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## Sign Language and Language Development: A Meta-analysis

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SIGN LANGUAGE AND LANGUAGE DEVELOPMENT: A META-  
ANALYSIS

by

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A thesis submitted in partial fulfillment of the requirements  
for the Honors in the Major Program in Psychology  
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## ABSTRACT

This study takes a look at baby signing and its effect on caregiver responsiveness, considering how vital caregiver responsiveness is when it comes to language development. A meta-analytic review that quantitatively combines data was conducted to estimate the effect size between baby signs and caregiver responsiveness. There were no restrictions on geography or culture in which studies were conducted. However, the time period of publication was limited from 2009 to 2020 in an attempt to examine the most recent research possible. The following search terms were used: baby signing, gestures, caregiver responsiveness, caregiver interactions, and caregiver. For a study to be included it must have met a specific criteria. Based on the criteria, a total of three articles related to baby signs and caregiver responsiveness were located. Each study was coded for outcomes related to caregiver responsiveness and the influence of signs and gestures. Age of participants was classified as months of age based on either the age range of participants provided or the mean age of participants. Each study was also coded for the research design that best described the study, the location of data collection, and publication year. The present meta-analysis found a significant positive relationship between baby signs and caregiver responsiveness. The  $r$  value for the relationship between the use of baby signs and caregiver responsiveness was .72. The estimates of the study were not substantially different from the overall effect size which indicates that no single study made a disproportionate contribution to the overall effects. The current study provides preliminary evidence that the use of baby signing influences caregiver responsiveness, which in turn, promotes language development.

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## CHAPTER ONE: INTRODUCTION

Before their first birthday, babies start to exhibit both the ability and the strong desire to communicate with those around, but most aren't able to do so until a few months later (Capirci et al., 1998). This is where baby signing comes into play. 'Baby signing' refers to the use of hand gestures that allow infants and toddlers to communicate their desires, emotions, and objects prior to vocal development (Seal, 2010). Existing research suggests that sign language can advance vocal development, reduce frustration between parent and child, and enables them to communicate vital information (Acredolo & Goodwyn, 1985; Acredolo et al., 2000; Doherty-Sneddon, 2008; Capirci et al., 1998).

### Previous Studies

The first comprehensive baby sign language research was conducted by Acredolo and Goodwyn (1985). They noticed that there was evidence for a positive correlation between the use of infant sign language and both vocal and cognitive development. It is impossible though to determine the reasons behind this: it is possible that it enhanced vocal development by promoting communication, but it is also possible that both signing and vocal behaviors in the subject were symptomatic. The data presented does, however, argue against the theory that vocal development is delayed by the gestural system.

Later on, they conducted a bigger study with the main goal of determining whether the experience of baby signing during the early stages of vocal development would affect it in a positive way, but this time, with a bigger group (103 11-month-old infants to be exact) (Acredolo et al., 2000). This brought more attention to the topic because of how many infants they used in the study compared to their earlier study (Acredolo & Goodwyn, 1985) where there was only one

infant. Acredolo and Goodwyn pushed baby signing into the mainstream, which prompted more research to be done.

Iverson and Goldin-Meadow (2005) pointed out that gesturing may provide a way for new meanings to enter a child's communicative repertoires, which can lay the foundation for eventual appearance in speech. In the study conducted by Bonvillian and colleagues (1983), they noted that rather than slowing down the rate of language development in their subjects, they continued to show an increased rate of learning which backs up what Acredolo and Goodwyn (1985) noticed in their study. As a bonus for parents, sign training could be accomplished within activities, such as mealtime and play, which can be accomplished with minimal additional effort on part of caregivers (Thompson et al., 2004).

In another study conducted by Rowe and Goldin-Meadow (2009), it was hypothesized that early gesture use was linked to later word learning. After testing on fifty-two children, it seems that they were correct, and it could even be an early index of global communicative skill. In Johnston and colleagues (2005) study, they mentioned that "sign language uses a manual mode of communication rather than an oral one; however, the same language foundation encompasses the two modalities." This means that the language fundamental acquired through the manual modality could possibly be transferred to the oral modality.

### Baby Signing Debate

Throughout the years though, there has been some controversy over 'baby signing' that has many people question whether it is a good or bad thing. The research that has been done sways one of two ways: babies learn signs more easily than they learn words and it can help in the advancement of vocal development or that there is no actual proof on this and that there are

holes in the studies on this topic (Doherty-Sneddon, 2008). There is also the concern associated with the early use of sign language potentially delaying the onset of vocal language. In Capirci and colleagues (1998) study both of the subject's parents were deaf and used sign language around him. At first, Marco (the subject) used gestures to communicate more frequently than either words or signs. Afterwards, words began to outnumber gestures and at the end, his overall manual vocal vocabulary and his total vocabulary size fell well within the range displayed by monolingual children. In other words, he may not have been more advanced than the others, but he was certainly not falling behind.

#### Other Uses

Baby signing has been used for many years by individuals who have difficulty learning to communicate. Additionally, individuals with developmental disabilities, such as autism, have learned to communicate through signs. Signing could be a great alternative to vocal communication for individuals who have poor oral motor control, but adequate manual control (Thompson et al., 2007; Acredolo & Goodwyn, 1985).

#### Caregiver Responsiveness

Research over the years have shown that caregiver responsiveness has an influence on the language development of a child. The study conducted by Vallotton (2012) shows that children's uses of both typical gestures and infant signs elicit greater caregiver responsiveness. Infants who use clear communication cues may help parents attune more closely to their cues which in turn, helps parents interpret these cues in a way that makes them more likely to respond with warmth. These positive responses provide the infant with a secure base for exploring their world and facilitate language growth.

There was another study conducted by Hirsh-Pasek and Burchinal (2006) that found that children benefit from sensitive interactions with adults and these experiences across time are associated with language outcomes. Children scored higher on language tests when they experienced more sensitive caregiving. Children scored even higher when caregivers became increasingly more responsive and stimulating from 6 and 54 months. Language was enhanced when mothers or caregivers became more responsive, regardless of the initial level of responsiveness.

The National Institute of Child Health and Human Development Early Child Care Research Network (2000) examined children's language development and comprehension in regard to the amount of childcare. Results showed that sensitive and responsive caregiving is important throughout the first two years of life in language stimulation. The more that the child's environment is characterized by caregiver-child interactions that are both supportive and positive, the better the child will perform. The less supportive and negative the care experience, the more poorly the child will perform.

### The Current Study

Due to the debate regarding baby signs and language development it seems apparent that a meta-analytic review that quantitatively combines data from more recent research in this area is needed. The majority of previous research shows that there could be a relationship between baby signs and language development caused by caregiver responsiveness (Kirk et al., 2013; Vallotton, 2009; Vallotton, 2012). Consequently, much of the research examining the role of baby signs on language development is older (Bonvillian et al., 1983; Acredolo & Goodwyn, 1985; Acredolo et al., 2000; Capirci et al., 1998). To date, there have been no meta-analytic

reviews on this topic. A meta-analytic review that quantitatively combines data on more recent research in this area to estimate the effect size between baby signs and caregiver responsiveness is needed and over-due. The current study examined baby signs and caregiver responsiveness, considering how vital caregiver responsiveness is when it comes to language development (Hirsh-Pasek & Burchinal, 2006; Kirk et al., 2013; Vallotton, 2009; Vallotton, 2012). Because this study was a meta-analysis, approval from the University of Central Florida Institutional Review Board was not required as no new data was collected.

## CHAPTER TWO: METHOD

### Literature Search Procedures and Selection of Studies

A systematic, computer-based search was conducted through MedLine and PsycINFO between November 2020 and January 2021 to search for relevant articles. There were no restrictions on geography or culture in which studies were conducted. However, the time period of publication will be limited from 2009 to 2020 in an attempt to examine the most recent research possible. The following search terms were used: baby signing, gestures, caregiver responsiveness, caregiver interactions, and caregiver. For a study to be included it must have met the following criteria:

1. Each study must measure the influence of baby signs on caregiver responsiveness.
2. Each study must present statistical outcomes or data that could be used to determine the effect size  $r$ .
3. Participants in the study must be classified as infants or young children (6 months to 4 years). Longitudinal studies that began during infancy and extended into childhood could be included.
4. Each study must be written or translated in English to be included in this study.

### Coding of Studies

Based on the criteria listed above, a total of three articles related to baby signs and caregiver responsiveness were located. According to Valentine and colleagues (2010), a minimum of two research articles are needed for a meta-analysis. Therefore, the three research articles that were located should suffice for the current meta-analysis. Each study was coded for outcomes related to caregiver responsiveness and the influence of signs and gestures. The sex of

each study sample was coded based on the percentage of male participants in the study. Age of participants was classified as months of age based on either the age range of participants provided or the mean age of participants. Only studies examining baby signs were included. Each study was also coded for the research design that best describes the study (e.g., longitudinal, cross-sectional, experimental), the location of data collection, and publication year.

### Estimating Effect Size

In the current study, controlled effect sizes (i.e., standardized regression weights) were examined. The effect size  $r$  was used in this analysis because  $r$  is a straightforward effect size and easy to interpret. Additionally, considering that confounding variables may exist, Savage and Yancey (2008) argued that controlled effect sizes are the preferred inclusion for meta-analyses. While many studies reported regression weights or correlational results, the results of other studies had to be converted to  $r$  prior to analysis (e.g., odds ratio,  $f$ ,  $t$ ,  $M$  and  $SD$ ). The coding of research articles can be found in Table 1.

### Analyses Plan

The Comprehensive Meta-Analysis (CMA) software program was used to conduct the meta-analysis. The current study used a random-effects model weighted by variance, more specifically the DerSimonian and Laird method (see Borenstein et al., 2009, Chapter 12) to estimate effect sizes, rather than a fixed-effects model, due to estimation limitations of fixed-effects models (Cafri et al., 2010; Hunter & Schmidt, 2004). Additionally, positive effects represent associations between the use of baby signs and caregiver responsiveness.

## CHAPTER THREE: RESULTS

### Overall Effect

Results for caregiver responsiveness can be found in Table 2. The overall effect size estimate ( $r$ ) of the use of baby signs on caregiver responsiveness was .72 ( $N = 57$ ,  $Z = 7.31$ ,  $p < .001$ , 95% CI [.58, .82]). Additionally, the studies included in this meta-analysis showed a positive relationship between the use of baby signs and caregiver responsiveness.

### Single Study Sensitivity and Publication Bias

The disproportionate influence of single studies on the overall effects for caregiver responsiveness was examined by reconducting the meta-analysis with a different study removed each time. The  $r$  in these estimates ranged from .58 to .82. The fact that these estimates were not substantially different from the overall effect size indicates that no single study made a disproportionate contribution to the overall effects.

The possibility of publication bias was also examined for caregiver responsiveness using a funnel plot that included study precision (1/standard error) on the  $y$  axis and Fisher's  $Z$  on the  $x$  axis. In this plot, larger, more precise studies typically cluster closer around the mean effect than smaller, less precise studies, which tend to spread out toward the bottom of the plot (Borenstein et al., 2009). Publication bias is likely if less precise studies with smaller than average effects are missing from the bottom left of the plot. In the present case, no indication of publication bias was found for caregiver responsiveness.

### Moderation Effects for Caregiver Responsiveness

A  $Q$  test of homogeneity of variance indicated significant heterogeneity among correlations for caregiver responsiveness,  $Q_w(2) = 0.192$ ,  $p = .909$ . Consistent with this, the  $I^2$

(Higgins & Thompson, 2002) indicated that a low percentage (0.00%) of the variation in effect sizes for caregiver responsiveness between studies was due to systematic variation. Because of this, moderator variables were not examined.

## CHAPTER FOUR: DISCUSSION

The present meta-analysis found a significant positive relationship between baby signs and caregiver responsiveness. The  $r$  value for the relationship between the use of baby signs and caregiver responsiveness was .72. The current meta-analysis included a total of three recent studies, bringing the total sample size to 57, increasing the power of the test (Levine, 2013). This indicates that the effect size found in this meta-analysis is probably an accurate indicator of the effects of the use of baby signs on caregiver responsiveness.

One way to interpret the size of the effects is to consider them in relation to Cohen's (1988) effect size benchmarks, which proposed that  $r$  values around .10, .30., and .50 marks should be considered small, medium, and large. This means that the overall effects in the present study can be classified as large ( $> .50$ ).

Findings from the current meta-analysis suggest two conclusions: (1) baby signing does have an influence on caregiver responsiveness and (2) there is a positive relationship between the use of baby signs and caregiver responsiveness. When an infant uses baby signs and gestures to respond to their caregiver, the caregiver is more responsive overall to the infant.

### Moderation Effects

The results of the Q test of homogeneity of variance were non-significant in the current study. These results may indicate that there is true heterogeneity among the three studies included in the meta-analysis (Heudo-Medina et al., 2006). However, this interpretation may also be incorrect as this meta-analysis included a small number of studies (i.e., three), even though other research suggests that only two studies are needed to conduct a meta-analysis (Valentine et al., 2010). One weakness of the Q test of homogeneity of variance is that it has reduced power to

actually detect heterogeneity among studies included in a meta-analysis when a small number of studies are included, which may be the case for this study (Heudo-Medina et al., 2006).

The  $I^2$  was also examined to assess heterogeneity of the studies included in the meta-analysis (Higgins & Thompson, 2002). Higgins and Thompson (2002) have suggested that  $I^2$  values of 25%, 50%, and 75% should be interpreted as low, medium, and high levels of heterogeneity among the studies included in the meta-analysis. An advantage of the  $I^2$  is that the number of studies included in the meta-analysis should not have an impact on the results. Considering the results of the  $I^2$  in the current study, it can be assumed that the three studies included in this meta-analysis were conducted under similar conditions and that the only difference between these studies was the power in their study (Higgins & Thompson, 2002).

#### The Case for Looking at Caregiver Responsiveness

Caregiving responsiveness of young children involves attending, perceiving and responding appropriately to children's cues. Preverbal children have the challenge of communicating their needs with limited ability. Although caregiver responsiveness varies, previous research has shown that parents' abilities to read children's cues can affect language development (Hirsh-Pasek & Burchinal, 2006; National Institute of Child Health and Human Development Early Child Care Research Network, 2000; Vallotton, 2012).

Caregiver responsiveness is vital to language development, especially in the first two years of life. Baby signing and gesturing, including pointing, showing, nodding, and waving- could enhance this by improving caregiver, child communication during the preverbal and emerging language years. These gestures arise as children watch from adults' actions within everyday routines and turn them into gestures that symbolize an action or object. Infants who use

these cues help caregivers to direct their attention and respond appropriately with positive reinforcement. This, in turn, allows caregivers to view the child more positively, also reducing parenting-related stress. These positive reinforcements from both the caregiver and the child allows for this to continue throughout the infant's language development, including earlier onset of language milestones and better performance in expressive language (Vallotton, 2012).

Over the years, baby signing has become a popular parenting practice with preverbal children. Before children begin to talk, these gestures and baby signs serve the place of words then fade away as words develop.

#### Limitations and Future Directions

Even though this research shows a great significance between baby signing and caregiver responsiveness, it must be treated with caution given that it is specific to only three studies. It was noted that effect can vary by the sex and age of the baby, but not so much by location. There were more males compared to females which could create a bias. As for age, typically the older infants practiced gesturing more which created a higher chance of caregiving responsiveness. In addition to the outcome measured in this study, different kinds of caregiver responsiveness, family dynamic, and economic status can have an influence on baby gestures. It could be that parents with higher income-to-needs ratios with better education can have a higher influence on children developing their language skills (National Institute of Child Health and Human Development Early Child Care Research Network, 2000). These types of topics should be looked at during future research.

Since children are spending more time in childcare and early child education programs, non-parental caregivers could also be a part of the child's language development. Vallotton

(2009) noted that infants affect the care they receive from non-parental caregivers, which means that increasing the use of gestures and signs may be a way to enhance responsiveness. Research, including the one just mentioned, shows that responsive caregiving from both home and childcare can relate to language outcome as the child grows and should be examined further.

### Conclusion

In conclusion, the current study provides preliminary evidence that the use of baby signing influences caregiver responsiveness, which in turn, promotes language development. There was an increase in caregiver responsiveness in moments when babies were using signs. With more research, it may be an effective way to promote responsive parent-child relationships within families and schools to aid children's language development.

## **APPENDIX A: TABLES**

Table 1. *Studies Included in Meta-Analysis*

Article	N	r	SE	% male	Age (months)	Research Design	Location	Outcome
Kirk et al. (2013)	18	0.98	0.13	50	10-20	Longitudinal	Europe	Caregiver responsiveness (nonverbal responsiveness)
Vallotton, C. (2009)	10	0.89	0.95	30	4-19	Longitudinal	United States	Caregiver Responsiveness (attachment related caregiver sensitivity)
Vallotton, C. (2012)	29	0.72	0.06	59	10-31	Longitudinal	United States	Caregiver Responsiveness (responsiveness to social cues)

Table 2. *Meta-Analysis Results for Caregiver Responsiveness*

	<i>k</i>	<i>r</i>	CI <sub>LL</sub>	CI <sub>UL</sub>	<i>z</i>	<i>p</i>
Overall Effect	3	.72	.58	.82	7.31	<.001

Note. *k* =number of studies; *r* = mean correlation coefficient; CI<sub>LL</sub> and CI<sub>UL</sub> = lower limit and upper limit of the 95% confidence interval.

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