# WHAT DOES THE RESEARCH SAY?

*A Resource for Families with Children*
*Who Are Deaf/Hard of Hearing*

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*Taylor Hallenbeck and Charlotte Enns*

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# What Does the Research Say?

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**ABOUT THE AUTHORS**


**Charlotte Enns.** I am a professor and the Associate Dean, Graduate Programs & Research, in the Faculty of Education at the University of Manitoba. My research is focussed on the language and literacy development of deaf children. I believe strongly in the need for all children to realize their potential through the development of their learning and literacy practices.

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# What Does the Research Say?

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**INTRODUCTION**

The purpose of this booklet is to help you, as parents, make sense of all the information and research about deaf/hard of hearing children so you can make informed decisions that are best for your family. The booklet is organized into three main sections: 1) Definitions, 2) Tips for reading research, and 3) Summaries of research findings.

**Lungs need air. No air means you can't breathe.**
**Hearts need blood. No blood means you can't pump.**
**Brains need language before the age of 3 years. No language means you can't communicate fully. While access to language is not life or death (unlike access to air or blood), the brain can become physically altered over time if no language develops. The brain needs language to think and connect with other people (family, friends, etc.).**

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**PIECES OF LANGUAGE**


"The basic impoverishment of deafness is not lack of hearing, but lack of language." (Meadow, 1968)

The above quote might be something you already know – language development for deaf/hard of hearing (DHH) children is often a big challenge. For this reason, a lot of research is focused on this area. To understand the research, it is important to be familiar with the complexity and various meanings of language – which includes spoken language, signed language and written language.

If you ask a random person, *"What is language?"* most people will likely reply "Speaking and listening" or "Reading and writing". However, language is actually made up of lots of little pieces, with speaking/listening and reading/writing being just some of many important pieces.

In reality (particularly for DHH children), just because a child is skilled at one piece, does not mean they are skilled at another piece. To have good communication and language, one must be skilled at *all* of the pieces. Knowing about these pieces can be important when reading research for yourself.

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Here is a diagram (adapted from http://nerissaryan5.weebly.com/the-components-of-language.html) that explains the linguistic terms for all the various pieces of language:

| Language Piece | Definition |
|---|---|
| Phonetics | • Sounds of speech (in spoken language)<br>• Shapes and movements of hands (in signed language) |
| Phonology | • How sounds relate to spoken words<br>• How hand movements relate to signs |
| Morphology | • The rules for how to make and change words/signs (in any language) |
| Syntax | • The rules for putting words/signs into sentences so someone else understands |
| Semantics | • What words/signs, phrases, and sentences mean |
| Pragmatics | • Using appropriate conversational rules to communicate ideas |

**Questions when Reading Research:**
**1.** What is Study X looking at? (For example, talking, signing, reading, or one part of language, as outlined in the diagram above).

2. How do those results potentially apply to my child's *language*?

**KEY TERMS**


Speech
Sounds made with the mouth and heard with the ear.

Sign
Shapes and movements made with the hands and seen with the eye.

Language
A formal system of symbols (can be speech sounds, signs made with the hands, printed letters, etc.) used to communicate our ideas, feelings, and thoughts – includes all the words we know and how we put these into sentences, stories, and conversations.

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Communication

Involves the exchange of information through two processes: *expressive* (making your ideas, wants, and needs known to another person), and *receptive* (understanding another person's ideas, wants, and needs). Both must happen for successful communication.

*Typically, speech, language, and communication all happen together, but they do have separate meanings. For example:*

| | |
|---|---|
| Can you have speech without language? | Yes – babies babbling; birds (parrots) mimicking speech sounds |
| Can you have language without speech? | Yes – signed language; written language |
| Can you have communication without language? | Yes – gestures, pointing, facial expressions, drawing pictures can communicate meaning without using a formal language system |
| Can you have language without communication? | Yes – speaking English to someone who only knows French; talking/signing about your problems at work to a baby or a pet (you are using language, but it is not being understood, therefore communication is not happening) |

Another way of understanding the relationship among these terms (speech/sign, language, communication) is considering the act of "going to the store". There are many different ways you can travel to the store – walk, car, or bicycle. Similarly, there are many different modes of communication you can use with your child – spoken English, American Sign Language, written English, or Sign Supported Speech. The success of going to the store is not measured by *how* you get there, but rather, if you are able to get there and back and buy everything you need. In the same way, the success of communicating with your child is not measured by how you communicate with your child (the mode of communication), but whether your child understands you and if you understand your child's responses.

***Parenting Goal***

*Your goal as the parent of a child who is Deaf/Hard of Hearing is to maximize your child's communication – their ability to express and comprehend language (words and sentences) so they can understand and share ideas and feelings with other people.*

*How the ideas are comprehended (through speech, sign, or both) is not as important as the amount of ideas your child can understand and share. The more ideas your child can understand and share, the higher their language level, and the better their communication.*

## APPROACHES TO COMMUNICATION

Auditory Verbal Therapy

A communication approach emphasizing the development of spoken language and listening skills through auditory therapy, often involving the use of hearing aids and/or cochlear implants. Visual supports such as speech reading and/or signed language are not taught.

American Sign Language

A natural language of the North American Deaf Community that is understood through the eyes instead of the ears. Uses the hands, facial expressions, movement and space to express meaning and share ideas. Is a recognized language, like French, English or Spanish.

Speech Reading (also Lipreading)

The ability to understand speech by watching a person's facial expressions and lip movements. Some (not all) people who are Deaf/Hard of Hearing can become very skilled at this, even though many speech sounds are not easily visible on the lips.

Auditory Oral Therapy

Emphasizes the development of spoken language. Uses hearing aids and/or cochlear implants to help the child hear sound. Use of speech reading is encouraged. Other visuals, like signed language, may be used too (see Sign Supported Speech).

Sign Supported Speech

The use of signs together with spoken language to help clarify meaning. For example, if you wanted to say to your child "Would you like some milk?" you would speak the entire sentence, and add individual signs for key words (such as, LIKE, MILK).
*Note: This is *not* American Sign Language; the use of signs here is not a recognized language. It is a way to make *some* words visible and possibly easier to understand.

Bimodal

Communicating in two modes (visual, auditory, tactile), but not necessarily two languages, i.e., written English (visual mode) and spoken English (auditory mode). For DHH children the term bimodal typically implies that the children can understand and use both speaking/listening and signing/seeing.

Bilingual

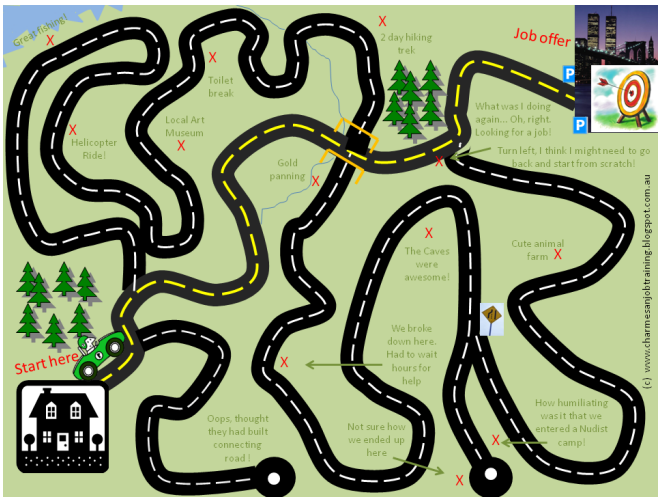
Knowing and/or using two languages, for example, English and French, or ASL and English. For DHH children the term is often used to describe programs where ASL is used as the "face-to-face" language and English is taught in written form. Some programs are described as "bimodal and bilingual", indicating that children are using and learning ASL, as well as written and spoken English.

## TIPS FOR READING RESEARCH

As you meet with professionals they may give you research about the development of children who are DHH. You might also feel like you want to look at some research yourself (for places to start, see the APPENDICES, REFERENCES and ADDITIONAL RESOURCES at the end of this document).

*Not all research is created equal!* Like other things in life (food, furniture, etc.) just because the research comes in a pretty package (is written in an official looking document), does not mean it is good quality research.

All research results, even results from good quality research, must be used carefully. Because every child is unique, it is not possible to have research findings that apply to every single child who is DHH. Use research results to help you make choices about your parenting, but *always* continue to question, and be prepared to change things around if your child does not appear to be making progress.




Think of research results as a "road map" – the map can offer ideas of where to go, but if the route isn't working, you need to look at the map again and adjust your route or choose a completely different route. The research results can offer ideas of what strategies have worked for others, but do not assume it will work for your child. Always be thinking about your child's language & communication development. Follow your child's lead – if your child shows a strong preference for one way of communicating, or even one way of communicating in a specific setting (ex. noisy mall versus quiet home), follow that! All children's brains – whether hearing or deaf/hard of hearing – *want* to communicate! Your child demonstrates with their behaviour how their brain wants to communicate with you.

Part of following your child's lead is making sure your child is developing language. It is important your child's language is tested every 6 months, to check if it is developing appropriately, or as expected. Outlined below are more questions to ask and things to think about when reading research.

**THINGS TO THINK ABOUT WHEN READING RESESARCH**

Significant

Research, based on statistics, will talk about "the findings were significant" or "the findings were not significant". Consider the following quote from a study about word learning and children with cochlear implants (CIs):

"Kindergarten receptive vocabulary had a *significant direct association* with Grade 4 comprehension" (Dickinson & Porche, 2011, p. 878).

The phrase *significant direct association* means the children's ability to understand vocabulary (words) in kindergarten, and their reading comprehension in Grade 4, was not due to random chance.

Bottom Line: If you are reading research that uses statistics, look for whether the findings are significant or not. Remember that significance in research does not mean "important"; it means, "these results did not happen because of chance or luck".

Correlation does not equal causation

Correlation means that one action is connected to another, or that two things tend to happen together. For example, when it rains people tend to use more umbrellas. Or, when it is hot outside, people tend to wear fewer sweatshirts. It is tempting to say "Well, because A and B have a statistical relationship, A causes B." There are many statistically correct correlations where A does not cause B. For example, a statistician once proved that as children's shoe sizes increased, so did their ability to read (Perrett, 2014). Should parents start buying their children bigger shoes so their child will read better? Clearly not. Better reading skills and larger shoes are both caused by a child's growth.

Another example comes from a study published in the *New England Journal of Medicine* stating that, statistically, the more chocolate a country's citizens tended to consume, the more Nobel Prizes were won in those countries. So, Switzerland had the highest rate of chocolate consumption *and* Nobel Prize winners (Messerli, *The New England Journal of Medicine,* 1562-4). Should people wanting to win Nobel Prizes start eating more chocolate? Or are both caused by completely different things?

Bottom Line: When reading research, think about the correlation (relationship) suggested by the researcher and ask, *"Could something else create this relationship behind the scenes?"*

What context was the study conducted in?

Sometimes research is conducted in very specific conditions. For example, if your child attends a local school, the results of a study conducted in a school for the deaf may not fit with your child or may need to be interpreted with extra caution. Or, perhaps the research was conducted in Finland or the United States (very different education systems than Canada), and so might not fully apply to a Canadian context.

Another part of context to think about when reading research is the type of hearing loss of the study participants. Children with mild hearing loss can develop very differently than children with profound hearing loss. If your child has a mild hearing loss, research about children with profound hearing losses might not be the best "fit" for comparing results to your child's situation.

Bottom Line: Research from other countries and education systems is freely used (and is encouraged to be used) to support education here in Canada, but keep this in the back of your mind when considering results.

Researcher Bias

Be aware that some of the research you read may be influenced by the strong beliefs about either signing or speaking held by the researchers. Though most researchers attempt to be neutral in their work, sometimes their personal beliefs about language development for children who are deaf/hard of hearing can lead them to strongly support or criticize certain types of research they agree/disagree with.

*Parenting Goal*

*Language is the main tool for building identity. You figure out who you are by interacting with others. Have you ever been in a place where you didn't speak the language? Think about how hard it was to "be yourself" when you couldn't understand the questions or express your opinions. Strong language will help your child make connections and friendships, and talk about their hopes, dreams, and frustrations with others. Being able to have these conversations is what leads to a strong sense of identity: "This is who I am" and "This is how I want to be in the world."*

## SUMMARIES OF RESEARCH FINDINGS

We have collected and reviewed some key research studies (using the guidelines outlined above). We provide an overview of the most important findings. If you want to read about the studies these results came from, please see APPENDIX A: RESEARCH EXAMPLES section on pages 15 - 30. New research is coming out all the time, but this should give you a good starting point.

# What Does the Research Say?

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| Topic | Research Findings Summarized |
|---|---|
| General Language Development | 1. It is critical for a child to become skilled at a language before the age of 5 years.<br>2. Children can have language disorders in speech or sign. |
| Speaking and Listening Development | 1. A child who uses cochlear implants (CIs) and/or hearing aids is *not* a hearing child. They are a hard of hearing child. Compared to the human ear, the CIs and hearing aids are imperfect machines because they make *everything* louder but not necessarily clearer.<br>2. There is no such thing as the "standard" child who is DHH. All children's brains are different in successfully turning the sound of CIs/hearing aids, or the sight of hand movements (signs), into a full language. Your job, with the help of professionals, is to be a "detective" and figure out how your child's unique brain learns language best.<br>3. The earlier a child receives a CI and/or hearing aid(s), and the more involved the parents are in therapy, the better their chances of acquiring a spoken language. |
| Signed Language Development | 1. All babies' brains want to learn language. The brain doesn't care how it gets the language – through ears or eyes.<br>2. Signed languages are learned in the same way, and at the same rate, as spoken languages.<br>3. Signed languages do not have written forms, so the connection between signed languages and written languages are not as direct as the connection between spoken languages and their written forms.<br>4. Parent signing skills are an important factor in the success of a child's signed language development. |
| Brain Development and Language/ Communication | 1. Just like a muscle becomes physically smaller if you don't use it, the parts of the brain that create language physically change if it is not stimulated enough, and early enough.<br>2. The longer a child's brain goes without language, the more awkward their brain will be at learning and developing language.<br>3. Overall, no matter how the language enters the brain (ears/eyes) and how it leaves the brain (mouth/hands), *if ideas are understood completely and expressed completely*, language development will happen. |

# What Does the Research Say?

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| Topic | Research Findings Summarized |
|---|---|
| Bimodal and Bilingual Development | 1. The use of bimodal (speaking/listening + signing/seeing) language development can have a positive impact on a child's language development. This is not true for all children. Some will prefer speaking/listening only. Some will prefer signing/seeing only.<br>2. A parent's attitude and involvement is one critical factor in the potential success of the bilingual model (and indeed any model).<br>3. Another critical factor of success with the bilingual model is the language environment the family creates through books, discussion, conversation, and experiences.<br>4. A full spoken language is an achievable goal for many children who are DHH, but not guaranteed.<br>5. A full signed language is an achievable goal for many children who are DHH, but not guaranteed. |
| Role of Parents in Language Development | 1. The quality and quantity of language between the parent and child has a direct influence on the child's linguistic development.<br>2. Communication is harder work between hearing parents and children who are DHH than between hearing parents and hearing children. |
| Impact of Language on Mathematics | 1. Children who are DHH can struggle with mathematics, in addition to reading, writing, and communication development.<br>2. Children who are DHH can have pockets of strength in math. Just because a child is good at memorizing their facts does not mean they will understand *when* to use addition versus division to solve real-life problems. Skills in knowing facts *and* how to apply those facts are both critical for mathematical success.<br>3. Parental involvement, the environment set up for exploring math and logic, and the quality of communication between parent and child are all factors in how well a child who is DHH might fair in mathematics. |
| Impact of Language on Social Development (Behaviour) | 1. Stronger language often leads to stronger social skills.<br>2. It is critical children who are DHH spend some of their time with others like them – other children who are also DHH.<br>3. Language development can be a factor in children's behaviour – often when you can communicate more, your frustration is lower, and you act out/behave poorly less. |

**CONCLUSION**

We hope that the information included here has been helpful to you in your role as parents of children who are deaf/hard of hearing. We know that the research in this field can be confusing and overwhelming because much of the information is not conclusive (for example, some research suggests using phonics to teach reading and other research suggests using phonics is not effective).

Children, just like all people, are complicated and unique, so no one way is best for all of them, and decisions that are right at one time in a child's life, may not be at another. As you travel this journey with your child, try to gather as much information as you can and use it to guide your decisions, never forgetting that you know your child best.

*Parenting Goal*
*Each child is unique. The communication approach that provides strong language for one child may not provide strong language for another. As a family, choose a program and give it your best shot. Continue to monitor and ask questions to make sure your child is developing language.*

***Bottom Line:*** *Whatever program you choose, follow the professional's guidance as closely as you can (to ensure the highest chance of success), but don't get "stuck" there if it isn't working. Change things around, if you have to.*

***Ultimate Parenting Goal***
***A full and complete language in your child's brain, whatever it looks like!***

## APPENDIX A: QUESTIONS TO ASK PROFESSIONALS

1. **How can we meet families who have children that have experienced and not experienced success in this program?** (No program works for everybody – there will be children who have wonderful language, and children who do not gain strong language development, in any program. One size does not fit all!)

2. **How do we meet young people and adults who have found success in this program and who have left this program for another program?** (To only know the experiences of those who have experienced success inside a program is to only know part of the story.)

3. **How do we meet *multiple* people who communicate in different ways – speaking/listening only, sign only, and speech plus sign?** (Meet people who speak; meet people who sign; meet people who speak and sign. There are two benefits to this. 1) You meet role models who will help you create new dreams and goals for yourself and your child. Meeting successful, happy, well-adjusted Deaf/Hard of Hearing people will help you imagine your child as a grown up, and will give you a vision to aim for; 2) You get to hear about the challenges and successes of life as a Deaf/Hard of Hearing person, in different communication models, from the source.)

4. **How do you track my child's language development? What kind of information do you use?** (It is recommended a child's language be tested every 6 months. The professionals should explain how they use multiple sources of information, not just one test.)

5. **What "red flags" are you looking for to be sure my child is developing language appropriately within your program?** (The professional should be able to very clearly explain what they are looking for to measure success, just like a doctor explains what they are looking for when tracking development or disease in the body.)

6. **If my child is not developing language fast enough in the first program/model we try, what kinds of changes/options are you comfortable with? What kinds of changes/options are you *not* comfortable with?** (The professional should, a) Explain that they understand their expertise does not benefit all children, and b) Demonstrate a willingness to believe that sometimes their expertise is not the model that will best benefit your child.)

7. **If it seems my child is not developing language, and we need to change to a completely different model, how will you help in such a transition?** (The professional should, a) State they have good relationships with other agencies in the province, and b) State they are comfortable either partnering with, or transitioning your family, to another model of language development if it is needed.)

## APPENDIX B: DIFFERENT KINDS OF RESEARCH STUDIES

- *Single Subject:* Uses individual people to look at ideas. The researcher sets up an intervention or process for the people to experience (for example, computer program or writing strategy), and then examines how the intervention or process affects each person. Is it good quality? (a) Did at least 3 children receive the intervention or process? (b) Does the study measure change over time? Were children given the intervention or process at least 3 different times? (c) Were children compared to other children who did *not* receive the intervention or process? (Horner et al., 2005)

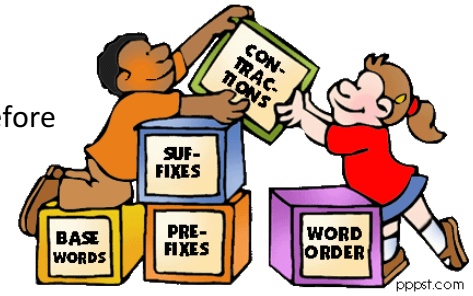
- *Case Study:* Uses one person to look at ideas. The researcher does *not* provide an intervention or process (unlike Single Subject), but describes and looks for patterns in that person's behaviour. Is it good quality? (a) Does it take place over a long period of time? (Minimum 1 year) (b) Does the researcher describe observations and findings with enough detail that you can decide if this child is similar to your child, and if results might apply to your child?

- *Groups:* Uses a group of people, or different groups of people, to look at ideas. The researcher sets up an intervention or process for a group of people to experience. Sometimes different groups will have different interventions to compare, for example, three groups use three different spelling programs to see which spelling program might be the best. Is it good quality? (a) Does the researcher talk about "significant" (better than chance) results and "not significant" (worse than chance) results? (b) Can the groups be compared fairly? (Look at the research questions to help with this judgement. If the research question is "Do children with hearing loss learn speech reading faster than children with no hearing loss?" then you would expect the groups to be 1. Children with hearing loss and 2. Children with no hearing loss.) (c) After the study was done, did researchers go back and re-test the children weeks or months later? (If not, it's hard to say what the long-term effects of the intervention are.) (Gersten, Fuchs, Compton, Greenwood, & Innocenti, 2005)

## APPENDIX C: EXAMPLES OF RESEARCH STUDIES

Each of the next sections lists the key information (Research Says…) and then the studies this information is from (Research Examples…).

### General Language Development




**Research Says…**

1. It is critical for a child to become skilled at a language before the age of 5 years.
2. Children can have language disorders in speech or sign.

**Research Examples…**

*(Marschark & Knoors, 2012)*

- A multitude of research shows that the language of students who are DHH has, on average, smaller vocabulary, less variety (depth), and more misconnections than hearing peers.
- Children who are DHH, whether they use CIs, hearing aids, speaking/listening only, or signed language, all perform the same on tests of vocabulary knowledge and development.

*(Francis, 2005)*

- If a child learns their first language (speaking and listening or signing and seeing) after early childhood, the ability to develop strong language is weaker.

*(Morgan, Herman, & Woll, 2007)*

- It is important to know that children who are DHH can struggle with language – spoken and/or signed – beyond simply lacking access to language. This idea is similar to reading with dyslexia – no matter how big or colourful the print is, a child with dyslexia may still struggle to read it.

## Speaking and Listening Development

**Research Says….**

1. A child who uses cochlear implants (CIs) and/or hearing aids is *not* a hearing child. They are a hard of hearing child. Compared to the human ear, the CIs and hearing aids are imperfect machines because they make *everything* louder but not necessarily clearer.

2. There is no such thing as the "standard" child who is DHH. All children's brains are different in successfully turning the sound of CIs/hearing aids, or the sight of hand movements (signs), into a full language. Your job, with the help of professionals, is to be a "detective" and figure out how your child's unique brain learns language best.

3. The earlier a child receives a CI and/or hearing aid(s), and the more involved the parents are in therapy, the better their chances of acquiring a spoken language.

**Research Examples…**

*(Cramér-Wolrath, 2013)*

- One child had age appropriate sign language before her CI surgery. She had CI surgery at 3 years of age. Five years after her CI surgery, she had 5-year old speaking/listening and 8-year old sign language abilities.

*(Kermit, 2010)*

- There is excellent research that shows us two things about children with CIs: (1) It is impossible for children to have 'normal' hearing through CIs; even with a CI, your child will have hearing loss. (2) Children who are implanted early have a better chance of learning through speaking and listening.

- As a parent, be aware that lots of educational settings out there want a "one-size fits all approach". This means you as the parent must hold the educational setting accountable for, (a) continually monitoring your child's language development, and (b) changing your child's communication and/or instructional plan beyond the "one-size fits all" approach to respond to your child's personal language progress, if needed.

- Some children do not gain strong speaking and listening skills through their CI or hearing aid. Research cannot predict a child's experiences with a CI before implantation or before hearing aid use.

- Children who are being exposed to only speaking and listening *and* who are not developing their spoken and listening language are at risk in two ways: 1) Their language development may be slowed down because the only way they have language is through their CI/hearing aid, which does not work well for them; and 2) If a child transitions to sign after "trying" speaking/listening, a message is sent to the child that they did not achieve the primary goal of good speaking/listening, and so they achieved second-best in the eyes of others (and perhaps also themselves).

*(Percy-Smith, Cayé-Thomasen, Breinegaard, & Jensen, 2010)*

- When parents use only speaking/listening at home (as opposed to speaking/listening + sign) with a child who has CIs, the speaking/listening only child is stronger at: (1) Detecting sound without looking, (2) Understanding language without looking, (3) Vocabulary knowledge, (4) Speaking clearly.
- Where a child went to school – in a mainstream classroom (speaking/listening) or a special program for children who are DHH (signed language) – did not have an effect on the child's speech and language development.
- Children who had good access to sound for more than 3 years spoke more clearly, on average, than children who had access to sound between 0 – 3 years.

*(Moore & Shannon, 2009)*

- Children who use a CI all vary in their development of language with regards to age, time, and achievement.
- Multiple studies show that a child's speech perception (*hearing* it, not understanding it) can be improved by structured practice, sort of like doing math flash cards.

*(Ruth Swanwick & Tsverik, 2007)*

- For children to reach their personal potential with a CI, *lots* of speaking and listening experiences are critical.

*(Houston, Carter, Pisoni, Kirk, & Ying, 2005)*

- A child's performance with their CI varies widely. One study showed that children who use CIs scored between 60% – 100% correct on a *listening* vocabulary test; these same children scored between 0% – 63% on a *spoken* vocabulary test.
- The more a child understood the ideas behind one vocabulary word, the better they were at applying this word to other words and objects.
- Children who receive CIs at a younger age tend to learn names (of objects) through speaking/listening better than children who received CIs at an older age.

## Signed Language Development

**Research Says…**

1. All babies' brains want to learn language. The brain doesn't care how it gets the language – through ears or eyes.

2. Signed languages are learned in the same way, and at the same rate, as spoken languages.

3. Signed languages do not have written forms, so the connection between signed languages and written languages are not as direct as the connection between spoken languages and their written forms.

4. How skilled at signing parents become is a very important factor in the success of a child's signed language development.

**Research Examples…**

*(Rinaldi, Caselli, Renzo, & Gulli, 2014)*

- Children who use signing can understand more than they can express, just like children using speaking/listening.

- Children who use sign label things incorrectly more often than hearing children. On the other hand, children who look at a sign and choose the matching picture, perform the same as hearing children. *Bottom line:* Some parts of signed language development are different, or more varied, than spoken language development. Some parts of signed language develop in the same way, at the same rate, as spoken language development.

*(Thompson, Vinson, Woll, & Vigliocco, 2012)*

- How successful a child is in learning sign vocabulary can depend on the following factors:
  1. *Complexity:* How complicated is this idea to sign? Does the sign use one hand, making one simple shape? Or does the sign use both hands moving around in space?
  2. *Familiarity:* Has your child seen/used this sign before? How often?
  3. *Age:* It goes without saying, the older a child is, the more vocabulary they should have.
  4. *Linked to Real Life:* Does the sign "look like" the thing in life it represents? For example, the sign for book (press your hands together, and then open them like you're opening a book) may be easier and quicker to learn and remember than the sign for black (swipe your index finger across the forehead).

*(Woolfe, Herman, Roy, & Woll, 2010)*

- In general, children who start learning signed language earlier develop a larger vocabulary overall. However, whether a child begins learning sign at birth or a bit later, how fast the child learns (the rate of learning) is the same.

- For some children who begin learning signs at 8 months old (or younger), they can experience a big growth spurt around 16 – 19 months.

- The stronger a parent's signing skills, the stronger their child's vocabulary development.

*(Morgan et al., 2007)*

- Sign language is not necessarily a "magic" language, just like spoken language is not necessarily a "magic" language for hearing children. It is possible for children to have difficulty learning sign language, just like a child learning spoken language. A child struggling with sign language may develop normally in some ways (ex. vocabulary) and struggle in other ways (ex. grammar). Professionals who work with you and your child on signed language development will help you identify any struggles like this.

*(Anderson, 2006)*

- Children who grow up using signed language with hearing parents tend to have a smaller vocabulary, and develop this vocabulary more slowly than children who grow up using signed language with deaf parents/parents fluent in sign. Note that vocabulary development does happen in a similar process to hearing children learning spoken vocabulary. It is suggested that the reason children of hearing parents have a smaller sign vocabulary that develops slowly is because they are learning language from their parents who are also leaning language. *Bottom line:* It is very important your child gets to be with deaf people who are fluent in signed language on a regular basis, even when they are very small.

*(Loots, Devisé, & Jacquet, 2005)*

- Parents who use a combination of auditory/oral and sign communication with their children interact back and forth with their child as much as deaf signing parents; parents who use auditory/oral only have less give-and-take interaction with their child.

*(Anderson & Reilly, 2002)*

- Children who are exposed to fluent models of American Sign Language (ASL) develop important vocabulary (signs) similar to hearing peers. These include questioning, signs for emotions, and signs about thinking.

- When babies and children spend time with native users of ASL, they can develop language at the same pace as their hearing peers.

## Brain Development and Language/Communication

**Research Says….**

1. Just like a muscle becomes physically smaller if you don't use it, the parts of the brain that create language physically change if it is not stimulated enough, and early enough.

2. The longer a child's brain goes without language, the more awkward their brain will be at learning and developing language.

3. Overall, no matter how the language enters the brain (ears/eyes) and how it leaves the brain (mouth/hands), if ideas are understood completely and expressed completely, language development will happen.

**Research Examples…**

*(Penicaud et al., 2013)*

- The physical structures in a child's brain that provides language is physically affected by the timing of language acquisition. Children who learn language earlier achieve more complex use of language in their brain.

*(Gordon et al., 2011)*

- A child's auditory cortex – where much of understanding spoken language happens – can be stimulated by visual language cues as well. This shows that a child's brain can make effective use of language, as long as the language is accessible.

- Children who use CIs, but use signed language only, show some limited benefit in terms of the brain's ability to use sound-based information over a long period of time (after 2 years).

*(Mayberry, Chen, Witcher, & Klein, 2011)*

- Children who acquire language earlier, learn grammar more quickly.

- Brain imaging shows that children who develop signed language later in life, after limited functional spoken language, process language in a physically different way than typical brains.

- How differently a child's brain processed language was directly related to how long they went without language (experienced language deprivation) in early childhood.

*(Moore & Shannon, 2009)*

- Young children's brains are more sensitive to speech perception than older children's brains.
- The sounds a child will receive through their CI are influenced by the following factors: how clear the sound signal is, how well the implant feeds information to the auditory system, and how effective the child's brain is at using the sound that comes in to go from *hearing* sound to *understanding* language. Ensuring the child has access to personalized auditory training might help each child reach their personal speaking/listening-based language capacity.

*(Krentz & Corina, 2008)*

- It is possible that babies as young as 10 months begin to lose their sensitivity to absorbing American Sign Language (ASL), if it is presented as a non-native language. (That is, the only exposure a child has to ASL is from non-native users).
- Babies' brains want language, any language, spoken or signed.

*(Goldin-Meadow, 2005)*

- A child who cannot hear still has a brain that can learn language; their brain will learn language if given an accessible (visual) language.

*(Mayberry, Lock, & Kazmi, 2002)*

- How well a child's brain learns language is affected by how early they have access to full language; what this language *looks like* (speaking/listening, signing/seeing) does not matter.

## Bimodal and Bilingual Development

**Research Says…**


1. The use of bimodal (speaking/listening + signing/seeing) language development can have a positive impact on a child's language development. This is not true for all children. Some will prefer speaking/listening only. Some will prefer signing/seeing only.
2. A parent's attitude and involvement is one critical factor in the potential success of the bilingual model (and indeed any model).
3. Another critical factor of success with the bilingual model is the language environment the family creates through books, discussion, conversation, and experiences.

4. A full spoken language is an achievable goal for many children who are DHH, but not guaranteed.

5. A full signed language is an achievable goal for many children who are DHH, but not guaranteed.

**Research Example…**

*(Levesque, Brown, & Wigglesworth, 2014)*

Note: This study observed one deaf boy aged 23 – 42 months over 20 months.

- The more sensitively a parent responds to a child's language preferences, the higher the child's vocabulary scores and the quicker they develop language.

- Parents can gain confidence in developing their child's language when they understand how their child's auditory skills are developing, and understand the difficulties the child's ears and brain have in developing language through sound.

*(Mouvet, Matthijs, Loots, Taverniers, & Herreweghe, 2013)*

- The language that is accessible to your child in your home is just as important to think about as your child's language development.

- A child is always looking for a way to communicate. If parent and child interact using a form of communication that the child feels is not working for them, the child may abandon that in favour of a more successful model. The lesson of this study is *listen to your child*. Children are smart. They know when communication isn't happening.

- Sometimes parents who use speaking/listening and signing with their children, can find it tough to strike a balance. Both signing/seeing and speaking/listening must happen daily and be incorporated into routine activities. Expect the professionals you're working with to help you find and maintain this balance.

*(Mann & Marshall, 2012)*

- It is important to understand that children cannot learn signs simply by reading. This is because the letters on the page do not connect to signs the same way they connect to speech sounds.

- As when children are learning sound-based languages, children learning signed language at first understand more than they can express.

- One difference in learning a signed language versus a spoken language is how words are remembered. When learning words, different pieces have to be remembered. For

children using signed language, some pieces are harder than others. In order, from easiest to hardest, the pieces are:

1. Recognizing the meaning when given a picture or related word to jog your memory
2. Recognizing the spelled word in a group of words
3. Remembering how to spell the word
4. Remembering what the word means

*(Mayer & Leigh, 2010)*

- Spoken language *can* be a good first language for many children who are DHH. The question is – for those children who do not work well with speaking and listening, how will the parents and professionals a) recognize this and b) respond to it? How does signed language fit into this dilemma?

- It is critical that children identified at birth as having hearing loss, who use signed language (either alone or with spoken language) meet with adults who are fluent in signed language on a very regular basis, especially while the parent is learning to sign.

*(Swanwick & Marschark, 2010)*

- A child's use of language with familiar people in familiar and quiet environments (ex. signed language with mom or using a CI to identify words in a sound proof booth), measure performance in the best situation. This will not necessarily be the performance in a noisy, distracting environment like a daycare or classroom.

*(Snoddon, 2008)*

- Though bilingual language development (through ASL and English) has shown to be successful, the most important thing to remember is that *every* child is unique and their progress and skill in spoken language may vary from that of other DHH children who appear to be similar to them.

*(Luckner, Sebald, Cooney, Young, & Goodwin, 2006)*

- Children who are DHH benefit from being read to, a lot, and from the use of closed captioning and small group or one-on-one teaching.

*(Swanwick & Tsverik, 2007)*

- Using sign language before getting a CI does not negatively affect speaking/listening language development after getting a CI. After getting a CI, spoken language tends to develop faster in children who primarily use spoken language, as opposed to children who primarily use sign language. In other words, sign language entering a child's brain before a CI does not affect speaking/listening language afterwards. After getting a CI, language tends to develop like other skills – whichever language is used more is the language that develops faster.

- Signed language can be a successful "bridge" to spoken language by helping children learn new ideas and rapid conversation through a strong sense – their eyes – before accessing ideas and communication through a weak sense – their ears.

*(Easterbrooks & Stephenson, 2006)*

- Research into the success of phonics (teaching reading by connecting speech sounds to printed letters) to help children who are DHH learn to read are mixed. Sometimes phonics works; sometimes it doesn't.

*(Swanwick, 2005)*

- Parents who view their child's deafness as a *difference*, rather than a disability, often create a richer environment for language development. Someone who sees deafness as a *difference* says, "My child can't hear well, but, my child has a wonderful brain and *can* learn anything! They just don't use their ears like I do to get information into their brain. They either need to use their eyes and signed language, or use machines (CIs/hearing aids) and speaking and listening, or both." Someone who sees deafness as a *disability* says, "My child can't hear, and won't be able to learn things until we fix the ears."

- Young children should *enjoy* the books they read with others. Parents should sometimes read books for language instruction, and sometimes read books for fun, even if those books are easier than your child's actual reading level. If every book your child picks up becomes an intensive language lesson, the enjoyment of reading may be lost.

*(Capirci, Montanari, & Volterra, 1998)*

- Exposing young children to signed language does affect how often the hands and eyes are used to communicate (as opposed to ears and mouth), but does not affect how quickly general communication develops.

- There is at least one clear example of a child who did not find success with signing before being implanted. This is the opposite of another, similar study, where a child had full signed language before being implanted. This shows how variable children who are DHH are, and how critical it is to not sit back and simply move through a one-size-fits all approach. It is also an example of the rare, but certainly possible, instance where a child's brain works with spoken language much easier than signed language.

## Role of Parents in Language Development

**Research Says….**

1. The quality and quantity of language that helps the parent and child communicate has a direct influence on the child's linguistic development.

2. Communication is harder work between hearing parents and children who are DHH than between hearing parents and hearing children.

**Research Examples…**

*(Ferrell, Bruce, & Luckner, 2014)*

- The following points are *more important* than how the child communicates (speech, sign, or both), for a child to have successful language:
  - How involved parents are in language development
  - How well children perform non-verbal tasks
  - If the child has additional disabilities or not
  - The quality of education that helps the child develop language and communication.

- Multiple studies show that families who participate in early intervention before the age of 3 (0 – 3 years is the best time for a child's brain to learn language) tend to have greater success.

*(Pagliaro, 2010)*

- *How* parents interact with their children is important for their mathematics development. If parents respond to their child's questions and communications all the time, even when it's annoying, the child tends to experience success in school mathematics.

*(Quittner et al., 2010)*

- Parents find communication and choosing a school/program the two most stressful things about raising a child who is DHH.

- When raising a child who is DHH, parental stress outside of language, communication, and behaviour, is similar to stress for hearing parents. For example, stress from lack of sleep, worrying about their child's future, and a child's fussiness (to name a few).

- Parents feel the following to be sources of stress (from most to least):
  - Communication difficulties
  - Educational worries
  - Caring for hearing aids/CIs
  - Teaching their child language.

*(Klatter-Folmer, van Hout, Kolen, & Verhoeven, 2006)*

- For successful communication between parents and their child who is DHH, parents must (at first) do *most* of the work. For example, parents must either figure out how to adapt their spoken language for their child's mechanical ears (hearing aids/CIs), or the parent must learn an entirely new language (signed language). Children will take on more of the work over time, as they get older.

## Impact of Language on Mathematics

**Research Says…**

1. Children who are DHH can struggle with mathematics, in addition to reading, writing, and communication development.

2. Children who are DHH can have pockets of strength in math. Imagine two builders (Nancy and Jane) are each building a house. Jane is better than Nancy at installing windows and doors, but she struggles to install walls and floors. A house must be built with all of the components. Thus, Jane is not good at "building a house"; Jane is good at "some pieces of house building". In the same way, children who are DHH are not necessarily strong in all mathematics, but they can be strong at pieces of it.

3. Parental involvement, the environment set up for exploring math and logic ideas, and the quality of communication between parent and child are all factors in how well a child who is DHH might fair in mathematics.

**Research Examples…**

*(Edwards, Edwards, & Langdon, 2013)*

*Note: This study examined children with CIs only.

- Children who are DHH very often have struggle in mathematics, because of the lower language level they often experience.
- Any aspect of mathematics – numbers, counting, shapes – are all affected by language skills.

*(Pagliaro & Kritzer, 2013)*

| Strengths | Weakness |
|---|---|
| • Counting things<br>• Skip counting by 10s (10, 20, 30…)<br>• Matching shapes, based on size, not orientation. For example:<br><br><u>Strength (Size)</u><br>  <br><br><u>Weakness (Orientation)</u><br>  | • Estimation<br>• Understanding more/less<br>• Writing numbers<br>• Understanding time<br>• Months of the year |

*(Pagliaro & Kritzer, 2010)*

- Children who ask questions (and have their questions answered through accessible language), who make connections, and who explore ideas are better at early mathematics.

*(Pagliaro, 2010)*

- Children who are DHH often develop their mathematical understanding by first using blocks and toys to model, then using their counting, and then learning their facts. This is different than hearing children, who tend to use counting first and then toys and blocks to model. *The lesson – don't be afraid to talk about math, and play games, with your child using toys, blocks, and counting!*

- Children who are DHH often count more accurately than hearing children. (Note, just like vocabulary is a piece of language, counting is a piece of math. Just because you can count, does not mean you can use math well.)

*(Gottardis, Nunes, & Lunt, 2011)*

- Some research suggests that as many as 80% of children who are DHH struggle with mathematics. This fact is not meant to scare you. It's meant to put you on your guard.

*(Zarfaty, Nunes, & Bryant, 2004)*
Context: This study examined 3 to 4 year olds. All attended a special nursery school focused on listening and spoken language at least twice per week, and the remaining days, 3 or fewer, in a regular nursery.

- Children who are DHH, and use listening and speaking only, understand the idea of numbers just as well as hearing children. Children who are DHH are often better than hearing children at understanding quantities when laid out in a grid. (Ex. If you have 12 pennies, and 6 are laid out in a square of 2 pennies by 3 pennies, and the other 6 are simply grouped together, children who are DHH will identify "6 pennies" in a 2 x 3 grid better than the hearing children will.)

## Impact of Language on Social Development (Behaviour)

**Research Says…**

1. Stronger language often leads to stronger social skills.

2. It is critical children who are DHH spend some of their time with others like them – other children who are also DHH.

3. Language development has been shown to be a factor in children's behaviour – often when you can communicate more, your frustration level is less, and you act out/behave poorly less.

**Research Suggests…**
(Marschark & Knoors, 2012)

- The more effective a mother and baby are at communicating (in any form) the more likely the child will learn social skills smoothly.

(Ludlow, Heaton, Rosset, Hills, & Deruelle, 2010)

- Children who are DHH often struggle more to identify emotions based on facial recognition. Even so, the development of their emotion recognition skills followed the same order as hearing children. In other words, children who are DHH may struggle more to learn about emotions, and how people represent them, but they *can* learn it in the same way as hearing children. This is regardless of how severe the hearing loss is, or whether the child used speaking or signing to communicate.

(Quittner et al., 2010)

- A delay in language, any language, can cause higher levels of behaviour issues and negativity.

- When a child is behind in how well they understand and express language, it can lead to stress for the parent and the child, as well some behaviour problems.

(Dammeyer, 2009)
Context: "All are public schools for deaf and hard-of-hearing children in Denmark. All use signed language, oral Danish, or some kind of a combination (total communication) adjusted to the child" (p. 52)

- Children with low language – spoken or signed – tend to have more difficulty learning and understanding social cues.

- Boys tend to struggle more than girls with social difficulties. On the other hand, the following factors were shown *not* to affect difficulty: child hearing status (deaf, hard of hearing, CI), child age, type of school (mainstream or deaf), parent education level, and if there are any deaf parents in the home or not.

- Research is not firm on whether children, who have profound hearing loss, with CIs have stronger social skills than children with hearing aids. Some studies say, yes, and some say, no.

(Swanwick & Tsverik, 2007)

- Research tentatively suggests that the best social/emotional outcomes for children who are DHH come from environments where the following happens; a) individual expectations of language development, b) access to fully fluent signing deaf adults, and c) access to developing speaking and listening skills.

(Brunnberg, 2005)

- Children who are DHH often need to be directly taught social skills like sharing, and helping others. This means children who are DHH do not always "pick up" on social cues because they may not hear/understand it in the world around them. Sometimes an adult will need to sit them down, with a pre-planned activity, and say "This is how you _____." (share, ask or offer help, wait in line etc.)

- On the playground (an important place to develop social awareness), children who are DHH interacted more when the playground was at a special school with children like them (86% of the time). There were far fewer interactions when the DHH children were on a playground full of hearing children (15%). This shows how critical it is for your child who is DHH to meet and learn from others like them, who are also DHH.

- When children who are DHH are playing with other children who are DHH, there is a stronger feeling of belonging and fellowship. This is not a bad thing. It simply highlights a difference, similar to girls sometimes preferring to play with other girls, and boys sometimes preferring to play with other boys.

## APPENDIX D: ADDITIONAL RESOURCES

Websites

- Understanding statistical significance: https://www.iwh.on.ca/wrmb/statistical-significance
- Fun Language at Home http://www.aussiedeafkids.org.au/activities-for-home.html
- Developing Communication with Deaf Baby/Toddler http://www.middlesbrough.gov.uk/?articleid=5557

Videos

- Caring Without Coddling (Speaking/Listening focus) https://www.youtube.com/watch?v=vbBeIU_-43I
- Two Deaf Women Show Us Bilingualism at It's Finest https://www.youtube.com/watch?v=M5vPEhAuLWQ&index=4&list=RDi5BlXMY9U2M
- BC Parent Video: Road Taken https://www.youtube.com/watch?v=1dl8LsqfP38

Print Resources

- Hard of Hearing: https://www.amazon.com/Not-Deaf-Enough-Raising-Hearing/dp/0882002015/ref=sr_1_7?ie=UTF8&qid=1471612354&sr=8-7&keywords=raising+deaf+child
- Parenting Oral Deaf: https://www.amazon.com/Raising-Kids-Cochlear-Implants-Narratives/dp/0991403207/ref=sr_1_8?ie=UTF8&qid=1471612354&sr=8-8&keywordSs=raising+deaf+child
- VL2 Parenting Website: Parent Information Packet http://vl2parentspackage.org

- 101 Ideas for Families (Listening/Speaking focus) http://www.clarkeschools.org/uploads/files/resources/101-ideas.pdf

- We're All In: How and Why One Family Chose Sign
  - Power Point: http://ehdimeeting.org/Archive/2016/System/Uploads/pdfs/Monday_Sunset_200_LisaCrawford_2059.pdf
  - Handout: http://ehdimeeting.org/Archive/2016/System/Uploads/Handouts/Handout_2059LisaCrawford.pdf

**REFERENCES**


Anderson, D. (2006). Lexical development of deaf children acquiring signed languages. In B. Schick, M. Marschark, & P. E. Spencer (Eds.), *Advances in the Sign Language Development of Deaf Children* (pp. 13–160). Oxford: Oxford University Press.

Anderson, D., & Reilly, J. (2002). The MacArthur communicative development inventory: Normative data for American Sign Language. *Journal of Deaf Studies and Deaf Education2*, *7*, 83–119.

Brunnberg, E. (2005). The school playground as a meeting place for hard of hearing children. *Scandinavian Journal of Disability Research*, *7*(2), 73–90. http://doi.org/10.1080/15017410510032163

Capirci, O., Montanari, S., & Volterra, V. (1998). Gestures, signs and words in early language development. *New Directions for Child Developent*, (79), 45–60.

Cramér-Wolrath, E. (2013). Sequential bimodal bilingual acquisition: Mediation using a cochlear implant as a tool. *Deafness & Education International*, *15*(4), 201–221. http://doi.org/10.1179/1557069x13y.0000000023

Dammeyer, J. (2009). Psychosocial development in a Danish population of children with cochlear implants and deaf and hard-of-hearing children. *Journal of Deaf Studies and Deaf Education*, *15*(1), 50–58. http://doi.org/10.1093/deafed/enp024

Dickinson, D. K., & Porche, M. V. (2011). Relation between language experiences in preschool classrooms and children's kindergarten and fourth-grade language and reading abilities. *Child development*, *82*(3), 870-886.

Easterbrooks, S. R., & Stephenson, B. (2006). An examination of twenty literacy, science, and mathematics practices used to educate students who are deaf or hard of hearing. *American Annals of the Deaf*, *151*(4), 385–397. http://doi.org/10.1353/aad.2006.0043

Edwards, A., Edwards, L., & Langdon, D. (2013). The mathematical abilities of children with cochlear implants. *Child Neuropsychology*, *19*(2), 127–142. http://doi.org/10.1080/09297049.2011.639958

Fagan, M. K., & Pisoni, D. B. (2010). Hearing experience and receptive vocabulary development in deaf children with cochlear implants. *Journal of Deaf Studies and Deaf Education*, *15*(2), 149–161. http://doi.org/10.1093/deafed/enq001

Ferrell, K. A., Bruce, S., & Luckner, J. L. (2014). *Evidence-based practices for students with sensory impairments*.

Francis, N. (2005). Research findings on early first language attrition: Implications for the discussion on critical periods in language acquisition. *Language Learning*, *55*(3), 491–531. http://doi.org/10.1111/j.0023-8333.2005.00313.x

Gersten, R., Fuchs, L. S., Compton, D., Greenwood, C., & Innocenti, M. S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, *71*(2), 149–164. http://doi.org/10.1177/001440290507100202

Goldin-Meadow, S. (2005). What language creation in the manual modality tells us about the foundations of language. *Linguistic Review*, *22*(2-4), 199–225. http://doi.org/10.1515/tlir.2005.22.2-4.199

Gordon, K. A., Wong, D. D. E., Valero, J., Jewell, S. F., Yoo, P., & Papsin, B. C. (2011). Use it or lose it? Lessons learned from the developing brains of children who are deaf and use cochlear implants to hear. *Brain Topography*, *24*(3-4), 204–219. http://doi.org/10.1007/s10548-011-0181-2

Gottardis, L. (Oxford U., Nunes, T. (Oxford U., & Lunt, I. (Oxford U. (2011). A synthesis of research on deaf and hearing children's mathematical achievement. *Deafness & Education International*, *13*(3), 131–150. http://doi.org/10.1179/1557069X11Y.0000000006

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, *71*(2), 165–179. http://doi.org/10.1177/001440290507100203

Houston, D. M., Carter, A. K., Pisoni, D. B., Kirk, K. I., & Ying, E. a. (2005). Word learning in children following cochlear implantation. *The Volta Review*, *105*(1), 41–72. http://doi.org/10.1016/j.biotechadv.2011.08.021.Secreted

Kermit, P. (2010). Choosing for the child with cochlear implants: a note of precaution. *Medicine, Healthcare and Philosophy*, *13*, 157–167. http://doi.org/10.1007/s11019-010-9232-9

Klatter-Folmer, J., van Hout, R., Kolen, E., & Verhoeven, L. (2006). Language development in deaf children's interactions with deaf and hearing adults: A dutch longitudinal study. *Journal of Deaf Studies and Deaf Education*, *11*(2), 238–251. http://doi.org/10.1093/deafed/enj032

Krentz, U. C., & Corina, D. P. (2008). Preference for language in early infancy: The human language bias is not speech specific. *Developmental Science*, *11*(1), 1–9. http://doi.org/10.1111/j.1467-7687.2007.00652.x

Levesque, E., Brown, P. M., & Wigglesworth, G. (2014). The impact of bimodal bilingual parental input on the communication and language development of a young deaf child. *Deafness & Education International*, *16*(3), 161–181. http://doi.org/10.1179/1557069X13Y.0000000033

Loots, G., Devisé, I., & Jacquet, W. (2005). The impact of visual communication on the intersubjective development of early parent-child interaction with 18- to 24-month-old deaf toddlers. *Journal of Deaf Studies and Deaf Education*, *10*(4), 357–375. http://doi.org/10.1093/deafed/eni036

Luckner, J. L., Sebald, A. M., Cooney, J., Young, J., & Goodwin, S. M. (2006). An examination of the evdience-based literacy research in deaf education. *American Annals of the Deaf*, *150*(5), 443–456.

Ludlow, A., Heaton, P., Rosset, D., Hills, P., & Deruelle, C. (2010). Emotion recognition in children with profound and severe deafness: do they have a deficit in perceptual processing? *Journal of Clinical and Experimental Neuropsychology*, *32*(9), 923–928. http://doi.org/10.1080/13803391003596447

Mann, W., & Marshall, C. (2012). Investigating deaf children's vocabulary knowledge in british sign language. *Language Learning*, *62*(4), 1024–1051. http://doi.org/10.1111/j.1467-9922.2011.00670.x

Marschark, M., & Knoors, H. (2012). Educating deaf children: Language, Cognition, and Learning. *Deafness & Education International*, *14*(3), 136–160. http://doi.org/10.1179/1557069X12Y.0000000010

Mayberry, R. I., Chen, J.-K., Witcher, P., & Klein, D. (2011). Age of acquisition effects on the functional organization of language in the adult brain. *Brain and Language*, *119*(1), 16–29. http://doi.org/10.1016/j.bandl.2011.05.007

Mayberry, R. I., Lock, E., & Kazmi, H. (2002). Linguistic ability and early language exposure. *Nature*, *417*(6884), 38. http://doi.org/10.1038/417038a

Mayer, C., & Leigh, G. (2010). The changing context for sign bilingual education programs: issues in language and the development of literacy. *International Journal of Bilingual Education and Bilingualism*, *13*(2), 175–186. http://doi.org/10.1080/13670050903474085

Moore, D. R., & Shannon, R. V. (2009). Beyond cochlear implants: Awakening the deafened brain. *Nature Neuroscience*, *12*(6), 686–691. http://doi.org/10.1038/nn.2326

Morgan, G., Herman, R., & Woll, B. (2007). Language impairments in sign language: breakthroughs and puzzles. *International Journal of Language & Communication Disorders*, *42*(1), 97–105. http://doi.org/10.1080/13682820600783178

Mouvet, K., Matthijs, L., Loots, G., Taverniers, M., & Herreweghe, M. Van. (2013). The language development of a deaf child with a cochlear implant. *Language Sciences*, *35*(1), 59–79. http://doi.org/10.1016/j.langsci.2012.05.002

Pagliaro, C. M. (2010). Mathematics instruction and learning of deaf and hard-of-hearing students: What do we know? Where do we go? In *The Oxford Handbook of Deaf Studies, Language, and Education* (pp. 156–171). http://doi.org/10.1093/oxfordhb/9780195390032.013.0011

Pagliaro, C. M., & Kritzer, K. L. (2010). Learning to learn: An analysis of early learning behaviors demonstrated by young deaf/hard-of-hearing children with high/low mathematics ability. *Deafness & Education International*, *12*(2), 54–76. http://doi.org/10.1179/146431510X12626982043723

Pagliaro, C. M., & Kritzer, K. L. (2013). The math gap: A description of the mathematics performance of preschool-aged deaf/hard-of-hearing children. *Journal of Deaf Studies and Deaf Education*, *18*(2), 139–160. http://doi.org/10.1093/deafed/ens070

Penicaud, S., Klein, D., Zatorre, R. J., Chen, J. K., Witcher, P., Hyde, K., & Mayberry, R. I. (2013). Structural brain changes linked to delayed first language acquisition in congenitally deaf individuals. *NeuroImage*, *66*, 42–49. http://doi.org/10.1016/j.neuroimage.2012.09.076

Percy-Smith, L., Cayé-Thomasen, P., Breinegaard, N., & Jensen, J. H. (2010). Parental mode of communication is essential for speech and language outcomes in cochlear implanted children. *Acta Oto-Laryngologica*, *130*(6), 708–15. http://doi.org/10.3109/00016480903359939

Quittner, A. L., Barker, D. H., Cruz, I., Snell, C., Grimley, M. E., & Botteri, M. (2010). Parenting stress among parents of deaf and hearing children: Associations with language delays and behavior problems. *Parenting*, *10*(2), 136–155. http://doi.org/10.1080/15295190903212851

Rinaldi, P., Caselli, M. C., Renzo, A. Di, & Gulli, T. (2014). Sign vocabulary in deaf toddlers exposed to sign language since birth. *Journal of Deaf Studies and Deaf Education*, *19*(3), 303–316. http://doi.org/10.1093/deafed/enu007

Snoddon, K. (University of T. (2008). American Sign Language and Early Intervention. *Canadian Modern Language Review*, *64*(4), 581–604. http://doi.org/10.3138/cmlr.64.4.581

Swanwick, R. (2005). Literacy in the homes of young deaf children: Common and distinct features of spoken language and sign bilingual environments. *Journal of Early Childhood Literacy*, *5*(1), 53–78. http://doi.org/10.1177/1468798405050594

Swanwick, R., & Marschark, M. (2010). Enhancing education for deaf children: Research into practice and back again. *Deafness & Education International*, *12*(4), 217–235. http://doi.org/10.1179/1557069X10Y.0000000002

Swanwick, R., & Tsverik, I. (2007). The role of sign language for deaf children with cochlear implants: Good practice in sign bilingual settings. *Deafness and Education International*, *9*(4), 214–231. http://doi.org/10.1002/dei.226

Thompson, R. L., Vinson, D. P., Woll, B., & Vigliocco, G. (2012). The road to language learning is iconic: Evidence from British Sign Language. *Psychological Science*, *23*(12), 1443–1448. http://doi.org/10.1177/0956797612459763

Woolfe, T., Herman, R., Roy, P., & Woll, B. (2010). Early vocabulary development in deaf native signers: A british sign language adaptation of the communicative development inventories. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *51*(3), 322–331. http://doi.org/10.1111/j.1469-7610.2009.02151.x

Zarfaty, Y., Nunes, T., & Bryant, P. (2004). The performance of young deaf children in spatial and temporal number tasks. *Journal of Deaf Studies and Deaf Education*, *9*(3), 315–326. http://doi.org/10.1093/deafed/enh034