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Joint Attention and Imitation: How Early Social Skills Relate to Language, Social Behavior, and Overall Responsiveness to Early Intervention in Children with Autism

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JOINT ATTENTION AND IMITATION: HOW EARLY SOCIAL SKILLS RELATE TO LANGUAGE, SOCIAL BEHAVIOR, AND OVERALL RESPONSIVENESS TO EARLY INTERVENTION IN CHILDREN WITH AUTISM

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Joint attention, the ability to coordinate one's attention with that of another person (Dawson et al., 2004), and imitation, the ability to copy another person's behavior (Sevlever & Gillis, 2010), are two of the initial methods by which children learn from and interact with the world around them (Trevarthan, 1979). These two skills are related to the development of language, social skills, and play. Further, they seem to come naturally in typically developing children. For children with autism spectrum disorder (ASD), however, these skills are often delayed or entirely absent, thereby potentially leading to significant impediments in the acquisition of crucial functional skills (Dawson et al., 2004). Social orienting theory posits that children with ASD exhibit such deficits in joint attention and imitation because of their lack of attention to social stimuli and, as a result, the decreased attempts by others in their environment to engage them (Dawson et al., 2004).

Current estimates report that the prevalence of autism spectrum disorder (ASD) averages one in every fifty-nine children (CDC, 2018). For children with ASD, research has repeatedly emphasized the importance of both early identification and early intervention (Koegel, Koegel, Ashbaugh, & Bradshaw, 2014; National Research Council, 2001). One early intervention model that is based on social orienting theory is the Early Start Denver Model (ESDM), which considers dyadic interactions between the therapist and the child as a prime avenue for learning not only

basic social skills such as joint attention and imitation but also more complex social skills, language, and play (Rogers & Dawson, 2010).

Data from 23 children participating in an ESDM program were examined in the current study; specifically, the researcher assessed whether children demonstrated significant skill growth over the first six months of intervention. Further, the researcher evaluated the relationship between joint attention and imitation as well as how these core areas correlated with additional skills, including language, social skills, and play. Finally, the researcher investigated whether level of joint attention and imitation at baseline predicted overall responsiveness to the intervention.

Results showed that all children in the study made significant progress in all areas in the first six months of intervention. The hypothesized positive relationship between joint attention and imitation was supported; however, results did not indicate a trajectory wherein joint attention was acquired prior to imitation. Results supported the relationship between both joint attention and imitation skills and subsequent language, social, and play skills. Finally, baseline skill levels did not significantly predict overall performance.

KEYWORDS: autism, joint attention, imitation, ESDM, language, social skills, play

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C.E.K.

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CHAPTER I: THE PROBLEM AND ITS BACKGROUND

Statement of the Problem

One of the primary means through which young children learn is social interaction. For example, research has shown that the social act of imitation is one of the first methods through which infants and their caregivers bond (Trevarthan, 1979). Additionally, evidence suggests that that typically developing children as young as five months show evidence of preference and attention to social stimuli (Rochat & Striano, 1999). While these social interactions are frequent in children with typical developmental histories, such interactions are less common and sometimes almost entirely absent in children diagnosed with Autism Spectrum Disorder (ASD) (Dawson et al., 2004). Studies have shown differences in social behaviors between typically developing children and children with ASD as early as one year of age (Osterling & Dawson, 1994). For example, videotapes of first birthday parties indicate that children with ASD were less likely to respond to their name being called, to follow another person's gaze or point, and to orient to other people in general (Osterling & Dawson, 1994; Osterling, Dawson, & Munson, 2002).

Some researchers have suggested that children with autism possess a general deficit called a social orienting impairment, defined as the lack of spontaneous attending to social information in the everyday environment (Dawson et al., 2004). Two crucial social skills could be said to fall under this larger umbrella – joint attention and imitation. Joint attention, defined as the ability to share, attend to, and control the attention of another person, is a skill that has been shown to be lacking in children with ASD, both in terms of initiating and responding (Dawson et al., 2004). Because one must orient oneself to another person in order to engage in a social interaction, it is likely that this skill may serve as a precursor to more complex ones

(Dawson et al., 2004). In a similar vein, imitation requires a person to attend to and then copy another's behavior. Typically developing children learn various skills via imitation, including language and play behaviors (Eckerman & Didow, 1996; Eckerman & Stein, 1990; Ingersoll, 2008). Research has demonstrated that children with ASD can learn to imitate when the behavior is elicited; however, children with ASD do not usually imitate spontaneously, as typically developing children do (Ingersoll, 2008; Whiten & Brown, 1999).

While the literature highlights joint attention and imitation as early identifiers for ASD, researchers do not yet fully understand how the development of these skills affects outcomes for children with autism (Dereu et al., 2012). For example, studies examining the trajectories of the development of social communicative skills (i.e., joint attention, imitation, shared affect) have found large amounts of inter- and intra-individual variation among children with ASD (e.g., Carpenter, Pennington, & Rogers, 1998; Dereu, Roeyers, Raymaekers, & Warreyn, 2012). However, due to an average age of diagnosis that is past the apparent critical window for the development of joint attention and imitation, the ability to examine the development of these skills prior to the age of three in children with autism is limited (CDC, 2014).

Given the evidence pointing both to the importance of joint attention and imitation in early development (i.e., Schertz & Odom, 2004; Stone & Yoder, 2001; Adamson & Russell, 1999; Eckerman & Didow, 1996), as well as the well-documented deficit – and sometimes, absence – of these skills in children with autism, it is imperative that researchers examine possible therapies by which to intervene in these areas. In terms of intervention in autism, research has repeatedly emphasized the importance of early diagnosis and early intervention (i.e., Koegel, Koegel, Ashbaugh, & Bradshaw, 2014; National Research Council, 2001). One early intervention model is the Early Start Denver Model (ESDM). The ESDM is a naturalistic, child-

directed intensive behavioral intervention that was developed for children between the ages of eighteen months and five years (Rogers & Dawson, 2010). It capitalizes on developing relationships between children with autism and their caregivers (i.e., parents, teachers, therapists) to create opportunities for core social interaction skills such as joint attention and imitation. Further, by increasing growth in those areas, the model aims to intervene in more complex domains such as play, multifaceted social skills with both adults and peers, and language (Rogers & Dawson, 2010).

Research has provided evidence for the efficacy of the ESDM (i.e., Dawson et al., 2010; Rogers et al., 2012), but many studies have been limited to individualized sessions and/or parent training models. The current study examined data from children who received ESDM therapy in a group-based setting – specifically, by examining their skill development trajectories from pre-intervention (i.e., baseline) through the intervention period, assessing skills at three-month intervals. Further, this study examined the theorized relationship between two early social communication skills – joint attention and imitation – by examining whether the two are correlated and, further, whether growth in these skills is related to growth in other social domains – specifically, language, social skills, and play. Finally, this study investigated whether joint attention and/or imitation served as predictors for children's overall performance in this early intervention model.

CHAPTER II: REVIEW OF RELATED LITERATURE

Autism Spectrum Disorder (ASD), a developmental disorder, has shown a dramatic diagnostic increase over the past two decades (APA, 2013; Rice, 2009). It is characterized by two primary factors: deficits in social communication and evidence of stereotyped and repetitive behaviors or restricted range of interests. Deficits in social communication skills have been grouped into three categories: social emotional reciprocity (e.g., shared enjoyment in an activity), nonverbal communicative behaviors with a social function (e.g., joint attention, imitation) and a lack of ability in creating, maintaining, and understanding social relationships (e.g., difficulty making friends, holding a conversation). Evidence of stereotyped and repetitive behaviors is demonstrated in actions such as the classic hand flapping and verbal scripting. This category also includes a rigid adherence to schedule and routine, an unusually intense interest in an object or activity, and hyper- and/or hyposensitivity to certain sensory stimuli. Finally, an ASD diagnosis is given with a severity rating in terms of impairment, with ratings ranging from level one ("requiring support") to level three ("requiring very substantial support"). An independent rating is given to each of the diagnostic criteria – for example, a child may receive a level three rating in terms of social communication and a level one rating in stereotyped and repetitive behaviors (APA, 2014).

In addition to the categorical qualifications, these impairments must be evident in the early childhood years (before the age of eight), must significantly impair daily life functioning, and must not be the result of an intellectual disability or broader developmental delay (APA, 2014). It is currently estimated that the current prevalence of the disorder averages one per fifty-nine children (CDC, 2018). Research has shown that ASD diagnoses can be given reliably as early as two years of age; however, the average age of diagnosis is at approximately four years

old (CDC, 2014). Finally, the latest edition of the Diagnostic and Statistical Manual of Mental Disorders allows for the co-morbid diagnoses of several disorders, including but not limited to Attention Deficit/Hyperactivity Disorder, intellectual impairment, and language impairment. By definition, children with ASD demonstrate marked deficits in various areas of social communication (APA, 2014). These deficits have been shown to be related to subsequent crucial development in several areas, including language (e.g., Loveland & Landry, 1986; Stone & Yoder, 2001), social skills (e.g., Ingersoll, 2008), and play (Charman, 1998; Baron-Cohen, 1996). Of the many crucial skills that underlie social communication, two primary skills have been highlighted for their developmental importance: joint attention and imitation. These two skills were the focus of the current study. Due to the fact that children with ASD demonstrate deficits in these two skills, as well as the fact that these deficits may be linked to secondary impairments in further skills, it is important for research to examine interventions that will effectively improve these skills in children with ASD. The following sections discuss both skills in detail, highlighting development and each skill's effects in both typically developing children and children with ASD.

Joint Attention

Joint attention has been both broadly and more narrowly defined. In broad terms, psychologists have agreed that joint attention can be defined as a social communicative skill that allows one person to show interest about something and attempt to engage another person in that interest (Mundy, Delgado, Block, Venezia, Hogan, & Seibert, 2003). More specifically, joint attention indicates an attempt to synchronize one's own attention with another person about a person, an object, or an activity (Mundy & Sigman, 2006). Examples of such attempts at joint attention include trying to get another's attention by pointing to a stimulus, looking back and

forth from a person to a stimulus, and combining verbal responses with these behavioral strategies (Schertz & Odom, 2004). Some definitions choose to focus on the visual attention of another person (i.e., Butterworth, 1995) while others center on the motivational aspect that suggests one person wants his or her interest and understanding to coincide with another person's (Carpenter, Nagell, & Tomasello, 1998). For the purposes of this investigation joint attention is defined as either responding to another person's attempt to direct one's attention – response to joint attention – or trying to direct another's attention – initiation of joint attention.

Literature in the field of developmental psychology has suggested three theoretical constructs for understanding joint attention – cognitive-perceptual, language, and social-affective. It is important to highlight the fact that information in one theory does not discount another theory – rather, all three theories contain components of the others while focusing on different causal pathways. The cognitive-perceptual focus suggests that joint attention serves as a preliminary skill prior to theory of mind, defined as a person's recognition that another person's thoughts, beliefs, and emotions are different from one's own (Baron-Cohen, 1991). Research suggests that four cognitive abilities underlie joint attention – an intentionality detector, an eye direction detector, a shared attention mechanism, and a theory of mind mechanism – and that, despite the fact that these develop in a chronological order in typically developing children, they do not do so in children with ASD. Despite this theory's information, research has also posited that its deterministic view is not helpful in developing joint attention interventions. It seems to suggest a somewhat fatalistic view of the development of joint attention skills in children with ASD. While it does not necessarily preclude that intervention could not lead to improvements in joint attention skills, it also does not offer a direction for these interventions (Baron-Cohen, 1991).

The language theory of joint attention suggests that joint attention serves as the basis for later language development (Carpenter et al., 1998). Research supporting this theory demonstrates that children learn language by attending to the intention in another's communication. Specifically, by developing joint attention skills, children learn the interests of others and their reasons for attending to certain things, which can aid them in developing language skills (Carpenter et al., 1998). This theory of joint attention has also been posited as having a causal relationship for the language deficits often seen in individuals with ASD (Carpenter & Tomasello, 2000). Research has provided substantial evidence showing the relationship between joint attention skills at six months of age and both receptive and expressive language skills by approximately 18 months of age (Carpenter et al., 1998; Mundy & Gomes, 1998; Mundy, Sigman, & Kasari, 1990). Additionally, research has further suggested that joint attention deficits may specifically impact social language development (National Research Council, 2001). Because language is a crucial skill in terms of social development, this view of joint attention points to a strong need for joint attention intervention (Schertz & Odom, 2004).

Finally, the third view of joint attention focuses on social-affective development. This view suggests that children's social interactions – eye contact, smiling at others, and touch- serve as the basis for, as well as motivation to, engage in joint attention. This model additionally emphasizes emotion regulation as a part of joint attention; around nine months of age, when joint attention is often first seen, research has demonstrated that children begin to learn to use their facial and verbal expressions of emotion to direct and manipulate others' attention and behavior (Adamson & Russell, 1999). Given that both of these skills – shared affect and joint attention – are shown to be impaired in children with autism suggests further evidence for their relationship (Wetherby, Prizant, & Schuler, 2000). This theory suggests that joint attention is the basis for

the deficit in reciprocal interactions often seen in children with ASD (Schertz & Odom, 2004); for instance, in comparison to typically developing children, children with ASD demonstrate reciprocal smiles with their mothers less often and also rarely pair smiling with eye contact (Dawson et al., 1990).

Although the three theories emphasize different aspects of the role that joint attention plays in development, all three indicate that joint attention serves as an important precursor skill for learning more complex social skills, in terms of theory of mind, language development, and shared affect (Adamson & Russell, 1999; Baron-Cohen, 1991; Carpenter et al., 1998).

Typical Development

Typically developing children first show a reliable demonstration of joint attention skills at six months of age, as evidenced by their ability to follow an adult's eye gaze when an adult directed this gaze within the child's visual capacity (Morales, Mundy, & Rojas, 1998). Further joint attention development occurs later in life, with children demonstrating a full range of skills that become relatively mastered at nine months of age, including not only gaze tracking but also prompting another to follow their own attention (Carpenter, Nagell, & Tomasello, 1998). Interestingly, typically developing children display mastery of joint attention skills at approximately 9-12 months of age, the same developmental age wherein it becomes evident that this skill is impaired in children with autism (Osterling, Dawson, & Munson, 2002; Carpenter, Nagell, & Tomasello, 1998; Osterling & Dawson, 1994).

Research has demonstrated that the development of joint attention follows a relatively homogeneous trajectory in typically developing children. Typically developing infants demonstrate a preference for social stimuli from birth, as evidenced by gaze orientation preference and length (Goren, Sarty, & Wu, 1975). When shown faces with accurately-arranged

features in comparison to faces with strangely-arranged features (e.g., ears where the mouth should be), infants are more likely to direct their attention to the natural face for a longer period of time (Cassia, Valenza, Simion, & Leo, 2008; Valenza, Simion, Macchi, Cassia, & Umiltá, 1996). Further, infants also prefer faces that seem to be directing their attention toward the infants themselves, as shown by eye contact (Farroni, Massaccesi, Memon, & Johnson, 2007).

By three months of age, typically developing children begin to evidence dyadic interaction, meaning that they engage in play with another person while making eye contact. This dyadic interaction is thought to be a precursor to full emergence of joint attention. At six months, typically developing children begin attending to and preferring certain objects (McArthur & Adamson, 1996). Following this mutual sharing of attention, children then become able to follow the lead of another's behavior, subsequently controlling another's attention and, finally, leading another's behavior (Carpenter, Pennington, & Rogers, 2002). More specifically, research has found that children begin to demonstrate the ability to follow another's gaze between eight and ten months, mastering this skill between twelve and fifteen months; at twelve months, children demonstrate the ability to follow another person's point. It is at this stage, between nine and fifteen months, that joint attention is considered fully developed (Carpenter et al., 1998).

Development of Joint Attention in Children with ASD

In contrast to the relatively homogeneous developmental trajectory seen in typically developing children, individuals with autism tend to follow a distinctly different pattern of development (Carpenter, Pennington, & Rogers, 2002).

Children with ASD often demonstrate a lack of joint attention skills, a deficit visible as early as at one year of age (Osterling & Dawson, 1994). A study examining videotapes of children with ASD on their first birthdays found that, in comparison to typically developing

children and children with intellectual disabilities, these children showed marked differences in their orienting to others (Osterling, Dawson, & Munson, 2002). These deficits seem to persist into early childhood with evidence that, at eighteen-months of age, children with ASD demonstrated social communicative deficits including a lack of joint attention behaviors (i.e., changing eye focus between a toy and an adult's face, synchronizing of emotional responses) and deficits in imitation skills (Charman, Swettenham, Baron-Cohen, Cox, Baird, & Drew, 1997); skills that were present in typically-developing and developmentally delayed counterparts.

Unlike typically developing children, children with ASD do not demonstrate a preference for human faces and voices. In fact, research has shown that these children demonstrate impairment in the ability to process human faces as early as three years old. This deficit is evident in the way that children process human faces. For example, children with autism have been shown to pay less attention to the facial features that may convey social information, such as the eyes (Dawson, Webb, & McPartland, 2005). Additionally, these children are more likely to view a face as many separate, individual features rather than to process it as a whole (Dawson et al., 2005). Finally, while typically developing children tend to process social stimuli such as faces faster than nonsocial stimuli, children with ASD do not demonstrate this pattern (Dawson et al., 2005). As joint attention requires individuals to attend to social stimuli such as faces and voices, this non-preference, as well as the disturbance in processing such social stimuli, may contribute to the overall impairment found in joint attention ability.

In terms of the aforementioned trajectory, research has shown that only sixty-seven percent of children with ASD follow a common course, while the remaining thirty-three percent demonstrate variability in the development of joint attention, highlighting the diverse nature of the disorder. Even for those children with ASD who follow a common course, it is distinctly

different from that seen in typically developing children. Specifically, in contrast to typically developing children, children with ASD tend to begin the development of joint attention skills with behavioral rather than attentional skills, starting by following another person's behavior rather than their eye gaze (Carpenter, Pennington, & Rogers, 2002). After this behavioral skill is mastered, they begin to share attention. Following mastery, children with autism learn to attend to an object or person that another is attending to, ending this pattern with the ability to control another person's attentional resources, a sign of fully-developed joint attention (Carpenter, Pennington, & Rogers, 2002).

Current research has not yet definitively produced a typical time scale for joint attention development in children with ASD. However, it has been shown that ASD symptomology is relatively heterogeneous; that is – children with ASD show differing patterns of strengths and weaknesses in terms of their skill development. In fact, the latest diagnostic criteria for ASD demonstrate this by allowing for different functioning levels included in the overall diagnosis (APA, 2014). While joint attention is considered a strong marker of the presence of ASD, some children with the disorder do demonstrate typical joint attention skills.

Research has shown that the level of joint attention impairment in children with ASD is positively correlated with their social orienting ability in general; however, no relationship has been shown between children with ASD's joint attention skills and their ability to attend to nonsocial stimuli. This suggests that, for children with ASD, impairments in joint attention are more pronounced when social cues are involved (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Two primary theories surround why the joint attention impairment may be a reflection of a greater social impairment in ASD.

Theoretical Explanations of Joint Attention Deficits in Children with ASD

Attention shifting. Neuropsychological research has suggested that physical brain abnormalities in both the cerebellum and parietal lobe of children with ASD may be the underlying cause of an impairment in attentional processes, including: basic attention, inflexibility in changing the focus of attention, spreading attentional resources effectively among different stimuli, and joint attention (Courchesne, Chisum, & Townsend, 1994). Unlike typically developing individuals, as well as individuals who sustain brain damage to these areas following birth, individuals with ASD demonstrate an impairment of quickly shifting attention among different types of stimuli, suggesting a general deficit in the ability to control one's attention when presented with an abundance of stimuli. Further, researchers have posited that because joint attention requires one to focus on numerous qualities of a person or an object as well as shifting attention among these various attributes, individuals with ASD may miss many important social cues due to their tendency to focus on more singular, discrete qualities rather than the whole picture. Although these social cues may be small and unpredictable (i.e., a smirk or a small smile), individuals with ASD may be at a particular disadvantage in perceiving them (Courchesne et al., 1994).

Reward value of social stimuli. A second theory of the joint attention deficits in children with ASD suggests these deficits are due to the lack of reinforcement gained from social interactions. Children with ASD demonstrate partiality towards contingencies that are predictable and constant (Gergely & Watson, 1999). As social contingencies are often anything but predictable, theories have suggested that children with ASD find them less reinforcing. For example, when a child presses a button on a toy and music begins to play, this cause and effect relationship is present each and every time the button is pressed, and the child experiences a

constant, reliable contingency. However, when a child tries to share a toy with another and only occasionally experiences success, the child enters into a complex, variable contingency. Therefore, it has been theorized that children with ASD find less reinforcement in social stimuli because social stimuli are less reliable and predictable than cause-and-effect toys. This leads to children with ASD showing less attention towards social aspects of their environment and consequently learning less through their interactions with others (Dawson, Carter, Meltzoff, Panagiotides, & McPartland, 2002).

Even when children with ASD are taught joint attention skills, the underlying motivation for engaging in this social interaction is theorized to be significantly different than for typically developing children. Specifically, children with ASD are often taught joint attention skills through behavioral methods, motivated by arbitrary reinforcers, whereas the development of joint attention skills in typically developing children appears to be motivated by social engagement and social reinforcers. This difference is highlighted by the fact that children with ASD rarely demonstrate signs of positive affect when engaging in joint attention, as compared to their counterparts who are demonstrate significant enjoyment in these social interactions (Dawson et al., 2002).

Further, the social motivation hypothesis suggests that a fundamental deficit in social motivation exists in individuals with autism (Dawson, Webb, & McPartland, 2005). Research has found that this deficit may be associated with issues within one's neurological system; specifically, both differences have been found in the orbitofrontal cortex-amygdala pathway, an area which allows individuals to determine the value of social stimuli (Schoenbaum, Setlow, Saddoris, & Gallagher, 2003). Research has also examined how neurological pathways change when social motivation increases; for example, as children received more exposure to others'

faces and voices, resulting in an increase in their desire to interact with others, cortical specialization for faces and voices increased. Additionally, perceptual mechanisms in the brain correlated with interpreting social and language processing show increased activity and development (Johnson, Griffin, Csibra, Halit, Farroni, De Haan, et al., 2005).

Finally, due to their lack of social initiations, children with ASD are less likely to receive these overtures from others, further removing them from the reciprocal cycle of social interactions. Children with ASD often do not attempt to engage others, nor do they typically respond to others' attempts to engage with them. This may result in others around them making fewer attempts to engage them and/or stop trying to gain their attention altogether. This cycle may prove to be especially detrimental to children with ASD because they are unlikely to gain skills in joint attention and further social interaction skills without the active input of others, and they are unlikely to seek that out for themselves, it is critical that others around them continue to try to engage with them (Dawson et al., 2004).

To summarize, in contrast to typically developing children, research has shown that joint attention is substantially impaired in children with ASD, possibly due to neurobiological and/or social-cognitive causes (Courchesne et al., 1994; Dawson et al., 2004). Additionally, while studies have painted a clear picture of the developmental trajectory of joint attention in neurotypical children (e.g., Carpenter et al., 1998), the pattern is different and more variable in children with ASD.

Three key theories—cognitive perceptual, language, and social-affective—have emphasized the importance of joint attention for functional and social development (e.g., Gillespie-Lynch, Sepetaj, Wang, Marshall, Gomez, Sigman…Hutman, 2012; Loveland & Landry, 1986). In addition, research has indicated a relationship between joint attention and

another important precursor to social development – imitation. Further, evidence linking joint attention and imitation in children with ASD suggest a possible developmental relationship between the two constructs (Dawson et al., 2004). By examining this possible link, as well as their chronological development, the current study aims to determine whether knowledge of this trajectory may contribute to information on treatment effectiveness.

Imitation

Generally defined as a process by which individuals emulate another person's behavior, in terms of both physicality and implication, imitation can be more specifically delineated in numerous ways. Three categories of imitation exist: object imitation, gestural imitation, and oral-facial imitation. Further, these categories can be subtyped by single versus sequential, immediate versus deferred, and spontaneous versus elicited (Sevlever & Gillis, 2010). Due to imitation's evidenced impact on learning, especially in terms of social skills such as communication and play, it is an important skill to study (e.g., Eckerman & Didow, 1996; Stone & Yoder, 2001).

Typical Development of Imitation

Imitation is a skill that is evident in typically developing infants as early as twelve to twenty-one hours after birth. Research has demonstrated this capability through imitation of simple, concrete actions in this young population. Additionally, when the infant is between thirty-six and forty-eight hours old, studies have found that they can emulate facial expressions such as happy, sad, and surprised (Field, Woodson, Greenberg, & Cohen, 1982; Meltzoff & Moore, 1977). At six weeks old, research has shown that infants are able to engage in deferred imitation of more complex motor routines, such as opening their mouths and sticking out their tongues twenty-four hours after both actions were first shown to them (Meltzoff & Moore,

1994). At thirteen months, infants have the ability to truly imitate, meaning that they can understand a behavior's purpose and therefore imitate that behavior with the intention to accomplish that purpose (Carpenter, Nagell, & Tomasello, 1998). As these infants are unable to verbally communicate, researchers have posed that this type of imitation may serve a communicative function (Nadel, 1982).

Imitation becomes increasingly prominent in children eighteen months and older, its use hitting its zenith when children are thirty months of age. In children of this age, imitative social exchanges show norms of reciprocal communication such as taking turns and exchanging roles in a conversation (Nadel, 2002). Additionally, these imitative exchanges occur with temporal consideration, each child participating in a give-and-take depending on the start and finish of each other's actions. Interestingly, widespread use of reciprocal imitation seems to decline as children develop language. This implies not only imitation's communicative function, but also children's recognition of it as such (Nadel & Fontaine, 1989).

Development of Imitation in Children with ASD

While typically-developing children evidence a seemingly innate imitation ability, children with ASD demonstrate overt differences not only in the amount of imitative behaviors but also the quality of those behaviors compared to their typically developing peers (Ingersoll, 2008). Because children with ASD are rarely diagnosed before the age of four (CDC, 2014), however, there is a lack of research examining the development progression of imitation in this population during infancy and early childhood. Research has found that differences in joint attention skills can be observed as early as one year of age through observations of home videos of children with ASD taken prior to diagnosis but at these early ages (Osterling & Dawson, 1994).

While children with ASD can learn to imitate in an elicited context – for example, if taught the skill through discrete trial training (Lovaas, Freitas, Nelson, & Whalen, 1967) – this rarely results in increases in spontaneous imitation (Whiten & Brown, Ingersoll, 2008). In fact, spontaneous imitation is often absent in children with ASD (Whiten & Brown, 1999). One explanation for this deficit comes from the social requirements of the imitative exchange, of which attention is of the utmost importance. In order to engage another in the reciprocal contingency of imitation an individual must not only be able to gain another person's attention, but also to attend to that person long enough to recognize that this person is copying the individual's behavior. Without attention to these types of social stimuli, neither the initiation nor response to imitation can occur (Nadel, 1982). Three primary theories have posited imitation as a secondary deficit in deference to a primary impairment in social attention: social processing (Nadel, 2002), social orienting (Dawson et al., 2004), and social motivation (Whiten & Brown, 1999).

Theoretical Explanations of Imitation Deficits in Children with ASD

Social processing. The social processing theory supports the notion that imitation is not a primary deficit in ASD but rather a secondary result of more immediate social deficits. In a functional sense, this suggests that it is not the skill of imitation itself but rather the ability to recognize and attend to the social act of imitation that is particularly impaired in children with ASD. This theory also posits that children with ASD develop typical imitation skills, comparative to those seen in typically developing children, but that children with ASD do not demonstrate them due to broader social deficits. Even though imitation ability may be present, the skill does not develop further due to the lack of opportunity to practice this skill, both because of the children's failure to initiate and respond to social engagement from others as well

as the lack of social overtures from others, as typically developing individuals may not expect responses from these children (Nadel, 2002). This theory suggests that the relationship between joint attention and imitation is a chronological one, with the former preceding the latter. Because children with ASD lack skills in both initiating and responding to joint attention overtures from others, they may miss cues that signal they are being imitated and that imitation is an expected part of social interactions. Further, due to the primary consequence of their non-responsiveness and the lessened likelihood that others will attempt to engage them in the future, these children will likely not be given future opportunities to practice these social skills.

Social orienting. Similar to social processing theory, the social orienting theory suggests that imitation is a secondary deficit, however the primary deficit is hypothesized to be a lack of spontaneous attention to social stimuli. (Dawson et al., 2004) Research has demonstrated that children with ASD are less likely than typically developing children to attend to all types of stimuli (social and non-social), but that this deficit is significantly stronger for social stimuli (Dawson et al., 2004). Additionally, this comparison between typically developing children and children with ASD is mirrored in a comparison between children with developmental delays and children with ASD, suggesting that this social impairment may be specific to ASD overall. Therefore, similarly to the social processing conclusion, this theory seems to suggest that joint attention may act as the primary deficit that leads to secondary deficits in imitation. However, this theory posits that children with ASD do not develop typical imitation skills due to their impaired joint attention skills; rather, the authors suggest that the lack of development of imitation skills is due to the children's joint attention deficit. In other words, in comparison to the social processing theory, rather than hypothesizing that children with ASD lack exhibition of imitation skills that are fully developed but not evidenced due to a lack of social opportunity, this

theory suggests that deficits in joint attention lead to a lack of imitation skill development (Dawson et al., 2004).

Social motivation. The social motivation theory ties imitation to broader social impairments. This theory suggests that children with ASD do not view other human beings as social agents, and thus withhold expectations of social overtures or responses from them (Whiten & Brown, 1999). Due to this altered expectation, children with ASD may not attempt to engage others in a social manner. While children with ASD can be taught to imitate when prompted to do so (Ingersoll, 2008; Lovaas et al., 1967), research has shown that they are less likely to spontaneously imitate another person. This suggests that perhaps imitation as a whole does not qualify as a deficit in children with ASD, but instead only as it pertains to social interactions (Whiten & Brown, 1999). In respect to the relationship between joint attention and imitation, this theory proposes that children with ASD demonstrate these two skill deficits because they are not motivated to engage in the basic premise of social interaction. Further, it suggests that if children with ASD develop early social skills, such as joint attention, they may simultaneously acquire more social motivation, which may then lead to the attainment of imitation.

While the social orientation, processing, and motivation theories differ in their positions on whether children with ASD possess the basic skills of imitation; all three suggest that joint attention and imitation are related. Specifically, they posit a general order in the development of joint attention and imitation – namely, that deficits in joint attention skills serve as a barrier to the development and/or expression of imitation skills (Dawson et al., 2004; Nadel, 2002; Whiten & Brown, 1999). Further research is needed to provide evidence for this proposed chronological development. By examining the effectiveness of an intervention targeting the first skill – joint attention – and its corollary effects on the development of imitation, research can shed more light

on the developmental nature of the relationship between joint attention and imitation in children with ASD.

Relationship among Joint Attention, Imitation, and Related Areas of Development

The pervasiveness of joint attention and imitation deficits in children with ASD pose significant challenges to development in other crucial areas. Research has demonstrated links between joint attention and imitation, receptive language, expressive language, play, and a myriad of social behaviors. As deficits in these corollary skills, can pose significant challenges to both daily and social functioning, it is important to strengthen knowledge of the relationships between joint attention/imitation and these areas. Specifically, it is important to identify whether gains in the potentially pivotal skills of joint attention and imitation may be associated with improvements in these secondary areas. Evidence of such relationships is described in the following sections.

Joint Attention and Related Areas of Development

Language. Research has demonstrated a link between joint attention skills and both receptive and expressive language development beginning at a very young age in typically developing children (e.g., Loveland & Landry, 1986; Morales, Mundy, & Rojas, 1998; Tomasello, 1992), as well as in children with ASD (Loveland & Landry, 1986; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman & Ungerer, 1984). One explanation for these relationships is that when children are first beginning to comprehend the meaning of language, they require joint attention skills to help language to become meaningful (Bakeman & Adamson, 1984). The following sections review the current literature on the relationship between joint attention and language development in children with autism and their typically developing counterparts

Receptive language. Receptive language, defined as the ability to comprehend communication input, has been shown to have a significant relationship with the development of joint attention skills (American Speech-Hearing-Language Association, 2014). Studies of typically developing children reveal that children with higher joint attention skills at six months demonstrate a larger receptive vocabulary at twelve months (Morales et al., 1998). At two years of age, a child's skills in using conventional social gestures (a sign of joint attention) also predicted performance in receptive language skills (Watt, Wetherby, & Shumway, 2006).

Further research suggests that perhaps the type of joint attention – response to or initiation of – may determine which type of language is impacted. For instance, an investigation examining children with ASD between the ages of fourteen and twenty-one months found that children's skills in responding to joint attention bids from another person significantly predicted their level of receptive language (Mundy & Gomes, 1998). Further, evidence for the importance of joint attention in relation to receptive language is found in the ability of joint attention skill level to differentiate between children with ASD and children with developmental language delays (Loveland & Landry, 1986). In this investigation, children with ASD exhibited both significant joint attention deficits and receptive language deficits – specifically in following communicative gestures and receptively following verbal directions paired with gestures. However, children with developmental language delays performed significantly better on the joint attention and receptive language tasks than children with ASD (Loveland & Landry, 1986). Taken together, this research suggests that joint attention may serve as a unique predictor for language deficits and development in both typically developing children and children with ASD. Additional research that examines the impact of interventions focused on improving joint

attention on receptive language skill development would be beneficial in further clarifying the nature of the relationship between the two skills.

Expressive language. Expressive language is defined as the ability to produce language that is comprehensible to others (American Speech-Hearing-Language Association, 2014). Similar to links between joint attention and receptive language, typically developing children with better joint attention skills at six months of age also demonstrated a larger expressive vocabulary at the ages of 18, 21, and 24 months (Morales et al., 1998). Joint attention ability continues to influence more complex language abilities, with children with highly developed joint attention skills demonstrating greater understanding of the various components of language (e.g., syntax, semantics, pragmatics) and more highly developed conversational skills. (Morales et al., 1998). Research has also suggested that joint attention may serve as a mechanism by which children learn the specific component of conversational pronoun switching (Morales et al., 1998). That is, being able to answer a question such as "Are you hungry?" correctly by reversing the "you" pronoun to "I" (e.g., "I am").

It is important to note while many studies point to the relationship between a child's skill in initiating joint attention and expressive language skills, studies have also demonstrated that a child's ability to respond to an initiation of joint attention by another is another important factor in the development of expressive language. For instance, in a study examining two- to six-year-old typically developing children's language development, response to joint attention served as a predictor of language gains over an eight-year period of time (Sigman et al., 1999). Similarly, children with better skills in response to joint attention between the ages of two and six years old tended to speak in longer phrases when assessed between the ages of ten and thirteen years old

than children with poorer response to joint attention skills (Murray, Creaghead, Manning-Courtney, Shear, Bean, & Prendeville, 2008).

As has been demonstrated in typically developing children, research has shown the existence of a significant relationship between joint attention and expressive language in children with ASD. For instance, children with ASD who demonstrated more coordinated play with adults demonstrated coordinated gains in joint attention and language skills over a sixteen-year period (Siller & Sigman, 2002). Research has also demonstrated that children with ASD with impairments in joint attention had corollary difficulties in using pronoun reversals (Loveland & Landry, 1986). Conversely, children with ASD who were able to demonstrate pronoun reversal skills were marginally more likely to engage in spontaneous joint attention initiation (Loveland & Landry, 1986).

At this time, research has not yet fully demonstrated the exact nature of the relationship between joint attention and language; however, evidence does seem to suggest that a general relationship between the two constructs does exist, both for typically developing children and for children with ASD (e.g., Mundy & Gomes, 1998; Siller & Sigman, 2002). Delineating the relationship between these two skills will allow researchers and clinicians to determine whether interventions targeting joint attention may lead to subsequent gains in expressive language as well as whether there are specifics to either skill (i.e., initiation of versus response to joint attention) that serve as links to particulars of the other skill.

Social skills. In addition to the relationship demonstrated between joint attention skills and language development, researchers have also studied the relationship between joint attention and further social skills. Researchers have proposed a developmental course for the social-affective aspect of joint attention (Schertz & Odom, 2004). Beginning with a general ability to

share another's attention, children begin to engage with one other person, moving to a curiosity about objects and the further development of triadic relationships, which is where it is hypothesized that the true nature of joint attention emerges. It is theorized that once joint attention skills are mastered, children are able to act as "independent social agents" with other people (Schertz & Odom, p. 45, 2004). Further, studies have shown that at nine months of age – the same milestone for the solidification of joint attention skills – children are able to use facial expressions to influence others' attention and behavior as well as to communicate and share the emotions they are experiencing (Adamson & Russell, 1999). Additionally, joint attention is distinguished from requesting in that the former is often accompanied by a sharing of positive affect with the target of the initiation (Lawton & Kasari, 2012). By combining affect with joint attention, the initiator of the social act lets the target of the act know the shared intention behind it (Bruner, 1983).

As has been demonstrated with typically developing children, joint attention skills and social skills are linked in children with ASD. For instance, the level of response to joint attention skill in children with ASD at three years of age is positively related to their later social skills as an adult (Gillespie-Lynch et al., 2012). In terms of social engagement with others through play, studies have shown that when children and their parents play in a connected manner (i.e., shared understanding of the game), children develop stronger joint attention skills in addition to higher language skills (Siller & Sigman, 2002). The fact that children with ASD lack joint attention skills may help to explain the often-observed impairments in social behaviors.

Further evidence of the relationship between joint attention and social skills can be found in studies examining the effects of a joint attention intervention on this domain. One such study found that an intervention using discrete trial training and child-directed methods to improve

both joint attention skills and symbolic play found that both areas of the intervention resulted in improvements in joint attention initiations in children with autism (Kasari, Freeman, & Paparella, 2006). Finally, research has suggested overall that effective joint attention interventions are likely to have collateral benefits in social interactions of children with ASD, especially when they are conducted in a play-based manner (White et al., 2011).

Similar to the purpose of examining the relationship between joint attention skills and language development, it is hoped that by examining the relationship between joint attention and social skills, researchers will be able to better understand possible causal as well as correlational relationships. By furthering understanding in this area, the effectiveness of interventions aimed at improving such skills may be able to be increased; additionally, if interventions can target one skill – joint attention – and result in improvements in additional skills – social skills – then interventions may be shown to be not only effective but also cost-effective.

Play. Play is a means by which children learn and make sense of the world around them, serving as a framework for learning (Siraj-Blatchford, 2009; Vygotsky, 1993). Play also allows for children to explore and construct meaning of their experiences (Bloom, 1993). In typical development, children demonstrate functional, or pre-symbolic, play by one year of age and more multifaceted symbolic play beginning at two years of age (Toth, Munson, Meltzoff, & Dawson, 2006).

Research has demonstrated a significant role for joint attention in the development of play skills in typically developing children (i.e., Bigelow, MacLean, & Proctor, 2004; Bornstein, Haynes, O'Reilly, & Painter, 1996; Beizer & Howes, 1992). Specifically, at one year of age, there is a significant relationship between children's use of joint attention (showing, giving, pointing) and their functional object play (Bigelow et al., 2004). Further, through joint attention

episodes, a mutual relationship between child and mother as play partners serves as a mechanism to grow children's play skills. Research has shown that children engage in more sophisticated play when engaging with their mothers than when playing alone (Bornstein et al., 1996; Beizer & Howes, 1992). The authors suggest that, through joint attention, children are tuned in to their mothers' actions in play as well as mothers demonstrate sensitivity to children's play actions and therefore are able to scaffold their children's play

Research has shown that the mere presence of a play partner is not enough to affect play development in children – rather, it is the interaction between the play partner and the child that truly affects social skills growth. One study showed that when their mothers were present, children were equally likely to engage in object play, regardless of whether or not they engaged in joint attention. However, they demonstrated more sophisticated play in the midst of joint attention episodes: when joint attention behaviors were absent, children were more likely to demonstrate immature and/or stereotypical play. Finally, after engaging in such joint attention episodes, children were more likely to demonstrate more advanced play when engaging in solitary play, suggesting that through joint attention, children learn new play skills (Bigelow et al., 2004).

The literature on children with autism shows significant deficits in play for these children. Children with autism show a lack of functional, or pre-symbolic, play skills as early as eighteen months of age (Charman, 1998; Baron-Cohen, 1996). Further, research has shown that while children with autism can learn and improve their play skills, most often their skills remain at a lower developmental level than would be expected when considering their language level (Amato, Barrow, & Domingo, 1999; Ungerer & Sigman, 1981). Finally, while children with

autism may demonstrate symbolic play, it is often repetitive and stereotypic (Wing, Gould, Yeates, & Brierly, 1977).

Due to the importance of play in overall child development, and, additionally, the deficits in play often shown in autism (i.e., Baron-Cohen, 1996), it is valuable to examine the relationship between early skills (i.e., joint attention), and play in children with autism. Particularly, if clinicians can teach joint attention skills, they may find that children gain play skills as a secondary result.

Imitation and Related Areas of Development

Language. Similar to the relationship shown between joint attention skills and language development – both receptive and expressive – studies have demonstrated a link between imitation skill proficiency and language development. Imitation, evident from birth, lays the ground for both learning the form and function of verbal interaction with others. Prior to developing functional verbal communication, infants use imitation in a somewhat communicative function, learning the give and take of typical conversations by engaging in reciprocal imitation (i.e., imitating one's mother as well as being imitated by one's mother). As verbal skills develop, imitation sharply decreases, suggesting that once a child can successfully verbally communicate and interact with others in this way, they no longer rely on imitation as a primary means of communication (Ingersoll & Lalonde, 2010).

Using imitation prior to verbal communication allows preverbal children to learn that human beings place meaning behind their communication. For instance, when individuals engage in "rational imitation", they not only gain understanding about why someone performed a certain action, but they also must decide whether that motivation is relevant for another unique situation (Tomasello, Carpenter, Call, Behne, & Moll, p. 6, 2005). By developing this

understanding of intention while communicating pre-verbally through imitation, young children learn that communication has meaning and purpose.

Research in this area has identified particular relationships between different kinds of imitation and language. For instance, motor imitation significantly predicts the level of expressive language in both typically developing children and children with ASD; children who demonstrate stronger motor imitation skills are more likely to have more mature expressive language skills (Stone & Yoder, 2001). More specifically, for children with ASD, motor imitation skills at two years act as a significant predictor of their expressive language skills at four years, regardless of the level of expressive language at two years old, suggesting that imitation skills are more predictive than expressive language skills at age 2 (Stone & Yoder, 2001). The authors suggest that this finding may be explained by a primary deficit in attention to social stimuli, rather than a skill deficit in imitation, per se. That is, in order to imitate another's actions, a person must attend to another person as well as create a mental image of the action – harkening back to the social processing theory (Nadel, 2002). The person must also be motivated to engage with another person in a social manner (Whiten & Brown, 1999). Finally, as typically developing children frequently develop language by observing and imitating others in their environment, similar skills as those needed for motor imitation are required, explaining the link between the two skills (Stone & Yoder, 2001).

Another type of imitation that has been related to language in children with ASD is role reversal imitation. Role reversal imitation is the ability to imitate an action in the same manner by which another person enacted it toward him- or herself. For example, if a person touches his or her nose, the child would touch his or her own nose to imitate (Carpenter, Nagel, & Tomasello, 1998). A deficit in this type of imitation implies that the child has difficulty

understanding that he or she must convert an observed action from one directed at them to one that the child directs toward another person. For example, when a child with ASD is learning how to wave at another person, they often wave at others with their palms facing themselves rather than directing the gesture to the other person (Carpenter, Tomasello, & Striano, 2005). This deficit similar to those several language impairments commonly found in individuals with ASD, including echolalia, difficulty in choosing correct personal pronouns, and mixing up the use of questions versus statements. For example, if one were to ask a child with ASD, "How are you?" he or she may incorrectly respond, "You are happy" rather than "I am happy" (Peeters, Grobben, Hendrickx, Van den Eede, & Verlinden, 2003). Further, research has demonstrated that children who demonstrate mastery of role reversal imitation skills tend to have higher skills in language (Carpenter, Tomasello, & Striano, 2005), providing support to the notion that imitation of this type is related to language development.

Finally, studies have demonstrated a relationship between facial imitation skills and language development. Specifically, adolescents with ASD who demonstrated more mastery of upper and lower facial imitation were observed to use more spontaneous speech than adolescents who struggled with this type of imitation. Adolescents who demonstrated imitation of another's actions such as blinking their eyes, scrunching up their eyes, sticking out their tongues, and opening their mouths were more likely to spontaneously name articles, events, and verbs as well as demonstrate better articulation as well as use more typical speech cadences and rhythm when speaking (Freitag, Kleser, & von Gontardf, 2006).

Research has demonstrated the significant link between the development of imitation and language skills in both typically developing children and children with ASD (e.g., Ingersoll & Lalonde, 2010). Further, research has suggested that the language deficit often seen in children

with ASD may be at least partly explained by the impairment in imitation skills often simultaneously observed (e.g., Carpenter et al., 1998; Stone & Yoder, 2001). By examining this relationship further, as well as determining whether interventions targeting social communicative skills such as imitation, researchers may be able to use this connection to intervene at the most effective level.

Social skills. Just as children learn language through imitation, research has demonstrated that they also learn social skills using imitation skills. Social learning theory suggests that typically developing children learn behaviors by observing the behavior of others and then copying it in their own behavioral repertoire; children are observing behaviors completed by a social agent, thus the development of social behavior is often at least partly accomplished in this manner (Bandura, Ross, & Ross, 1961). Additionally, research has suggested that in order to improve social skills and interactions one must learn within this context; for example, for a child to learn that taking a toy without asking is not socially appropriate, he or she must engage in a social situation with others (Haring & Lovinger, 1989). Research has found evidence that typically developing children use imitation to develop social skills using video modeling. Video modeling is a procedure by which children watch a taped social interaction that demonstrates either replacements for inappropriate social behavior or examples of new social behavior (Grant & Evans, 1984). Research has shown that for typically developing children, employing this strategy has led to increased frequency of social interaction, including in the context of play (Ballard & Crooks, 1984).

In typically developing children, imitation's role in social interaction can be seen as early as twenty-four months of age. Children who are imitated by other children are more likely to continue to play a game with another child, initiate a new game with a peer, and also attend more

to the faces of their peers (Eckerman & Stein, 1990). Further, typically developing children use nonverbal imitation to communicate shared understanding when engaging in pretend play, later leading to the use of verbals to communicate their play intentions to their peers (Eckerman & Didow, 1996). Considering the importance of imitation in social development as well as the deficits in imitation often observed in children with ASD, it is important to consider the connection between the two skills.

Research studying the relationship between imitation and social skills in children with ASD has demonstrated unique links. Studies have shown that imitation serves as a way for children to enter their social worlds, learning by observing and practicing social skills through imitation. Imitation's importance, and the related deficits observed in children with ASD, may explain the finding that young children with ASD frequently struggle to form and maintain good relationships with their peers (Ingersoll, 2008). As in studies with typically developing children, research has shown that video modeling – a form of imitation – can be effective in teaching children with ASD numerous skills, including social behaviors (e.g., Nikopoulous & Keenan, 2003). In addition to video modeling, child-directed imitation interventions that use more natural contingencies to teach imitation skills have demonstrated the development of skills that were not directly targeted in the intervention, including pretend play (Ingersoll, 2008; Nikopoulous & Keenan, 2003).

In general, research has posited that imitation serves as an important step in developing more complex social skills and engaging in social behavior (e.g., Ingersoll, 2008). By examining the relationship between imitation and social skills, research can further determine the most effective way to target both skills.

Play. As with several skills, including language and social skills, children learn to play by imitating the actions of others (i.e., Carpenter et al., 1998; Rogers, Cook, & Meryl, 2005). As previously mentioned, research has shown that children learn to play in the presence of and while interacting with a more sophisticated play partner. Such play not only involves attending to the play partner's actions but also copying those actions in the children's own play (Bigelow et al., 2004).

Research has shown that for children with autism, imitation and play skills are significantly related. For example, children's ability to imitate actions on objects at two years of age was related to play development at three years of age (Stone, Ousley, & Littleford, 1997). Additionally, research has suggested that the fundamental deficit in imitation skills may predict further deficits in play skills, rather than play development being a first-order deficit in autism (Rogers et al., 2005). This is supported by interventions specifically targeting imitation in children with autism. In the context of a naturalistic behavioral intervention, one study showed that as children with autism began to demonstrate increased spontaneous object imitation, they further demonstrated new, not previously taught actions with familiar toys as well as appropriate engagement with unfamiliar toys. Additionally, in the midst of the intervention as well as at post-intervention, children demonstrated increases in pretend play skills, suggesting that through learning imitation skills, children acquired more advanced play skills (Ingersoll & Schreibman, 2006).

Due to the power of play in child development and learning, it is beneficial to examine how a hypothesized core deficit in autism – imitation – may be related to children with autism's growth in typical, functional play. Specifically, intervention in this crucial area of imitation may be serve as an avenue for children with autism to gain corollary play skills.

Early Intervention in Autism

As demonstrated above, the core deficits often observed in individuals with autism can lead to significant challenges in several areas in daily life (i.e., communication, social skills, personal independence). Therefore, it is crucial to evaluate the effectiveness of interventions designed to improve skills in fundamental areas for young children with autism.

Importance of Early Intervention

Research has demonstrated diagnostic reliability at eighteen months of age with highly experienced examiners (Chawarska, Klin, Paul, & Volkmar, 2007). However, the average age of diagnosis remains much higher, at four years (Baio, Wiggins, Christensen, Maenner, Daniels, Warren,…Dowling, 2018). First, early diagnosis is imperative because, in most cases, the earlier a child receives an appropriate diagnosis, the earlier the child can begin to receive intervention. Second, brain plasticity is highest while the brain is at this critical stage of development; therefore, it is imperative that children receive intervention during this period to maximize outcomes. Studies have shown that core autism symptoms, such as decreased attention to others, can be seen by age one and more can be seen between the ages of two and three, such as eye decreased eye contact and lack of joint attention (Osterling et al., 2002; Dawson et al., 1998), thereby demonstrating evidence that abnormal brain activity is likely evident very early on (Dawson, Webb, & McPartland, 2005). Further, research has suggested that by intervening early in these basic social skills, it may lead to neurological improvements that trend toward normalized brain functioning in addition to the behavioral changes (i.e., skill acquisition) from early intervention (Dawson, Webb, & McPartland, 2005). Third, early intervention therapy that addresses primary symptoms of autism (e.g., communication, joint attention, social skills) may prevent challenging secondary symptoms such as aggression, tantrums, and self-injury (Koegel

et al., 2014). Finally, research has demonstrated that what has been termed the "wait-and-see" method (i.e., failing to address core symptomology) for children with autism likely results in poor outcomes and may also contribute to the aforementioned secondary symptoms (National Research Council, 2001).

Several early intervention models have been posited as options for young children with ASD. It is important that all models be investigated to examine whether evidence supports significant, positive outcomes for these children. The following sections illustrate two primary, overarching models that are commonly incorporated into early intervention for children with autism – Applied Behavior Analysis (ABA) and Pivotal Response Training (PRT) – as well as a more recent model that incorporates aspects of the two while adding elements of child-directed activities and a developmental sequence, the Early Start Denver Model (ESDM).

Traditional Model: Applied Behavior Analysis (ABA)

Applied Behavior Analysis (ABA) is perhaps the most widely-known method of early intervention for children with autism. This method is based on the principle of operant conditioning, which states that through reinforcement and/or punishment, behavior is either strengthened or weakened; specifically, if a behavior is followed by either positive reinforcement (adding something pleasurable) or negative reinforcement (taking away something aversive), it is more likely that this behavior will happen again. If a behavior is followed by either positive punishment (adding something aversive) or negative punishment (taking away something pleasurable), the behavior will be less likely to happen again.

This paradigm is known as the "ABC" model. The antecedent (A) – or the discriminative stimulus – tells the student what behavior (B) to perform. This behavior is then followed by the consequence (C) that, as illustrated above, either reinforces or punishes the behavior, making it

thereby more or less likely to re-occur. (Cooper, Heron, & Heward, 2007) For example, in the antecedent phase, the therapist may hold up a picture card showing a duck while asking the student, "What is it?". In the behavior phase, the child may respond "duck", followed by the consequence phase, wherein the therapist delivers reinforcement, such as a high five. Because the therapist reinforced a correct response, the child will be more likely to deliver a correct response when the antecedent occurs in the future.

ABA is generally considered an adult-controlled model, wherein the therapist chooses the materials and retains firm control over antecedent variables that signal the desired response as well as consequences that follow the response (Lovaas, 1987; Mohammadzaheri, Koegel, Rezaee, & Rafiee, 2014). Additionally, ABA is an evidence-based treatment, demonstrating its effectiveness across a large number of studies (i.e., Eldevik, Hastings, Hughes, Jahr, Eikeseth, & Cross, 2009; Rogers & Vismara, 2008; National Research Council, 2001), including an original ABA study that showed that approximately fifty percent of children who participated in ABA were considered to resemble their typically developing peers following treatment (Lovaas, 1987). Despite its effectiveness and while several principles used in ABA have been included in more modern models, the formal, structured intervention has been criticized for three main concerns: First, ABA recommends forty hours per week of therapy, making the treatment a time-consuming one; additionally, children sometimes require a large amount of massed trials to learn a single skill. Second, research has demonstrated difficulties with skill generalization outside of structured sessions. Third, research has also demonstrated a lack of motivation in children participating in ABA, as evidenced by escape-related behaviors. This may be due to the intervention being primarily adult-driven (Koegel & Koegel, 1995). In response, more recent

models have incorporated theories of child development to increase children's responsiveness, as evidenced in naturalistic models.

Naturalistic Models

Pivotal Response Training (PRT). Pivotal Response Training (PRT) targets key deficit areas, such as improving children's initiation and responding to social, communication, and other learning opportunities in the natural environment, by increasing children's social motivation. By focusing on these core ("pivotal") areas, PRT aims to increase skills in other domains as well. In addition to these pivotal responses, PRT incorporates more naturalistic aspects into a therapy session. First, the materials used in treatment are those that the child encounters regularly in his or her environment; additionally, the child gets to choose the materials. Second, a child's steps toward mastery are reinforced; when the child attempts to display a correct response, they are rewarded for trying in order to build up those skills to perform a completely independent response. Third, social reinforcers (i.e., tickles, verbal praise) are combined with natural reinforcers (i.e., getting access to play materials that the therapist is using in session) to increase the child's attention to the interaction between the child and the therapist (Koegel, Koegel, & Carter, 1999).

PRT has three main goals:(a) to teach children to engage in social learning interactions in the natural environment; (b) to decrease the need for a therapist or other adult to be continuously present; and (c), to create more opportunities for children to be in their natural environment rather than in more structured, isolating services. (Koegel, Koegel, Harrower, & Carter, 1999). Research has demonstrated that PRT is effective for increasing expressive language acquisition (i.e., Laski, Charlop, & Schreibman, 1988; Koegel, O'Dell, & Koegel, 1987), social skills (i.e., Koegel, Koegel, Shoshan, & McNerney, 1999; Koegel, Bimbela, &

Schreibman, 1996), and play skills (Stahmer & Gist, 2001; Stahmer, 1995; Thorp, Stahmer, & Schreibman, 1995).

Early Start Denver Model (ESDM). The Early Start Denver Model (ESDM) is an intensive behavioral intervention for children ages twelve months to five years that combines applied behavior analysis (ABA) and a developmental, relationship-based approach. The ESDM model posits that because children with autism are less likely to initiate social interactions with others, they receive fewer opportunities to learn. Additionally, because children with autism are not engaging in social interactions, the people around them often attempt fewer initiations with them. Therefore, the ESDM model works to deliver intervention that creates opportunities to learn through the therapist acting as a "play partner" who follows the child's interests and is sensitive to the child's communication. Through interactions with the therapist, the child learns to that he or she has power through communication and, through principles of reinforcement, learns to value social interaction with others (Rogers & Dawson, 2010).

In terms of theoretical leanings, the ESDM shares several aspects with research surrounding the Still-Face Paradigm, which was used to investigate whether children with autism hold expectations for people they do not know (Nadel et al., 2000). The Still-Face Paradigm is structured in four phases. In the first phase, an adult with whom the child has never previously interacted sits motionless in a room with the child and does not interact with him or her. In the second phase, the adult imitates all of the child's behaviors. In the third phase, the adult resumes his or her non-interactive position. Finally, in the fourth phase, the adult and child engage in spontaneous behavior. When this model was used with children with autism, research showed that children engaged in significantly more social behaviors – such as looking at the adult, touching them, getting closer to the adult, and gesturing toward them – in the third phase than

they did in the first phase. The authors concluded that this change in behavior suggests that children with ASD can, in fact, come to expect social behaviors from unfamiliar adults (Nadel et al., 2000).

Further research using the Still-Face Paradigm investigated whether children with ASD showed any difference in responsiveness when they were imitated by another adult versus when the adult simply responded to them in a predictable manner. Studies demonstrated that children in the imitation group showed more expectant social behavior than those in the contingently responsive group (Escalona et al., 2000). Additionally, research has shown that when children with ASD receive repeated exposure to imitation in the form of adults imitating their behavior, the children subsequently engage in more social behavior (Field, Field, Sanders, & Nadel, 2001) – including joint attention (Ezell et al., 2012). Finally, referring specifically to the ESDM's focus on play-based interactions between therapists and children, research has shown that children with ASD tend to initiate more social behaviors with adults who imitate them and act in a playful manner (Nadel, Martini, Escolan, & Lundy, 2008).

Curriculum. The ESDM curriculum targets skills in all developmental domains, assuming that autism, as a disorder, affects a child's development across the board. The curriculum contains goals in (a) language, both receptive and expressive; (b) social skills, including: play, imitation, joint attention, and adult and peer interaction; (c) cognition; (d) motor skills, both fine and gross; and (e) personal independence.

In curriculum implementation, the ESDM follows four main tenets. First, the ESDM intervenes in the area of language through social interaction. Specifically, by the therapist following the child's lead, the therapist reinforces the notion that communication is key; for example, if a child spontaneously requests "car", the therapist repeats "car" and hands the car to

the child and further imitates the child's actions with the car prior to introducing his or her own play actions. Additionally, therapists follow what is referred to as the "one-up rule", meaning the therapists only adds one additional word to phrases used when communicating with the child; for example, if the child primarily speaks in single words, the therapist will use a maximum of two words when speaking to the child, reinforcing the child's understanding while also modeling phrase expansion.

Second, the ESDM curriculum levels build upon each other, beginning with small steps that lead to more multifaceted skills. For example, the child first develops fine motor skills to build and pull apart connecting blocks prior to learning how to ideate building structures on their own. Additionally, teaching is always set within preferred play activities in order to capitalize on the child's motivation. Finally, ESDM sessions include goals from several developmental domains that are taught simultaneously, modeling the way that skills are typically acquired.

Third, the ESDM takes a multidisciplinary approach, including professionals from the fields of developmental and clinical psychology, applied behavior analysis (ABA), early childhood special education, speech-language pathology, and occupational therapy. By collaborating across these fields, the child receives a well-rounded, inclusive intervention that targets several needs at once.

Finally, while all children receive the same ESDM curriculum, each child's treatment plan is individually tailored to provide intervention that is matched with the child's developmental level. Additionally, children's preferences and interests are strongly incorporated into the intervention. Similarly, family input is highly important; therapists take into account family values, preferences, and goals for each child. Finally, a systematic way to move forward

when a child's progress is not as expected is provided within the manual in order to further individualize each child's treatment.

Teaching procedures. As previously mentioned, ESDM therapy is delivered within preferred play activities and includes goals that span several developmental domains. In terms of intervention methods, the ESDM incorporates principles of applied behavior analysis (ABA) and pivotal response training (PRT) as well as aspects that are unique to the model.

From ABA, the ESDM uses the "ABC" approach to teaching new skills, albeit describing the process in less strict behavioral terms. First, the therapist gains the child's attention and delivers the instruction (the *antecedents)*, which is thereby followed by the child's behavior (*the behaviors,* either the correct or incorrect response to the instruction) and, depending on the behavior, a response from the therapist, either reinforcing or corrective (the *consequences)*. Additionally, the ESDM includes the use of principles such as prompting, shaping, and chaining. Finally, the ESDM recommends that children who are exhibiting problematic behaviors (i.e., aggression) participate in a functional behavior analysis (FBA) to determine the function of and, further, interventions for those behaviors (Rogers & Dawson, 2010).

From PRT, the ESDM incorporates principles such as reinforcing children's approximations of skills, intermixing new and already mastered skills, and turn taking between the therapist and the child. The ESDM additionally promotes using reinforcement in the context in which the child and therapist are engaging; for example, if the therapist is working on the child imitating play actions within a transportation theme, the reinforcement may be allowing the child access to his or her favorite vehicle after the child imitates the therapist driving the car down a ramp. Perhaps most notably, the ESDM values a child's preferences in activities and

materials and aims to follow the child's leads throughout the intervention session (Rogers & Dawson, 2010).

In addition to these previously established teaching procedures, the ESDM introduces some additional variables specific to the model. In following the model's attention to the child's preference and learning state, as well as his or her relationship with the therapist, the ESDM model instructs therapists to pay close attention to three variables in the child: affect (i.e., the child's emotional status and responses), arousal (i.e., the child's energy level), and attention (i.e., the child's engagement with the therapist). By creating an ideal affective relationship between the child and therapist, the ESDM model posits that the therapist will be more successful in teaching the child. In relation to this principle, the therapist values the use of positive affect in interacting with the child and is careful to maintain a reciprocal interaction throughout the session. Additionally, the therapist demonstrates a high degree of attention and sensitivity to what a child is trying to communicate, whether that be a request for a toy or an attempt to communicate that he or she is finished with an activity (Rogers & Dawson, 2010).

In addition to the more emotional considerations in the ESDM, the therapist also uses a particular structure in his or her teaching. The ESDM employs what are called "joint activity routines" during therapy. A joint activity routine begins with a child initiating and/or choosing an activity, which the therapist follows by imitating the child's play actions. After the foundation of the routine has been built, the therapist begins to include variations in the play theme in order to elaborate on the child's actions. These variations can include the addition of new materials, using the same materials in a new way, or, most importantly, teaching opportunities across various domains. Finally, when the child indicates that they are finished with the activity, and/or the therapist determines that there are no further appropriate variations

and/or teaching that can be accomplished in the joint activity routine, the therapist and child close down the activity and promote a smooth, clear transition to a new one (Rogers & Dawson, 2010).

Evidence for effectiveness of ESDM. While the ESDM was originally developed over thirty years ago (Rogers, Herbison, Lewis, Pantone, & Reis, 1986), it is only recently that studies have examined the model's effectiveness with more rigorous research designs. The first study that employed a randomized control treatment design examined the outcomes of young children with autism between the ESDM and an "assess and monitor" group (Dawson et al., 2010). Forty-eight children between the ages of 18 and 30 months were randomly assigned to either group. Children in the ESDM group participated in individual two-hour sessions twice a day, five times a week, for two years. Children in the "assess and monitor" received an average of eighteen hours of individual and/or group therapy per week.

Results showed promising results for ESDM effectiveness. After one year of treatment, children in the ESDM group demonstrated significantly more gains, on average, in IQ (15.4 points) than children in the "assess and monitor" group (4.4 points). After two years of treatment, children in the ESDM group continued to demonstrate significantly greater IQ gains (17.6 points) than children in the "assess and monitor" group (7.6 points). Additionally, at this point, children in the ESDM group also showed gains in adaptive behavior that, while still behind the normative sample of the Vineland Adaptive Behavior Scales, grew at the same as pace as the normative sample, while children in the "assess and monitor" group continued to decline in this area (Dawson et al., 2010). In a follow-up study (Estes, Munson, Rogers, Greenson, Winter, & Dawson, 2015), thirty-nine children from the original sample were assessed at six years of age. Promisingly, children in the ESDM group demonstrated skill maintenance in

both IQ and adaptive skills. Additionally, these children also showed more improvement in their overall ASD symptomology, demonstrating less severe diagnostic status.

In addition to the long-term follow up study described above, the same group of researchers assessed the brain activity of the participants from the original RCT. Researchers studied data from electroencephalograms (EEGs), which measure electrical activity in the brain. The EEGs of children in the ESDM group demonstrated attention to and cognitive processing of social stimuli that resembled brain activity of typically developing children. In contrast, children from the "assess and monitor" group demonstrated atypical brain activity in comparison to typically developing children. Children in the ESDM group also showed greater responsiveness to social stimuli in comparison to nonsocial stimuli, as measured by faster brain responses when shown faces versus when shown objects. In comparison, children from the "assess and monitor" group showed reversed results (Dawson, Jones, Merkle, Venema, Lowu, Faja…Webb, 2010).

More recently, researchers have begun to examine the effectiveness of ESDM when administered in group settings. Preliminary studies have found similar results to those that assessed ESDM when administered in one-on-one or parent training sessions. One such study looked at children receiving 15 to 25 hours per week of ESDM in a community daycare setting as compared to a non-manualized community program. As previously found, children in the ESDM setting demonstrated significantly more gains in IQ (14 points) than children in the non-manualized setting (7 points). Additionally, while children in the ESDM group demonstrated gains in several other areas (i.e., adaptive behavior, decreased diagnostic severity ratings), these differences were not significantly different than those that were found in the non-manualized group setting (Vivanti, Paynter, Duncan, Fothergill, Dissanayake, Rogers…the Victorian ASELCC Team, 2014). Another study examining the group model found that children receiving

15 to 20 hours per week of group ESDM demonstrated similar gains in IQ but also a decrease in problem behaviors, as rated by their therapists (Fulton, Eapen, Crncec, Walter, and Rogers, 2014).

In sum, research suggests that the ESDM is an effective early intervention for young children with ASD. Thus far, studies have used standardized assessments to measure progress, which is recommended in research settings, due to the fact that established assessments typically have measures of reliability and validity. However, administering these measures can be expensive in terms of time, monetary costs, and clinician expertise required, thereby making it impractical to conduct these assessments frequently enough to adequately observe progress. In contrast, the ESDM Checklist is designed to be administered by treating clinicians as a standard part of treatment

To the researcher's knowledge, no study has yet used the ESDM Checklist, which is used to measure progress within the intervention, as a primary measure. Therefore, data on reliability and validity is nonexistent at the time of this study. The researcher hopes to examine the potential use of the ESDM Checklist as an outcome measure. In this study, the ESDM Checklist is used both to examine possible replication of children's skill gains through ESDM intervention as well as study relationships between variables considered core deficits in ASD (joint attention and imitation) and secondary variables (i.e., language, social skills, play).

Statement of the Problem

Joint attention and imitation are two of the first social skills that typically developing children learn in order to interact with others and the world around them (Osterling & Dawson, 1994; Trevarthan, 1979). These behaviors allow infants to create an attachment to caregivers as well as learn skills such as language and social play (Eckerman & Didow, 1996; Ingersoll, 2008;

Trevarthan, 1979). While these skills are seemingly innately present in typically developing children, children with autism spectrum disorder often exhibit significant deficits in both skills (e.g., APA, 2014).

Several explanations have been posited to determine possible causes for these social interaction deficits in children with ASD, including a neuropsychological deficit in attention shifting (Courchesne et al., 1995), social orienting and processing deficits (Dawson et al., 2004 and Nadel, 2002, respectively), and finally motivational deficits (Dawson et al., 2002; Whiten & Brown, 1999). The current study draws its impetus primarily from the social orienting theory, which posits that children with ASD do not develop imitation skills because they lack attention to social stimuli, both when directed by others and spontaneously. Due to an impairment in joint attention, children with ASD miss others' attempts to engage them, let alone demonstrate behaviors to imitate. In summary, because children with ASD have deficits in attention to social stimuli and do not follow bids for joint attention, they do not observe others' behaviors sufficient to imitate them (Dawson et al., 2004).

In addition to the aforementioned theories, researchers have examined the differences in social interaction skill trajectories between typically developing children and children with ASD. While typically developing children are shown to prefer social stimuli at the time of birth (Goren, Sarty, & Wu, 1975), children with ASD do not show this partiality and further, do not process social stimuli faster than nonsocial stimuli as typically developing children do (Dawson, Webb, & McPartland, 2005). Further, while the majority of typically developing children develop by using and observing various forms of joint attention (following, controlling, leading the behavior of another) in parallel to the development of imitation skills, ending with mastery of

verbal language, children with ASD follow a more heterogeneous and less well understood path (Carpenter, Nagell, & Tomasello, 1998; Carpenter, Pennington, & Rogers, 2002).

Given the literature on social-behavioral skills, it appears that joint attention and imitation, in themselves, are important for development. Joint attention and imitation also appear to act as precursors to other important skills such as receptive and expressive language as well as general social interaction. Thus, it is important to conduct research which attempts to understand the relationship between joint attention and imitation in children with ASD (i.e., Dawson et al., 2004). Further, it is useful to investigate not only how the two constructs are associated but also the effectiveness of interventions that set them as their intervention targets.

The overarching goal of the current study was to examine the relationship between joint attention and imitation skills in children with ASD. Additionally, the effectiveness of an early intervention that targets early social skills (i.e., joint attention, imitation), the Early Start Denver Model (ESDM), was investigated to examine this relationship as well as these early social skills' relationship with corollary skills such as language, expressive language, social skills, and play.

Specifically, this study examined the following six research questions.

1. Do participants enrolled in a child-directed, intensive early intervention program show significant growth in developmental domains in the first six months of intervention? Specifically, do children in a hospital-based, group Early Start Denver Model (ESDM) program show gains that replicate previous studies that demonstrate effectiveness of the ESDM? Several studies have shown the effectiveness of the ESDM for children with autism (i.e., Vivanti et al., 2014; Dawson et al., 2010; Rogers & Dawson, 2010), but these studies were primarily conducted in one-on-one or parent-mediated sessions, with a fewer studies examining the effectiveness of the model in a group setting. Based on the studies that exist so far, it was hypothesized that

participants would demonstrate significant gains in all domains within six months of intervention.

2. Does a positive, significant relationship between joint attention skills and imitation skills exist for children with ASD? Research has begun to examine the relationship between the two, suggesting a significant relationship (e.g., Schertz & Odom, 2004; Schietecatte, Roeyers, & Warreyn, 2012). It was hypothesized that there would be a positive correlation between joint attention skills and imitation skills at baseline evaluation, with children with less developed joint attention skills demonstrating less developed imitation skills and children with higher levels of joint attention skills exhibiting higher levels of imitation skills.

3. Are joint attention skills related to later growth in imitation skills? Due to evidence demonstrating that typically developing children demonstrate developmental trajectories following the mastery of joint attention prior to imitation (Carpenter, Nagell, & Tomasello, 1998), it was hypothesized that joint attention mastery is a prerequisite to imitation skill development in children with ASD. More specifically, it was hypothesized that a non-parametric sign test would demonstrate a gain in joint attention prior to imitation, as shown by positive median differences between joint attention and imitation scores at baseline. Further, it was hypothesized that as children acquire joint attention, the median difference scores between joint attention imitation would narrow but remain positive, evidencing a trajectory wherein joint attention is mastered first.

4. Are joint attention and imitation skills related to later growth in receptive and expressive language skills? Based on evidence that suggests the relationship among these skills (Siller & Sigman, 2002; Smith, Mirenda, & Zaidman-Zait, 2007), it was hypothesized that children with

higher joint attention skills would demonstrate greater development in receptive and expressive language.

5. Are joint attention and imitation skills related to later growth in social domains, including social skills with both adults and peers, as well as play? Based on research suggesting a relationship between joint attention skills and general social skills (e.g., Schertz & Odom, 2004), it was hypothesized that children who demonstrate greater joint attention skills will also show evidence of higher levels in social skills.

6. Do baseline joint attention and imitation skills predict the degree of responsiveness to a child-directed intervention? With previous research signaling the importance of core skills, such as joint attention and intervention, it was hypothesized that children who demonstrate stronger joint attention and imitation skills would be more responsive to such an intervention, while children who lack these skills would be less likely to respond to the intervention (i.e., Dawson et al., 2004; Stone & Yoder, 2001; Adamson & Russell, 1999; Loveland & Landry, 1986).

CHAPTER III: RESEARCH DESIGN

Method

Participants

Twenty-three children between the ages of 19 and 37 months, with a medical diagnosis of autism spectrum disorder given by either a developmental pediatrician or pediatric neurologist within the hospital network, participated in the current study. All of the children were either previously or currently enrolled in a Midwestern early intervention clinic for children with ASD at the time of the study. Children received, on average, three-and-a-half hours of therapy four times a week, with the exception of children who graduated into a subset of the program that received three-and-a-half hours of therapy twice a week. Specific criteria for decreasing therapy dosage was not available at the time of the study; per anecdotal conversations with supervising therapists, children were recommended for fewer hours based on progress thus far in the program, parent choice, and spaces available. The majority of participants were male ($N = 22$) with an average age of 27.4 months. There were no exclusionary criteria for participation.

Due to limitations set by the hospital Institutional Review Board (IRB), demographic information as well as medical and psychological data (other than ESDM initial evaluation and progress monitoring scores) on children was limited to age at start of intervention and gender.

Setting and Intervention

The study took place at an early intervention program housed in a large Midwestern hospital system. All children received early intervention services in a large group therapy room in clinic. The room contained toddler-sized chairs, tables, and appropriate toys.

All children in the study either had previously received or were receiving services in the hospital-based clinic. All therapy took place in a group setting, both in a classroom and in a

small motor room with playground equipment, with a maximum of five children per classroom. Children ages three years and under received three and a half hours of direct therapy four times a week, while children older than three years of age received one of two therapy options: the same quantity as the younger children, or a more transitional two day a week program. Upon turning three, the decision to place children in the more intensive versus the more transitional program was based primarily on therapists' recommendation, with children making gains at a relatively slower rate entering the more intensive program and children making gains more quickly (especially in social skills) entering the transitional program. For all programs, children received one hour of intensive, one-on-one therapy wherein a therapist focused on each child's individual goals. For the remainder of the session, children participated in group-based activities including: fine motor and language stations, parallel and reciprocal play stations, music and movement stations, circle time, snack, motor time, and independent play time.

As is written in the ESDM manual (Rogers & Dawson, 2010), in addition to daily data collection for each child's individual goals, children were assessed at twelve-week periods using the ESDM Checklist for progress monitoring purposes. This data was shared with parents in quarterly conferences between families and therapists. Additionally, parents were encouraged and welcomed to observe and receive in-classroom training at least once per twelve-week period; however, this was not a requirement for program participation.

Measure

Early start denver model (ESDM) checklist. The Early Start Denver Model (ESDM) Checklist is an assessment tool used for initial evaluation prior to intervention as well as for progress monitoring. ESDM certified therapists administer the entire assessment upon initial

evaluation and then subsequently at twelve-week time periods throughout the child's participation in the intervention.

The ESDM checklist is divided in two ways: by level and by developmental domain. First, the ESDM checklist is broken down into four levels, each containing skills that would be expected for specific age ranges: Level 1 (12-18 months), Level 2 (18-24 months), Level 3 (24-36 months), and Level 4 (36-48 months). Further, each level encompasses a number of skill domains. Next, each domain is described and examples of goals for each level are provided (Rogers & Dawson, 2010); please see tables 5 through 14. Additionally, please see Figure 1 for a visual representation of which domains are included in each level.

Once the checklist has been administered, each goal on the ESDM checklist is scored as "A" (acquired), "P" (partial), or "N" (not acquired). More specifically, a goal is scored as "A" if the child consistently and independently demonstrates the skill. A goal is scored as "P" if the child demonstrates the skill inconsistently and/or with prompting. A goal is scored as "N" if the child does not demonstrate the skill. For further scoring purposes, goals scored as "A" are converted into "1" and goals scored as either "P" or "N" are converted into "0" s. Finally, scores are totaled for each domain in each level. For the purposes of the current study, total scores for each domain in each level were calculated and then converted into percentage of goals acquired by dividing the number of goals acquired by the number of goals per subsection (i.e., Imitation – Level Two). For example, there are 10 goals in the Imitation domain of Level Two; if a child had acquired four of these goals, percentage acquired was calculated by dividing four by 10, resulting in a percentage of Imitation – Level Two acquired of 40%.

	RC	EC	JA	SS	IM	COG	PL	FM	GM	PI
L1	■	■		■	■	■	■	■	■	■
L2	■	■	■	■	■	■	■	■	■	■
L3	■	■		■		■	■	■	■	■
L4	■	■		■		■	■	■	■	■

Figure 1. ESDM Domains Included by Level

Note. Red squares indicate domain is included in the level.

Procedure

Recruitment. Per the exempt classification from the Institutional Review Board (IRB), parents whose contact information was available due to their children's current enrollment in the program received an email from the researcher inviting them to give permission for their children's data to be included in the current study. Parents were informed that their children's data, other than the child's biological sex and age at initial enrollment, would be completely de-identified so that no data could be traced back to any individual child. Data thus represent both children currently enrolled at the hospital clinic and archival data (i.e., data from children who are no longer enrolled in the program) was also included.

Data collection. The researcher compiled initial evaluation and progress monitoring data for 23 participants. This data included data from each domain and each developmental domain across up to twenty-four months of intervention. Participants' data varied in terms of longevity, dependent on how long each child was enrolled in the program. While no systematic data on reasons for children leaving the program was available at the time of this study, anecdotal information from therapists in the program showed that children typically left for one of three reasons: parent choice (i.e., the family moved, the program became cost-prohibitive), graduation

(the child reached age of kindergarten eligibility), or early graduation (the child mastered a large majority of the skills in the ESDM prior to kindergarten eligibility). Overall, all participants had progress monitoring data for the first six months of the analysis period, with numbers gradually decreasing as time passed. Please see Table 12 for descriptive data that shows percentage of children whose data was available per twelve-week progress monitoring period.

Table 1

Percentage of Participants Per Progress Monitoring Period

Time Period	*N*	Percentage
Initial Evaluation (Baseline)	23	100%
3 Months	23	100%
6 Months	23	100%
9 Months	18	78%
12 Months	15	65%
15 Months	13	57%
18 Months	6	26%
21 Months	4	17%
24 Months	2	9%

Treatment integrity. All therapists who conducted the initial ESDM evaluations as well as progress monitoring assessments were certified ESDM therapists as well as masters level therapists in their respective fields (i.e., behavior analysis, speech pathology, occupational therapy). The ESDM certification process is conducted by certified ESDM trainers and takes approximately twelve months to complete. Trainees are required to reach at least 80% fidelity, as rated by their trainer, on two separate submissions, both of which include twenty individualized written goals and a thirty minute, uninterrupted therapy session wherein they implement those goals through the ESDM model.

Trainees begin the process by attending a three-day introductory course wherein they receive instruction in both goal writing and direct treatment delivery. Next, trainees submit a

"practice" round wherein they write five ESDM goals as well as submit a thirty-minute videotaped session with a child in which they implement those goals using the ESDM model. Trainees who are rated by their trainer to reach at 75% fidelity may move onto the next step in the training process. Further, trainees who reach 80% fidelity may use this practice submission as one of their two "full" submissions. Trainees who use their "practice" submission as one of their "full" submissions must submit one additional tape, accompanied by twenty written goals, and then an additional set of twenty goals (but not a videotape).

CHAPTER IV: RESULTS

This study investigated the relationship between joint attention and several outcome variables by examining data collected from children's progress in an Early Start Denver Model (ESDM) program in a hospital-based clinic. Analyses examined children's overall progress in the program as well as whether skill gains in particular developmental domains – specifically, joint attention and imitation – were related to related specific social-behavioral domains (i.e., language, social skills, play) as well as overall performance.

Twenty-three families agreed to allow their child's de-identified data to be utilized in these analyses. All children who enrolled in the program had a medical diagnosis of autism spectrum disorder prior to their initial evaluation. Of the twenty-three participants, 95.7% were male. The average age at which children enrolled in the program was 27.39 months. Due to program constraints on the release of personal medical information, available demographic information for the current study was limited to these two variables.

In order to examine participants' baseline and subsequent gains during intervention, this study utilized initial evaluation and progress monitoring data based on the ESDM checklist. In the ESDM model, this measure is used to gauge children's skill level at the initial evaluation and then later employed to measure progress over twelve-week periods. The checklist divides skills both by developmental level and by developmental domain. In terms of developmental levels, the checklist covers four developmental age ranges, containing skills that would be expected in each range in typical development: Level One covers twelve to eighteen month skills, Level Two eighteen to twenty-four month skills, Level Three twenty-four to thirty-six month skills, and Level Four thirty-six to forty-eight month skills. Across these four levels, the following developmental domains are assessed: Receptive Communication, Expressive Communication,

Joint Attention, Social Skills, Imitation, Cognition, Play, Fine Motor, Gross Motor, and Personal Independence (Rogers & Dawson, 2010).

The data included in analyses were data from baseline, three, and six months. Only these three data points were selected because all 23 children participated for at least six months of intervention. There was significant participant drop out after the six-month assessment point (See Table 11). Thus, data from the remaining assessment points are visually presented, but not included in the analyses.

This study aimed to answer six research questions. Please see below for results associated with each question.

ESDM Effectiveness

Prior to assessing relationships among specific variables, the first research question aimed to determine whether participants enrolled in this intensive, early intervention program demonstrated significant growth in developmental domains in the first six months of intervention. At initial evaluation, children's scores on the ESDM evaluation tool varied across developmental domains as well as across levels. Please see Appendix B for Tables 15 through 17 which contain mean percentages of skill mastered by ESDM domain and level at baseline, three months of intervention, and six month of intervention, respectively. Please see Appendix B for Table 18, which shows mean percentages of skill levels mastered across time.

Key Domains

To examine progress in developmental domains considered key outcomes, a repeated-measures analysis of variance was conducted that compared baseline scores with three-month and six-month progress monitoring scores across the following domains: Receptive

Communication, Expressive Communication, Joint Attention, Social Skills, Imitation, and Play. Please see Table 2 for a summary of results.

Table 2

Repeated-Measures ANOVA Results for Key Domains

Domain	*Df*	F	η^2
Receptive Communication	2	17.44*	.44
Expressive Communication	2	61.72*	.74
Joint Attention	2	22.82*	.51
Social Skills	2	61.49*	.74
Imitation	2	34.35*	.61
Play	2	67.41*	.81

Note. *p >.001

Joint attention and imitation. Participants demonstrated significant progress in both Joint Attention (JA) – $F(2,21) = 22.82$, $p = .000$, $\eta^2 = .51$ – and Imitation (IM) – $F(2,21) = 34.35$, $p = .000$, $\eta^2 = .61$. In addition, per Cohen's *d* outlined standards (Cohen, 1988), medium effects sizes were found in both domains. Please see Figure 2 for a graphic depiction of these results. Data from participants' initial evaluations (baseline), at 3 months of intervention, and at their six-month progress monitoring dates are shown to the left of the phase line. These data were those used for statistical analyses. Data from additional time points (9, 12, 15, 18, 21, and 24 months) are shown to the right of the phase line, with the number of participants noted for each additional data point. These data are separated by the phase line due to the fact that all 23 children participated for at least six months of intervention, thereby dividing the progress monitoring data into primary analyses.

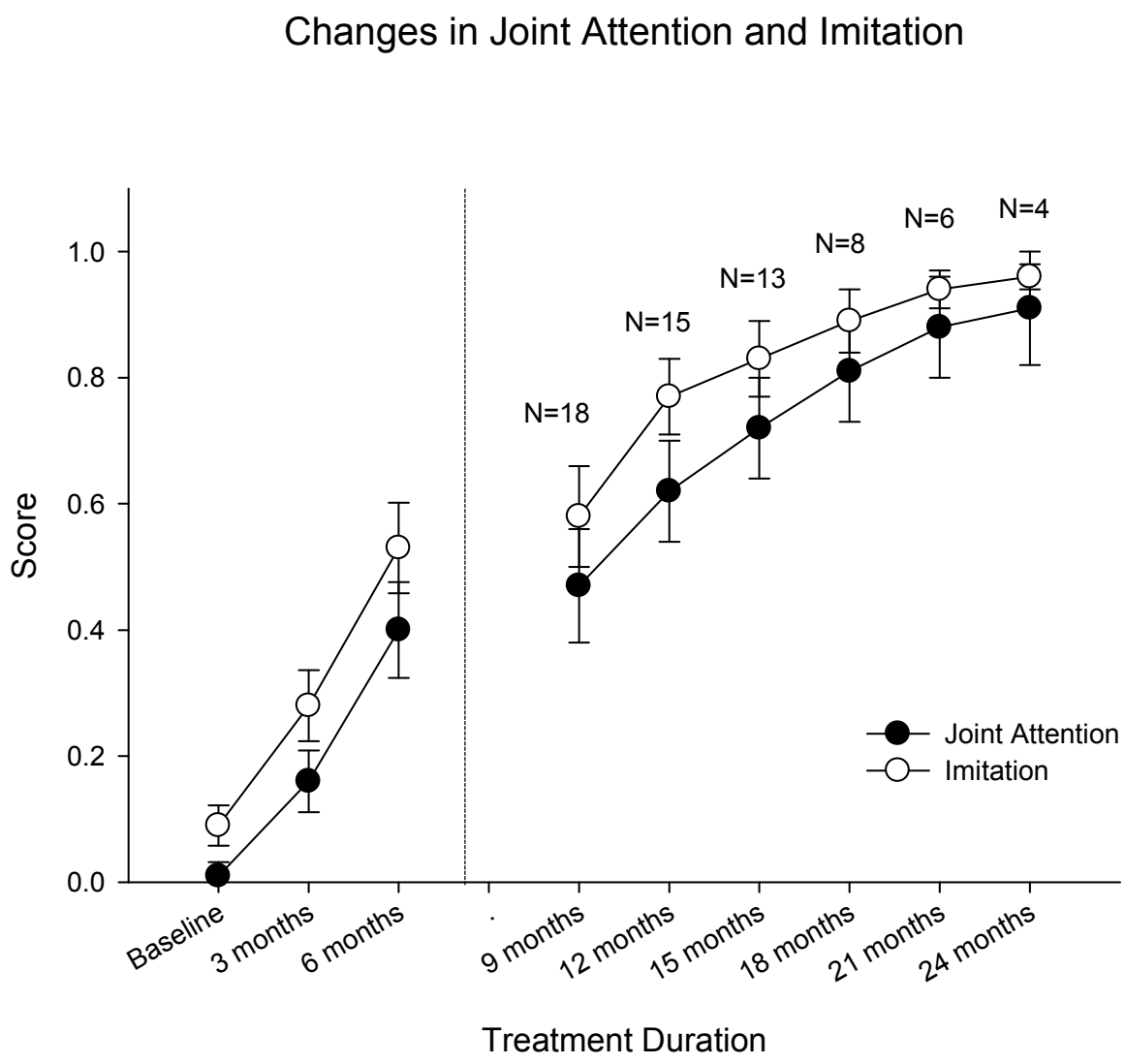

Figure 2. Gains in Joint Attention and Imitation from Baseline to 24 Months.

Receptive and expressive communication. Participants showed significant skill gains in Receptive Communication (RC) – $F(2,21) = 17.44$, $p = .000$, $\eta^2 = .44$ – and Expressive Communication (EC) – $F(2, 21) = 61.72$, $p = .000$, $\eta^2 = .74$. In terms of effect sizes, those found for Receptive Communication were small while those found for Expressive Communication were medium (Cohen, 1988). Please see Figure 3 for a graph of these data and refer to information detailed in the previous section for interpretation.

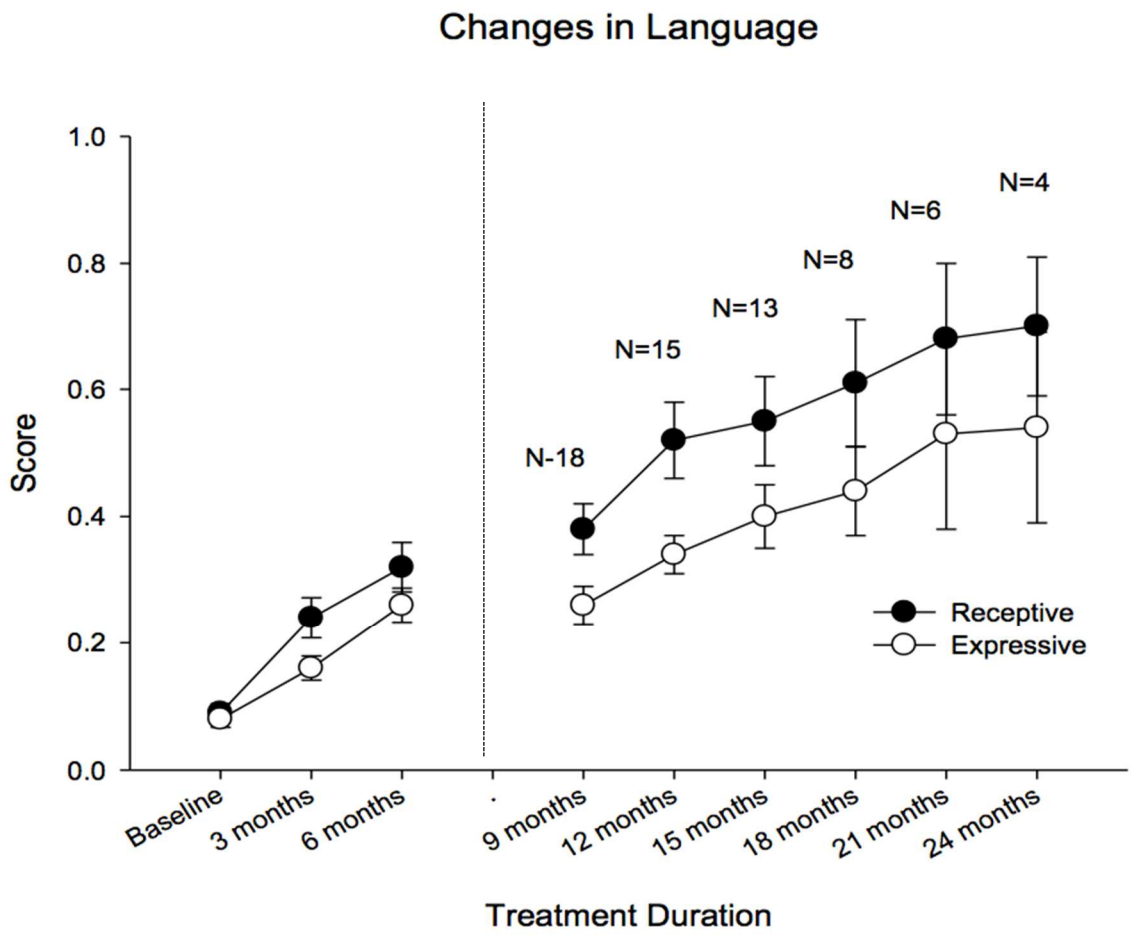

Figure 3. Gains in Receptive and Expressive Communication from Baseline to 24 Months.

Social skills and play. The final areas examined in key domain analyses were Social Skills and Play. Participants showed significant gains in Social Skills (SS) – $F(2,21) = 61.49$, $p = .000$, $\eta^2 = .74$ and Play (PL) – $F(2,21) = 67.41$, $p = .000$, $\eta^2 = .81$, with medium effect sizes demonstrated for Social Skills and large effective sizes found for Play. Please see Figure 4 for a graph of these results with interpretation based on the previously outlined details.

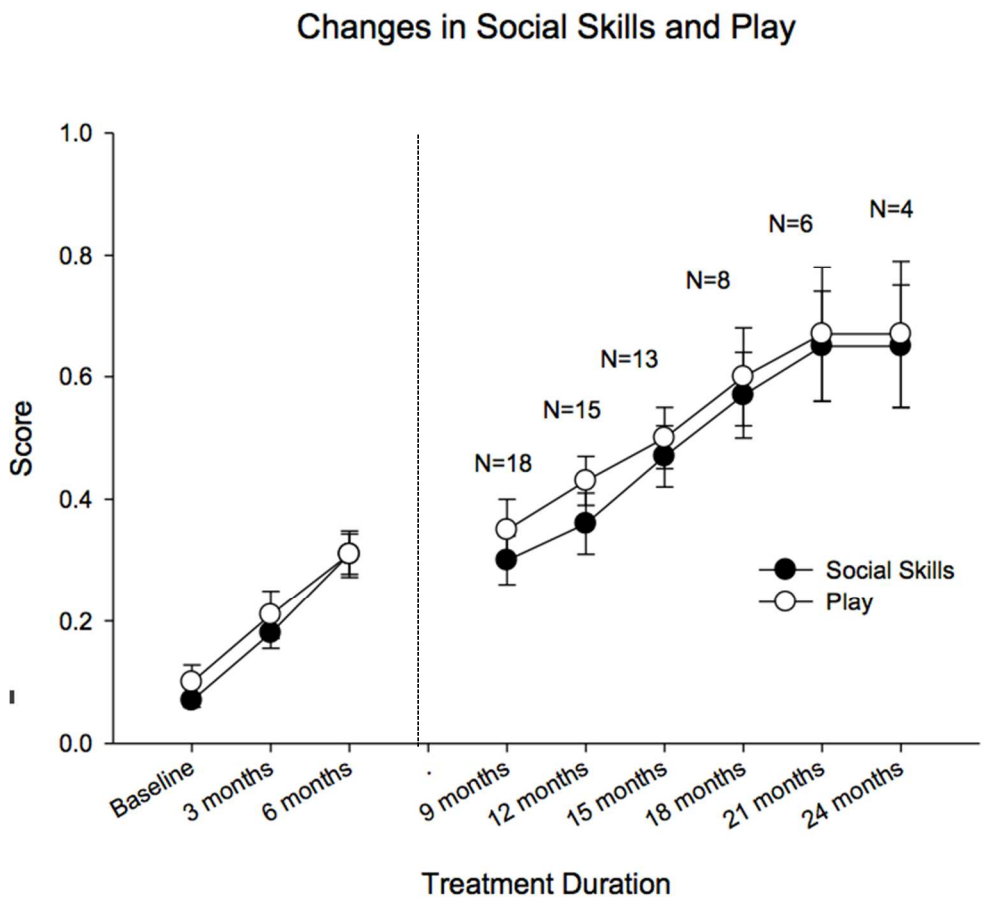

Figure 4. Gains in Social Skills and Play from Baseline to 24 Months.

It is interesting to note that results obtained for the children participating in treatment through 24 months show a continuation of the trends examined through 6 months. Although there were insufficient data to conduct statistical analyses, the data strongly suggest that treatment gains made during the first 6 months continued their trajectory for 24 months, at least for those participants whose data was available for assessment.

Additional Domains

Progress was also examined in the additional four domains of the ESDM Curriculum: Cognition, Play, Fine Motor, Gross Motor, Personal Independence. An identical statistical

design to the one used to analyze key domains was used for these areas. Please see Table 3 for a summary of results.

Table 3

Repeated-Measures ANOVA Results for Additional Domains

Domain	*Df*	F	η^2
Cognition	2	19.04*	.58
Fine Motor	2	57.85	.72
Gross Motor	2	14.20	.39
Personal Independence	2	37.34	.63

Note. *p >.001

Fine and gross motor. Participants demonstrated significant process in both Fine Motor (FM) – $F(2,21) = 57.85$, $p = .000$, $\eta^2 = .72$ – and Gross Motor (GM) – $F(2,21) = 14.20$, $p = .000$, $\eta^2 = .39$. Additionally, medium effect sizes were found for Fine Motor while small effect sizes were found for Gross Motor. Please see Figure 4 for a graph illustrating progress, with the same interpretation information as described above.

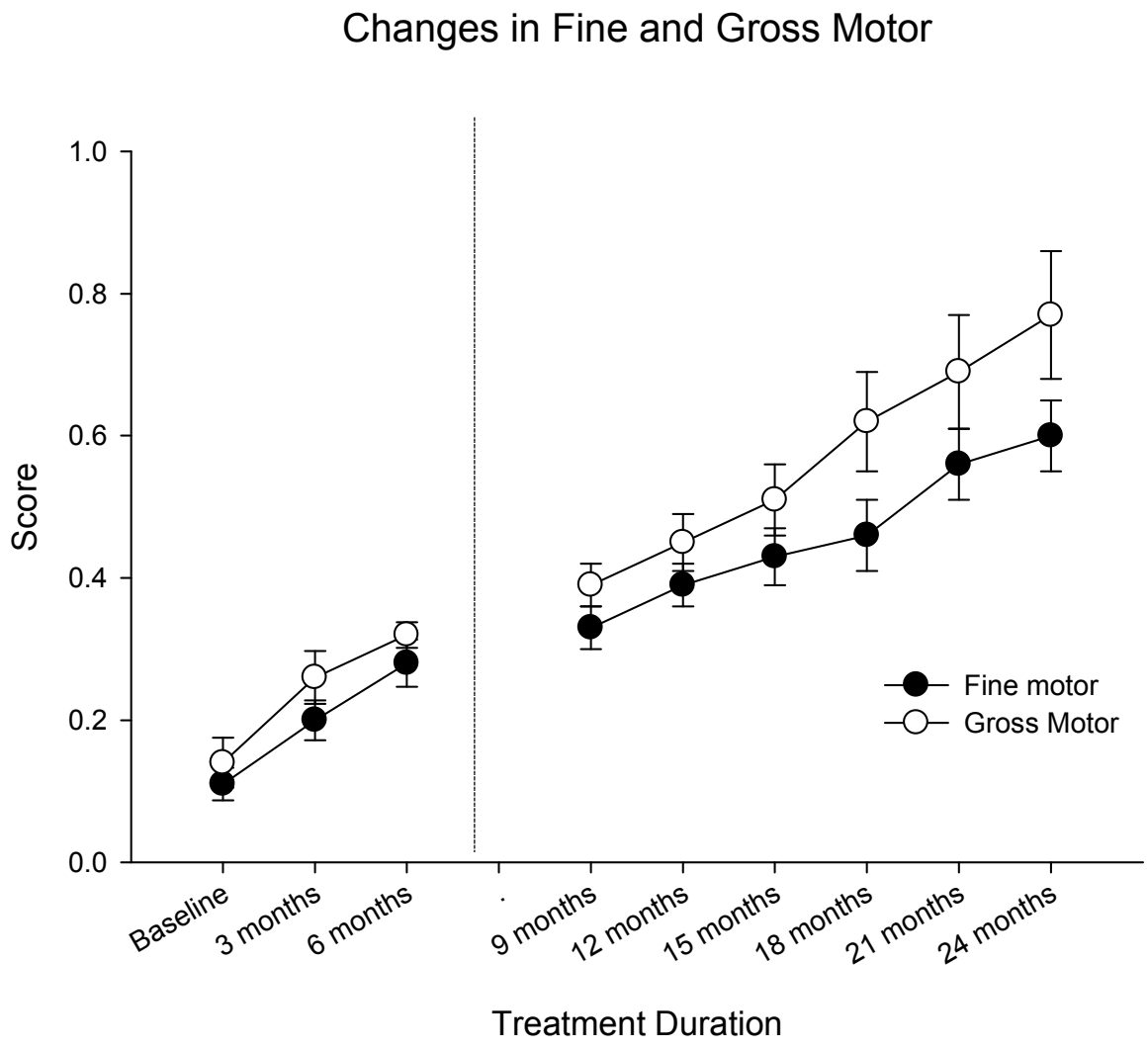

Figure 5. Gains in Fine and Gross Motor from Baseline to 24 Months.

Cognition and personal independence. Similarly to results previously described, in the final two domains of the ESDM, participants showed significant progress in both Cognition (COG) – $F(2,21) = 19.04$, $p = .000$, $\eta^2 = .58$ – and Personal Independence (PI) – $F(2,21) = 37.34$, $p = .000$, $\eta^2 = .63$. In addition, medium effect sizes were found for both domains. Please see figures 6 and 7 for graphic depictions of progress, with the same interpretation guidelines as previously discussed.

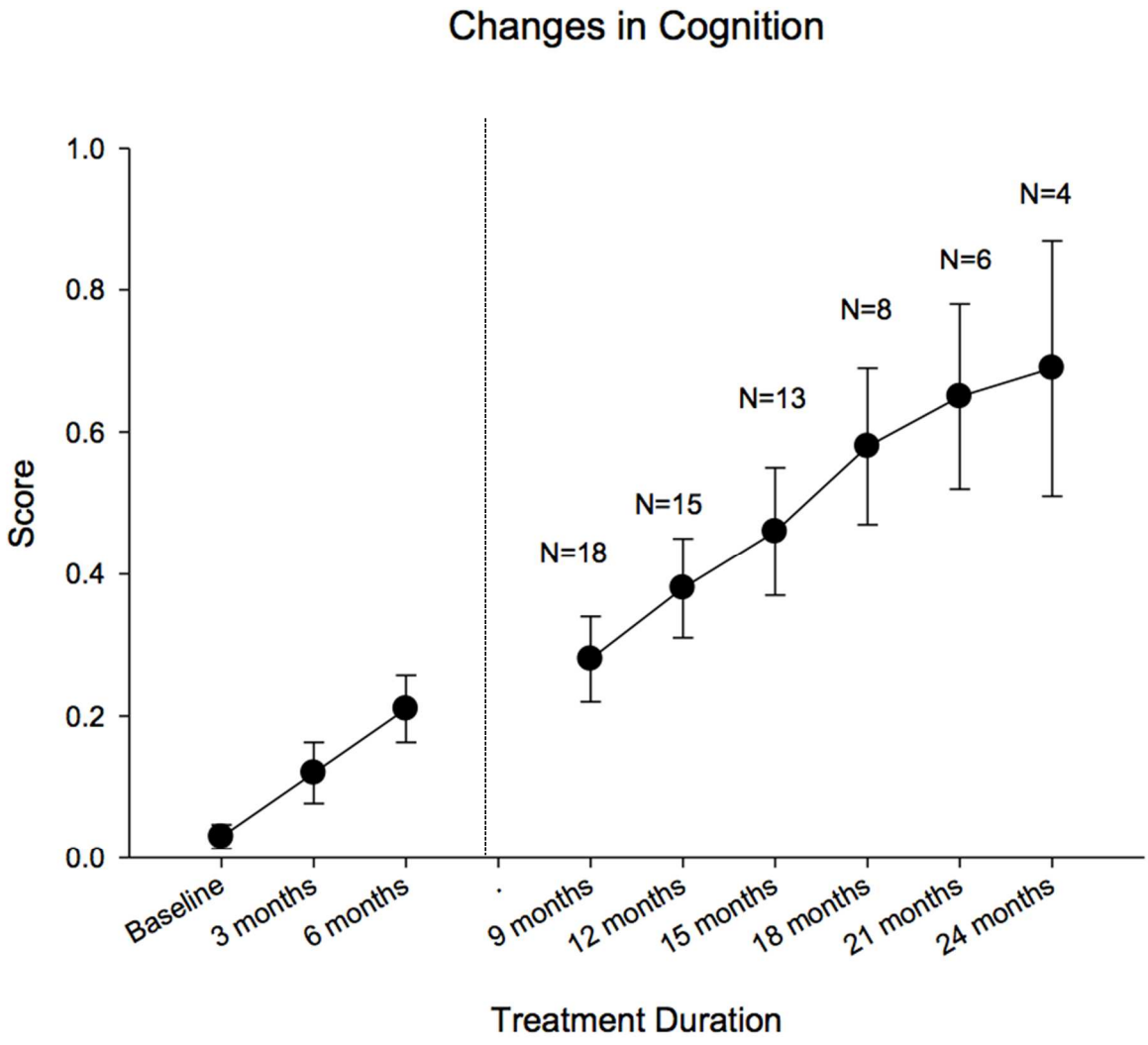

Figure 6. Gains in Cognition from Baseline to 24 Months.

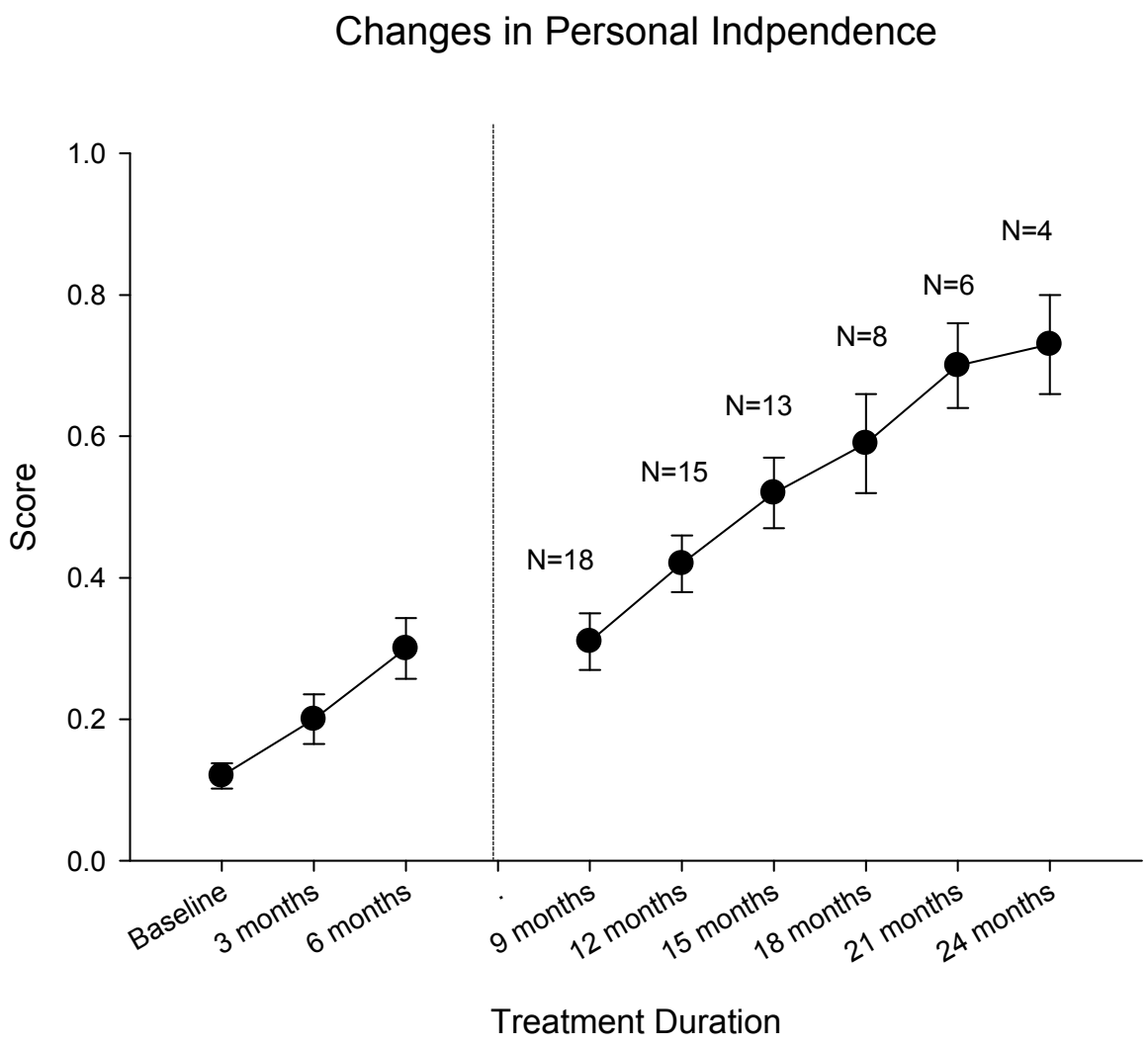

Figure 7. Gains in Personal Independence from Baseline to 24 Months.

As previously noted in key domains, available data for children continuing in treatment through 24 months similarly demonstrate continued gains. Despite the inability to conduct statistical analyses, results from these additional domains strongly suggest that participants continued positive trajectories past 6 months of intervention.

Relationship between Joint Attention and Imitation Skills

After establishing that participants demonstrated positive, significant change in skills over time, the remaining research questions examined relationships among particular variables.

To examine the relationship between joint attention skills and imitation skills, correlation analyses were run at three points in time: joint attention and imitation at baseline (Time 1), joint attention and imitation at three months of intervention (Time 2), and joint attention and imitation at six months of intervention (Time 3). Results indicated positive, significant relationships at each point in time: baseline – $r(21) = .70$, $p = .000$; three months – $r(21) = .85$, $p = .000$; six months – $r(21) = .73$, $p = .000$.

Relationship between Joint Attention and Imitation: Trajectory

To examine more specifically the relationship between joint attention and imitation – in particular, whether growth in joint attention is related to later growth in imitation – an exact sign test was used to compare differences in joint attention and imitation scores at three points in time – at baseline, at three months of intervention, and at six months of intervention. A sign test is a nonparametric measure that can be used to examine possible differences between matched data points to determine whether one piece of data tends to be greater and/or less than the other data point. Specifically, the sign test was conducted to determine whether the median differences between joint attention and imitation scores was positive (suggesting greater joint attention growth than imitation growth), negative (suggesting greater imitation growth than joint attention growth), or zero (suggesting equal growth in both domains).

Contrary to hypothesis, results of the sign test found a greater number of negative differences than positive differences at each point in time. Please see Table 4 for full results. Further, the negative difference between joint attention and imitation was statistically significant at baseline ($p = .039$) and three months of intervention ($p = .049$) and approached significance at six months of intervention ($p = .064$).

Table 4

Sign Test Frequencies for Joint Attention versus Imitation

Variable	Mean	SD	Minimum	Maximum
Joint Attention – Baseline	.04	.11	0	.50
Joint Attention – 3 Months	.16	.24	0	.75
Joint Attention – 6 Months	.40	.37	0	1.0
Imitation – Baseline	.09	.15	0	.54
Imitation – 3 Months	.28	.27	0	.85
Imitation – 6 Months	.52	.35	0	1.0

Joint Attention, Imitation, and Language

This study also investigated whether joint attention and imitation skills were related to additional skills. Based on previous evidence, it was hypothesized that children who demonstrated greater joint attention skills at baseline would demonstrate similarly higher scores in both receptive and expressive language. Similarly, it was predicted that children who showed greater imitation skills at baseline would demonstrate higher scores in the same domains. To examine these relationships, correlation analyses were conducted comparing each domain at the following points in time for joint attention: joint attention at baseline and the skill at three months, joint attention at baseline and the skill at six months, joint attention at three months and the skill at six months. Similar correlation analyses were run comparing each domain at the same points in time for imitation.

In the analyses examining joint attention, results indicated a significant positive relationship between joint attention at baseline and expressive language at three months of intervention: $r(21) = .52$, $p = .013$; Similarly, results indicated a significant positive relationship between joint attention at baseline and expressive language at six months of intervention: $r(21) = .64$, $p = .001$. Finally, results indicated a significant positive relationship between joint

attention at three months of intervention and expressive language at six months of intervention: $r(21) = .69$, $p = .000$.

In contrast, results showed that joint attention at baseline was not significantly correlated with receptive communication at three months – $r(21) = .07$, $p = .746$ – nor were the two significantly correlated at baseline and six months, respectively – $r(21) = -.03$, $p = .888$. Similarly, joint attention at three months was not significantly correlated with receptive language at six months $r(21) = -.22$, $p = .321$.

In analyses examining imitation, results indicated a significant positive relationship between imitation at baseline and expressive language at three months of intervention: $r(21) = .61$, $p = .003$. Results indicated similar significant positive relationship between imitation at baseline and expressive language at six months of intervention: $r(21) = .51$, $p = .015$. Finally, results indicated significant positive correlations between imitation at three months and expressive language at six months: $r(21) = .85$, $p = .000$.

Unlike the results presented above, results showed that imitation at baseline was not significantly correlated with receptive communication at three months – $r(21) = -.15$, $p = .500$ – or at six months – $r(21) = -.31$, $p = .157$. Contrary to expectation, imitation at three months was significantly related to receptive language at six months, but in the opposite direction predicted: $r(21) = -.42$, $p = .050$.

Joint Attention, Imitation, Social Skills, and Play

In addition to the relationship between the two variables and language, this study also examined how joint attention and imitation were related to social skills and play. Previous research indicated that children with more robust joint attention and imitation skills demonstrate greater social skills as well as more complex play skills; therefore, this study hypothesized that

similar relationships would exist in these data. Correlation analyses were conducted to examine the relationship between joint attention and both social skills and play at subsequent points in time. Specifically, these analyses were conducted between joint attention at baseline and each skill at three months, joint attention at baseline and each skill and six months, and joint attention at three months and each skill at six months.

As predicted, results indicated significant positive relationships between joint attention at baseline and social skills at three months ($r[21] = .68$, $p = .001$), joint attention at baseline and social skills at six months ($r[21] = .68$, $p = .001$), and joint attention at three months and social skills at six months ($r[21] = .80$, $p < .001$). Similarly, results indicated significant positive relationships between joint attention at baseline and play at three months ($r[21] = .73$, $p < .001$), joint attention at baseline and play at six months ($r[21] = .66$, $p = .001$), and joint attention at three months and play at six months ($r[21] = .70$, $p < .001$).

In a similar vein, predicted correlational results were indicated between imitation and both social skills and play. Specifically, results showed significant positive relationships between imitation at baseline and social skills at three months ($r[21] = .65$, $p = .001$), imitation at baseline and social skills at six months ($r[21] = .66$, $p = .001$), and imitation at three months and social skills at six months ($r[21] = .87$, $p < .001$). In terms of play, results demonstrated significant positive relationships between imitation at baseline and play at three months ($r[21] = .53$, $p = .011$), imitation at baseline and play at six months ($r[21] = .47$, $p = .028$), and imitation at three months and play at six months ($r[21] = .74$, $p < .001$).

Joint Attention, Imitation, and Responsiveness to ESDM

Finally, this study investigated whether joint attention and imitation skills predict degree of responsiveness to this intervention. In order to assess whether these domains served as

predictors, correlational analyses were conducted to examine the relationship between joint attention and imitation at baseline and total scores in Levels One through Four at the six-month progress monitoring point.

Results indicated that joint attention at baseline was significantly related to overall scores in Level Three ($r[21] = .87$, $p < .000$) and Level Four ($r[21] = .92$, $p < .000$). Similarly, results showed significant correlations between imitation at baseline and Level Two ($r[21] = .53$, $p = .010$), Level Three ($r[21] = .69$, $p < .000$), and Level Four ($r[21) = .80$, $p < .000$).

In contrast, results did not indicate significant correlations between Level One and joint attention at baseline ($r[21] = .30$, $p = .166$) or joint attention at baseline at Level Two, ($r[21] = .58$, $p = .166$). Additionally, a significant correlation was not found between Level One and imitation at baseline ($r[21] = .26$, $p = .237$).

CHAPTER V: DISCUSSION

Joint attention – coordinating one's attention with another to direct his or her focus to another person, object, or activity (Dawson et al., 2004) – and imitation – a means by which one copies another person's behavior (Sevlever & Gillis, 2010) – are social behaviors that are observed early in typical development (Carpenter et al., 1998; Trevarthan, 1979). These skills are two of the first by which typically developing children communicate, learn, and explore their environment (Ingersoll, 2008; Eckerman & Didow, 1996; Eckerman & Stein, 1990). For these children, these skills need not be taught but rather come naturally, helping them grow and further develop. For children with autism, who often experience significant deficits in such social behavior (Dawson et al., 2004), the delay in or absence of joint attention and imitation may cause further setbacks in other developmental domains, such as language, social skills, and play (Schertz & Odom, 2004; Stone & Yoder, 2001; Adamson & Russell, 1999; Eckerman & Didow, 1996).

The lack of joint attention and imitation in children with autism's behavioral repertoires may affect not only their initiations and interacts with the world around them, but also the degree to which others in their world attempt to initiate with them (Dawson et al., 2004). Therefore, it is crucial that these skills are addressed in intervention. Several sources have detailed the importance of early diagnosis and intervention for children with autism (i.e., Koegel et al., 2014; National Research Council, 2001). Thus, it follows that these core skills should be addressed in early intervention. One such early intervention model that focuses on these early social behaviors is the Early Start Denver Model (ESDM). The ESDM is an intensive, early intervention that combines the more traditional model of applied behavior analysis (ABA) with

more naturalistic models (i.e., Pivotal Response Training [PRT]) to address several skill domains from a developmental, play-based approach (Rogers & Dawson, 2010).

In addition to intervening with children with autism early, it is crucial that researchers, clinicians, and parents have research outlining the effectiveness of early intervention models that are available to them. This study contributed to the existing research regarding the effectiveness of the ESDM, as well as examined the standard ESDM assessment instrument – the ESDM Checklist, to determine whether children enrolled in a hospital-based group program demonstrated significant growth in these critical skills over time. To do so, this research examined data from children enrolled in the program both at initial evaluation (i.e., baseline) as well as progress monitoring at twelve-week intervals.

Once it was determined that participants in the current study demonstrated significant progress across skill domains, this data was further analyzed to answer subsequent research questions. This study aimed to investigate the relationship between joint attention and imitation in children with ASD. Specifically, this research examined this relationship in terms of trajectory between the two skills, each skill's relationship to language, social skills, and play, and whether these core skills can serve as predictors for overall performance in a child-directed intervention.

In total, the current study set out to answer six research questions. The first research question stated: *Do participants enrolled in a child-directed, intensive early intervention program show significant growth in development domains in the first six months of intervention?* Results indicated that, indeed, participants in the current study showed significant improvements both in domains targeted for investigation in this study (Receptive Communication, Expressive Communication, Joint Attention, Social Skills, Imitation, Play) as well as those domains that

were more secondary in analyses (Cognition, Fine Motor, Gross Motor, Personal Independence). Perhaps most importantly, the ability to demonstrate meaningful gains in a relatively short period of time is a promising result for young children with autism, as early intervention is crucial for positive outcomes (Koegel et al., 2014; Dawson, Webb, & McPartland, 2005; National Research Council, 2001). In addition to the statistical significance demonstrated in the gains across domains, the majority of the effect sizes found ranged from medium to large, according to Cohen's *d* standards (Cohen, 1988). These findings suggest that the changes in gains over time for these children were substantial and likely significant in terms of how these children functioned in day to day life. While it is acknowledged that these effect sizes are within-subjects – meaning that the effects can only be assessed for the particular children in this sample – they suggest encouraging results that warrant further examinations in a between-subjects research design, such as whether children receiving the intervention versus a control group would demonstrate similar results.

These data are similar to those found in previous studies that demonstrated the effectiveness of the ESDM for young children with ASD (i.e., Estes et al., 2014; Vivanti et al., 2014; Dawson et al., 2012; Dawson et al., 2010). However, this study provides unique data in that skills were measured using the ESDM Checklist rather than more traditional standardized measures, such as the Mullen Scales of Early Learning (Mullen, 1995) and the Vineland Adaptive Behavior Scales (Sparrow, Saulnier, Cicchetti, & Doll, 2016), which were used in the previously cited articles. Replicated results of significant progress suggest that the ESDM Checklist may be an additional useful measure not only for clinical progress monitoring but also for research purposes.

Additionally, these data provide additional evidence for the effectiveness of ESDM delivery in a group setting. While the ESDM was traditionally used in either an individual or parent-training capacity, implementing the model in a group setting is becoming more common, as evidenced by the recent publication of a group-based ESDM model manual (Vivanti, Duncan, Dawson, & Rogers, 2017). While the intervention setting for the participants in this study received group-based ESDM, the establishment of the program was prior to the publication of the group-ESDM manual and therefore it cannot be said that participants were receiving true group-ESDM as intended by the authors but rather the individualized approach with an inclusion of some group activities that employed ESDM principles. However, due to the often vast differences between tightly-controlled research studies and the reality of community-based treatment, it is beneficial to examine data that were collected in this more commonly-found setting (Vivanti et al., 2014).

The second research question asked, *does a positive, significant relationship between joint attention skills and imitation skills exist for children with ASD?* As hypothesized, results showed a strong, positive relationship between these two skills – the higher the percentage of joint attention skills mastered, the higher the percentage of imitation skills mastered. This robust relationship was found at all three points in time analyzed: baseline, at three months of intervention, and at six months of intervention. Further, these trends continued for 9 through 24 months. These data suggest the possibility of the relationship between the mechanisms by which children with ASD acquire joint attention and imitation, and therefore warrant further examination. If these two skills are related, is there a temporal relationship between the two? While the correlation analyses provide confirmation that the two skills are linked, additional analyses are required to determine more complex information about the relationship.

This led to the third research question, *Are joint attention skills related to later growth in imitation?* In other words, does some degree of joint attention need to be present prior to the acquisition of imitation skills? The current study hypothesized that these skills' trajectory would place joint attention prior to imitation, on the basis that this course has been documented in typically developing children (Carpenter et al., 1998). However, contrary to this hypothesis, results indicated the opposite – in this study, more children with ASD acquired imitation skills before or at the same time as joint attention skills. This suggests that these 2 skills are intimately intertwined.

This contrary finding may be the result of several possibilities. First, in the ESDM Checklist, joint attention does not appear until Level Two, while imitation is included in Level One, therefore imitation is acquired prior to joint attention in the expected developmental trajectory because this skill is taught first. Because of the curriculum emphasis, it is possible that ESDM therapists created treatment plans that did not feature joint attention skills as a goal prior to working on Level One imitation skills, thereby resulting in children who acquired low-level imitation skills (i.e., imitating one-step actions on objects) prior to tackling joint attention skills.

Another possibility is that, while joint attention may have been informally incorporated into treatment sessions (i.e., pointing to objects for the child to reference during play), they may not have been formally assessed in any of the participants. Again, as joint attention is a Level Two skill, therapists may not have assessed the domain in children whose skills remained primarily in the Level One range. In fact, children may have been learning joint attention skills simply by interacting with trained therapists who promote back and forth communication with the children simply as part of the ESDM model. For example, in a joint activity routine, as illustrated previously, therapists begin by imitating the child and following the child's lead,

followed by the therapists interjecting novel actions and/or stimuli that the child must attend to in order to continue the play. While therapists may not have been requiring explicit joint attention skills or taking data on them, it is certainly likely that they were demonstrating joint attention (i.e., directing the child's attention to this novelty) in these routines.

Finally, it is important to note that while the majority of differences between imitation and joint attention scores were negative, indicating imitation as a precursor to joint attention, the variation in scores among individual participants was large. For instance, the range of scores in joint attention at baseline was between, at minimum, zero percent mastered, and at maximum, fifty percent mastered. These large ranges are reflected in both domains across baseline, three months of intervention, and six months of intervention. This illustrates the heterogeneity in the population of the current study, a finding that is not unlike the variability found in the autism population as a whole (Szatmari, Georgiades, Duku, Bennett, Bryson, Fombonne,…Thompson, 2015; Georgiades, Szatmari, & Boyle, 2013).

While the relationship between joint attention and imitation may be more nuanced than the analyses of the current study can ascertain, further research questions provide insight into how joint attention and imitation may be related to other important developmental domains; specifically, this study examined the relationships between these two foundational skills and language – both receptive and expressive -, social skills, and play.

In terms of language, previous studies have suggested that children who demonstrate stronger joint attention and imitation skills similarly demonstrate greater language skills (i.e., Stone & Yoder, 2001; Loveland & Landry, 1986). Thus, the fourth research question *examined the relationship between joint attention and expressive and receptive language.* The current study found comparable results in a positive relationship between both joint attention and

expressive language as well as imitation and expressive language. As illustrated in the literature, by attending to others and copying both their motor and spoken language, children learn to communicate with the world around them (Stone & Yoder, 2001). However, when receptive language was examined, results were surprising, demonstrating that children with higher joint attention and imitation skills displayed lower receptive language skills. It is unclear exactly why these relationships would exist, and further research should examine this relationship, especially in light of the fact that several studies that have assessed these relationships have focused heavily on expressive language (i.e., Siller & Sigman, 2002; Loveland & Landry, 1986) or have spoken more generally regarding language rather than specifying receptive versus expressive (i.e., Frietag et al., 2006; Mundy & Gomes, 1998).

Another possibly for these unexpected results may be related to the outcome measures employed. This study exclusively examined scores from the ESDM Checklist while others more frequently employ traditional assessments, such as the Mullen Scales of Early Learning (Mullen, 1995) or the Peabody Picture Vocabulary Test (PPVT-4) (Dunn & Dunn, 2007). To this researcher's knowledge, no studies currently exist that compare the ESDM Checklist to more standardized measures. However, as the ESDM Checklist is used for initial evaluation, progress monitoring, and treatment plan creation, it would be beneficial for future research to examine how scores on the ESDM Checklist compare to scores on such standardized measures to determine reliability across measures.

The fifth research question asked: *Are joint attention and imitation skills related to later growth in social domains, including social skills with both adults and peers, as well as play?* In comparison to the inconsistent results examining joint attention, imitation, and language, results assessing joint attention's and imitation's relationship to later growth in social domains

are more coherent with hypotheses. As expected, children who demonstrated higher joint attention skills also demonstrated higher social skills – both with adults and peers – as well as better play skills. This result is consistent with previous research, which has documented similar positive relationships (i.e., Gillespie-Lynch et al., 2012; Eckerman & Stein, 1990). Children who pay better attention and who can pick up on some of the social nuances in joint attention exchanges have better social skills because they can understand and respond to others' intentions, communication bids, and sharing of attention. They can also better initiate effective communication if they comprehend how to share their intentions and interests. More effective communication likely leads to better social skills overall, which, most importantly, lead to positive relationships. In terms of play, which is a large part of the way children interact and learn, children with stronger joint attention skills likely could more easily learn play skills as well as engage in imaginative play with another person, both sharing and following along with play scripts with play partners.

The same was true with imitation – children with stronger imitation skills also had higher scores in social skills and play. In the same vein as joint attention, by attending to and copying those social behaviors that are successful in creating positive interactions, children with stronger imitation skills are better able to emulate appropriate social interactions with others. Additionally, children with better imitation ability can imitate play partners' actions on toys, thereby learning new ways to play with toys as well as new play schemas that they may take from therapy and emulate in other settings.

The sixth research question asked: *Are baseline joint attention and imitation skills predictive of performance in a child-directed intervention overall?* The final research question originally aimed to assess whether joint attention and imitation skills are predictive of

performance in a child-directed intervention. Results suggested that scores in each domain at baseline were significantly correlated with higher overall scores in more advanced levels of the ESDM. For joint attention, specifically, the fact that more advanced skills were related to more progress in upper levels of the ESDM suggests that joint attention may be especially important in the acquisition of skills that require more sophisticated social skills. By more solidly acquiring a basic social skill such as joint attention, children may have been able to more easily learn higher level skills overall due to their increased attunement to their learning environment.

In terms of imitation's relationship to overall skill acquisition, the same can be suggested – children who demonstrated stronger imitation skills were more likely to demonstrate more growth in levels two, three, and four. As imitation has been shown to be one of the first and primary ways that young children learn, it makes sense that children with greater imitation skills would also show greater skill gains in developmental domains overall.

It is important to remember that while joint attention and imitation skills were significantly related to overall growth in the ESDM model, the fact that this study showed growth for the study population as a whole suggested that children of varying degrees of skills when beginning an ESDM program can all show significant progress – a promising outcome for ESDM effectiveness as a whole.

As a whole, the results from the current study provide replication and extension of previous studies documenting the effectiveness of ESDM. Additionally, they give insight into the relationship between two skills often marked as deficits for children with ASD early on – joint attention and imitation – and other important domains, including language, social skills, and play. The following sections describe the limitations of the research as well as suggestions for future research.

Limitations

The current study offers valuable information regarding the effectiveness of a naturalistic, child-directed intensive early intervention model as well as data that gives insight into the relationship between fundamental and related essential skill development in children with ASD. However, there were some limitations to the research, including both methodological and practical limitations.

First, due to limited access to participants, the sample size for the study is relatively small, thereby limiting the ability for the results of this study to be generalized to the broader population. Additionally, due to constraints specified by the setting, access to data was restricted. While the researcher was granted access to basic demographics (age and gender) as well as progress monitoring data, there were several variables that may have contributed to the productivity of this study that were unavailable. One such variable that may have influenced analyses is participants' autism severity rating. Research has demonstrated mixed results on the influence of symptom severity, with some studies documenting more promising outcomes for those with milder symptomology (i.e., Zachor & Itzchak, 2010) and others showing no significant differences among severity levels (i.e., Sutera, Pandey, Esser, Rosenthal, Wilson, Barton…Fein, 2007). By including this variable, these data would be able to provide additional information on how autism severity may affect progress in such an intervention.

Another potentially significant variable that may have impacted the noted improvements in the children, but for which data were unavailable to this study, was family support and involvement. Research has shown that family participation in intervention significantly affects outcomes for children with autism and their families (Moes & Frea, 2002; National Research Council, 2001; Koegel et al., 1996).

In addition to demographic variable limitations, the progress monitoring data available to the researcher lacked the ability to sufficiently analyze the potentially chronological relationship between joint attention and imitation. In order to more adequately investigate the trajectory of these two variables, and if one is more typically developed before the other in children with ASD, it would be beneficial to design a study that would recruit very young children with ASD who have not yet acquired joint attention or imitation. In this study, one could implement a joint attention intervention while conducting probes of possible imitation skills to see whether teaching joint attention skills may result in better imitation performance without direct intervention. Additionally, one could implement the reverse design – implementing an imitation intervention while assessing possible gains in joint attention without teaching the skill. By experimentally controlling which skill was acquired first, it would be possible to more directly assess whether the mastery of one skill might affect the acquisition of the other.

It is also important to remember that while several research questions that were examined in the current study produced significant results, these results are correlational. While these correlations indicated a significant relationship between variables in many cases, these results do not allow for any conclusions regarding a cause-effect relationship.

A notable limitation to the current study is the absence of a control group. While it is acknowledged that having a control group is one of the most effective ways to establish experimental control, it is important to consider the ethical implications of such an experimental design. As previously stated, it is imperative that children with autism receive both early diagnosis and early intervention in order to capitalize on outcome potential; further, employing what has been termed the "wait and see" method for early intervention decisions is likely to have meaningful negative results for children with ASD (National Research Council, 2001). For

example, if children with ASD do not receive intervention for core ASD symptomology (i.e., difficulty communicating wants and needs), it is more likely that these children will exhibit problematic secondary symptoms, such as aggression and self-injurious behavior (Koegel, Koegel, Ashbaugh, & Bradshaw, 2014). Additionally, even when a "treatment as usual" or "community treatment group" is employed, these interventions (or absence thereof) tend to vary greatly in terms of effectiveness and therefore may not serve as a true comparison to the study conditions (Koegel et al., 2014).

Finally, some children in the current study received interventions (i.e., school-based services, outpatient services) in addition to the one specifically examined. Therefore, it is impossible to determine or exclude the effects that these interventions may have had in comparison to what this study considers to be the primary intervention. In addition, requiring participants to opt out of these additional interventions in order to achieve better experimental control would be an unethical, as well as impractical, as all children typically interact with multiple educational sources, whether that be a typical school setting in addition to therapy or a situation as simple as a sports team in addition to the typical school setting.

Future Directions

As the ESDM – especially the group model – is a relatively new model, it is crucial that future studies continued to attempt to replicate the findings of previous studies demonstrating effectiveness. To give children with ASD the best chance at the most independent, fulfilling, and satisfying futures as possible, it is important that valid information about selecting early intervention models exists for parents and clinicians.

To extend the current study, future research should examine these research questions with additional participant variables. One important variable that has been highlighted in previous

work is severity of autism symptomology. In general, those with mild to moderate symptoms tend to have more positive outcomes. It would be valuable to examine whether the same is true for children receiving the ESDM as well as to examine whether diagnostic severity moderates (i.e., affects how strong the relationship between variables) and/or mediates (i.e., creates a relationship between two variables) the relationship between skills examined. Specifically, does diagnostic severity impact the relationship between joint attention and imitation? Does diagnostic severity influence the relationship between these core variables and later development in language and/or social domains?

In addition to autism symptom severity, it would be beneficial to examine these research questions with a larger and more diverse sample. Due to limited access to participants, the participants in this study were primarily Caucasian males. It has been reported that ASD prevalence is equally spread across race, ethnicity, and socio-economic status (Baio et al., 2014). As previously written, participants in this study do not adequately represent the ASD population as a whole and therefore the generalizability of results is limited; future studies should make ample effort to include a more representative sample.

In terms of measurement, research on the reliability and validity of the ESDM Checklist is scarce. It would be beneficial to conduct future studies to examine whether the assessment has convergent validity with commonly used measures in research and clinical settings, such as the Mullen Scales of Early Learning (Mullen, 1995) and the Bayley Scales of Infant and Toddler Development (Bayley, 2006). If the ESDM Checklist were found to be reliable with such measures, it may give clinicians a more practical way to assess progress than more traditional standardized tests, which may be more difficult and costlier to administer.

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APPENDIX A: EXAMPLES OF ESDM GOALS BY DOMAIN AND LEVEL

Table A-1.

Receptive Communication Goal Examples

Level	Goal Examples
Level One	Localizes to sounds by turning toward sound source
	Looks to partner when name is called
	Follows distal point to retrieve toy
Level Two	Follows instructions to (A) "stop" or (B) "wait" without prompts or gestures
	Identifies by pointing or showing several named body parts on self or other person
	Understands early spatial concepts (in, on, off)
Level	Follows one-step novel commands involving familiar objects/actions
Three	Identifies 5 or more actions in pictures and books
	Differentiates 4 colors upon requests
Level Four	Understands a variety of descriptive physical relationship concepts
	Understands gender pronouns
	Understands possessives and part-whole relations

Table A-2.

Expressive Communication Goal Examples

Level	Goal Examples
Level One	Uses a goal-directed reach to request
	Vocalizes with intent
	Expresses refusal by pushing away object or giving the object back to another person
Level Two	Uses target signs or gestures with vocalizations to express (request, all done, share, help, protest)
	Spontaneously produces multiple words associated with a play routine (roll, go, stop)
	Spontaneously labels objects and pictures
Level	Labels actions in pictures and books
Three	Gestures or vocalizes "I don't know" in context
	Says "Hi" and "Bye-bye" appropriately, both initiating and in response
Level	Responds to complex "wh" questions ("Why?", "How?")
Four	Speaks in three-to-four-word utterances consistently
	Uses a variety of noun phrases

Table A-3.

Joint Attention Goal Examples

Level	Goal Examples
Level Two	Responds to "Look" and offered object with gaze shift, body turn, and looks at offered object
	Gives and takes object from another person coordinated with eye contact
	Responds to "Show me" by extending object to adult

Table A-4.

Social Skills Goal Examples

Level	Goal Examples
Level One	Attends briefly to another person with eye contact
	Maintains engagement in sensory social routine for 2 minutes
	Watches and engages with imitative adult during parallel toy play activities
Level Two	Returns affection behaviors to familiar others
	Uses gesture or words to attain adult's attention
	Asks for help verbally or gesturally
Level Three	Initiates interactions and imitations of peers
	Plays in familiar dramatic play routine with peer in parallel play
	Uses politeness terms: "Please", "Thank you", "Excuse Me"
Level Four	Invites peers to play
	Expresses own feelings appropriately
	Takes turns in informal play independently

Table A-5.

Imitation Goal Examples

Level	Goal Examples
Level One	Imitates 8-10 one-step actions on objects
	Imitates 6 invisible motor actions on head, face inside song/game routines
	Imitates 6 oral-facial movements
Level Two	Imitates animal sounds and other sounds
	Imitates/approximates novel actions in songs
	Imitates pretend play acts to self and partner with miniatures

Table A-6.

Cognition Goal Examples

Level	Goal Examples
Level One	Matches/sorts identical objects
	Matches/sorts pictures to objects
	Matches/sorts objects by color
Level Two	Matches/sorts by shapes
	Sorts related common objects into functional groups
	Matches by quantities one through three
Level Three	Matches words
	Matches numbers
	Receptively and expressively identifies some letters, numbers, shapes, and colors
Level Four	Counts objects with 1:1 correspondence to 10
	Gives quantities through 10
	Knows terms for quantity concepts

Table A-7.

Play Communication Goal Examples

Level	Goal Examples
Level One	Fits behavior to the qualities of five different objects
	Plays independently with toys requiring two different motor actions
	Completes play task and puts away
Level Two	Combines related objects in play
	Demonstrates a trial-and-error approach to problem solving with constructive toys
	Gets materials, brings to table, completes play task, and puts away
Level Three	Links three or more related actions in a play sequence
	Physically places figures on miniature furniture, vehicles, etc., when appropriate
	Carries out actions on doll or animal figures spontaneously
Level Four	Directs partners in play
	Plays out several story themes in play
	Takes on a character role and plays it out

Table A-8.

Fine Motor Goal Examples

Level	Goal Examples
Level One	Puts pegs in a pegboard
	Pushes buttons on five different types of cause-effect toys
	Stacks big Legos
Level Two	Stacks 8-10 1-inch blocks
	Opens and closes a variety of containers, including screw-on lids
	Zips and unzips large zipper
Level Three	Completes five- to six-piece interlocking puzzle
	Imitates drawing circle, cross, square, diagonal line
	Imitates and builds different block structures using a variety of building materials
Level Four	Colors in picture with accuracy using different colors
	Colors in shapes that are outlined
	Connects dots with drawing tool

Table A-9.

Gross Motor Goal Examples

Level	Goal Examples
Level One	Gets on and off pieces of equipment
	Protects self when off balance
	Throws ball and beanbags in any direction
Level Two	Jumps off step and over obstacles on ground
	Pulls wagon or pushes wheelbarrow
	Kicks ball into target
Level Three	Kicks with good form and balance
	Jumps forward with two feet together
	Hops on one foot
Level Four	Kicks a moving ball
	Gallops and skips
	Walks without falling off balance beam, railroad ties, sidewalk curbs

Table A-10.

Personal Independence Goal Examples

Level	Goal Examples
Level One	Eats snacks and meals at the table Pulls on each piece of clothing with assistance Tolerates hair combing, nose wiping, and tooth brushing
Level Two	Wipes face with warm cloth when instructed Shows knowledge of sequence of bedtime routine Pours water/food into pet dish
Level Three	Opens and closes backpack independently; puts in and removes objects when requested Completes all the hand washing steps independently Covers mouth when coughing and sneezing
Level Four	Takes self to toilet as needed Washes face with washcloth independently Independently brushes or combs hair

(Rogers & Dawson, 2010)

APPENDIX B: DESCRIPTIVE STATISTICS OF SKILLS MASTERED BY ESDM DOMAIN AND LEVEL ACROSS TIME

Table B-1.

Percentage of Participants Per Progress Monitoring Period

ESDM Domain	Level One (M *SD*)	Level Two (M *SD*)	Level Three (M *SD*)	Level Four (M *SD*)
Receptive Communication (RC)	31% *21%*	5% *8%*	1% *4%*	0% *0%*
Expressive Communication (EC)	34% *23%*	5% *13%*	1% *2%*	0% *0%*
Joint Attention (JA)	N/A	4% *11%*	N/A	N/A
Social Skills (SS)	34% *24%*	2% *4%*	0% *0%*	0% *0%*
Imitation (IM)	10% *20%*	8% *17%*	N/A	N/A
Cognition (COG)	13% *29%*	3% *11%*	2% *8%*	0% *2%*
Play (PL)	31% *35%*	8% *19%*	2% *10%*	0% *0%*
Fine Motor (FM)	36% *35%*	11% *14%*	0% *0%*	0% *0%*
Gross Motor (GM)	43% *29%*	12% *21%*	1% *5%*	0% *0%*
Personal Independence (PI)	34% *21%*	11% *14%*	1% *3%*	0% *0%*

Table B-2.

Mean Percentage of Skills Mastered by ESDM Domain and ESDM Level at 3 Months Intervention

ESDM Domain	Level One (M *SD*)	Level Two (M *SD*)	Level Three (M *SD*)	Level Four (M *SD*)
Receptive Communication (RC)	71% *24%*	19% *33%*	11% *23%*	0% *2%*
Expressive Communication (EC)	60% *25%*	21% *26%*	2% *6%*	0% *1%*
Joint Attention (JA)	N/A	16% *24%*	N/A	N/A
Social Skills (SS)	69% *27%*	12% *15%*	3% *11%*	0% *2%*
Imitation (IM)	39% *37%*	23% *26%*	N/A	N/A
Cognition (COG)	32% *43%*	16% *30%*	11% *26%*	3% *10%*
Play (PL)	62% *39%*	17% *29%*	5% *21%*	1% *5%*
Fine Motor (FM)	65% *38%*	22% *24%*	2% *4%*	0% *0%*
Gross Motor (GM)	74% *28%*	26% *32%*	5% *17%*	2% *9%*
Personal Independence (PI)	55% *30%*	19% *27%*	5% *13%*	1% *6%*

Table B-3.

Mean Percentage of Skills Mastered by ESDM Domain and ESDM Level at 6 Months Intervention

ESDM Domain	Level One (M *SD*)	Level Two (M *SD*)	Level Three (M *SD*)	Level Four (M *SD*)
Receptive Communication (RC)	85% *23%*	32% *36%*	22% *33%*	2% *7%*
Expressive Communication (EC)	83% *23%*	46% *36%*	10% *20%*	1% *2%*
Joint Attention (JA)	N/A	40% *37%*	N/A	N/A
Social Skills (SS)	92% *14%*	32% *29%*	6% *17%*	0% *2%*
Imitation (IM)	64% *39%*	47% *34%*	N/A	N/A
Cognition (COG)	59% *47%*	28% *36%*	23% *31%*	4% *11%*
Play (PL)	79% *33%*	33% *32%*	9% *23%*	2% *12%*
Fine Motor (FM)	77% *34%*	42% *32%*	4% *12%*	0% *1%*
Gross Motor (GM)	89% *18%*	47% *33%*	11% *21%*	3% *14%*
Personal Independence (PI)	72% *27%*	32% *29%*	12% *20%*	3% *12%*

Table B-4.

Mean Percentage of Skills Mastered across Levels by Time

Level	Baseline (M *SD*)	3 Months (M *SD*)	6 Months (M *SD*)
Level One (12-18 Months)	31% *21%*	43% *17%*	56% *16%*
Level Two (18-24 Months)	7% *10%*	19% *22%*	38% *28%*
Level Three (24-36 Months)	1% *2%*	5% *12%*	12% *19%*
Level Four (36-48 Months)	0% *0%*	0% *3%*	2% *5%*