

Signing with Babies and Children:

A Summary of Research Findings
for Parents and Professionals



by Claire Vallotton, Ph.D.

Commissioned by Two Little Hands Productions

Preface

Until now, if you wanted to get an objective summary of the academic research on signing with babies and children that has been conducted over the past three decades, you would have had to pull together findings from a wide array of disparate and sometimes obscure sources. Now, thanks to Dr. Claire Vallotton, a trusted authority and leading researcher on this topic, you now have access to a comprehensive and concise summary of what research can tell us about the impact of signing on development and learning from early childhood through elementary school.

This white paper is for you - the many parents, teachers, health professionals, social workers, students, and writers who have asked us for unbiased information that can be used to inform practices and shape professional opinions. We are pleased to be sharing this paper with you and we encourage you to pass it along to anyone you think may benefit from it.

As new research that helps deepen our understanding of this subject becomes available, we will update this document. Please check our website periodically for more recent editions.

Happy signing,



Rachel Coleman



Emilie de Azevedo Brown

Co-founders, Two Little Hands Productions

Introduction

This paper gives an overview of research findings on the impacts of signing on development and learning for children of all ages and abilities – and provides research supported answers to common questions parents and teachers have about signing with children.

There are many benefits of using signs with students – from as young as preverbal infants [1, 2], to those in early elementary [3, 4-6], all the way to adult students who struggle with reading or those who are learning a new language [7]. Research has also shown benefits for children with special needs including dyslexia [8, 9], language impairments [10], Down syndrome [11, 12], and Autism Spectrum Disorders [13-16], as well as for both hearing and deaf children in an inclusive education environment [17]. Thus signs can be used to enhance education for learners of a wide range of ages and abilities.

The benefits of signing are not just for the students, but for teachers, too. When children can communicate more clearly, teachers can respond to them more easily [18, 19], and teachers' feel more competent in their own work [20].

In the last three decades, we've witnessed an amazing partnership between families, teachers, and researchers. This partnership created the impetus for the early research and the momentum for studies that followed. As we move into the future, our work will continue, fed by breakthroughs in neuroscience and technology which will lead to even more exciting discoveries about how signing influences human interactions and learning.



Claire Vallotton, Ph.D.

Signing with Infants and Toddlers

Research

Summary of research findings on the impact of signing with infants and toddlers

A. Impact of Signing on Language Development

We know from many studies that children who are hearing and typically-developing naturally use their hands to communicate before they can talk [21-25]. Still, when the idea of signing with infants and toddlers first began to take hold, parents wondered if signing would prevent or delay speech. In response, researchers Linda Acredolo and Susan Goodwyn [26] conducted an experimental study to test whether using signs with hearing infants before they could talk would delay their language milestones. They taught 32 families to use signs with their children from the age of 11 months, and compared their development to 32 children whose parents were taught to label everything in the child's environment with spoken words, and another group of 37 children whose families were not told to do anything in particular. What they found was that, on average, the children in the group of families using signs had better language skills than the other groups. For example, children in the signing group had bigger vocabularies and used longer sentences when they were two years old [27]. In the studies that have been done on using signs with infants and young children, none have shown that using signs causes a delay in language development.

Another study by Susan Goodwyn, Linda Acredolo, and Catherine Brown showed that children whose parents taught them to use signs before they could talk – starting at 11 months old – had better language skills than a group of comparison children whose parents did not teach them to use signs [27]. These language skills included children understanding more words from the time they were 15 months, and using more words and longer sentences from the time they were 2 years old until the end of the study when they were 3 years old.

There is some indication that signs help children and adults understand and remember the concepts represented by words. In a case study by Claire Vallotton, each time the child learned the sign for a certain concept, the word followed shortly after it, from the time the child was 8 months until 18 months [28]. Meredith Rowe and Susan Goldin-Meadow studied 52 typically developing children from toddlerhood to preschool age; they found that the number of different concepts children represented through gestures at 18 months predicted their vocabulary at 42 months [29]. Finally, there are several studies that have shown that the same areas of the brain – the areas for understanding meaning in symbols – are activated by symbolic gestures and signs as well as by words [7]. And a study by Spencer Kelly and colleagues has shown that these meaningful hand movements which activate this area of the brain make learning a new word easier [7, 30].

Signing with Infants and Toddlers

B. Impact of Signing on Cognitive Development

Linda Acredolo and Susan Goodwyn followed a group of children whose parents had taught them to use signs before they could talk, starting at 11 months old, and a comparison group of children whose parents did not teach them to use signs. They initially followed the children until they were 3 years old and found that the signing children had better language skills. Then they contacted the same two groups of children when they were in 2nd grade and gave them an IQ test. The verbal IQ's of the signing children were 12 points higher on average than their non-signing peers [31]. This is a remarkable difference and shows a long-term effect of using signs with preverbal children.

C. Impact of Signing on Social-Emotional Development

In addition to benefits for children's language, parents who use signs with their hearing children before they can talk report lots of different benefits for themselves and their children. For example, parents report that their signing children have fewer tantrums and better social skills, and that both the children and parents are less frustrated [32]. Researchers have tested some of these claims by comparing families who use signs to families who don't use signs. Parents who use signs with their children have less parenting-related stress, their interactions are more affectionate, and parents have an easier time responding to their children when children are upset [33, 34]. Also, studies by Claire Vallotton have shown that children who use signs before they talk can use signs to talk about their feelings [1] and to control their own behavior in order to comply with adults' requests [35].

In early child education settings, using signs with preverbal children is beneficial for both the children and the teachers. A study by Claire Vallotton showed that early child educators are more responsive to preverbal children when the children are using signs; when children used signs, teachers were better at making eye contact with them, talking to them, being warm and affectionate, and responding to their needs [18]. Another study by Vallotton showed that teachers feel they know the children better, and they pay closer attention to the children when children are using signs [20]. Signs allow preverbal children to initiate conversations with their caregivers about their own needs and feelings [1], hold extended conversations with their caregivers as part of everyday interactions [2], and can help them cope with stressful routines, such as saying goodbye to mom or dad, or getting their diaper changed [35]. Early child educators report that using signs with infants and toddlers forces them to pay closer attention to the children; and some classrooms are using signs as a tool for professional development with new teachers [20]. A study by Irma Heller and her colleagues showed that in inclusive classrooms, where children who are deaf or hard of hearing are integrated into a classroom with hearing children, the teachers' use of sign language during instruction seems to benefit both children who are deaf and those who are hearing [17].

Signing with Infants and Toddlers

There have been some experimental studies showing effects of a signing intervention on infants' and toddlers' social-emotional skills with their parents. A study by Brie Moore, using Acredolo and Goodwyn's experimental signing and control groups, showed that infants and toddlers in the sign intervention group joined their parents in more joint attention, meaning that both parent and child are paying attention to the same thing and are aware that they are sharing this attention. This makes children active interaction partners from a young age [36].

A small experimental study by Claire Vallotton showed that children who were taught to use signs were more engaged in interactions with their mothers, initiating more contact with their mothers than children who had not been taught to use signs [34]. A non-experimental study of four children who were all taught to use signs showed that children used these signs instead of crying and whining when they needed something from their parents [37].

The results showing that signs promote positive social interactions and relationships with parents [20, 33, 34, 36], and that signs can be used by young children to help them regulate their behavior [20, 35] and communicate their needs [1], indicate the strong possibility that using signs with pre-verbal children will promote social skills, but this needs to be tested experimentally. To date, there are no studies that compare the social skills of signing children to those of their non-signing peers.

Practice

Research-based answers to common questions about signing with infants and toddlers

A. When should I start teaching signs?

There is no research that has directly tested the best time to start teaching signs. Children who are introduced to signs when they are a little older are likely to start learning them more quickly because they are developmentally more ready to use them for intentional communication; however, children who are introduced to signs earlier do learn and use them at a younger age [38].

B. When will children start to sign back?

Children reach communication milestones (including those involving the eyes, hands, and mouth), at different ages [39]. Most children don't start to use conventional gestures – such as clapping, pointing, showing, and waving – to communicate until they are between 8 and 11 months old, and even a few months older for some children [23]. Children seem to go through a progression of their use of signs for intentional communication; first they use gestures and signs as part of the routine in which they learn the sign, then they use it spontaneously to initiate communication or express a need, and finally they use them in response to others' words or signs [2, 23, 40].

Signing with Infants and Toddlers

C. Should I use videos to teach signing?

Though some studies have shown that children can learn from watching educational media, young children learn most through responsive interactions with their family members [41, 42]. It makes sense then, that very young children – those younger than two – don't pay attention to most of the television programming they see [43, 44]. However, just because young children aren't paying full attention to the TV doesn't mean that the amount of TV they are exposed to does not impact their development. An extensive study of young children's exposure to television and other media, such as videos, showed that children who see the most television are those whose parents use the TV as a baby sitter, as well as those parents who see TV as an educational opportunity for their children. Children who are exposed to the most TV are also those who spend much less time reading or being read to, and older children who were exposed to the most TV had lower reading abilities [45]. Thus, it seems that the negative impact of extensive television exposure is likely due to a lack of interaction with parents, making it important for parents and children to view educational media together, to make it an interactive and responsive activity.

Although preschool children may experience developmental benefits from watching age-appropriate educational media [46], thus far, there have been no studies showing that viewing age-appropriate media either helps or hurts infants' and toddlers' development [45, 47]. Even so, many manufacturers of educational media for children claim that there are developmental or educational benefits [48], and many families say that they provide age-appropriate videos for their young children because they believe in the educational benefits [49]. Since the harm of viewing other types of television for young children is because it limits time interacting with family members, including less time reading books [45], it is likely that watching an age-appropriate video with family is not harmful for infants or toddlers, particularly if media-viewing is interactive, or is balanced by time spent interacting and reading together.

D. Should signing be a part of reading?

Studies of the qualities of parent-child book-reading show that children gain the most from these interactions when parents actively engage them in interacting with the book. Researchers call this dialogic reading, and it involves parents asking the children open-ended questions, asking questions about the functions or attributes of the things in the book, and responding to children's attempts to communicate about the book. A study by Laura Namy, Linda Acredolo, and Susan Goodwyn showed that the gestures that parents use during book-reading with their infants predicts the gestures the children will use [50]. When the quality of parent-child book-reading is enhanced, children's language skills are greater [51], and is especially helpful for children with limited vocabularies [52]. Parents who use signs with their preverbal children report that their children take a great interest in books [32], and use signs to actively participate in book-reading with their parents [28].

Signing with Infants and Toddlers

E. What signs should I teach?

There has been concern among some parents and teachers that infants and young children may find signs from a formal sign language, such as ASL, too difficult to learn. The only study that has contrasted the use of “made-up” infant signs with signs from a formal sign language (British Sign Language) showed that children could learn either of the forms of signs for the same concept equally well [53].

F. Should I teach fingerspelling?

Research by Laura Ann Pettito has shown that when babies are exposed to adults’ use of sign language and Fingerspelling on a regular basis, they start to “babble” with their fingers, just like they do with their mouths [54]. This is because young children are open to both oral and manual modes of communication when they are first learning language. While there has been no research yet that examines the effect of using Fingerspelling in particular with hearing children before they can talk, we do know that the earlier infants are exposed to signs, the earlier they will begin to use them [38]. We also know from the research on preschool and school-aged children, that teaching fingerspelling is helpful for verbal children’s language and literacy skills [8, 9, 55].

G. Should I keep signing once a child starts talking?

Some small studies by Claire Vallotton and colleagues have shown that when hearing children start to learn words, their learning of new signs slows down, and they use signs less frequently during their interactions with adults [28, 56]. However, these newly verbal toddlers will continue to use signs when they need to, including a) when the child’s home language is different than the language being spoken by her teachers, b) when they are upset and can’t find their words, and c) when the word they want to communicate is too hard to pronounce [57]. The research showing that using signs with preschoolers and kindergartners aids their language and literacy development [3, 8, 58-60] indicates that it is helpful, not harmful, to continue using signs with children who are talking.

Signing with Preschool and School-Age Children

Research

Summary of research findings on the impact of signing with children ages three and above

Though there are many benefits for introducing signs to children when they are preverbal, there are still reasons to introduce signs to children who have already started to talk. Studies show that using sign language with hearing children can lead to improved literacy and language skills, and that using signs can help older children who struggle with reading.

A. Impact of Signing on Language and Literacy

Research showing that using signs with preschoolers and kindergartners aids their language and literacy development [3, 8, 58-60] and indicates that it is helpful, not harmful, to continue using signs with children who are signing. Several studies have also shown that signing can help kindergartners, and even older children, gain bigger vocabularies [58, 59], and improve their spelling and reading skills [3, 8, 9, 60].

A study by Marilyn Daniels showed that preschoolers whose teachers use both signs and speech in the classroom have bigger spoken vocabularies toward the end of the school year [58], and these gains in vocabulary were sustained into kindergarten [59].

We also know from the research on preschool and school-aged children, that teaching fingerspelling is helpful for verbal children's language and literacy skills [8, 9, 55] and can help those who are struggling with spelling and reading [3, 8, 9].

Marilyn Daniels studied the use of sign language to enhance hearing kindergartners' literacy skills by comparing the first grade reading placement scores of a classroom of kindergartners whose teacher used signs, and a classroom of kindergartners in the same skills whose teacher did not use signs. The children in the signing classroom had higher scores in letter identification, word recognition, and concepts about print [60]. Another study by Laura Felzer showed that signing helped a group of kindergartners who were English language learners read at or above grade level by the time they were in first grade [3].

Further, there have been several studies comparing the literacy skills of children who have been exposed to signs to children with no exposure to sign. However, these studies have not been rigorous scientific experiments, but rather, quasi-experiments. For example, studies have compared children's scores at the beginning of a school year to their own scores at the end of a school year [3], or compared the scores of a classroom of children whose teacher used signs to the scores of children in another classroom [60]. These quasi-experimental results are promising, but this is definitely a topic that needs to be addressed further through rigorous experimental research.

Signing with Preschool and School-Age Children

B. Impact of Signing on Learning Across Subject Areas

Research shows that teachers who use two modes of communication – with both their mouths and their hands – in the classroom can help their students learn and retain information better. Studies by Susan Cook and her colleagues have shown that when teachers use gestures and signs while explaining a lesson, such as simple or advanced math, children are likely to use the same signs, which helps them learn and retain the new information [4, 5]. Another study by Cook and colleagues showed that when teachers instruct children to use gestures, the gestures bring out knowledge the children didn't know they had, and help them learn more from instruction [6]. Now some teachers are even adapting other curricula in other subject areas, such as physical education, to include sign language [61].

Practice

Research-based answers to common questions about signing with children ages three and above

A. Should I teach fingerspelling?

Several studies have shown that using signs, particularly fingerspelling, with older children and adults who struggle with reading, including those with dyslexia, is an effective way to help these students gain skills involved in reading. These skills include isolating speech sounds (phonemic segmentation) [9], sounding out words [55], and spelling [8]. The teachers who use signs and fingerspelling as a technique for teaching reading believe that signs serve as a way for the students to trigger their own memories for the right way to spell or sound out a word, and that manual signs serve as a bridge between the visual word and the oral word.

B. Should I teach ASL grammar and syntax as well as ASL vocabulary?

Research shows that children can acquire a substantial sign vocabulary and use it to communicate without having seen the signs used with the syntax and grammar of a formal language [1, 22, 26, 28, 40].

Signing with Specific Populations

The research on using signs with children with developmental delays and disabilities shows mixed results, though overall it appears that signs can be useful to children with disabilities as well as adults in a variety of ways. There is some research showing that children with disabilities in cognition and language can share the same benefits from using signs as those that typically developing children experience, and other studies showing less benefit, or different kinds of benefits.

A. Children with Specific Language Impairments (SLI)

Many families or interventionists working with children with SLI have been hesitant to incorporate the use of signs into their treatment for fear that learning signs would keep the children from learning oral language. There is no evidence yet that signs actually impair oral language development for children with SLI, or for anyone else. There is one small study by Robertson with 2 young children with SLI; this study compared the children's ability to learn words that were taught to them through oral modeling only to those words taught through both speech and sign. The children learned twice as many of the words that were presented in speech and sign as the words presented through speech only, and incorporated those new words into their everyday vocabularies [10]. More extensive research is needed on this topic to affirm and extend these initial findings.

B. Children with Down Syndrome

Research has shown that children with Autism and those with Down syndrome can detect the meaning in gestures as well as typically developing 5 to 6 year olds, however, they can't necessarily replicate the gesture when asked to [62]. Other studies have shown that moderately mentally disabled individuals can understand the associations between signs and their meaning as well as non-handicapped individuals [63]. However, children and adults who have more severe intellectual disabilities may not benefit from the iconic aspect of signs, that is, the fact that the sign carries some of the meaning in its form and is usually more concretely related to a concept than an oral word is [64]. Thus, children with moderate disabilities may benefit from the use of signs in the same way that typically developing children do, but those with severe disabilities may not share the same benefits. However, for those with more severe disabilities, including lack of oral motor skills necessary to speak, the use of signs may provide a functional means to communicate.

One small study by Mary Ann Ronski and Kenneth Ruder tested whether the use of signs along with speech would help children with Down syndrome learn new oral vocabulary in children who had some verbal abilities. They did not find a difference in the effect of the speech-only training and the speech + sign training [11]. However, a study by Gaye Powell and John Clibbens showed that using signs helps adults with Down syndrome communicate more clearly to others; that is, other adults understand the language of those with Down syndrome better if those with Down syndrome were also using signs [12]. Thus, signs may provide a different kind of benefit for children and adults who struggle to communicate orally than it does to typically developing children.

C. Children on the Autism Spectrum (ASD)

Signing with Specific Populations

An extensive review of research by Debora Nunes revealed that teachers have been using sign language as an instruction tool with children who have ASD for over 30 years [13]. Though there are a few studies that showed no effect of using signs, the majority of studies reported that using signs and speech together helped children with ASD learn both receptive and expressive vocabulary [14-16]. More research is being conducted on the use of signs with children who have Autism Spectrum Disorders, including the best way to teach signs to children with ASD.

D. Children with Dyslexia

Several studies have shown that using signs, particularly fingerspelling, with older children and adults who struggle with reading, including those with dyslexia, is an effective way to help these students gain skills involved in reading. These skills include isolating speech sounds (phonemic segmentation) [9], sounding out words [55], and spelling [8]. The teachers who use signs and fingerspelling as a technique for teaching reading believe that signs serve as a way for the students to trigger their own memories for the right way to spell or sound out a word, and that manual signs serve as a bridge between the visual word and the oral word.

E. Children Learning a Second Language

A study by Laura Felzer showed that signing helped a group of kindergartners who were English language learners, read at or above grade level by the time they were in first grade [3].

F. Adults Learning a Second Language

A study by Spencer Kelly and his colleagues showed that adults learn the vocabulary of a second language more easily when the oral instruction is accompanied by a sign that bears some meaning to the new word [7]. This study also showed that a certain region of the brain, responsible for remembering the meaning of words, was activated more when these students heard words for which they had learned a sign. The relationship between signed and oral language is founded in the brain. In a review on this issue, Kelly and his colleagues state, "Brain regions that process speech also process actions made with the hand" [65](p. 4), specifically meaningful hand movements.

A study by Kathee Christensen has shown that American Sign Language can serve as a bridge between children learning English and their parents or teachers who speak another language because the concepts represented by signs are the same concepts that are represented by the oral words they are learning in multiple languages [66]. It is possible that signs may also serve as a bridge between two languages being learned by a child who is growing up bilingual, but this has not been systematically tested by research yet.

A study by Pierre Feyereisen showed that using signs helps students retain sentences that they just learned [67], and a study by Autumn Hostetter showed that forcing adults to sit on their hands actually suppresses their language for describing information they already know [68]. Further, Spencer Kelly and his colleagues found that adults learn vocabulary in a second language more easily when the oral instruction is accompanied by a sign [7].

Section Four: Opportunities for Further Research

Opportunities for Further Research

Though there is strong evidence for many benefits of using signs and sign-language with children of many ages, there are also many questions about the use of signs with children who are hearing that have not yet been answered by experimental research. First, though there is preliminary evidence that using signs with preverbal children helps parents to be more responsive to their infants and toddlers, there are many other aspects of parenting that may also be affected by using signs. For example, parents say they are less stressed when their children use signs, and that they feel they have a “window” into their babies’ minds. These reports by parents indicate that there may be effects of using signs on parents’ perceptions of their children, as well as their responsiveness.

As reviewed above, research has shown that signs allow preverbal children to express their emotions and talk about others’ feelings. Also, research has shown that children use signs in the process of regulating their own behavior. However, there has not yet been an experimental study to determine whether signs actually increase children’s social-emotional skills.

Finally, there have not yet been any experimental studies of the effects of using signs with young children who have language delays or disorders.

1. Vallotton, C., Signs of emotion: What can preverbal children “say” about internal states? *Infant Mental*

About



Claire Vallotton, Ph.D.

Dr. Claire Vallotton is an Assistant Professor at Michigan State University. She studies the development of young children's language/communication and social-emotional skills from infancy through early childhood. Many of her studies involve the use of signs with infants and toddlers in order to understand (1) how the use of signs affects children's relationships with parents and other caregivers, (2) how using signs affects children's own cognitive and social-emotional skills, and (3) how the specific gestures and signs used with young children vary across cultures and are a reflection of cultural values for parenting.

Dr. Vallotton earned a Bachelor's degree in Psychology from Simpson College, and a Ph.D. in Human Development from the University of California, Davis. She won a research training grant from the National Institutes of Health to study as a postdoctoral fellow at Harvard University. She received the Young Investigator Award from the World Association for Infant Mental Health in 2006 for her research showing that preverbal infants and toddlers can express emotions and feelings through infant signs. Dr. Vallotton teaches undergraduate and graduate classes on infant development, social-emotional development, child assessment, and quantitative methodology in the study of behavior and development.

Claire Vallotton can be contacted at: vallotto@msu.edu; you can learn more about her research at <http://vallottonresearch.hdfs.msu.edu> or <http://michiganstate.academia.edu/ClaireVallotton>.



two little hands
p r o d u c t i o n s

Two Little Hands Productions is a leading publisher of innovative educational products that enhance children's learning, communication and self-esteem. In 2002, two sisters, Rachel Coleman and Emilie Brown, started the company which now distributes their fun and interactive songs, videos, mobile applications, and books for children of all ages and abilities. Together, they developed the award-winning Signing Time, Baby Signing Time, and Potty Time programs. Rachel was nominated for an Emmy, and today their programs are a part of children's television programming on Nick, Jr. and public television stations across the U.S. Inspired by Rachel's youngest daughter, Lucy, who has spina bifida and cerebral palsy, Emilie and Rachel started the Signing Time Foundation, a non-profit dedicated to dissolving communication barriers for children everywhere. Today, Two Little Hands has expanded to offer new curriculums, teacher resources, and training opportunities to educators, caregivers, and parents around the world. For more information, visit www.twolittlehands.com.

References

- Health Journal, 2008. 29: p. 234-258.
2. Vallotton, C., Sentences and conversations before speech? Gestures of preverbal children reveal cognitive and social skills that do not wait for words, in *Integrating Gesture: The Interdisciplinary Nature of Gesture*, G. Stam & M. Ishino, Editors. 2011, John Benjamins: Amsterdam, The Netherlands. p. 105-120.
 3. Felzer, L., A multisensory reading program that really works. *Teaching and Change*, 1998. 5: p. 169-183.
 4. Cook, S.W. and S. Goldin-Meadow, The role of gesture in learning: Do children use their hands to change their minds? *Journal of Cognition and Development*, 2006. 7(2): p. 211-232.
 5. Cook, S.W., Z. Mitchell, and S. Goldin-Meadow, Gesturing makes learning last. *Cognition*, 2008. 106: p. 1047-1058.
 6. Broaders, S.C., et al., Making children gesture brings out implicit knowledge and leads to learning. *Journal of Experimental Psychology: General*, 2007. 136(4): p. 539-550.
 7. Kelly, S., T. McDevitt, and M. Esch, Brief training with co-speech gesture lends a hand to word learning in a foreign language. *Language and Cognitive Processes*, 2009. 24(2): p. 313-334.
 8. Vernon, M., et al., Using sign language to remediate severe reading problems. *Journal of Learning Disabilities*, 1980. 13: p. 215-218.
 9. Koehler, L. and L. Loyd, Using fingerspelling/manual signs to facilitate reading and spelling, in *Biennial Conference of the International Society for Augmentative and Alternative Communication*. 1986: Cardiff, Wales.
 10. Robertson, S. Using sign to facilitate expressive vocabulary in late talkers, in *American Speech-Language-Hearing Association*. 2004. Philadelphia, PA.
 11. Ronski, M.A. and K.F. Ruder, Effects of speech and speech and sign instruction on oral language learning and generalization of action + object combinations by Down syndrome children. *Journal of Speech and Hearing Disorders*, 1984. 49: p. 293-302.
 12. Powell, G. and J. Clibbens, Actions speak louder than words: Signing and speech intelligibility in adults with Down syndrome. *Down Syndrome Research and Practice* 1994. 2(3): p. 127-129.
 13. Nunes, D.R.P., AAC interventions for Autism: A research summary. *International Journal of Special Education*, 2008. 23(2): p. 17-26.
 14. Barrera, R., D. Lobato-Barrera, and B. Sulzer-Azaroff, A simultaneous treatment comparison of three expressive language training programs with a mute autistic child. *Journal of Autism and Developmental Disorders*, 1980. 10: p. 21-37.
 15. Barrera, R. and B. Sulzer-Azaroff, An alternating treatment comparison of oral and total communication training programs with echolalic autistic children. *Journal of Applied Behavior Analysis*, 1983. 16: p. 379-394.
 16. Yoder, P. and T. Layton, Speech following sign language training in autistic children with minimal verbal language. *Journal of Autism and Developmental Disorders*, 1988. 18: p. 217-229.
 17. Heller, I., et al., Let's all sign! Enhancing language development in an inclusive preschool. *Teaching Exceptional Children*, 1998. 30(3): p. 50-53. 18.

References

18. Vallotton, C., Do infants influence their quality of care? Infants' communicative gestures predict caregivers' responsiveness. *Infant Behavior and Development*, 2009. 32: p. 351-365.
19. Girolametto, L. and E. Weitzman, Responsiveness of child care providers in interactions with toddlers and preschoolers. *Language, Speech, and Hearing Services in Schools*, 2002. 33: p. 268-281.
20. Vallotton, C., Babies open our minds to their minds: How "listening" to infant signs complements and extends our knowledge of infants and their development. *Infant Mental Health Journal*, 2011. 32(1): p. 115-133.
21. Behne, T., M. Carpenter, and M. Tomasello, One-year-olds comprehend the communicative intentions behind gestures in a hiding game. *Developmental Science*, 2005. 8(6): p. 492-499.
22. Acredolo, L. and S. Goodwyn, Symbolic gesturing in normal infants. *Child Development*, 1988. 59: p. 450-466.
23. Crais, E., D.D. Douglas, and C.C. Campbell, The intersection of the development of gestures and intentionality. *Journal of Speech, Language, and Hearing Research*, 2004. 47: p. 678-694.
24. Liszkowski, U., et al., Twelve-month-olds point to share attention and interest. *Developmental Science*, 2004. 7: p. 297-307.
25. Liszkowski, U., et al., 12- and 18-month-olds point to provide information for others. *Journal of Cognition and Development*, 2006. 7: p. 173-187.
26. Goodwyn, S. and L. Acredolo, Symbolic gesture versus word: Is there a modality advantage for onset of symbol use? *Child Development*, 1993. 64(3): p. 688-701.
27. Goodwyn, S., L. Acredolo, and A.L. Brown, Impact of symbolic gesturing on early language development. *Journal of Verbal and Nonverbal Behavior*, 2000. 24(2): p. 81-103.
28. Vallotton, C.D., K.B. Decker, and M. Fusaro. A bridge to somewhere: Symbolic gestures as concrete representations that build towards abstract ones, in XVIIIth Biennial International Conference on Infant Studies. 2010. Baltimore, MD.
29. Rowe, M.L. and S. Goldin-Meadow, Early gesture selectively predicts later language learning. *Developmental Science*, 2009. 12(1): p. 182-187.
30. Xu, J., et al., Symbolic gestures and spoken language are processed by a common neural system. *Proceedings of the National Academy of Sciences*, 2009. 106(49): p. 20664-20669.
31. Acredolo, L. and S. Goodwyn, The long-term impact of symbolic gesturing during infancy on IQ at age 8, in International Society for Infant Studies. 2000: Brighton, U.K.
32. Acredolo, L. and S. Goodwyn, *Baby Signs: How to Talk with Your Baby Before Your Baby Can Talk*. 2002, Chicago: Contemporary Books.
33. Gongora, X. and C. Farkas, Infant sign language program effects on synchronic mother-infant interactions. *Infant Behavior & Development*, 2009. 32: p. 216-225.
34. Vallotton, C., Infant signs as Intervention? Promoting symbolic gestures for preverbal children in low-income families supports responsive parent-child relationships. *Early Childhood Research Quarterly*, in press.
35. Vallotton, C., Infants take self-regulation into their own hands. *Zero To Three*, 2008. 29: p. 29-34.

References

36. Moore, B., L. Acredolo, and S. Goodwyn. Symbolic gesturing and joint attention: Partners in facilitating verbal development, in Biennial Meeting of the Society for Research in Child Development. 2001. Minneapolis, MN.
37. Thompson, R.H., et al., Enhancing early communication through infant sign training. *Journal of Applied Behavior Analysis*, 2007. 40: p. 15-23.
38. Vallotton, C.D., Support or Competition? Dynamic development of the relationship between pointing and symbolic gestures from 6 to 18 months of age. *Gesture*, 2010. 10(2-3): p. 150-171.
39. Fenson, L., et al., Variability in early communicative development. *Monographs of the Society for Research in Child Development*, 1994. 59(5).
40. Acredolo, L. and S. Goodwyn, Symbolic gesturing in language development: A case study. *Human Development*, 1985. 28: p. 40-49.
41. Tomasello, M., Joint attention as social cognition, in *Joint attention: Its origins and role in development*, C. Moore and P.J. Dunham, Editors. 1995, Erlbaum: Hillsdale, NJ. p. 103-130.
42. Tomasello, M., S. Mannle, and A.C. Kruger, Linguistic environment of 1- to 2-year old twins. *Developmental Psychology*, 1986. 22: p. 169-176.
43. Anderson, D.R. and S.R. Levin, Young children's attention to Sesame Street. *Child Development*, 1976. 47: p. 806-811.
44. Schmitt, K.I. and D.R. Anderson, Television and reality: Toddlers' use of visual information from video to guide behavior. *Media Psychology*, 2002. 4: p. 51-76.
45. Vandewater, E.A., et al., When the television is always on: Heavy television exposure and young children's development. *The American Behavioral Scientist*, 2005. 48(5): p. 562-577.
46. Bogatz, G.A. and S. Ball, *The second year of Sesame Street: A continuing evaluation*. 1971, Children's Television Workshop, New York, NY.; Educational Testing Service: Princeton, NJ.
47. Courage, M.L. and A.E. Setliff, Debating the impact of television and video material on very young children: Attention, learning, and the developing brain. *Child Development Perspectives*, 2009. 3(1): p. 72-78.
48. Garrison, M.M. and D.A. Christakis, *A teacher in the living room? Educational media for babies, toddlers and preschoolers*. 2005, Menlo Park, CA: The Henry J. Kaiser Family Foundation: Children's Digital Media Centers.
49. Zimmerman, F.J., D.A. Christakis, and A.N. Meltzoff, Television and DVD/video viewing in children younger than 2 years. *Archives of Pediatric and Adolescent Medicine*, 2007. 161: p. 473-479.
50. Namy, L.L., L. Acredolo, and S. Goodwyn, Verbal labels and gestural routines in parental communication with young children. *Journal of Nonverbal Behavior*, 2000. 24(2): p. 63-79.
51. Whitehurst, G.J., et al., Accelerating language development through picture book reading. *Developmental Psychology*, 1988. 24(4): p. 552-559.
52. Hargrave, A.C. and M. Senechal, A book reading intervention with preschool children who have limited vocabularies: The benefits of regular reading and dialogic reading. *Early Childhood Research Quarterly*, 2000. 15(1): p. 75-90.

References

53. Kirk, E., The impact of encouraging infants to gesture on their language development. 2009, University of Hertfordshire.
54. Pettito, L.A. and P.F. Marentette, Babbling in the manual mode: Evidence for the ontogeny of language. *Science*, 1991. 251(5000): p. 1493-1496.
55. McKnight, J., Using the manual alphabet in teaching reading to learning disabled children. *Journal of Learning Disabilities*, 1979. 12: p. 581-584.
56. Zientek, A., et al., Trajectories of symbolic gesture acquisition and use in infants and toddlers, in Biennial Conference of the Society for Research in Child Development. 2011: Montreal, Quebec, Canada.
57. Grinbaum, L., Symbolic gesturing as a caregiving tool: Facilitating communication and regulation in infants and toddlers in *Human Development*. 2001, University of California: Davis. p. 63.
58. Daniels, M., The effect of sign language on hearing children's language development. *Communication Education*, 1994. 43: p. 291-298.
59. Daniels, M., Seeing language: the effect over time of sign language on vocabulary development in early childhood education. *Child Study Journal*, 1996. 26(3): p. 193-208.
60. Daniels, M., Happy hands: The effect of ASL on hearing children's literacy. *Reading Research and Instruction*, 2004. 44(1): p. 86-100.
61. Holland, S.A., Hearing, seeing, and signing in elementary physical education. *Strategies: A journal for physical and sport educators*, 2006. 20(2): p. 17-21.
62. Attwood, A., U. Frith, and B. Hermelin, The understanding and use of interpersonal gestures by Autistic and Down Syndrome children. *Journal of Autism and Developmental Disorders*, 1988. 18(2): p. 241-257.
63. Doherty, J.E. and L.L. Lloyd. Effects of production mode, translucency and manuality on sign acquisition and recall by retarded adults, in 107th Annual Meeting of American Association for Mental Deficiency. 1983. Dallas, Texas.
64. Bornstein and Jordan, *Functional signs: an approach from simple to complex*. 1984, UPP Baltimore.
65. Kelly, S., D. Manning, and S. Rodak, Gesture gives a hand to language and learning: Perspectives from cognitive neuroscience, developmental psychology and education. *Language and Linguistics Compass*, 2008. 2.
66. Christensen, K.M., Conceptual sign language as a bridge between English and Spanish. *American Annals of the Deaf*, 1985. 30: p. 244-249.
67. Feyereisen, P., Further investigation on the mnemonic effect of gestures: Their meaning matters. *European Journal of Cognitive Psychology*, 2006. 18(2): p. 185-205.
68. Hostetter, A.B., M.W. Alibali, and S. Kita. Does sitting on your hands make you bite your tongue? The effects of gesture prohibition on speech during motor descriptions, in Proceedings of the 29th annual meeting of the Cognitive Science Society. 2007: Erlbaum.