Gesture and Language in Children Enrolled in Early Intervention

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ABSTRACT

Gesture and Language in Children Enrolled in Early Intervention

by

Makenzy Turner, Master of Science

Utah State University, 2023

Major Professor: Dr. Lisa Boyce
Department: Human Development and Family Studies

Preschool language development is important, as children with early language delays are at risk for persistent deficits in literacy skills, behavioral skills, and social/emotional skills. Gesture has been found to be linked to and predictive of later language skills in several studies. This study seeks to expand the current literature by examining gesture use and language development in a group of 83 parent-infant dyads receiving early intervention services. This study used parent-child play interactions, child assessment, and parent report measures to examine the complex associations between gesture and language.

This study found that children with language delays at 24 months exhibited fewer gestures during play and had lower parent-report scores of gesture behaviors. Additionally, gesture measures were positively associated with child language at 24 months, child language at 36 months, parent responsiveness, parent gesture frequency, and household income. Furthermore, 24-month child gesture score was a significant predictor of 36-month child language, above and beyond child 24-month language, parent
responsiveness, and household income. These results suggest that gesture use could be an effective intervention strategy to support young children’s language development. Additionally, gesture measures could be used to identify children at risk of language delays who may benefit from early intervention services.
PUBLIC ABSTRACT

Gesture and Language in Children Enrolled in Early Intervention

Makenzy S. Turner

Language development in preschool-age children is important, as children with early language delays are at risk for difficulties in other areas such as literacy skills, behavioral skills, and social/emotional skills. Gesture has been found to be linked to language skills in young children. This study examined gesture use and language development in a group of young children receiving early intervention services.

This study found that children with language delays at 24 months used fewer gestures during play. Additionally, gesture use was positively associated with other factors that may influence language, such as parent responsiveness and household income. Furthermore, 24-month child gesture score was found to predict 36-month child language, above and beyond child 24-month language, parent responsiveness, and household income. These results suggest that gesture use could be an effective intervention strategy to support young children’s language development. Additionally, gesture assessments could be used to identify children at risk of language delays who may benefit from early intervention services.
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Makenzy S. Turner
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Chapter I: Introduction

Roughly fifteen percent of children exhibit language delays by age two (Hawa & Spandoudis, 2014). Children with early language delays are at risk for persistent deficits in literacy skills, behavioral skills, and social/emotional skills (Morgan et al., 2019). Early intervention has been found to have a positive effect on language development in children with language delays (Buschmann et al., 2015). Some children who exhibit early language delays catch up to their peers, but it is difficult to identify which children will catch up and which children need intervention services (Morgan et al., 2019). As a result, the children who are unidentified may not have access to early intervention.

Language development is complex and influenced by several factors including socioeconomic status, parent language input, parent/caregiver responsiveness, and gesture (Dimitrova et al., 2015; Lieberman et al., 2019; Rowe & Goldin-Meadow, 2009; Rowe et al., 2008). Gesture is defined as intentional or goal-directed non-verbal movement of a body part (including but not limited to hands, arms, and head) that contains meaning. Gesture use has been studied as an important prelinguistic skill with several important types and functions. Gesture has been found to be linked to and predictive of later language skills in several studies (Cohen & Billard, 2018; Iverson & Goldin-Meadow, 2005; Rowe et al., 2008). Some studies suggest that infant gesture may even influence caregiver responsiveness and language input (Valloton, 2009). Other researchers suggest that early gesture measures can be used to identify preverbal children who are at-risk for language delay, subsequently making access to intervention services possible earlier and maximizing outcomes (Buschmann et al., 2015; Morgan et al., 2019).
Some studies have also found success in designing interventions focused on gesture 
(Choi et al., 2021; Romano & Windsor, 2020; Valloton, 2012).

Gesture is well-established as an important aspect of language to study in the 
context of language delay and additional insight into the use of gesture could guide 
earlier intervention efforts. However, before adequate intervention can be developed, the 
basic research in this area needs to be expanded. There appears to be a gap in the research 
literature with only a few studies examining gesture in children with language delays. 
Most of the studies which were identified in this area had very small sample sizes and 
were framed around diagnosable disabilities that language delay is symptomatic of, such 
as Down syndrome or autism (Lee & Lee, 2015; Luke et al., 2017; Manwaring et al., 
2019; O’Neill & Chiat, 2015; Thal & Tobias, 1994). Additionally, although 
responsiveness has been related to language in research, very few studies identified in the 
wider body of literature on gesture examined both gesture and caregiver responsiveness 
in relation to language. A greater understanding of the role of parent and child gestures in 
children with language delay could inform early intervention efforts and improve 
language outcomes.

This study seeks to expand the current literature by studying gesture use and 
language development through observing parent-child play interactions, child assessment, 
and parent report measures to shed more light on the complex associations among a 
sample of children receiving early intervention services. Research questions include:

Q1: Do children enrolled in early intervention who score 1.5 standard deviations 
below the mean in 24-month total language scores use significantly fewer gestures at 24
months as measured by parent report and observation data than children scoring within the average range in language development at 24 months?

**Q2:** What family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors are related to children’s use of gesture at 24 months?

**Q3:** What family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) variables are related to children’s total language scores at 36 months?

**Q4:** Does children’s use of gesture at 24 months predict total language scores at 36 months above and beyond family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors?
Chapter II: Literature Review

Language development is complex and influenced by several factors including socioeconomic status, parent language input, parent/caregiver responsiveness, and gesture (Dimitrova et al., 2015; Lieberman et al., 2019; Rowe & Goldin-Meadow, 2009; Rowe et al., 2008). This study seeks to shed light on the associations between gesture, language, and other parent, child, and family factors through child language assessment, parent and child behavioral observations, and parent report measures. The study will examine gesture in children with and without language delays, measure associations between parent, child, and family variables, and analyze predictors of 36-month language scores. The literature review will first provide a theoretical framework for the study, then discuss the literature regarding gesture as a construct, gesture in relation to language, and gesture across cultures. Previous literature regarding parent, family, and individual factors in relation to language will then be discussed. The literature review will then outline relevant research regarding gesture and language delay.

Theoretical Framework

Vygotsky’s Sociocultural Theory of Cognitive Development was used to frame this study. From a Vygotskian perspective, social interaction drives children’s development (Vygotsky, 1978). Vygotsky also emphasizes the importance of play in development. This study uses video observations to capture gesture and language in a play-based setting involving parent and child social interaction.
Vygotsky presents the zone of proximal development as the ideal setting for learning. The zone of proximal development involves a child practicing mental functions that have yet to fully develop with a parent or caregiver. It includes skills that the child cannot achieve independently but can achieve with support. Vygotsky’s work also demonstrates that children practice mental functions externally before internalizing and mastering them (Vygotsky, 1978). Researchers have suggested that gesture provides a way for children to practice concepts that they cannot yet vocalize (Capone & McGregor, 2004). Gesture has also been found to elicit responses from parents (Iverson & Goldin-Meadow, 2005). In these ways gesture seems to facilitate parent and child interaction in the child’s zone of proximal development, promoting development. Gesture has been found to help children understand concepts and instructions that are at the edge of their ability with greater accuracy (Capone & McGregor, 2004). Additionally, gesture may help parents understand what concepts their child is still developing, allowing parents to provide appropriate scaffolding (Capone & McGregor, 2004).

**Introduction to Gesture**

**Gesture Types and Definitions**

A gesture is an intentional or goal-directed non-verbal movement of a body part (including but not limited to hands, arms, and head) that has meaning. The movement cannot be a direct manipulation of a referent unless it falls under the “deictic” category (defined below) and has a show, give, or point function (Iverson & Goldin-Meadow, 2005). For example, a movement attempting to kick a ball is not a gesture but a
movement or action imitating kicking a ball is a gesture. An attempt to grab something is not a gesture but a child reaching for something to communicate that they want it is a gesture. Gesture can be communicative or self-directed. This study focuses on communicative gesture.

As children grow and begin to develop communicative capabilities, they typically begin to use gesture as a communicative symbol around 8-9 months of age (Capone & McGregor, 2004). Gestures are typically categorized by type, including deictic gestures, conventional gestures, and representational (symbolic) gestures. Various researchers may use slightly different categories, depending on the study. Deictic gestures have a meaning that is dependent on the context, and the same gesture can be used regardless of the context. This includes pointing, showing, giving, or requesting an object (Iverson & Goldin-Meadow, 2005). Conventional gestures contain a specific meaning that is culturally defined, such as nodding for “yes” (Iverson & Goldin-Meadow, 2005). Some studies also include a type of conventional gesture that contain no semantic information but provide emphasis while speaking, referred to as beat gestures. Representational or symbolic gestures are symbols for the referent, with meaning that remains constant regardless of context. For example, using a hand to the ear as a “phone.”

**Gesture Development**

The development of gesture use has been documented by various researchers and summarized by Capone and McGregor (2004). Infants first begin using “showing-off” gestures to obtain adult attention, and often repeat behaviors that have been previously successful in this regard (Capone & McGregor, 2004). The remaining deictic gestures
sequentially develop shortly after, including giving, pointing, and requesting (reaching as they open and close their hand). Representational or symbolic gestures have been observed to emerge before the child reaches 25 expressive words, which is typically around 18 months of age (Capone & McGregor, 2004). Beat gestures (a specific type of conventional gesture) emerge at about 24 months of age and have been found to aid communicative clarity and predict later narrative abilities (Vila-Gimenez et al., 2021).

Between 24 and 42 months of age, children typically use gesture with speech much more frequently than they use gesture alone. Toddlers at this age use gesture concurrently with speech at levels that are comparable to adults (Capone & McGregor, 2004, Rowe et al., 2008). This multimodal communication is categorized as equivalent (gesture and word carry the same meaning or referent), complementary (verbal label for the gesture referent), or supplementary (gesture adds meaning or context to the word e.g., a “give me” gesture with the spoken word “water”).

During the preschool years children start to use symbolic gestures as “body part as object” gestures, such as using a finger to represent a toothbrush and pretending to brush their teeth. Shortly after “body part as object” gesture use develops, the use of “imaginary object” gestures, such as pretending to hold the toothbrush, emerge and increase in frequency.

**Functions of Gesture**

Gestures can function in a variety of ways. Gesture can be used to clarify and give context for symbols that may be confusing (Capone McGregor, 2004). Visual and spatial concepts may also be easier to understand and express using gesture (Iverson & Goldin-
Meadow, 2005). Scaffolding has been identified as another important function of gesture. Several studies have found that children understand and follow complex directions more accurately when gesture was used to give direction, but only when the tasks were at the edge of their ability (Capone & McGregor, 2004). These studies suggest that gesture seems to facilitate receptive language comprehension and aid in directing a child’s attention and focus.

During infancy and early toddlerhood, gesture may be used to convey word-like meaning that the child may not be able to express verbally. Although this function is not eliminated as a child’s expressive vocabulary increases, the frequency of gesture use seems to decrease (Capone McGregor, 2004). However, Iverson and Goldin-Meadow (2005) found that items seen in children’s gestural vocabularies subsequently appeared in their verbal lexicons, suggesting that gesture allows children to practice and receive input on an item or word that they are not yet comfortable using expressively.

**Gesture and Language**

Gesture has been consistently found to be positively associated with language development. Infant gesture use has been linked to vocabulary development in a number of studies (Rowe et al., 2008). Rowe and Goldin-Meadow (2009) examined the gesture use of 52 children at 18 months and speech at 42 months. They found that gesture vocabulary (the number of meanings conveyed through gesture) at 18 months predicted verbal vocabulary at 42 months, and the number of gesture + speech combinations at 18 months predicted sentence complexity at 42 months. Iverson and Goldin-Meadow (2005)
followed ten typically developing children, videotaping them monthly between 10 months of age and 24 months of age. In their sample, the children who produced gesture + word combinations earlier also began producing two-word sentences earlier. They also found that words or meanings that were produced in gesture subsequently appeared in speech.

Gesture has also been thought of as an indicator of underlying linguistic skills. The understanding of symbolic representation is a foundational skill necessary for language acquisition. Some types of gesture, primarily symbolic gesture, can provide some preverbal insight to a child’s understanding of symbolic representation (Cohen & Billard, 2018). The literature in this area is well-established, but many of the identified studies are older with limited replication beyond the setting of the original studies.

**Gesture across Culture**

Gesture types and functions remain similar across culture, but some cultures use a higher frequency and broader range of gesture in communication (Iverson et al., 2008). For example, Salomo and Liszkowski (2013) compared parent and child deictic gesture use in Yucatec-Mayan, Dutch, and Chinese dyads. They found that Chinese parents and children used gesture most frequently, followed by Dutch dyads, with Yucatec-Mayan dyads gesturing the least frequently. In the Kuchirko et al. (2018) sample, Mexican American parents and children gestured most when the children were 14 months old, and Dominican American parents and children gestured most when the children were 24
months old. African American families gestured least frequently at both time points. They found that gesture was associated with both parent and child responsiveness. Additionally, Italian children exhibit a higher number of representational/symbolic gestures than American children. However, Iverson et al. (2008) found that despite this difference, gesture-speech combinations, and subsequently two-word spoken combinations, emerged at the same time in Italian and American children. Iverson et al. (2008) had a very small sample size (n=6), limiting generalizability. The literature in this area seems to be thin, and there seem to still be gaps regarding how cultural differences in gesture use impact language.

**Parent, Family, & Individual Factors**

**Parent Language Input and Responsiveness**

It is well-established in research that language input received is important in child language development (Rowe & Goldin-Meadow, 2009). Some researchers have speculated that the link between gesture and language is in part due to gesture eliciting linguistic input. Dimitrova et al. (2015) conducted a study analyzing parent linguistic input and parent and child contingent responsiveness in typically developing children, children with autism, and children with Down syndrome. They found that parents in all three groups provided verbal input to translate the child’s gesture or expand on the referent. In each group, the referents that parents translated into words were significantly more likely to enter the child’s spoken vocabularies. In this case, it seems that child gesture elicits parent verbal input, which helps them expand and develop language.
It is also well established that parent responsiveness has an impact on child language development in typically developing children and with children who exhibit language delays (Lieberman et al., 2019). The findings of Dimitrova et al. (2015) support the idea that child gesture provides a way for responsive parents to recognize what the child is referring to and allow them to provide relevant/salient linguistic input.

Kuchirko et al. (2018) studied parent and infant contingent responsiveness, measuring whether infants responded to a parent’s vocalization or gesture within three seconds using vocalization and/or gesture. Infants often responded within three seconds. They found that highly responsive infants had highly responsive parents (Kuchirko et al., 2018). Vallotton (2009) measured child gesture and non-parental caregiver responsiveness in a high-quality childcare setting. Infants who used gestures and signs to respond to caregivers elicited more caregiver responsiveness, even when child age and individual characteristics (gesture, temperament) were controlled. This finding was not due to caregiver-child individual relationship; it was consistent across caregivers. Taken together, these studies suggest that parent gesture, infant gesture, parent responsiveness, and infant responsiveness all influence each other (Kuchirko et al., 2018, Vallotton, 2009). There were very few studies beyond these that considered responsiveness and gesture together, and the results of these studies seem to indicate that further research could help inform intervention around responsiveness and gesture.

**Parent Gesture Input**

There is some evidence that demonstrates the effect that parent gesture use has on child gesture use and child language growth. For example, infants and young children
tend to exhibit gesture types and frequencies similar to their parents (Iverson et al., 2008). Gesture frequency and age of emergence is socially mediated (Salomo & Liszkowski, 2013).

Dimitrova and Ozcaliskan (2013) found that similar to verbal motherese, or child directed speech, mothers tended to adjust their gesture to match the comprehension level of their children. Parent gesture has been found to aid in child comprehension, child gesture amounts and types, as well as directly impact vocabulary development (Dimitrova & Ozcaliskan, 2013). Kisa et al. (2019) found that parent gesture input increases with child age, a finding that is consistent with several previous studies.

Rowe & Goldin-Meadow (2009) measured parent and child gesture production. In their sample, spoken word types and gesture types were positively correlated for both parents and children. In addition, parents who produced more gesture types had children who produced more gesture types. Parent word types were not related to child word types or child gesture types. These findings, taken together, point to the importance of parent gesture input. Similarly, Rowe et al. (2008) found that parent gesture correlated with infant gesture use, infant gesture use predicted vocabulary, but parent gesture was not related to child vocabulary.

Romano & Windsor (2020) conducted an intervention study aiming to support language development through increasing deictic gesture use in children from low socioeconomic status (SES). They used frequent gesture modeling and created opportunities for children to gesture, responding and expanding when child gesture occurred. All three of the children in their study made significant gains in deictic gesture
rates and gesture + speech combinations, providing further evidence regarding the impact of gesture input.

In their 2018 study, Ozcaliskan et al. compared parent gesture use, and child gesture production in typically developing children, children with autism spectrum disorder, and children with Down syndrome. They found that parent gesture use did not significantly differ across the three groups, but child gesture use was specific to the child’s diagnosis. This study suggests that parent gesture does not always depend on child gesture, and although parent gesture use is critical, child gesture reflects diagnosis-specific abilities regardless of parent gesture input.

**SES and Other Individual Factors**

Child SES has been found to impact language development, and low SES is typically considered a risk factor (Rowe & Goldin-Meadow, 2009). Researchers have also found that children with low SES tend to receive less gestural input and produce fewer gestures (Romano & Windsor, 2020). Rowe and Goldin-Meadow (2009) measured parent and child gesture of 50 families of varying SES. They found that SES was positively related to both parent and child gesture when the children were 14 months of age. The children from high-SES families gestured significantly more at 14 months. This disparity was explained by parent gesture, a relation that held even when parent speech was controlled. These findings further support the idea that parent gesture is an important factor when studying gesture and language.

Romano et al. (2021) evaluated an intervention meant to increase childcare providers in supporting low-SES child gesture use. The intervention was found to be
effective, increasing behaviors that encourage child gesture use and increasing provider self-efficacy. Researchers suggest that intervention focused on gesture can enhance the language development of children experiencing poverty and can be useful when attempting to close the commonly found SES vocabulary gap.

Child individual factors also affect gesture use. Girls typically produce gesture, first words, gesture + word combinations, and two-word combinations earlier than boys (Dimitrova & Ozcaliskan, 2013). Additionally, bilingual children have been found to perform better on an expressive symbolic gesture task than their monolingual peers at age three (Wermelinger et al., 2019).

**Gesture and Language Delay**

Gesture has also been studied in the context of language delay. Thal et al. (1991) conducted some follow-up data collection one year after studying a group of ten children between 18 and 32 months who exhibited expressive language delays. They found that some of the children had caught up to typically developing peers one year after the original study. They compared these two groups using the original data and found that the children with continuing language delay performed significantly poorer on a series of gesture tasks than the group who demonstrated a language delay originally but caught up by the one-year follow up (Thal et al., 1991). Researchers speculate that the “late bloomer” group used gesture at the first time point to compensate for lack of expressive language, and that this use of gesture helped them catch up (Thal & Tobias, 1992). Thal and Tobias (1994) conducted a similar study comparing a different group of 14 children
with an expressive language delay and had similar results: late talkers performed similar
to language-matched peers when measuring spontaneous and imitated gesture production.
These early studies have been used to set up other research studies but have not been
replicated with larger sample sizes.

Lee and Lee, (2015) found that toddlers with language delay used communicative
gesture significantly less than age-matched peers, but not significantly different than
language-matched peers. This study had three groups, each containing ten children.
Some studies have found that toddlers with an expressive-only delay (no receptive delay)
who catch up to their peers do not significantly differ from typically developing peers in
communicative gesture use (Hawa & Spandoudis, 2014). These studies also had small
sample sizes.

Luke et al. (2017) analyzed infant deictic gesture use in 30 children with typical
language and ten with delayed language. They analyzed caregiver response, verbal input,
and gestural input longitudinally. Caregivers of both groups provided comparable verbal
input. They found that children in the delayed group used fewer pointing gestures than
the typically developing group at the beginning of the second year. At the end of second
year (21 months) the language-delayed group produced more pointing gestures than the
typically developing group. Caregiver input did not account for the difference between
the groups, suggesting that gesture is important above and beyond parent language input
(Luke et al., 2017). Researchers only measured one type of gesture and suggest that
measuring gesture beyond deictic pointing could add clarity to their results. They also
suggest measuring child gesture at older ages and using a larger sample size to examine whether this relationship holds as children age.

Manwaring et al. (2019), measured deictic and conventional gestures at 18 months in 62 typically developing children and 30 children with a language delay who were identified as at risk for autism, and examined the relationship between gesture and later receptive and expressive language. They found a significant association between deictic gesture and the number of words produced between 18 and 36 months. The group with a language delay had reduced conventional and deictic gesture use. Children who were diagnosed with autism at 36 months displayed a more pronounced deficit in deictic gesture production at 18 months.

O’neill and Chiat (2015) compared 12 children with expressive language delays and 10 receptive and expressive language delays, measuring gesture use and symbolic comprehension. Children with both receptive and expressive delay had significantly poorer performance than children with an expressive only delay. Their results provide evidence of a relationship between early receptive language difficulties and poor gesture use. Researchers also found that the group with both receptive and expressive delay had difficulty understanding symbolic gesture. Researchers recommend further research using a larger sample size and differentiating between different types of gesture.

The literature regarding language delay and gesture is thin. Many of the identified studies have small sample sizes and are conducted in a clinical setting rather than a play-based, naturalistic setting. Early intervention has been moving toward a natural, family-based approach. A natural setting rather than clinical would give a more accurate picture
of the day-to-day language and gesture use. Additionally, many of these studies did not consider things like responsiveness or parent gesture.

**Summary**

Previous research has found links between child gesture and language development. Gesture can be categorized as deictic (meaning is dependent on situation), conventional (meaning is consistent and culturally defined), and representational or symbolic (meaning remains consistent and symbolize a referent). Child gesture has been found to be predictive of later language skills. Culture, parent gesture, parent responsiveness, and other individual factors impact child gesture production. Poor gesture production can be used to identify risk of later language delay and may be an effective focus of intervention. The literature is thin regarding gesture in relation to language delay. Most of the few studies that were found had very small sample sizes, most including between 10 and 30 participants. Most of these studies were framed in the context of disability and in a clinical setting rather than a naturalistic play-based setting. There were no identified studies that measured all of the following factors: parent language, parent gesture, parent responsiveness, child gesture, child expressive and receptive language, and demographic variables in a naturalistic setting. Additionally, a strong majority of the identified research measured gesture through either parent report measures or video coding, but not both. A greater understanding of gesture use in addition to other more commonly examined predictors of children’s language...
development could guide future intervention efforts to support children with language delays.

**Purpose of the Present Study**

The current study seeks to expand on the literature regarding gesture use and language development in children who qualify for early intervention services. This study examines mother and child gesture use, mother and child response to gesture, child language, and maternal responsiveness in 83 mother-child dyads using video data and parent report measures. Gesture is measured through parent report as well as observational data recorded in the homes of the participants as they interact with toys and books.

**Research Questions and Hypotheses**

**Q1:** Do children enrolled in early intervention who score 1.5 standard deviations below the mean in 24-month total language scores use significantly fewer gestures at 24 months as measured by parent report and observation data than children scoring within the average range in language development at 24 months?

**H1:** Consistent with the results of Luke et al. (2017), children who score within 1.5 standard deviations of average in total language will score significantly higher than the language delay group in gesture use at 24 months.
Q2: What family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors are related to children’s use of gesture at 24 months?

H2: Consistent with previous literature, children with higher parental income, education, gesture use, and responsiveness will demonstrate higher gesture frequency at 24 months (Dimitrova & Özçaliskan, 2013; Dimitrova et al., 2015; Rowe & Goldin-Meadow, 2009; Rowe et al., 2008). Children with higher total language will demonstrate higher gesture frequency at 24 months (Luke et al., 2017).

Q3: What family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) variables are related to children’s total language scores at 36 months?

H3: Consistent with previous literature, children with higher parental income, education, gesture use, and responsiveness, and children with higher 24-month total language scores will score higher in total language at 36 months (Dimitrova et al., 2015; Rowe & Goldin-Meadow, 2009; Rowe et al., 2008).

Q4: Does children’s use of gesture at 24 months predict total language scores at 36 months above and beyond family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors?

H4: Consistent with previous literature, children with higher gesture frequency at 24 months have higher total language scores at 36 months above and beyond family
(income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors (Kuchirko et al., 2018; Lieberman et al., 2019; Romano & Windsor, 2020).
Chapter III: Methods

Participants

Participants for this study consisted of 83 mother-child dyads who were recruited through Part C early intervention programs in two urban school districts in Utah as part of a larger study (Boyce et al., 2017). Children under the age of 3 qualify for early intervention under Part C of the Individuals with Disabilities Education Act if they are diagnosed with a disability or developmental delay, or if they are at risk of having substantial developmental delay. A child is considered to have a developmental delay when they score 1.5 standard deviations below the mean in one or more developmental areas. The participants were involved in a shared book reading intervention that did not involve gesture.

Participating children were between 20 and 32 months of age at pretest \(M = 25.14\) and were included in the study regardless of disability status, home language or other demographic factors. Posttests were administered when children either transitioned out of the program at 36 months, or no longer qualified for early intervention. Participating children consisted of 28% females and 72% males. The sample self-identified as 82.8% Caucasian, 1.1% Asian, 14.0% Hispanic or Latino, with 2.2% marking “other.” Maternal education ranged from completion of 6th grade to completion of a bachelor’s degree and beyond, with two years of college as the average. Yearly family income ranged from $5,000 to $170,000 with the average being $61,034. English was identified as the first language for 92.5% of participants, with 7.5% identifying
Spanish. Ninety-one percent of participating mothers reported that they were married or living with someone, with 2.2% reporting separated, 1.1% divorced, and 5.4% single.

Out of the 83 participants, 37.35% of the sample (n=31) had total language scores that were 1.5 standard deviations below the mean at pretest. At posttest 31.3% of the sample scored 1.5 standard deviations below the mean in total language (n=26).

**Procedures**

Trained assessors visited the homes of the participants when the children were about 24 months and 36 months old (Boyce et al., 2017). Pretest visits occurred when children were approximately 24 months or upon entry to the program if they qualified for early intervention services after 24 months. The posttest visits occurred at approximately 36 months or when they no longer qualified for early intervention services if this happened before 36 months. Both pretest and posttest assessments included video observations of parent and child play and book sharing and assessments of children’s language development. The parent-child play interactions were recorded for 15 minutes in their homes after being instructed to interact with toys and books as they typically would. Video observations occurred in the homes of the participants to capture parent and child gesture in naturalistic play interactions. The video observations were used to measure parent responsiveness, parent gesture, and child gesture. Family income, parent education, and a parent report measure of children’s gesture use were collected at pretest.

**Video Coding Procedures**
Mother-child play videos were coded for parent and child gesture and response to gesture. The coding scheme that was used is adapted from Choi et al. (2021), Iverson and Goldin-Meadow (2005) and Manwaring et al. (2019). Videos were assessed for frequency of each gesture type and frequency of response to the communicative partner’s gesture. Gestures were coded into deictic, conventional, symbolic and non-communicative. Responses were coded into attentional/actional, expressive (verbal, gestural, or both), and no response.

Deictic gestures refer to referents that are in the immediate environment and have a meaning that is dependent on the context. This includes pointing, showing, giving, reaching for, or requesting an object (Iverson & Goldin-Meadow, 2005).

Conventional gestures are defined as gestures that have a ritualized or culturally defined form and meaning, such as nodding for “yes” (Iverson & Goldin-Meadow, 2005).

Symbolic gestures are defined as gestures that depict actions or attributes of a referent, symbolize the referent itself, or carry a mutually understood meaning (such as baby signs) (Manwaring et al., 2019).

Non-communicative gestures are any gestures that are not directed toward a communicative partner in an attempt to direct the partner’s attention. The communicative or non-communicative nature of a gesture may be seen through eye gaze, postural shifts, or facial expression (Iverson & Goldin-Meadow, 2005).

Parent and child responses to gesture were coded if they occur with the first two verbal or gestural utterances following the communicative partner’s gesture and if they were a response to the gesture rather than a redirection (Choi et al., 2021).
Undergraduate research assistants were taught the coding definitions and procedures, then independently coded a video sample of a parent-child dyad who was not included in the present sample due to incomplete data. Coders were asked to mark the time stamp of the gesture, which communicative partner displayed the gesture (mother or child), the gesture type, the activity they were engaged in at the time of the gesture, whether the gesture was accompanied by a verbal utterance, and whether the partner responded. Any discrepancies were discussed, and the coding procedures were edited to resolve any unforeseen confusion. This process was repeated until the coders reach 90% agreement on all coding categories in three consecutive videos, consistent with previous literature (Choi et al., 2021; Iverson & Goldin-Meadow, 2005; Manwaring et al., 2019). Ongoing inter-rater reliability was calculated on 32.5% of the videos. Reliability on individual videos ranged from 85.00% to 95.56% with and was 90.20% across the 27 videos.

Measures

The Communication Symbolic Behavior Scales Developmental Profile (CSBS-DP) was used to assess parent report of child gesture. The CSBS-DP measures functional communicative competence in children between the ages of 6 and 24 months (or communicative equivalence). The CSBS-DP measures seven language predictors including emotion and eye gaze, communication, gestures, sounds, words, understanding, and object use. The gesture domain was used for the current study. Chronbach’s alpha for the measure ranges from 0.86 to 0.93 (Wetherby & Prizant, 2002).
The Preschool Language Scale, Fourth Edition (Zimmerman et al., 2002) was used to assess toddlers’ language skills including receptive language, expressive language, and total language. Higher scores indicate higher language competence. The PLS-4 uses interactions and various toys to assess language skills including auditory comprehension (receptive language), expressive language, and total language (receptive and expressive). Test-retest coefficients ranged from 0.90 to 0.97.

The Parent Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO) scores of Maternal Responsiveness (Roggman et al., 2013) was used to code parent-child play videos. PICCOLO is a checklist of observable parenting behaviors with children from age 1-3 in affection, responsiveness, encouragement, and teaching. Chronbach’s alpha is greater than .75 for all four domains (Boyce et al., 2017). Research assistants coded videos for all four domains. Coding reliability was calculated on 30% of the transcription, with an inter-rater reliability of 95%. Discrepancies were corrected through consensus (Boyce et al., 2017). The responsiveness domain and used for this study.

Family demographic variables were obtained through a questionnaire administered at the first home visit. Information gathered included maternal age and education, household income, race/ethnicity, relationship status, child gender, and child age.
Chapter IV: Analysis & Results

Analyses were conducted using Statistical Package for the Social Sciences (SPSS) software. In the original study, children were split into groups with one group receiving a supplemental family bookmaking approach in addition to their regular early intervention services. While intervention impacts from the supplemental family bookmaking approach were not found, intervention status was included as a covariate in the analyses to control for possible group differences that may be related to the intervention (Boyce et al., 2017). On average, children scored slightly lower than one standard deviation below the mean at pretest and slightly higher than one standard deviation below the mean at posttest on the standardized language assessment (PLS-4). The maximum possible responsiveness score was 14, so the parents in this sample consistently demonstrated highly responsive behaviors throughout the observed play interactions. The parent report of child gesture showed variation with a standard deviation of 2.35 on a scale that ranged from zero to ten. The observed number of child and parent gestures had a wide range across the sample, with children ranging from zero to 99 gestures and parents ranging from eight to 117. Descriptive statistics for language, responsiveness, and gesture variables are shown in Table 1.

Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>Median</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
</table>

Descriptive Statistics
Q1: Do children enrolled in early intervention who score 1.5 standard deviations below the mean in 24-month total language scores use significantly fewer gestures at 24 months as measured by parent report and observation data than children scoring within the average range in language development at 24 months?

The first research question was addressed using independent samples t-tests comparing the language delay group (n = 31) to the average language group (n = 52) with the frequency count of gesture use from the observational data, then with the parent report of gesture use variable (CSBS-DP). The first t-test examining child gesture frequency count showed that children in the average language group used gesture more frequently than the language delay group. The second t-test showed that children in the average language group scored higher than the language delay group in the parent report.
of gesture measure. These findings support the hypothesis that children who gesture more also score higher in 24-month language.

Table 2

Independent Samples T-Tests

<table>
<thead>
<tr>
<th>Language Delay</th>
<th>Average Language</th>
<th>t(94)</th>
<th>p</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Parent Report of Child Gesture</td>
<td>5.700</td>
<td>2.766</td>
<td>8.020</td>
<td>1.443</td>
</tr>
</tbody>
</table>

Q2: What family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors are related to children’s use of gesture at 24 months?

The second research question was addressed using bivariate correlations to assess the associations between child gesture at 24 months (parent report and observation) and income, parent education, parent use of gestures, parent responsiveness, and child 24-month language score. As seen in Table 3, statistically significant positive correlations
were found between 24-month observed gesture frequency and household income, parent gesture frequency, child 24-month language, and parent responsiveness. Children who gesture more frequently during play also tend to have higher total language scores. Parents of children who gesture more frequently, used gesture more frequently, were more responsive, and had higher household incomes than parents of children who gesture less frequently. Similarly, the parent report measure of child gesture was also positively associated with household income, parent responsiveness, and children’s 24-month language scores.

**Q3:** What family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) variables are related to children’s total language scores at 36 months?

The third research question was addressed using bivariate correlations to assess the associations between 36-month total language and household income, parent education, parent use of gesture, parent responsiveness, and child 24-month total language scores. As seen in Table 3, statistically significant positive correlations were found between 36-month total language and household income, parent gesture frequency, parent responsiveness, and 24-month total language scores. These correlations suggest that children who score higher in total language at 36 months also scored higher in language at 24 months. In addition, children who score higher in total language at 36 months also have parents who gesture more frequently, report a higher household income and are more responsive than parents of children who score lower in language at 24 months.
### Table 3

**Bivariate Correlations**

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total Language at Pretest (PLS-4)</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Total Language at Posttest (PLS-4)</td>
<td>.691**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Total Number of Observed Child Gestures</td>
<td>.300**</td>
<td>.254*</td>
<td>.385**</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Total Number of Observed Parent Gestures</td>
<td>.262*</td>
<td>.267*</td>
<td>.066</td>
<td>.349**</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Parent Responsiveness (PICCOLO)</td>
<td>.176</td>
<td>.274**</td>
<td>.353**</td>
<td>.251*</td>
<td>.075</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>7. Household Income</td>
<td>.276**</td>
<td>.319**</td>
<td>.281**</td>
<td>.273**</td>
<td>.283**</td>
<td>.390**</td>
<td>--</td>
</tr>
<tr>
<td>8. Primary Caregiver Education</td>
<td>.174</td>
<td>.127</td>
<td>.252*</td>
<td>.178</td>
<td>.133</td>
<td>.489**</td>
<td>.477**</td>
</tr>
</tbody>
</table>
* p < .05. ** p < .01.

**Q4:** Does children’s use of gesture at 24 months predict total language scores at 36 months above and beyond family (income), parent (education, use of gestures, responsiveness during play) and child (total language at 24 months) factors?

After the first three questions were addressed the fourth question was analyzed using hierarchal multiple regression to determine if parent report of children’s 24-month gesture uniquely contributes to children’s language scores at 36 months above and beyond other predictor variables. The results from the correlation analyses were used to select the strongest correlates from the family and parent variables to include in the regression analyses as predictor variables for children’s language at 36 months (along with the control variables of children’s language scores at 24 months and the intervention status grouping variable from the larger study) while also minimizing multicollinearity. Based on the correlations in Table 3, children’s language at 24 months, household income, and parent responsiveness were included on the first step of the regression model. Parent report of children’s gesture use was entered on the second step, as it was more highly correlated with 36-month language than child gesture frequency. As shown in Table 4, 24-month language, household income, and parent responsiveness accounted for 52.8% of the variance in 36-month language scores. When 24-month child gesture was entered in the model, an additional 3.5% of the 36-month language scores was accounted for with a statistically significant change in the R-squared value. In both steps of the model, the standardized beta coefficient for total language at pretest was
statistically significant and household income was not statistically significant. Parent responsiveness was a statistically significant predictor of 36-month language scores in the first step but only approached significance ($p=.086$) in the second step. The parent report of child gesture was a significant predictor of 36-month total language when added in the second step of the model.

**Table 4**

*Hierarchal Multiple Regression*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>95% CI for B</th>
<th>SE B</th>
<th>β</th>
<th>R²</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-40.331</td>
<td>-84.117</td>
<td>3.455</td>
<td>22.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Language at Pretest (PLS-4)</td>
<td>.866**</td>
<td>.654</td>
<td>1.077</td>
<td>.106**</td>
<td>.635**</td>
<td>.528**</td>
</tr>
<tr>
<td>Household Income</td>
<td>5.571E-5</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.103</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Parent Responsiveness (PICCOLO)</td>
<td>3.867*</td>
<td>.596</td>
<td>7.139</td>
<td>1.644*</td>
<td>.195*</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------</td>
<td>--------</td>
<td>------</td>
<td>-------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-31.792</td>
<td>-</td>
<td>74.620</td>
<td>11.036</td>
<td>21.517</td>
</tr>
<tr>
<td></td>
<td>Total Language at Pretest (PLS-4)</td>
<td>.754**</td>
<td>.532</td>
<td>.976</td>
<td>.112**</td>
<td>.553**</td>
</tr>
<tr>
<td></td>
<td>Household Income</td>
<td>5.097E-5</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
<td>.094</td>
</tr>
<tr>
<td></td>
<td>Parent Responsiveness (PICCOLO)</td>
<td>2.847</td>
<td>-.412</td>
<td>6.105</td>
<td>1.637</td>
<td>.143</td>
</tr>
<tr>
<td></td>
<td>Parent Report of Child Gesture (CSBS-DP)</td>
<td>2.056</td>
<td>.472</td>
<td>3.641</td>
<td>.796**</td>
<td>2.17**</td>
</tr>
</tbody>
</table>

* p < .05, ** p < .01.
Chapter V: Discussion

The purpose of this study was to examine gesture and language along with other predictors of language such as household income and parent responsiveness. Understanding the effects of gesture on language is important in supporting language development in early childhood. This study found that associations between language and gesture are evident in children enrolled in early intervention. In this sample, children with language delays (scoring more than 1.5 standard deviations below the mean on the PLS-4) had lower gesture scores than children in the “average language” group. Gesture was correlated with language as well as several other factors that have been known to impact language. Additionally, gesture was found to predict 36-month language above and beyond 24-month language, parent responsiveness, and household income.

Gesture and Language Delay

In this sample, children with 24-month language delays had lower scores in the parent report of child gesture and lower frequency of gesture during play than the average language group. Previous literature regarding gesture and language delay is thin and typically includes very small sample sizes and comparisons between children with expressive-only language delays and children with expressive and receptive delays. The sample for this study included only three children with an expressive-only delay so I was not able to examine these groups separately. However, the results from this sample align with the receptive and expressive delay groups from previous studies (Lee & Lee, 2015;
O’neill & Chiat, 2015; Thal & Tobias, 1994). Each of the referenced studies measured gesture and language between 24-months and 36-months of age. The current study demonstrates that the positive association between gesture and language holds with a larger sample size. Manwaring et al. (2019) measured gesture at 18 months and had similar results: children with significant language delays gestured less frequently than children with typically developing language.

However, Luke et al. (2017) found that their language-delayed group demonstrated less gesture at 12 and 14 months but demonstrated more gesture at 21 months when compared to the typical language group in their sample. This conflicts with the current study in which the language delayed group demonstrated less gesture at 24 months than the average language group. These differences could be due to several factors. Luke et al. (2017) used a frequency count of pointing-only gestures while the current study used a frequency count of any communicative gesture. Additionally, while pointing is one type of deictic gesture, there are other types that we included which Luke et al. (2017) did not, such as showing or giving. The culture and language of the sample was also different, as the sample from Luke et al. (2017) consisted of children and families from Germany. The current study in addition to most of the identified studies did not measure gesture longitudinally so were unable to assess whether a similar change in gesture frequency occurs after 24 months. Further research is needed to gain more clarity concerning how gesture use develops over time in children with language delay compared to children with typical language.
Parent, Family, and Individual Factors

In this sample 24-month language was positively associated with 36-month language, parent report of child gesture, total observed child gestures, total observed parent gestures, and household income. Additionally, 36-month language was positively associated with parent report of child gestures, total observed child gestures, total observed parent gestures, parent responsiveness, and household income. These findings suggest that gesture is among several factors that positively relate to language development.

This is the first study I am aware of to use both an observational frequency count during parent-child play and parent report, the CSBS-DP, to measure gesture. It is noteworthy that the correlation coefficients for parent report of child gesture tended to be higher for family income, maternal responsiveness, and child language than observations of child gesture use during play. Interestingly, the two gesture measures were significantly correlated to each other but only the observed frequency of child gesture use was associated with the observed parent gesture frequency during play. The parent report of child gesture measure involved parents marking “not yet,” “sometimes,” or “often” in response to five questions about child gesture behavior. The observed gesture frequency involved coding a 15-minute play video. While both measures examine child non-verbal communication, these measures should be examined further to determine what they each specifically measure and shed more light on how they may contribute to language in potentially different ways.
The parent report measure asked three questions regarding deictic gesture, and two questions regarding conventional gesture, whereas the observational measure included deictic, conventional, and symbolic gestures. As Luke et al. (2017) suggested, it may be important to examine different types of gesture separately.

It is possible that the parent perspective of child gesture influences parent behavior, therefore influencing language. Additionally, specific disability diagnoses were not included in this study. If a parent knows that their child has a developmental disability that impacts language, they may be more attentive to nonverbal communication, both gesturing more frequently and encouraging their child to gesture more frequently. It may also be common for parents to frequently teach and use symbolic gestures with a child who has been diagnosed with a disability that impacts language. Given the differences between the two measures of gesture, researchers should not assume that parent report and observational measures are the same.

**Gesture, Language, and Implications for Practice**

While the correlation results indicate that gesture and language are related, the regression analysis results can offer some insight into how gesture is related to language. Parent report of child gesture at 24 months uniquely contributed to 36-month language, accounting for 3.5% of the variance above and beyond the other predictors (24-month language, household income, parent responsiveness). Interestingly, parent responsiveness was no longer a statistically significant predictor when gesture was considered. Results point to gesture as a possible avenue for intervention; helping parents attune to child
gesture could lead to improved language in early childhood. Gesture could be used as a concrete way to teach parents to improve communication with their children.

Previous researchers have suggested that gesture may elicit parent language input and interaction if the parent is attentive to child gesture (Dimitrova et al., 2015; Iverson & Goldin-Meadow, 2005; Kuchirko et al., 2018). If this is the case, intervention for children who gesture less could focus on teaching parents to encourage gesture through modeling and teaching parents to attend to and respond to child gesture.

Other research has suggested that gesture could be used to identify children at risk for language delays (Buschmann et al., 2015; Morgan et al., 2019). If this is the case, gesture could be used as a routine screening to help children access intervention before language delays are evident in speech. Additionally, gesture could be used to scaffold language, bridging the gap between current communicative ability and speech. If parents were taught to see gesture as a way to practice and learn concepts that the child isn’t yet ready to practice aloud, parents might support language development more effectively through scaffolding. This may also help parents see progress rather than becoming frustrated that language is not yet evident through speech.

**Limitations and Future Directions for Research**

This study examined gesture and language in a sample of children enrolled in early intervention. However, specific disability was not examined and parent language input/interaction was not examined. Parent language input has been found to be important to language development, and researchers have speculated that gesture may elicit parent
language (Dimitrova et al., 2015; Lieberman et al., 2019; Rowe & Goldin-Meadow, 2009). This speculation could be tested if parent language data were aligned with gesture data. Additionally, specific disabilities may impact results differently, as some disabilities, such as Down syndrome, impact language regardless of parent responsiveness or parent language input (Luke et al., 2017; Ozcaliskan et al., 2018). Gesture was only measured at 24-months. A better understanding of the ways in which gesture changes over time between 12 months and preschool years may help researchers understand its impact on language development (Capone & McGregor, 2004; Luke et al., 2017). Additionally, parent and child contingent response to gesture was not analyzed but could be important in understanding the benefits of gesture. Contingent responsiveness to gesture within a dyad could reinforce gesture and scaffold language development. Future research could identify if child gesture elicits linguistic input by examining contingent responsiveness, parent language input, and gesture production. Future research could also examine gesture as a mediator between language development and other important factors such as language environment, parent language input, parent education and income. As we gain more insight into the mechanisms that contribute to the gesture-language association, we may be able to develop interventions based on gesture to support language development through these mechanisms.

Conclusions

This study sought to examine gesture and language through comparing gesture in children with and without language delays and analyze predictors of 36-month language
scores. Children without language delays performed significantly higher than children with language delays in observational and parent report measures of gesture. Gesture at 24 months was a statistically significant predictor of 36-month language scores, above and beyond 24-month language, household income, and parent responsiveness. These findings point to the importance of gesture when studying language. Further research is needed to determine if gesture directly impacts language beyond this sample, if gesture improves parent linguistic input, if gesture is indicative of risk of language delay, or if gesture is simply a way to measure other factors that influence language more directly and to a greater degree.
References


