum. Therefore, the interventionists made the decisions about the strategies recommended to the families and often had ideas about when parents should implement those strategies. As a result, direct teaching and modeling behaviors were most often used in this model. In contrast, Kemp and Turnbull (2014) stated that within the relationship-derived protocol, interventionists focused on creating an intervention in which they collaborated with the parents on the strategies and contexts in which they would best be implemented. Therefore, reflection, joint interaction, and feedback were most often used in this model. While most interventions utilized some components of both types of coaching models (i.e., intervener- or relationship-focused), the type of intervention used was predictive of which coaching strategies were most frequently used within the intervention (Kemp & Turnbull, 2014). However, even with this understanding that interventionists may be more likely to use specific strategies based on the type of coaching intervention being implemented, it is essential to note that some behaviors are more and less likely to occur across all interventions.

Interventionists often implement child-focused behaviors within intervention sessions (McBride & Peterson, 1997; Salisbury & Cushing, 2013). McBride and Peterson (1997)

described this behavior as being instances in which the interventionists are focused solely on the child. Interventions that primarily use this behavior are described as following a more traditional approach (Fleming et al., 2011). This behavior does not follow the guidelines of family-centered practices nor conform to Rush and Shelden's (2011) definition of coaching. Therefore, it prompts questions about why interventionists often resort to child-focused interactions within intervention sessions when the intended service delivery approach is coaching. One explanation for these observations is the training background of the interventionists. Many interventionists have been trained to work directly with the child rather than to work with the child's caregivers (Campbell & Coletti, 2013; Fleming et al., 2011). As a result, they may have difficulty transitioning to a coaching style in which the goal is to focus more on actively involving parents within the intervention and empowering them to work with their child. Thus, insight into why interventionists are using child-focused behaviors may help us to understand why they may continue to occur within coaching service delivery models

In contrast to child-focused behaviors, two behaviors that interventionists use less frequently are reflection and problem solving (Lorio et al., 2020). Within their review of intervention studies, Lorio et al., (2020) reported that problem solving and reflection were often not included in the intervention descriptions. In addition, when problem solving and reflection were included in those articles, they noted that the authors often failed to provide sufficient descriptions of these coaching behaviors. They suggested that one possible reason why these strategies are not used frequently in intervention sessions is due to a lack of information about how to implement these strategies and the potential impact of these strategies. Therefore, limited training in capacity-building practices not only may account for the frequent use of child-focused

behaviors but also to the infrequent use of coaching behaviors such as reflection and problem solving.

Demographic variables and coaching behavior use

Variability in the use of coaching behaviors may be associated with interventionist factors, such as level of training, area of training, or years of experience, or to the characteristics of the family and child, such as the culture, motivation, and learning styles of the parent(s) participating in the intervention (Fleming et al., 2011; Friedman et al., 2012; Meadan et al., 2018). One particular demographic variable that appears to impact the coaching behaviors used by interventionists is the socioeconomic status of the families receiving the intervention, specifically the education level of the parent. Previous research has indicated that interventionists are more likely to engage in child-focused behaviors and not to describe these behaviors to the parents when the parents had attained less education (Sawyer & Campbell, 2017). This may be due to the interventionists' perceptions of the parents' needs as it relates to effectively implementing the intervention. For example, Fleming et al. (2011) stated that early childcare providers indicated that the education level of the parents was one factor that impacted parent participation within the intervention sessions. Within this same study, some of the providers stated that the education level of the parents impacted the ease in which they were able to implement the intervention as intended. Therefore, some interventionists may have preconceived notions about the family's understanding of the intervention and how much they will participate in it based on the family's education level, and select coaching behaviors accordingly.

In addition, interventionists may make assumptions about the parent's knowledge of early childhood development based on the education level of the parent. The relationship between

parental education level and early child development has been investigated within previous studies (Jeong et al., 2017). Children who have parents with higher education levels tend to demonstrate more advanced skills in areas such as language development than children with parents with lower education levels (Dollaghan et al., 1999; Hoff, 2003). This relationship between parent education and child developmental skills has been attributed to parent behaviors (Hoff, 2003; Jeong et al., 2017; Magnuson et al., 2009). For example, prior studies have documented that parents with higher levels of education generally were more responsive to their child (Magnuson et al., 2009), provided more verbal input (Hoff, 2003), used more complex language (Vernon-Feagans et al., 2019), and participated in more stimulating activities with their child (Jeong et al., 2017). Therefore, within coaching interventions, interventionists may also observe these differences in parenting behaviors based on parent education levels and individualize the coaching behaviors implemented within the session in an effort to meet the needs of the parent or what they perceive to be the needs of the parent. For example, interventionists may decide to use behaviors such as direct teaching or demonstration with parents who are less knowledgeable about child development and the behaviors that facilitate child development. While interventionists should not solely focus on the education level of the parent when determining which coaching strategies to use with the parents, the education level should be recognized as one characteristic of the parent that potentially impacts the interventionists' implementation of specific coaching strategies. Therefore, as we explore the coaching behaviors, it is also important to examine not only the types of coaching strategies that interventionists use with caregivers, but also factors that influence the coaching behaviors used by interventionists.

Coaching interventions and parent outcomes

Finally, research on the impact of the use of specific coaching behaviors on adult outcomes is limited. Trivette et al. (2010) noted the cascading effects of help-giving practices on family-system practices and also parent self-efficacy beliefs. These practices and beliefs were then observed to impact the well-being of the parents. Together, these factors ultimately influenced parent-child interactions and, consequently, child development. These results, however, are not explicitly focused on coaching interventions. Therefore, there is a call for research specific to the benefits of coaching practices on parent and child outcomes.

Recent literature has described the relationship between coaching strategies and parent outcomes. For example, Brown and Woods (2015) indicated that coaching strategies that required parent participation (i.e., observation, guided practice with feedback, and caregiver practice with feedback) were linked to the parents' use of intervention strategies within the intervention session. Although coaching behaviors that required the parents to interact with their children within the intervention session were more likely to encourage immediate use of strategies (Brown & Woods, 2015), it is unclear if this same relationship is observed between coaching behaviors used and outcomes measured over a longer period of time. Therefore, the relationship between coaching behaviors and parent outcomes over time should also be investigated.

One specific parent outcome investigated in early childhood development is parent responsiveness. Children diagnosed with ASD demonstrate challenges in their ability to engage with others (Adamson et al., 2009). Adamson et al. (2009) reported that children with ASD were less likely to demonstrate coordinated joint engagement than children with Down syndrome or children who were typically developing. Thus, within the Adamson et al. (2009) study, children

with ASD showed fewer instances in which they shifted their attention from the object and acknowledged the other person engaged in the same activity. Parents can perhaps compensate for their children's impairments in engagement with others by becoming even more responsive than they would naturally be to their child's cues. One intervention that focuses on building parent responsiveness is called Responsive Teaching (Mahoney & Perales, 2005). The aim of this intervention is to increase parent responsiveness in order to build the child's pivotal behaviors (e.g., joint attention, imitation) with the long-term goal of promoting better language and social emotional development (Mahoney & Perales, 2005). Mahoney and Perales (2005) documented that, following the intervention, parents demonstrated an increase in responsiveness to the child, and their increased responsiveness was associated with improved child outcomes. Similarly, Watson et al. (2017) used an adapted version of this intervention, Adaptive Responsive Teaching (ART), to train parents of children at EL-ASD on responsive strategies to improve the pivotal child behaviors in the domains of social-communication and sensory-regulation.

The purpose of the current study is to provide new information on the coaching strategies that interventionists use with parents within intervention sessions, factors that may impact the coaching strategies used, and the relationship between coaching strategies used within intervention sessions and the changes in adult outcomes. Therefore, the following research questions will be investigated in this study: 1. Which coaching strategies are most frequently used by interventionists implementing ART? 2. Do the strategies used by ART interventionists vary based on the education level of the parents? 3. After controlling for initial parent responsiveness, are there specific coaching strategies that are predictive of change in parent responsiveness after participating in ART?

Method

This study comprised a secondary analysis of extant data collected within a clinical trial that examined the efficacy of Adaptive Responsive Teaching (ART) (Watson et al., 2017). The methods included new coding of coaching videos collected in Watson et al. to address the research questions regarding coaching behaviors.

Participants and setting

Families

Recruitment for the ART trial occurred through mailings of the First Year Inventory 2.0 (FYI; Baranek et al., 2003) to families of one-year-old infants within a designated catchment area of central North Carolina which included 6 local counties. The families of children whose results met the FYI cut-off criteria for being at an elevated likelihood for later ASD (Turner-Brown et al., 2013) were invited to participate in this research study. There were a total of 87 infants enrolled in this study, with 45 of the infants randomized to the ART intervention (Watson, 2017). There was at least one intervention fidelity video available for 43 of the 45 families randomized to the ART group; videos available for these 43 families were used for the current study. ART took place in families' homes, and videos were recorded in that setting. The average age of the children included in this study was 13.8 months old (*sd*= 0.72) at pretest and 22.6 months old (*sd*=0.98) at posttest. The mother was the primary parent who participated in the intervention for 21 of the 43 families (Watson et al., 2017). For the remainder of the families, either the father alone (one family), a grandparent (two families) or both parents (19 families) participated in the intervention. For the purposes of this paper, the participating caregivers will be called "parents" due to the predominance of parent caregivers in the study. The education level of the primary parent ranged from 9^{th} -11^{th} grade to a graduate or professional degree. The average of the primary parent was 33 years old. See Table 3.1 for specific details about

demographics of the parents. For the purposes of analysis, the different education levels were reduced to three groups, as shown in Table 3.1

Table 3.1: Sample demographics

Education level *n*	Primary parent	Combined education levels
9th-11th grade	2	Some college or less (n=12)
High School Degree or GED	4	
Vocational or trade degree after High School	2	
Associates or 2 year degree	1	
Courses toward college degree	3	
College degree	13	4 year college degree (n=13)
Master's degree	13	Graduate/professional degree (n=18)
Professional degree	5	
Race	Primary parent *n (%)*	
White	32 (74%)	
Black or African American	10 (23%)	
American Indian/ Alaska Native	1 (2%)	
Age range	Primary parent *n (%)*	
<20	1 (2%)	
20-29	9 (21%)	
30-39	27 (63%)	
40-49	3 (7%)	
Unknown age	3 (7%)	

Interventionists

The six interventionists who provided ART coaching had previous knowledge about or experience working with children with developmental disorders. All six of the interventionists were White and female. Two of the interventionists had obtained a bachelor's degree in psychology. One of the interventionists with a bachelor's degree had 2 years of experience and the other interventionist had 12 years of related experience with children and their parents, including children with developmental disabilities. Two interventionists had a masters' degrees in occupational therapy, with one interventionist having 3 years of related experience and the

other interventionist having 24 years of experience. One interventionist had a master's degree in early childhood special education and she had 12 years of experience in that field. Finally, one interventionist had a master's degree in psychology and she had 10 years of related experience.

All of the interventionists were trained on the ART intervention by the lead interventionist, who had been trained in Responsive Teaching by two of the developers, Drs. Gerald Mahoney and Frida Perales. The interventionists' fidelity to the intervention was measured using the ART Implementation and Fidelity checklist, a 25-item tool adapted from Mahoney and MacDonald (2007) (Watson et al., 2017). Fidelity raters were asked to rate the extent to which expected interventionist behaviors were observed (i.e., minimally, moderately, maximally) using a scale of 1-7. The more the behaviors were used by the interventionist, the higher the rating score. As reported by Watson et al., (2017), they obtained a fidelity score of 0.87 on the ART fidelity tool, which was classified as "good" based on the qualitative fidelity levels. Although interventionists were not specifically trained on the coaching behaviors as defined by Friedman et al. (2012) and applied to the current investigation (see Table 3.2), all of the coaching behaviors included in the current study were either named or described on the fidelity rating tool. Therefore, interventionists' use of the coaching behaviors investigated in the current study was expected in the ART intervention as part of the behaviors associated with high fidelity implementation of ART.

Measures

Coaching behaviors

Coaching behaviors were coded using definitions from Brown and Woods (2015) and Friedman et al. (2012) to capture the frequency of the coaching behaviors used within the videos.

Parent responsiveness

A parent responsiveness coding system adapted from Yoder et al. (2015) was used to measure parent responsiveness within the original intervention study. Coders were trained to code child leads and parent responses within 5-second intervals (Watson et al., 2017). Watson et al. (2017) obtained parent responsiveness percentages by dividing intervals containing parent responsive behaviors by the total of codable intervals.

Demographic form

The demographic form provided information about the educational level of the parents, and the age and race/ethnicity of the children.

Procedures

Pretest and Posttest

Watson et al., (2017) collected the demographic information at pretest. Parent responsiveness was assessed at baseline and post intervention.

Intervention and coaching behavior coding

The ART intervention occurred within the homes of the participants. The average number of intervention sessions that each family participated in was 24.9 sessions out of a planned 30 sessions (Watson et al., 2017). For the majority of the families, the intervention spanned a six- to eight-month period. A maximum of 6 intervention sessions were recorded for fidelity purposes for each family. The primary author randomly selected two fidelity videos per family and used those videos to analyze the coaching strategies used within the intervention sessions. There was only one video available to code for four of the families. A total of 82 videos were coded.

The first author of the current study trained five research assistants on an adapted version of the Coaching Coding Manual developed by Friedman et al. (2012). The manual was adapted for this study in order to more reliably and completely capture behaviors demonstrated by the

interventionists. We adapted the manual by first reviewing the definitions and examples provided in the manual and then using it to code intervention videos not included within this study. Then, we added descriptions to the coaching behaviors defined in the manual to assist in classifying behaviors demonstrated by the interventionists within this intervention. A total of 12 possible behaviors were coded. One behavior, no coaching, included three modifiers (i.e., child focused, no opportunity and other). For the final analyses, the three modifiers for "no coaching" behavior were used to disaggregate "no coaching" into three distinct behavior categories to examine the frequency with which specific "no coaching" behavior categories occurred within the intervention sessions. Therefore, there were a total of 14 behaviors coded in this study.

The majority of the coaching behaviors were defined and described within the Coaching Coding Manual developed by Friedman et al. (2012). Those behaviors are information sharing, observation, joint interaction, direct teaching, demonstration with narration, guided practice, caregiver practice, feedback, problem solving, reflection, and no coaching-child focused, no coaching-other, no coaching-no opportunity (see Table 3.2 for a description of each behavior). For the purposes of this study, "uncodable" was added to the list of behaviors to serve as a code for instances in which the coder was not able to see or hear what the interventionist was doing in relation to the family. All coaching behaviors were based on the actions of the interventionists. Therefore, the interventionist had to demonstrate the behavior in order for it to be coded as a specific behavior. However, some of the coaching behaviors also required interactions from the parent in order to be coded as that particular behavior. For example, the problem solving code required both the interventionist and the parent to contribute to the conversation beyond an affirmation (e.g., nodding, saying "yes") (Friedman et al., 2012).

The coders used an observational coding system set up in Noldus Observer XT 14.2 to code the coaching behaviors observed within the intervention fidelity videos, using partial interval coding. Each video was segmented into 30-second intervals. The coders coded all of the behaviors that occurred within each 30-second interval. This allowed us to collect the frequency of intervals in which each coaching behavior was used within each of the intervention sessions. A proportion was obtained for each coaching behavior by dividing the frequency of intervals in which each coaching behavior was demonstrated by the number of 30-second intervals within the full video. The coders reached a kappa reliability of at least 0.75 across three training videos before they began coding the videos for this study.

Table 3.2: Coaching behavior descriptions

Coaching behavior	**Description**
Information sharing	The parent and interventionist discuss information pertaining to the child's development (e.g., child's progress with developmental milestones, child's other intervention services)
Observation	The interventionist observes the parent's interaction with the child
Joint interaction	The parent, interventionist, and child all participate in an interaction together
Direct teaching	The interventionist teaches the parent a strategy or explains information to the parent about child development
Demonstration with narration	The interventionist explains a strategy to the parent and models the strategy with the child
Guided practice	The interventionist prompts the parent to practice a strategy
Caregiver practice	The parent practices the strategy previously explained or modeled by the interventionist
Feedback	The interventionist provides input about the actions of the parent and/or child
Problem solving	The interventionist and parent discuss alternatives to improve the effectiveness of the intervention (e.g., the best routines for the strategy, how to alter the strategy to fit the need of the child)
Reflection	The interventionist provides his/her thoughts about a component of the intervention or asks parents questions that elicit reflection
No coaching-child focused	The interventionist interacts solely with the child

No coaching-other	The interventionist participates in other activities not considered coaching (e.g., writing notes, talking with the parent about topics not related to the child's development, interacting with the sibling of the child)
No coaching- no opportunity	The interventionist is not able to coach because the parent is not in the room
Uncodable	Coders are unable to see or hear what is occurring during the interval

Reliability

The primary author coded 20% of the videos for reliability. These videos were randomly selected. Reliability was measured by computing intraclass correlation coefficients (ICCs) for all of the behaviors combined and each behavior separately, using two-way mixed-effects models for absolute agreement. The results of the average measures ICCs are reported in Table 3.3. According to Koo and Li (2016) and Portney (2020), ICCs that are above 0.90 are considered to be excellent, ICCs between 0.75 and 0.90 are considered to be good, ICCs between 0.50 and 0.75 are considered to be moderate, and ICCs below 0.50 are considered to be poor. Therefore, based on the ICC and confidence interval for each behavior, there was excellent reliability when the ICC was calculated for all of the behaviors combined and for the ICC calculated for the no coaching-child focused, information sharing, direct teaching, and joint interaction behaviors independently. There was good reliability for no coaching-other observation, demonstration with narration, and feedback. There was moderate reliability for problem solving, reflection, and guided practice. There was poor reliability for no coaching-no opportunity, and uncodable and caregiver practice.

Table 3.3: ICCs for all of the coaching behaviors

Coaching behavior(s)	**ICC**	**95% confidence interval**	
		Lower bound	Upper bound
No coaching- child focused	0.98	0.93	0.99
All behaviors	0.97	0.96	0.98
Information sharing	0.96	0.88	0.99
Direct teaching	0.96	0.88	0.98
Joint interaction	0.91	0.76	0.97

No coaching- other	0.90	0.73	0.96
Observation	0.88	0.65	0.96
Demonstration with narration	0.85	0.53	0.95
Feedback	0.82	0.51	0.93
Problem solving	0.73	0.22	0.90
Reflection	0.54	-0.12	0.83
Guided practice	0.53	-0.38	0.83
No coaching- no opportunity	-0.11	-2.50	0.61
Uncodable	-0.19	-2.79	0.59
Caregiver practice	-0.22	-2.76	0.57

Analyses

We performed all analyses using Stata 16 (StataCorp, 2019)**.** For Question 1, in which we examined the frequencies of all coaching behaviors, we averaged the proportion of all the behaviors across all the sessions. For Question 2, we extracted the parent education level from the demographic form. For the purposes of this analysis, the education levels were grouped into three levels: (1) Some college or less (2) College: 4-year degree and (3) Graduate/professional degree. See Table 3.1 for specific demographic details. We then averaged the proportions of each behavior for participants with two observations in order to ensure the proportion of behaviors per participant were equally weighted within the models. For the four families for whom there was only one video available, we used the frequency numbers available for the one video in the analyses. Next, we conducted a multiple regression analysis, regressing the proportion of coaching behaviors on the parent education levels, types of behaviors, and interaction of education levels and types of behaviors. We then conducted an F-test to determine if there were significant differences between the education level of the parents and the proportion of each type of behavior and the magnitude of those differences. For Question 3, we conducted multiple regression analyses to determine if any specific coaching strategies were significantly

related to the change in parent responsiveness from pretest to posttest, after controlling for initial parent responsiveness. The following behaviors were not included in the analyses for Question 3 due to the poor reliability: no coaching-no opportunity, uncodable, and caregiver practice. In general, reliability was poor for low frequency behaviors; due to the restricted range for these behaviors, a disagreement between coders on even one such behavior per session could have a severe negative impact on the ICC for the single behavior category.

Results

Frequency of coaching behaviors

The behavior that occurred most frequently in the sessions was joint interaction. On average, the parent, child, and interventionist were all engaging in activities together for a third of intervals within the session. The next most frequently occurring behavior was the no coaching-child-focused behavior. These findings indicated that the interventionists interacted directly with the child and not the parent for approximately a quarter of the intervals. Information sharing and direct teaching both occurred within approximately one-fifth of the intervals within the sessions. These findings reflect that the interventionists often encouraged the parents to share information about their child's development, and they also spent time providing the parents with information about the pivotal behaviors used in ART and corresponding strategies to support the development of the pivotal behaviors.

Two behaviors that were performed less frequently were feedback and observation. On average, each of these behaviors each occurred in less than one tenth of the intervals coded.

The behaviors that occurred at the lowest frequencies overall included guided practice, caregiver practice, problem solving, reflection, demonstration with narration and uncodable. Of these behaviors, demonstration with narration occurred the most frequently across sessions.

There were relatively few instances in which the interventionists encouraged the parent to practice a strategy within the sessions, either by directly stating that the parent should practice the strategy or by indirectly encouraging the practice through methods like gestures or handing parents specific objects. The parents also did not explicitly practice the strategies frequently during the intervention sessions. Finally, reflection on the child's current state, their progress during the session, and overall development did not frequently occur within the intervention sessions. Similarly, the interventionists and parents spent little time problem solving together.

In general, the parents and interventionists were in the view of the camera, and therefore, uncodable was not coded frequently.

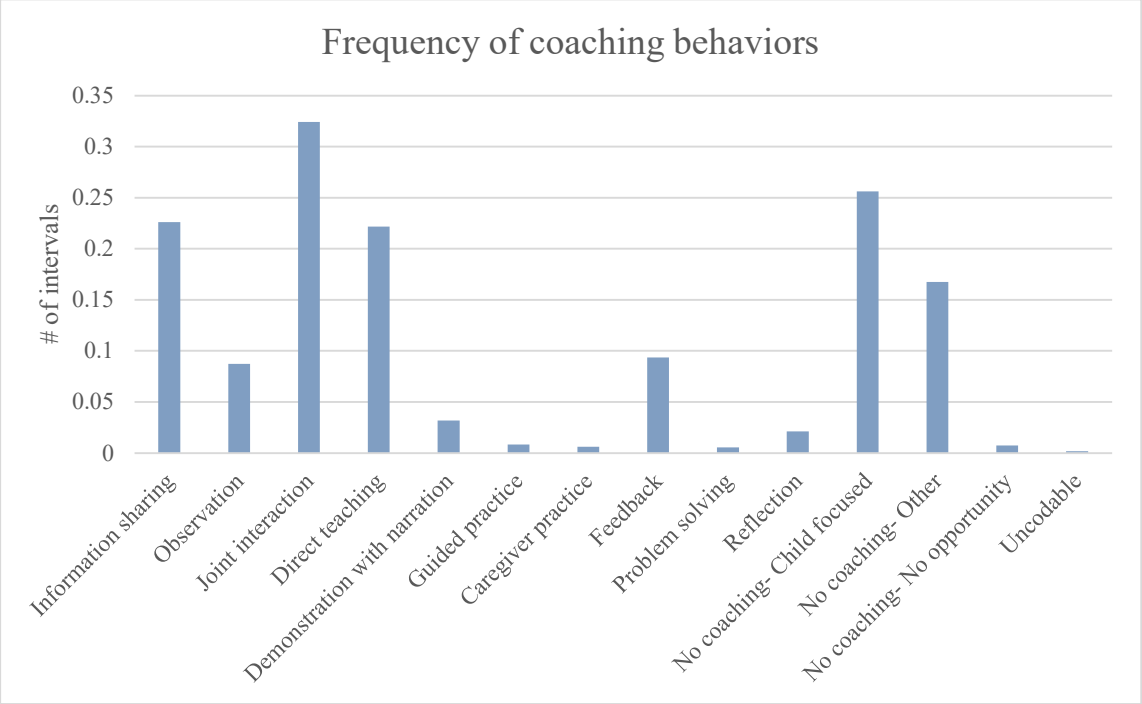

Figure 3.1: Average frequencies of coaching behaviors implemented by interventionists

Coaching behaviors and education levels

There were significant differences between the use of the no coaching-child-focused behavior when comparing the parents with lower levels of education to the parents with higher levels of education (Figure 3.2). Specifically, interventionists working with parents whose

education level was classified as some college or less used child-focused behaviors in more intervals than they did with parents with a four-year college degree (contrast = -0.17, F= 33.24, p-value < 0.01) and parents with a graduate or professional degree (contrast = -0.19, F= 44.51, p-value <0.01). In contrast, the interventionists used joint interactions in fewer intervals with parents whose education was classified as some college or less than parents who had a 4-year college degree (contrast = 0.13, F= 18.45, p-value <0.01) or a graduate/professional degree (contrast = 0.14, F= 25.29, p-value <0.01). There were no significant differences in the other behaviors based on the education level of the parents.

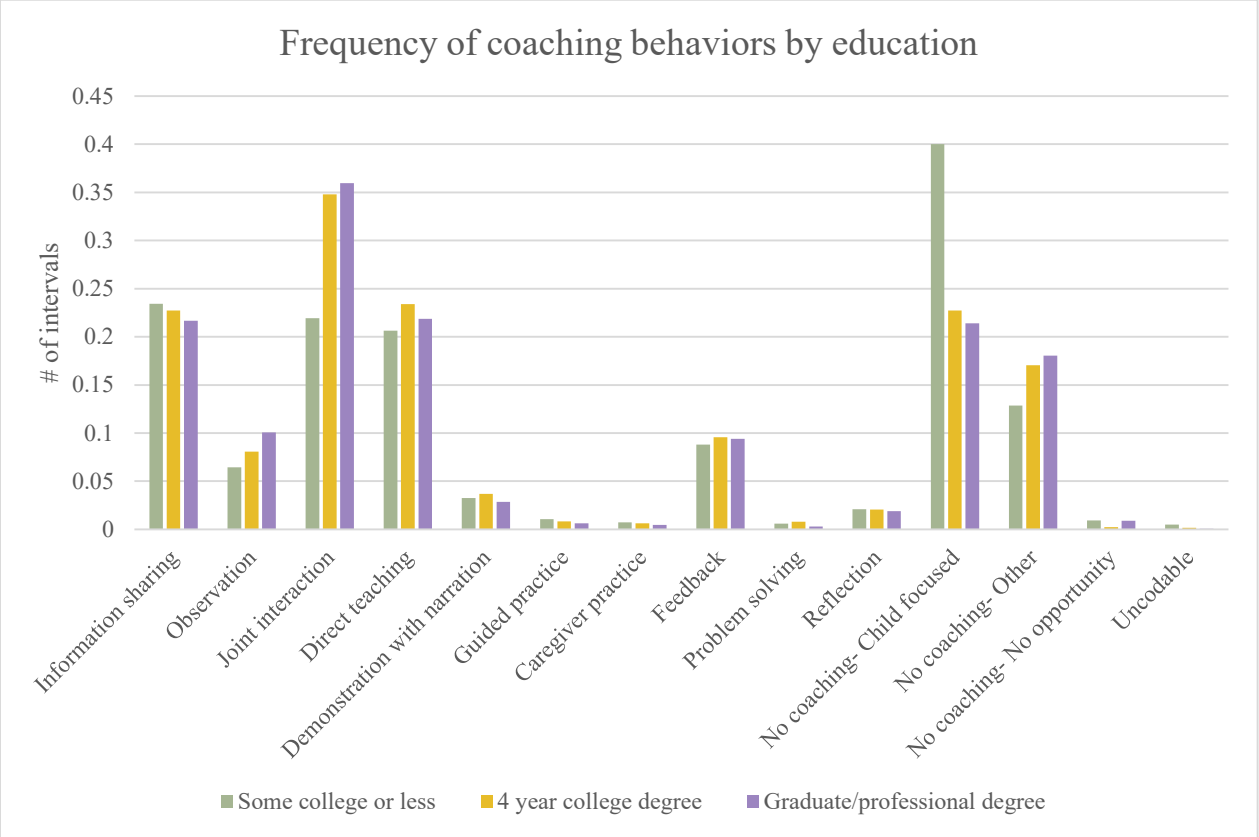

Figure 3.2: Frequency of coaching behaviors based on education level

Coaching behaviors and change in parent responsiveness

Parent responsiveness at baseline was significantly related to the change in parent responsiveness within the families that participated in the ART intervention (β= -0.63, t=-4.53, p

<0.01), such that parents with higher responsiveness at baseline showed less change in responsiveness over time (Table 3.3, Model 1). In addition to this significant relationship, there was also a relationship between the number of intervals with information sharing behaviors and change in parent responsiveness, after controlling for baseline parent responsiveness (β= 47.98, t= 2.40, p= 0.02) (Table 3.3, Model 2). Specifically, the more intervals that included information sharing, the larger the change in parent responsiveness from pre- to post-intervention. The association between the number of intervals that contained child-focused behaviors and the change in parent responsiveness after controlling for initial parent responsiveness was also significant (β= -48.09, t= -3.39, p= 0.02) (Table 3.3, Model 11). More intervals in which interventionists participated in child-focused behaviors, the less change in parent responsiveness. In addition, the association between the observation behavior and the change in parent responsiveness approached significance (β= 63.55, t= 1.77 p= 0.09) (Table 3.3, Model 3), such that more use of observation behavior by the coach was associated with a greater change in parent responsiveness. Finally, we conducted a regression model with both coaching behaviors that were significant independently (i.e., information sharing and no coaching); within this model, both baseline parent responsiveness (β= -0.77, t= -4.55. p <0.01) and no coaching (β= -40.04, t= -2.44. p= 0.02) remained significant (Table 3.3, Model 13), but information sharing did not.

Table 3.4: Results of multiple regression analyses predicting change in parent responsiveness from initial parent responsiveness and coaching behaviors

	Models												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Parent Responsiveness at Time 1	-0.63*	-0.54*	-0.69*	-0.70*	-0.64*	-0.63*	-0.65*	-0.64*	-0.64*	-0.63*	-0.84*	-0.67*	-0.77*
Proportion of Use													
Information sharing		47.98*											21.15
Observation			63.55										
Joint interaction				17.55									
Direct teaching					-4.81								
Demonstration with narration						16.59							
Guided practice							-266.87						
Feedback								21.98					
Problem solving									-103.63				
Reflection										-11.14			
No coaching-Child focused											-48.09*		-40.04*
No coaching- Other												34.75	
Intercept	50.59*	35.00*	48.37*	48.63*	51.88*	49.85*	53.49*	49.05*	51.50	50.61*	74.84*	46.72*	61.46*
R^2	0.33*	0.42*	0.38*	0.35*	0.33*	0.33*	0.35*	0.34*	0.34*	0.33*	0.48*	0.37*	0.49*
*** p< 0.05**													

Discussion

When examining the average use of all 14 behaviors within all of the videos coded, we see that interventionists engaged in facilitating joint interactions in more intervals than any other coaching behaviors. This is different from previous research in which interventionists were reported to be engaged in child-focused behaviors most frequently (Peterson et al., 2007). Perhaps, this shows that the ART interventionists were encouraging parents to play a more active role in the intervention session and facilitating opportunities for parents to be involved to a greater extent than occurred with previously examined parent-mediated interventions. This behavior, however, has its limitations within the context of coaching behaviors. Since this behavior captures a variety of interactions, we know less about if or how the interventionists are training parents on the child's skills or recommended strategies within this behavior (Marturana & Woods, 2012). Therefore, it is important to recognize that although this behavior encourages participation of the parent, to some extent, the use of this behavior may not necessarily facilitate adult learning to the same extent as some of the other coaching behaviors that encourage active participation from the parent.

Even though the joint interaction behavior occurred the most frequently on average across all of the sessions, the no coaching behaviors, particularly the child-focused behavior, also occurred frequently within the ART intervention sessions. The frequent use of this set of behaviors showed that a large amount of time was spent implementing behaviors that are not necessarily considered to be behaviors that directly improve parent-child interactions and build the parents' capacity to aid in their child's development (Woods et al. 2011). Therefore, it is important for us to develop a better understanding of why these behaviors continue to be implemented often within intervention sessions. One way to better understand why these

behaviors tend to occur frequently within intervention sessions is to continue to use codes that specify which types of behaviors are being coded as no coaching.

Some aspects of the no coaching behaviors may be important to interventions, although they are not necessarily perceived as being important to parent-child interactions. For example, the time the interventionists spent writing notes about the session and scheduling the next session with the parent were coded as no-coaching. Writing notes is often necessary within community-based early intervention sessions in order to document child progress, provide information relevant to revising the intervention plan, and bill for the intervention session. Scheduling the next session is also important in order to encourage the continuity of the intervention. While it is not always essential to spend a significant amount of time on this aspect of the intervention, it is important for interventionists to have time to complete these aspects of the intervention.

Another type of no coaching behavior that may be of benefit during the intervention session was the conversations between the interventionist and parent that were not directly related to the child. The conversations or chit-chat not related to the child's development were also coded as no coaching-other, but they may have served a purpose in the session. These conversations often encouraged communication between the parent and interventionist and perhaps helped to establish rapport between them. According to Ebert and Kohnert (2010), these components have been identified by speech-language pathologists as being important for the clinician-client relationship. Thus, the interventionists may have recognized those conversations as an opportunity to create a bond with the families. Therefore, there may also be benefits to the use of no coaching-other behavior as it relates to conversations with the parents for a short duration during the intervention session.

The no coaching-child-focused behavior is often discussed in the intervention literature, and it is one behavior that researchers and interventionists have indicated should occur less frequently within sessions (McBride & Peterson, 1997; Peterson et al., 2007; Woods et al., 2011). However, as noted by Salisbury and Cushing (2013), there are some instances in which the child-focused behavior is warranted. For example, interventions that focus on a child's motor abilities might require interventionists to work directly with the child during a portion of the session (Salisbury & Cushing, 2013). In this case, the interventionists may need to be focused on the child in order to accurately assess the child's skills and to recommend appropriate interventions for the family. Therefore, it is important to note that this behavior is useful in some contexts and should not be completely removed from all intervention services. With this notion, Salisbury and Cushing (2013) also stressed the importance of keeping this behavior to a minimum since time spent in child-focused behavior suggests that there is less time spent in interactions between the parent and interventionist and the parent and child. These ideas encourage more consideration about the function of the child-focused behavior and whether or not it can be shaped into other behaviors more conducive to active parent participation.

Of relevance to this point, it has been noted that interventionists may show child-focused behaviors within intervention sessions due to their belief that they are modeling the strategies to the parents (McBride & Peterson, 1997). In fact, there were instances within the recorded ART intervention videos in which interventionists appeared to be modeling a strategy. However, they did not describe the strategy that they were attempting to model, and therefore, these intervals were coded as child-focused. The description of the strategy plays a significant role within the demonstration with narration behavior by providing parents with cues that the interventionist is performing the behavior for the explicit purpose of demonstrating (Woods et al., 2011), rather

than trying to implement a child-focused intervention. Also, an explanation of the strategy creates opportunities for parents to better understand the actions of the interventionist, as they are not only seeing the strategy, but they are also hearing the description that corresponds to the strategy. Based on this explanation, it appears that one way to facilitate the decrease in child-focused behaviors is to encourage interventionists to explain the strategy that they are demonstrating to the parent. Even though there continues to be a need for a decrease in child-focused behaviors, the results for this behavior, in particular, show that, on average, these behaviors did not occur the most frequently of all behaviors in the current study. This suggests that there may have been a shift toward a practice in which the parents play a more active role, or the results may have been specific to the ART intervention itself.

Interestingly, information sharing was another behavior that frequently occurred during ART sessions. Peterson et al. (2007) noted that parents were often highly engaged during information sharing behaviors within their study. Therefore, the fact that information sharing occurred frequently is a promising sign that there were moments in which parents were highly engaged during the ART sessions. Information sharing was coded during intervals in which the parent and interventionists engaged in conversation about the child's development, access to additional services, and his/her progress with the intervention strategies (Friedman et al., 2012). The frequency in which this behavior occurred across sessions suggests that the interventionists were consistently encouraging this behavior. As a result, parents were actively engaged in the session for at least a portion of the session.

Just as important as the behaviors frequently demonstrated are the behaviors that were not demonstrated as often within intervention sessions. Of significance, many of these behaviors required active participation from the parents. These behaviors are observation, caregiver

practice, guided practice, problem solving, and reflection. Three of these behaviors (i.e., observation, caregiver practice, and guided practice) facilitate parent and child interactions with little input from the interventionists. Trivette et al. (2010) noted that in order to encourage adult learning, adults must have the opportunity to apply the information that they are being taught. As a result, we would expect there to be more instances of caregiver practice and guided practice in order to help facilitate the parents' understanding of the strategies by providing them with opportunities to practice the strategy during the intervention session. Specifically, on the ART implementation fidelity rating form, there is an item explicitly related to this expectation: "Coach parents while they interact with their child."

In addition, observing the parent and child provides the interventionist with an opportunity to see the natural interactions between parent and child in hopes of helping to build on these interactions (Woods et al., 2011). Unless they implement these observation coaching behaviors, interventionists may be missing out on opportunities to learn more about the parent and child interactions and provide the optimal type of support to build target skills.

There is a similar case for problem solving and reflection codes. Both behaviors encourage parents to engage in conversations with the interventionists and not just state what is happening but why they believe it might be occurring or possible solutions to difficulties that may arise within the intervention. As with the other low-frequency coaching behaviors, it is important to understand why interventionists may not be using these behaviors. The infrequent use of these behaviors may be because they have limited knowledge about these behaviors or perhaps because these behaviors are harder to implement. For example, when examining the conversations used within coaching sessions, Jarayaman et al. (2015) noted that reflection was the strategy that was used the least. Similarly, Meadan et al. (2014) indicated that interventionists

used reflection and feedback the least. Yet, in both studies, the interventionists noted that all of the behaviors, including reflection, were important. Thus, these studies indicate that the interventionists were aware of this behavior, and these studies suggest that interventionists may have perceived it to be difficult to implement the reflection strategy within the session. Perhaps, there was a similar case with the ART intervention, in which interventionists appeared to know about the behavior, as it was listed on the fidelity tool, but they had difficulty implementing it in the context of the intervention. As stated by Romano and Schnurr (2020), additional professional support may be useful in order to facilitate the implementation of these behaviors within intervention sessions.

The limited use of some coaching behaviors calls for more exploration of professional development models that best promote the implementation of these coaching behaviors within intervention sessions. For example, Salisbury and Cushing (2013) noted the importance of visual supports within their training. They specifically used graphic designs such as pie charts to show the differences between how often coaching behaviors were used with different coaching models. They noted that this, along with discussions about implementation difficulties and the potential impact of specific coaching models, helped the interventionists to see the relevance of the recommended practices. While coaching models will need to be individualized to meet the needs of the families, further information about the coaching behaviors included in the model may help interventionists better understand and implement those behaviors.

Coaching strategies and education level

The frequency of two coded behaviors varied based on education level. Those two behaviors were joint interaction, and no coaching-child focused. Interventionists working with parents with a higher education level (i.e., college degree or graduate/professional degree) were

more likely to use more joint interaction when compared to interventionists working with parents with lower education levels (i.e., high school diploma and some college). In contrast, interventionists were more likely to demonstrate more no coaching-child-focused behaviors with parents with lower education levels than with parents with higher education levels. These two behaviors, no coaching-child focused and joint interaction, reflect two different types of parent engagement. Within joint interaction, parents are participating in the action with the child and interventionist. In contrast, during child-focused behaviors, parents are more likely to observe the interventionist and child interacting with one another.

The fact that there was a relationship between these two behaviors and the parent education level raises more questions within this area of research. While interventionists may be adapting themselves to the needs of the family, it is vital to understand the reason why it may occur specifically for these two behaviors. Potentially, it could be because the parents of higher education levels were more assertive and did not perceive interventionists to be there solely to provide information or direct services to the child, but also to aid the parent in using strategies with their child. Interventionists could have also facilitated joint interactions with these parents and perceived less of a need for these parents to observe. In contrast, the parents with less education may have been less sure of their role and the interventionist's role within the intervention session. As a result, they may have decided to play a more passive role in the intervention, such as observing the interventionist work with the child. Therefore, while it is vital to know in which way interventionists alter their therapy sessions based on the culture of the parent, it is also essential to understand why they are altering their sessions. One method for gaining insight about explanations would be to require interventionists to reflect and take notes on why they use specific strategies within the intervention session.

Relationship between change in parent responsiveness and coaching behaviors

After controlling for the initial parent responsiveness, there were two coaching behaviors that related to the change in parent responsiveness. The first coaching behavior was information sharing. As mentioned previously, information sharing is one coaching behavior in which a parent and interventionist converse about aspects of child development (Friedman et al., 2012). There are many advantages to this coaching behavior. First, parents are often actively engaged in the intervention strategy and are encouraged to share information about their child or events related to their child. In addition, this coaching behavior provides interventionists with the opportunity to learn more about the recent progress of the child or concerns that parents may have about their child's development. From this information, it is possible that the interventionists selected the most appropriate strategy to meet the family's needs. As Woods et al. (2011) stated, it is important for parents to understand why a specific strategy is being encouraged as it helps them to understand the relevance of the strategies recommended. Thus, both the parent and the interventionist are likely to see the value in dialogue about the child's development. Therefore, it is not a surprise that this coaching behavior related to a change in parent responsiveness since it appears to help establish a relationship between the parent and interventionists and potentially leads to more individualized intervention strategies.

Information sharing is also one of the three coaching behaviors that encourage parents to engage in conversation or for the interventionist to facilitate input from the parent, with the other two coaching behaviors being problem solving and reflection (Friedman et al., 2012). Since problem solving and reflection were not implemented frequently within these intervention sessions, the frequency of their use was less likely to be correlated with the change in parent responsiveness. However, these data about information sharing raises the possibility that

increases in problem solving and reflection would also encourage active participation of the parents and provide parents with examples of how strategies may relate to their child's development and should, therefore, have a positive relationship with parent responsiveness.

Another coaching strategy that related to the change in parent responsiveness was the no coaching-child-focused behavior, with more child-focused behaviors associated with less of a change in parent responsiveness from pre-intervention to post-intervention. Perhaps, the passive role that parents take within this coaching behavior does not build the parent's capacity to implement the strategies with their child that equates to an increase in parent responsiveness. Parents do not have an opportunity to practice the strategy while this behavior is being implemented. In addition, parents may not necessarily know how to identify the strategy that the interventionist is implementing or understand its importance for their child's development. So, the purpose of the interventionist's child-focused behaviors may not be apparent to the parents. Of even more concern is that this strategy was used more with parents of lower education levels when compared to parents with higher education levels. While interventionists may be assuming that specific families will benefit from observing these child-focused behaviors, there is no evidence that this behavior is effective in improving the outcomes of parents at any educational level. Therefore, interventionists should continue to monitor the use of this behavior, and if they often use this behavior within therapy sessions, they should determine why this behavior is occurring and if there is a way that they can use coaching behaviors that involve more active parent participation. For example, instead of using child-focused behaviors throughout the session, they can narrate the behavior that they are trying to encourage with the child (i.e., demonstration with narration) and then prompt the parent to practice this same behavior (i.e., guided practice). Based on the parents' needs, interventionists may need to provide more or

fewer prompts to practice the strategy, and following guided practice they can allow the parent to practice independently (i.e., caregiver practice) and offer feedback as needed. This slight change in the initial behavior can lead to opportunities to employ other coaching behaviors.

One final coaching behavior that was approaching significance as it related to change in parent responsiveness, after controlling for initial parent responsiveness, was the observation behavior code. An increase in the use of observation by the interventionists was related to a larger change in parent responsiveness. Not only does observation allow the interventionist to see the parent and child interact together, but it also ensures that the parent plays an active role and has the potential to boost the parent's confidence (Woods et al., 2011). This further supports the notion that within this ART intervention study, behaviors that encouraged active participation from the parents often related to a greater change in parent responsiveness when compared to behaviors that did not encourage that active participation.

Surprisingly, the relationship between the use of joint interaction and the change in parent responsiveness was not significant. This suggests that parents and interventionists engaging in activities with the child may not have as much of an impact as the specific coaching behaviors mentioned previously. Similarly, Brown and Woods (2016) reported that joint interaction was not related to the parent's use of targeted strategy within the intervention session. A more in-depth investigation of what is occurring within joint interaction would be informative, specifically as it relates to study outcomes. One explanation for its non-significant relationship with final outcomes is that there is that the behaviors of the interventionist, parent, and child often vary within joint interactions. For example, the interventionist, parent, and child may all be playing together with limited connection to the strategy introduced during the intervention session, or the interventionist and parent instead may be practicing the strategy with the child

that was introduced by the interventionist. Thus, the goal of the joint interaction may be different based on the parent, interventionist, child, or context in which it is implemented. Therefore, to determine its effectiveness in building parent and child outcomes, we would need to explore the actions occurring during joint interaction and whether or not parents play an active or passive role within those particular interactions.

Limitations

One limitation of this study was that it was focused specifically on the ART intervention. Therefore, findings from this study may not be generalizable to studies of other interventions employing coaching as a service delivery model.

A limitation of the sample is that the generally high levels of parent education provided us with less opportunity to observe whether there may have been additional differences in strategy use related to parent education than would have been possible if the sample of parents was more diverse educationally. For example, we had to combine all of the parents who had indicated that their education level was some college or less for the purpose of analysis, but important differences in coaching strategies might be seen in interventionists working with parents who have less than a high school education compared to parents who have completed coursework toward a bachelor's degree.

A limitation of the procedure is that we specifically coded the occurrence of coaching behaviors within 30-second intervals, with a specific behavior only being coded once for any given interval if it was observed during any part of the interval. Therefore, the data in this study neither provide the precise frequency of occurrence data (e.g., in some cases, a behavior may have occurred more than once in a 30-second interval, but would only have been coded one time), nor the exact duration of each of these behaviors across the intervention sessions. Another

limitation of the procedure was that the reliability for some of the behaviors was poor. The low reliability occurred particularly for low-frequency behaviors, which had limited variability within and across subjects. According to Portney (2020), ICCs are based on the variance of behaviors across subjects. Thus, the low variance in the frequency of the behaviors coded by the raters is impacting these ICCs more and causing deflated ICCs (Portney, 2020). In order for the reliability to be higher for these low-frequency behaviors, the raters would have needed to have been closer to exact agreement on their occurrence.

Future directions and Conclusions

Interventionists should have opportunities to receive professional development regarding evidence-based coaching behaviors and should be trained on how to implement these coaching behaviors within diverse populations. In addition, preservice students should also receive training on how to implement coaching interventions, as it has been noted that preservice students often have limited knowledge about coaching before entering early intervention (Stewart & Applequist, 2019). Future research should also continue to study the behaviors demonstrated by interventionists within intervention sessions and to determine how these coaching behaviors improve parent outcomes and potentially mediate the relationship between parent behaviors and child outcomes. If these coaching behaviors are deemed to be important for parent-mediated interventions, investigations should move toward addressing questions not only regarding whether these behaviors are being implemented within intervention sessions, but also for how long they are being implemented, whether professional development can successfully increase the use of strategies observed to occur with low frequency, and if increases in the use of specific strategies impact long term outcomes.

In addition to understanding why interventionists often implement certain coaching behaviors, we should also explore the attitudes and beliefs of the parents about these intervention strategies. It is difficult to determine if coaches were more likely to implement specific strategies due to their preferences or because the families were less comfortable with specific coaching strategies. Therefore, it is not only important to investigate the beliefs about these coaching strategies from the perspective of the interventionists but also from parents who are also key stakeholders in the intervention. Potentially such input from parents as key stakeholders in parent-mediated interventions could support the development of a tool to assess parent preferences or other variables predicting which coaching strategies are more likely to meet a parent's needs, align with their preferences, and ultimately be more effective in supporting parent implementation of intervention strategies with their child.

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CHAPTER 4: CONCLUSIONS AND FUTURE DIRECTIONS FOR RESEARCH INVESTIGATING EARLY LANGAUGE DEVELOPMENT AND COACHING INTERVENTIONS FOR INFANTS AT EL-ASD

Summary of Findings

This dissertation comprises two manuscripts focused on the development of infants at EL-ASD. Within the study focused on the early language development of infants at EL-ASD, our results showed that the early language profiles of infants at EL-ASD did not differ substantially from the early language profiles of infants at LL-ASD. In addition, neither parent responsiveness nor response to joint attention (RJA) predicted the difference between expressive and receptive language scores. Finally, ASD features (i.e., social communication skills and restrictive and repetitive behaviors) were not significantly correlated with the language difference scores. Posthoc examinations of the association of these skills and features with expressive and receptive language scores rather than language difference scores revealed some significant correlations, particularly within the same time points, but did not provide support for a clear pattern of longitudinal associations.

Within the coaching study, our results indicated that interventionists were more likely to implement joint interaction and no coaching-child-focused behaviors in the ART intervention. While the use of the child-focused behavior has often been described in previous literature (McBride & Peterson, 1997; Peterson et al., 2007), it was encouraging to see joint interaction used more frequently than child-focused behavior within the ART intervention sessions. This suggests that the parents were participating in the intervention and not just observing the interventionist and child. However, with the joint interaction behavior, we do not know to what

extent the parents were participating in interactions relevant to learning responsive strategies. For example, parents could have been participating in the interaction by handing objects to the interventionist or child and not necessarily practicing the recommended strategies with the interventionist and child. Our results also revealed that interventionists were more likely to engage in child-focused behavior with parents with less education and more likely to engage in joint interaction with parents with more education. Finally, the use of information sharing, a behavior in which parents were actively engaged in discussion with the interventionist, was associated with an increase in parent responsiveness. In contrast, the use of child-focused behaviors was associated with a decrease in parent responsiveness. This last finding was concerning in light of interventionists' more frequent use of child-focused behavior when coaching parents with less education. In summary, these results suggest the need for professional development that provides instruction and support in implementing coaching practices that encourage active participation from parents.

The results of these studies have implications for recommended clinical practices and future research investigating the development of infants at EL-ASD and interventions for this population.

Early language patterns and early identification

Due to the similarities in the profiles demonstrated by the infants at EL-ASD and the infants at LL-ASD, language profiles within this age range based on differences between receptive and expressive language scores do not appear to be useful for identifying infants who are at EL-ASD. Previous literature has indicated that some children diagnosed with ASD demonstrate below average language scores; however, this is not the only population that demonstrates these delays (Ozonoff et al., 2010; Swanson et al., 2017). Thus, these studies

suggest that we cannot rely on language skills alone to indicate which children are at EL-ASD. However, I propose that early language skills along with social communication skills can help us to determine which infants are at EL-ASD. As previously noted, within the first study included in this dissertation, we assessed each child's ability to respond to bids for joint attention. While comparing RJA skills was not addressed as an aim of this study, the striking difference between RJA mean scores for the two groups at Time 1 (2.76 for the EL-ASD group versus 5.05 for the LL-ASD group led me to test for group differences. These group differences were significant (X^2 = 23.38, $p<0.01$)). Thus, this relatively quick measure appears to provide us with additional information that differentiates children at EL-ASD from children at LL-ASD. Since children with ASD show impairments in social communication skills (American Psychiatric Association, 2013), and RJA is a social communication skill that typically emerges in the first year of life and is well established early in the second year (Morales et al., 1998), it is understandable that delays in RJA may be an indicator of EL-ASD in infancy. This further explains the importance of the items that address joint attention that can be found on screening tools like the FYI-Lite (Baranek et al., 2014). Clinicians may not have to probe for these behaviors if parents have already identified them as an area of delay on a screening measure. Thus, low language scores paired with delays in social communication skills, such as RJA, appear to be a better indicator of infants at EL-ASD than early language profiles. Therefore, clinicians who assess infants that are demonstrating low language scores should also investigate the infants' social communication skills.

Early intervention

Language development

Similar to previous literature, our findings also suggest that the expressive dominant profile demonstrated by some children with ASD may not occur before the age of 20 months old. It only appears to be highly prevalent among children with ASD within a specific age range, approximately 20-40 months (Seol et al., 2014). In order to determine which skills are contributing to this atypical profile at this specific age range, we will need to further investigate the domains targeted in specific language assessments used to identify language profiles. As indicated within the paper, the MSEL (1995) is a measure often administered in research to assess the language skills of young children. The MSEL is a global language measure as it includes items that target different language domains. As a result, it may be helpful to do an item analysis to examine differences in the performance of children on specific items, then consider the nature of items on which infants at EL-ASD versus LL-ASD perform better versus worse. In other words, the patterns of differences may not specifically be associated with receptive versus expressive language modalities, but with other features of the items. Patterns of item differences may help us to identify specific types of early language challenges for infants with ASD and determine which skills need to be targeted within interventions.

In general, there is a need for a more in-depth investigation of the receptive language skills of children diagnosed with ASD. Two systematic reviews that focused on the language development of young children with developmental disabilities which include ASD and specific language impairment have indicated that the interventions that were reviewed often affected the expressive language skills but not the receptive language skills of the children (Roberts & Kaiser, 2011; Sandbank et al., 2020). The review by Sandbank et al. (2020) includes older

children with ASD, with the average age of four years old, and the review by Roberts and Kaiser (2011) does not solely include children diagnosed with ASD. Thus, these studies are not explicitly focused on infants at EL-ASD, but they have implications for the study of language development in children with ASD and infants at EL-ASD. These studies indicate that either the receptive language skills are not as responsive to intervention as expressive language skills, or that we are somehow not capturing the change in receptive language skills on these assessments. This further justifies the need to more comprehensively identify which receptive language skills are expected in young children at specific age levels and identify or develop measures that can accurately assess those skills.

The significant associations between RJA and language scores and also between social communication features as measured on the BOSCC and language scores suggest that there is an aspect of attention that may be crucial for normal language development. While these associations were not apparent across time points in the study of language development patterns in this dissertation, they do support the assumption that a child's ability to attend to and engage with others is related in some part to early language development. Thus, interventions that focus on engagement between the adult and child, be it through RJA bids or reciprocal interactions between the parent and child, may help to develop the language skills of infants.

Coaching interventions

The coaching study adds to the literature investigating the coaching behaviors used within early interventions. Our results indicate that the joint interaction and child-focused behaviors, which have previously been identified as commonly occurring interventionist behaviors (McBride & Peterson, 1997; Peterson et al., 2007), were used quite often within ART intervention sessions. Thus, as noted by Woods et al. (2011), parent-mediated interventions have

not yet reached the intended goal of assisting caregivers in becoming the primary implementer of the intervention with their child. As a result, these results suggest that it is difficult for interventionists to facilitate participatory practices with parents within intervention sessions. This point brings up two important considerations for future practices and studies targeting early interventions. First, in examining the next steps for interventions for this population, we should consider whether the coaching model is truly the best intervention for this population or if there are specific factors that should be included in selecting this intervention as the most appropriate for individual children and families. Within their review of intervention studies for children with ASD, Sandbank et al. (2020) reported that interventions implemented with somewhat older children by the parents alone were not as effective in improving language outcomes as interventions implemented by the clinician alone or the clinician and caregiver together. Therefore, studies should continue to identify the person who is delivering the intervention to the child and consider which outcomes are most impacted by different interventions using different service delivery models. Continuing to value family-centered practices in early intervention does not necessarily imply that caregivers should be the primary implementers of all early interventions, but rather that caregivers are integral to decision-making on services for their infants and toddlers. Intervention studies should also continue to include demographic information about the participants of the study. This information can help us to tailor our interventions to best meet the needs of the family and better understand if and why some interventions work best for specific populations.

Given that coaching interventions likely will continue to be used within research studies and clinical practice, then the second consideration is to determine how to best support interventionists in using all recommended coaching behaviors. Over the last ten years, there has

been an increase in studies examining the coaching behaviors used by interventionists (Romano & Schnurr, 2020). Within some of these studies, researchers have begun to ask interventionists about the behaviors that they use within coaching interventions (Jayaraman et al., 2015). In addition, researchers also have asked interventionists to identify the barriers impacting their use of the specific behaviors that are significant within the coaching interventions (Fleming et al., 2011). As a result of these efforts, there has been a clear call for more specialized training for interventionists in coaching strategies (Romano & Schnurr, 2020). Rather than simply stating that interventionists should be using these coaching behaviors, researchers have noted the importance of providing clear definitions of these behaviors and supporting interventionists as they develop their coaching skills in serving parents of infants and toddlers (Fleming et al., 2011; Romano & Schnurr, 2020).

A variety of professional development strategies will ultimately be necessary for encouraging the use of coaching behaviors. For example, Fleming et al. (2011) noted that by just asking providers about their use of specific coaching behaviors and if they included parent participation, they noticed a change in behaviors. Thus, for these interventionists, it appears that awareness of the coaching behaviors was the key for them to start to use these behaviors more frequently. However, for some interventionists, the definition alone may not be sufficient. Interventionists are often aware of the strategies and how to implement the strategies in general (Campbell & Coletti, 2013), yet there is evidence that some of the coaching strategies, like problem solving and reflection, are not being implemented frequently (Lorio et al., 2020). The infrequent use of coaching behaviors like problem solving and reflection may not mean that interventionists are not aware of these coaching behaviors, but instead, that they may not be as familiar with how to implement these strategies with all of the families that they serve.

Therefore, we should continue to pay close attention to the demographics of the families that participate in the intervention as well as the demographics of the interventionists to determine if these factors are contributing to the use of specific behaviors within intervention sessions. Overall, there appears to be a need for professional development that targets the use of these strategies with diverse populations. This includes holding professional development trainings in which they have the opportunity to talk with others about difficulties in implementing coaching practices and brainstorm solutions (Romano & Schnurr, 2020).

One additional point that Salisbury and Cusing (2013) raised was the importance of having systems in place that encourage professional development in coaching practices. As noted in their study, their training occurred during a typical workday. As a result, it impacted the company's revenue as the interventionists were not able to work with their clients during the training. The company's encouragement of participation in the training spoke to the company's overall desire to support the best practices and provide the best care to their clients. Thus, professional development is more than just an individual choice made by the interventionists; it also needs to be supported by the early intervention systems within which interventionists practice. The development of these coaching skills also seems to require more than one day of training, so in order for coaching training to be successfully implemented within community practices, it needs to be recognized as an ongoing process. Therefore, the continuation of professional development across time will also require support from the companies or public agencies that provide early intervention services. The initial efforts described by Salisbury and Cushing (2013), however, offer reasons for optimism about the future of translating intervention research related to coaching to community practice. Therefore, over the next couple of years,

perhaps we will see evidence of this change in practices, not only within researcher-implemented interventions but in research findings on community practice as well.

Conclusion

Overall, both of the studies in the dissertation emphasize the need for future studies to not only study the early development of infants at EL-ASD, but also to provide specific details about the language development of infants at EL-ASD as well as the interventions implemented with this population. As noted in the first study, the summary language scores provide us with valuable information. However, details such as the language domains targeted in the assessments, and the relationship between the language scores and social communication skills can further enhance our understanding of the early language development of this population. Similarly, it is essential to not only have a better specification of language and communication skills that should be targeted within intervention for infants at EL-ASD, but also, it is vital to know how the intervention implementation can be optimized for diverse families. This information will improve the replicability of intervention effects and translation to community practice, and it will contribute to our ability to create individualized interventions that meet the needs of the clients we serve.

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