



25 May 2011

SUBJECT: THE RECOGNITION OF ITALIAN SIGN LANGUAGE

To: Members of the Chamber of Deputies, Members of the Parliament, and to Representatives of the Italian Government,

On behalf of researchers and scientists involved with the Science of Learning Center on Visual Language and Visual Learning, based at Gallaudet University, in Washington D.C., we are composing an open letter concerning the recent events in Italy.

We wish to take this opportunity to explain the research work our center does and the importance of recognizing Italian Sign Language as both a legitimate, full-fledged human language, and the official language of the Italian Deaf Community.

The National Science Foundation supported Science of Learning Center on Visual Language and Visual Learning (VL2), established in 2006, is a research center dedicated to the study of visual learning and cognition processes, visual language uses, and how they impact learning.

Decades of linguistic research, since the 1960s, on signed languages have set a strong foundation for our center. Sign languages have a complex set of grammatical properties and are richly spatial. In other words, sign languages are multi-dimensional by nature.

Our research has shown that deaf individuals' brains are naturally designed to acquire a real language (signed or spoken) from birth. There is no difference in brain activity of deaf or hearing children in acquiring a language – signed or spoken. For visual learners, in this case--Deaf children--sign language plays a crucial role in providing the linguistic foundation for normal cognitive development. A strong first language acquisition can lead to strong second language acquisition, and VL2 research has shown the advantages of bimodal bilingualism for deaf and hard of hearing children.

Our global team of researchers cannot emphasize enough the importance of understanding visual learning to better understand the cognitive effects of acquiring a visual language and maximizing exposure to a fully structured language--which in this case is Italian Sign Language--to ensure full access to language and education.

In addition, recognizing the official status of sign languages goes in accordance with the United Nations Convention on the Rights of People with Disabilities: Article 2, 9, 21, 24, and 30. The Articles clearly define that a language can be either “spoken or signed,” and encourages countries to accept and facilitate the use of sign language, as well as recognize and promote the use of sign language. It is a human right for a Deaf person to have full linguistic access.

It is of utmost importance to recognize Italian Sign Language to ensure a successful bilingual education for Deaf children in Italy.

Visual Language and Visual Learning is committed in understanding the biological, psychological, cognitive, socio-cultural, and pedagogical ways of visual learning and the uses of visual language.

Again, we support the recognition for official status of Italian Sign Language.

Sincerely,



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Attached

Research Brief No. 1: The Importance of Fingerspelling for Reading

Research Brief No. 2: Advantages of Early Visual Language

Research Brief No. 3: Visual Attention and Deafness

Research Brief No. 4: Reading Research and Deaf Children



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VISUAL LANGUAGE & VISUAL LEARNING RESEARCH BRIEF:



THE IMPORTANCE OF FINGERSPELLING FOR READING

JULY 2010



LEARNING FROM RESEARCH

1

Key Findings on the Importance of Fingerspelling for Reading:

- Deaf families fingerspell to their deaf children when they are very young.
- Early exposure to fingerspelling helps these children become better readers.
- Fingerspelling, reading, and writing are interrelated.
- Fingerspelling facilitates English vocabulary growth, and larger the lexicon, the faster new vocabulary is learned.
- Fingerspelling positively correlates with stronger reading skills. Deaf and hard of hearing children who are good fingerspellers are good readers, and vice versa.

Fingerspelling and American Sign Language

On the most simplistic level, fingerspelling can be defined as the use of handshapes to represent letters of the alphabet. Indeed, before the complexity of fingerspelling was documented, researchers thought fingerspelling was merely a manual representation of English orthography (print).¹ They believed fingerspelling was primarily for representing proper nouns or for English words without a sign equivalent.^{2,3} This form of fingerspelling is referred to by Padden as neutral fingerspelling.⁴ Fingerspelling, though, is complex and integrates American Sign Language (ASL) in systematic ways; it is not just a system to borrow English words.^{5,6,7} While fingerspelling can be neutral, it can also expand the ASL lexicon (vocabulary) through the use of abbreviations, two-word compounds, initialized signs, fingerspelled compounds, and through the process of lexicalization (see appendices).

Fingerspelling and Classroom Instruction

Native ASL signers use fingerspelling for 10-15% of their signed discourse, depending on the topic.⁸ In addition, deaf teachers use over 50% more fingerspelled words than hearing teachers during classroom instruction.⁹ Padden found that hearing L2 learners of ASL, including classroom teachers, tended to use neutral fingerspelling almost exclusively; as a result, children in these settings often miss the advantages of more advanced forms of fingerspelling.⁴

Deaf Families, Fingerspelling, and Reading

Deaf families fingerspell abundantly when communicating with their young children because they understand the important role that fingerspelling plays in visual learning. At 24 months of age, deaf children with deaf parents have vocabulary sizes that are comparable to that of

hearing children who are learning a spoken language.¹⁰ Additionally, older deaf and hard of hearing children from deaf families tend to read at higher levels than deaf and hard of hearing children from hearing families.¹¹ Fingerspelling likely contributes to this success. Unfortunately, young deaf and hard of hearing children from hearing families are not generally given the same early learning opportunity. Indeed, the absence of fingerspelling is particularly evident in preschools for deaf and hard of hearing children.⁹ To understand the role of fingerspelling in language acquisition and later literacy, it is important to understand how fingerspelling is naturally acquired by deaf and hard of hearing children with deaf families.

When do deaf children acquire fingerspelling?

Deaf children of deaf parents can begin to sign as early as eight months.¹² Early attempts at fingerspelling appear around 13 months of age^{13,14,15,16,17,18,19} with the first fingerspelled word appearing as young as two years of age.^{15,17,18} Young deaf children do not pay attention to the execution of each individual handshape in the given fingerspelled word. Instead they perceive fingerspelled words as whole units or signs.²⁰ Akamatsu coined the term *movement envelope* to describe the movement of the hand while fingerspelling.¹³ Deaf children's recognition of this movement envelope corresponds with their acquisition of signs. Deaf children in deaf families have also been observed to use sequences of three or four signs at two years of age.^{12,14,21} This early visual language development in deaf children is similar to early spoken language development in hearing children. The developmental stages and trajectories of fingerspelling have been documented (see appendices).

Fingerspelling and Reading

Grushkin stated that fingerspelling provides a linguistic link to English vocabulary and syntax.²⁴

Certainly, the importance of fingerspelling in the education of deaf and hard of hearing children has been documented in the literature.^{4,9,18,19,23,25,26,27,28,29,30,31} One comprehensive study, conducted by Padden and Ramsey, investigated reading ability and specific language skills of deaf students in third through seventh grade.⁹ The results revealed that knowledge of specific ASL structures, including fingerspelling, correlates with reading achievement. In this study, children who scored better on reading tests were competent in *associative skills*, such as the ability to write down words that were fingerspelled to them as well as the ability to translate initialized signs. Looking specifically at performance on the fingerspelling tasks, fingerspelling ability significantly correlated with reading comprehension: “better readers...were better at recognizing fingerspelled words and writing them down in print” (p. 185).

Fast Mapping New Vocabulary

Several findings have emerged from studies on the relationship of fingerspelling and vocabulary growth. As typically developing children move toward preschool age, they start learning new words on their own.³² This rapid word learning is attributed to fast mapping, which involves cognitive processes whereby new concepts are learned based only on brief exposure to a given unit of information.³³ Studies on word-learning abilities in deaf and hard of hearing preschool children indicate that word-learning abilities were related to the size of the children’s expressive vocabulary but not their chronological age.^{34,35} Regardless of the communication modality and the hearing status of the parents, performance was strongly related to the number of vocabulary words the children had in their lexicon. That is, it is the size of the vocabulary that makes indirect word learning relatively easy. In another study, students who had higher reading levels performed better at fast mapping fingerspelled words than those students who had lower reading levels.³¹

Haptonstall-Nykaza & Schick found that students’ retention of new vocabulary increased when lexicalized fingerspelling was added to instruction.³⁶ Furthermore, Hile’s work revealed a strong relationship between fluency in fingerspelling, reading, and vocabulary skills.²⁶

The research is clear that fingerspelling, reading, and writing skills are intertwined and that they converge for deaf children, who have early access to visual language, around the third grade.⁴ The convergence of these skills facilitates literacy development in deaf and hard of hearing children, allowing them to achieve reading levels that exceed the historically low norms.

Integration of Research in Education

The VL2 center publishes research briefs as a resource for educators and parents. The goal is to inform the education community of research findings, to summarize relevant scholarship, and, to present recommendations that educators and parents can use when addressing the multifaceted challenges of educating deaf and hard of hearing children.

The information provided in this brief is intended to clarify the importance of fingerspelling in the early language development of deaf and hard of hearing children. In addition to the research brief, appendices have been created that provide supplementary information for educators to share with families or to use when integrating fingerspelling into classroom practices. The appendices address:

- *Instructional Strategies for Using Fingerspelling*
- *The Developmental Process in Fingerspelling Acquisition*
- *Expanding the ASL Lexicon through Fingerspelling*

Research briefs are available at vl2.gallaudet.edu or on the VL2 Public Wiki.

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RESEARCH BRIEF: FINGERSPELLING

Appendix A.

Instructional Strategies for Using Fingerspelling

Instructional Strategies for Using Fingerspelling

Deaf teachers use visual strategies for incorporating fingerspelling into classroom instruction. Studies on these visual strategies show that they are a natural part of classroom interaction and are used to promote greater understanding and retention of academic material.

Three such instructional strategies for using fingerspelling are as follows:

Chaining

Chaining is used for introducing new concepts or new vocabulary terms. Chaining creates associations by connecting signs, fingerspelling, and the printed/written word in a sequence, with one format reinforcing the previous one. Through chaining, the teacher provides multiple ways for the students to learn the word and concept. In addition, teachers may use objects, pictures, or multimedia to reinforce the concepts.

For example, when teaching the word, tornado, a teacher might choose one of the following sequences:

- 1) Point to the word tornado written on the board;
- 2) fingerspell T-O-R-N-A-D-O; and
- 3) sign TORNADO.

Or:

- 1) Fingerspell T-O-R-N-A-D-O;
- 2) sign TORNADO; and
- 3) write tornado on the board.

Sandwiching

The sandwiching technique alternates between fingerspelling and signing. This method also reinforces the equivalency of ASL and English.

- 1) Fingerspell T-O-R-N-A-D-O;
- 2) sign TORNADO; and
- 3) fingerspell T-O-R-N-A-D-O again.

Or:

- 1) Sign TORNADO;
- 2) fingerspell T-O-R-N-A-D-O; and
- 3) sign TORNADO again.

Lexicalized Fingerspelling

Lexicalized fingerspelling transforms the fingerspelled word into a sign-like visual image. Deaf teachers often use this technique; first, they produce a neutral version of a fingerspelled word, and then follow that with a lexicalized version. This process supports visual memory and facilitates retention.



Common Fingerspelled Loan Signs

#BANK	#BACK	#OFF	#ON	#IF
#SALE	#EARLY	#BUT	#BUS	#CAR
#WHAT	#DO	#SO	#OK	#JOB
#YES	#NO	#DOG	#TOY	#FIX

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RESEARCH BRIEF: FINGERSPELLING

Appendix B.

The Developmental Process in Fingerspelling Acquisition



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Typically fingerspelling and American Sign Language acquisition occurs simultaneously; however, this chart (see back page) focuses upon approximate developmental trajectories for fingerspelling.

Stage One

The earliest handshapes produced by deaf and hard of hearing toddlers use the whole hand; more complex handshapes are developed later as dexterity improves. Substitution of visually similar handshapes in the place of more complex ones is common in young children. In addition, transitioning between some letters (e.g. D and R) requires the more advanced motor skills acquired at a later age.

When ready for preschool, children exposed to ASL from birth know which vocabulary words to fingerspell, such as names of people, places, and simple proper nouns. Signing children are developmentally ready to understand how fingerspelling represents printed English. It is during this time that children begin to explore the relationship between fingerspelled handshapes and the printed letters.

Stage Two

The second stage of fingerspelling development focuses on a shift of attention to individual letters when attempting to fingerspell. Deaf children in this stage become aware of individual letters, and this is similar to the development of the alphabetic principle in hearing children. This occurs around four years of age for deaf children of deaf families. The children, though, often have handshape substitutions (5 handshape for W). Stage two continues until approximately third grade for children with early access to visual language, but it can continue until later for children who did not have the advantage of early fingerspelling.

Stage Three

The third stage of fingerspelling development is when the child has finally mastered neutral fingerspelling, including the appropriate handshapes in the correct sequence with correct movement. In this stage, which occurs around third grade for native signers but can continue to adolescence, there is a convergence of skills or fingerspelling synthesis when the child is able to

8-12 months	12-24 months	24-36 months	36-48 months	48+ months
Finger babbles in response to conversations.	Uses simple handshapes to form signs, mostly whole-hand letters and numbers/ handshapes: B, C, O, A, S, 1 and 5.	Uses handshapes of increasing complexity, such as L, G, F, Q, D, Z, Y, I, and J, to form signs.	Uses more handshapes of increasing complexity, such as V, H, W, U, T, H, K, P, X, Y, R, E, M, and N to form signs.	Begins development of the alphabetic principle by learning that lexicalized signs are made of handshapes.
First signs may appear.	Perceives fingerspelled words as a whole unit, known as a <i>movement envelope</i> .	Understands simple fingerspelled words (own name, pet's name, etc.).	Uses lexicalized signs abundantly, e.g. BUS, TV, and NO.	
Uses pre-linguistic gestures.	Early attempts at fingerspelling, sometimes to self.	Uses lexicalized fingerspelling to spell own name and names of others.		
	Begins using lexicalized fingerspelling.			

fingerspell a word, write the word, and understand the word when someone else fingerspells it. That is, reading, writing, and fingerspelling are integrated to the extent that each supports the other.

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Affiliated Universities





RESEARCH BRIEF: FINGERSPELLING

Appendix C.

Expanding the ASL Lexicon Through Fingerspelling

A unique feature of American Sign Language is how fingerspelling expands the lexicon.

Lexicalized fingerspelled signs include nouns, verbs, adjectives, conjunctions, interjections and wh-words.

Neutral Fingerspelling

Commonly fingerspelled English words, such as proper nouns (e.g., names of people, cities, companies, brand names, and technical terms), are referred to as *Neutral Fingerspelling*. Hearing L2 learners of ASL, including classroom teachers, tend to only use this type of fingerspelling.

Abbreviations

ASL integrates abbreviations or shortened words. Examples of abbreviated signs are “A-P-T” for apartment and “R-E-F” for refrigerator. Interestingly, some state abbreviations that were lexicalized in the past (e.g., OKLA for Oklahoma) are still used instead of the two-letter abbreviations.

Lexicalized Fingerspelling

New signs are created through a process where fingerspelled words are altered or lexicalized to become more sign-like. Commonly referred to as *loan signs*, these signs sometimes omit letters (#JOB) while others blend the handshapes seamlessly (#BUS). Through this process, a loan sign is formed.

Two-Word Compounds

Two-word compounds in English can be represented through the use of an ASL sign that incorporates the handshapes corresponding to the first letters of the English words, such as in BOAD OF TRUSTEES and SOcial-WORK.

Initialized Signs

An initialized sign uses the handshape that corresponds to the first letter of a written word (e.g., **U**NIVERSITY). Some common initialized signs are items in a category, such as colors. Another commonly initialized group of words are those words associated with a concept or cluster, such as **G**ROUP, **C**CLASS, **F**FAMILY; these share the same location and movement, but the initialized handshape varies.

Signed-fingerspelled Compounds

Signed-fingerspelled compounds are another example of how fingerspelling is integrated into ASL. With this category, usually the first segment of a compound is signed while the second segment is fingerspelled (e.g., BLACK+M-A-I-L).

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VISUAL LANGUAGE & VISUAL LEARNING RESEARCH BRIEF:

ADVANTAGES OF EARLY VISUAL LANGUAGE

JANUARY 2011



LEARNING FROM RESEARCH

2

Key Findings on the Advantages of Early Visual Language:

- The brain is most receptive to language acquisition during “sensitive periods” early in a child’s development.
- Deaf and hard of hearing children who receive early intervention services have been found to have better language outcomes up to age five.
- High levels of family involvement have been found to produce greater language development outcomes in deaf and hard of hearing children.
- Acquiring a complete first language during early childhood is critical for later reading comprehension.
- Learning two languages [that is, American Sign Language (ASL) and English] is advantageous for deaf and hard of hearing children.
- A mother’s signing skills are predictive of later language development in deaf or hard of hearing children.
- A language foundation is an important factor in spoken language development.

Early Hearing Detection and Intervention

For almost twenty-five years, since the passage of PL 99-457 in 1986, young deaf and hard of hearing children and their families have received early intervention services. Age of identification has been found to be an important factor; therefore providers of early identification and intervention services aim to screen, diagnose, and provide services by 6 months of age.^{1,2,3,4} However, early language acquisition is not necessarily a medical event. Early language intervention requires specialists who are knowledgeable of both visual and spoken language development. They work with families to make informed communication and educational decisions.

Over the past 20 years, numerous studies have consistently found that the earlier hearing loss is identified and the earlier intervention services are initiated, the more positive the outcomes will be for language development.^{1,2,3,4,5,6,7} In a recent study, deaf and hard of hearing children who received early intervention services prior to three months of age had better language outcomes.⁸ Certainly, during infancy and early childhood, sensitive periods for language acquisition correlate with the brain's development.⁹ Additionally, early identification has been found to moderate factors that previously had negative effects on language development: for example, socio-economic status, family ethnicity, and the presence of additional disabilities.^{1,3,7}

Multiple Pathways to Language Learning

Each deaf child acquires language in his or her own unique way. Level of hearing loss, cause of hearing loss, age when hearing loss occurred, the extent of benefit from hearing technologies, presence of additional disabilities, and family dynamics vary from child to child. Multi-sensory approaches to language acquisition ensure that when one pathway is less effective, another pathway can be used as

an avenue for language learning. Early research in bilingual education found cognitive benefits from learning two languages; bilinguals have been reported to have greater cognitive flexibility and greater sensitivity to linguistic meaning than monolingual children.^{10,11,12} Deaf children can experience similar cognitive benefits from learning American Sign Language and a spoken language through print and listening and speaking when appropriate.¹³

Academic Performance of Deaf and Hard of Hearing Students

Early language has ramifications for academic achievement. Deaf and hard of hearing children underperform in comparison with hearing children of similar ages in most content areas, and especially in the area of reading.^{14,15,16} This is a long-standing trend that has not changed regardless of the use of various communication methodologies and the invention of new hearing technologies.¹⁷ Despite uneven outcomes,¹⁸ some cochlear implant teams are now advising families of children with implants to participate only in auditory-verbal therapy, and in doing so, are ignoring the enormous potential of a visual pathway to learning.¹⁹ The lack of early and fully accessible visual language exposure may be a contributing factor to the low levels of reading achievement in the deaf population.^{13,14,15,16,20,21,22}

Delay of language acquisition can have negative consequences on cognition, academic achievement, and social and emotional health.^{13,17,18,23,24,25}

In contrast to children using auditory-verbal therapy, most children from deaf families enter school ready to learn because as infants and toddlers they acquired a complete first language through communicating with family members who are fluent in ASL.²⁶ These children tend to perform similarly to what is expected of hearing children at the same age.⁸ Given signing adult language

models, deaf children with hearing parents can also acquire visual language competence and become literate.^{13,27}

The Advantage of Early Visual Language

Delay in the acquisition of a first language produces poorer language performance,^{28,29,30,31} regardless if the language choice is a signed language or a spoken language.⁹ In addition, without access to a complete linguistic code during early development, it is difficult for deaf and hard of hearing children's language acquisition to parallel that of hearing children.³²

Fortunately, the language areas of the brain have no preference for language input.^{24,33,34} The most accessible pathway for full access to linguistic information for many deaf children is through vision.¹³ Visual languages such as American Sign Language are natural language systems.^{9,20} Visual languages are not merely signs that represent spoken language; they function independently from spoken languages and have fully developed grammatical systems.³⁵

Some innovative early intervention programs have recognized the need for early visual language learning in children receiving implants. In one such program, a study revealed that children who were exposed to sign language while waiting for cochlear implants developed receptive language: they understood comments, questions, explanations, commands, and they were signing simple phrases.³⁶ In these programs, children achieving the most effective language outcomes signed early, suggesting that having access to early language, regardless of the modality, can provide a base on which skills in a different language modality can be built.^{36,37} After implantation, these children developed spoken language. The sign lexicon that the children acquired before implantation most likely facilitated rapid mapping onto speech.^{36,37,38}

Signed Language and Spoken Language Development

Early language experiences create the ability to learn throughout the lifespan, regardless of the mode of communication.⁹ Signed language is sometimes withheld from deaf children in the belief that it interferes with speech development.¹⁹ However, there is no evidence that using a signed language with deaf and hard of hearing children impedes spoken language development.^{19,39} Rather, spoken language skills increase as children learn more gestures and signs.^{25,40,41} Proficiency in ASL has been shown to positively influence spoken language development and the development of English literacy in deaf students.^{16,42,43,44} It is language that facilitates spoken language, not the mode of communication.⁴⁵

Benefits of Bilingualism

There are linguistic and educational benefits of learning two languages (for example, American Sign Language and spoken/written English).⁴⁶ Deaf children can acquire two languages simultaneously when adult language models follow language allocation strategies, where the amount of exposure to a spoken/written language is increased as the child acquires first language competence.⁴⁷ ASL, in many cases, functions as a first language or (L1), which supports the acquisition of spoken/written English as a second language (L2). On the whole, bilingual research has shown that fluency in a first language is a strong predictor of second language skill; competence in a second language is a function of proficiency in a first language.^{48,49}

Family Involvement

Family involvement is a critical factor in the language development of deaf and hard of hearing children, especially those with hearing parents.² It is important to note that high levels of family involvement produce higher language outcomes.² In addition, maternal signing skill appears to be another powerful indicator that results in better

language performance in deaf and hard of hearing children.^{6,18} Further, these factors have been found to buffer the negative effects of late enrollment in early intervention programs.²

Integration of Research in Education

VL² publishes research briefs as a resource for educators and parents. The goal is to inform the education community of research findings, to summarize relevant scholarship, and to present recommendations that educators and parents can use when addressing the multifaceted challenges of educating deaf and hard of hearing children.

The information provided in this brief is intended to clarify the importance of early visual language development in deaf and hard of hearing infants and toddlers.

Research briefs are available at vl2.gallaudet.edu.

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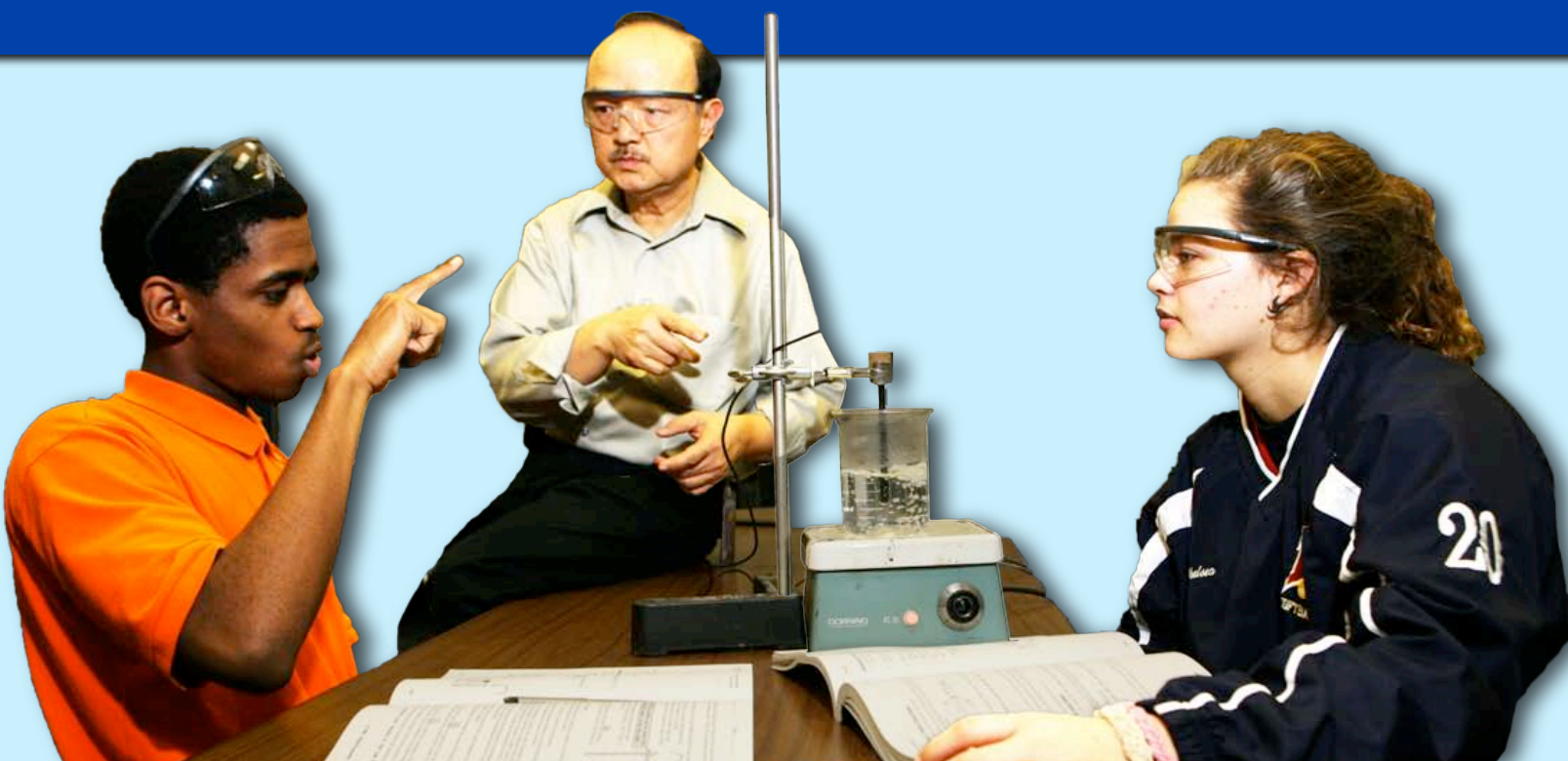
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VISUAL LANGUAGE & VISUAL LEARNING RESEARCH BRIEF:



VISUAL ATTENTION AND DEAFNESS

MAY 2011



Photos courtesy of Model Secondary School for the Deaf

Key Findings on Visual Attention and Deafness:

LEARNING FROM RESEARCH

3

- Deafness leads to changes specifically in visual attention, but not in all aspects of vision.
- Deafness enhances visual attention in the periphery.
- Evidence for changes to visual attention in the periphery can be observed in the brain.
- Changes in visual attention could have implications for reading and the ideal classroom environment.

Visual Selective Attention and Deafness

A common concern among parents and educators of deaf children is that they seem easily distracted and hard to keep focused in a busy environment. This observation is essentially describing a problem with visual selective attention. Visual selective attention refers to the ability to pay attention to things that are relevant to current goals while ignoring distractions that are not pertinent. In an educational setting, selective attention means that an individual is able to focus upon a teacher or interpreter while ignoring a bird flying by a window or a student walking by an open classroom door.

A Problem, or just a Different Way of Seeing?

There is some seemingly contradictory evidence in the literature on the effects of deafness on visual attention, but this discrepancy is largely a result of studying different deaf populations and also using different measures of visual selective attention. Individuals in the deaf population are quite diverse in regards to their preferred type of communication (sign language, oral communication, etc.), the age of acquisition of their native language, the hearing status of their parents, their hearing loss etiology (genetic, infection, etc.), and cochlear implant use (age of implantation and years of use). Most of the research suggesting that deaf children have problems with selective attention have focused on deaf children learning spoken language; these studies have looked at how their visual selective attention changes after restoration of auditory input through a cochlear implant.^{1,2,3}

Rather than thinking about the attention of deaf individuals as a concern, several researchers have come to think about this issue from a different perspective: not as a problem, but rather as a different way of processing visual information. There is mounting data that shows improved performance in visual attention in deaf individuals;

this data suggests that the visual system compensates for the lack of auditory input.⁴

Studies reporting better visual selective attention skills have been conducted with deaf adults, specifically those born to deaf parents and who acquired American Sign Language (ASL) as a first language. This is a good population to study the effects of deafness because deaf children who have early and full access to language have typical cognitive and language development from birth and reach the same milestones as hearing children. In these individuals, VL2 researchers Matthew Dye, Peter Hauser, and Daphne Bavelier--among others--have reported enhancements in selective attention in the visual periphery.⁵ This finding suggests that the visual system compensates for the lack of auditory input by enhancing the monitoring of the peripheral visual field.⁴

While deaf individuals do display differences in visual attention, it is important to note that not all aspects of vision are different in deaf and hearing people. Purely sensory visual abilities, like the ability to discriminate shades of gray,⁶ the ability to distinguish between quickly flashing items,⁷ and basic visual motion processing^{8,9} are similar in both deaf and hearing individuals.⁴ This finding dispels the widely-accepted idea that loss of hearing leads to changes in abilities in other senses. Vision does not change—visual attention does.

Changes to Visual Attention in Time and Space

Visual selective attention has more than one component.¹⁰ For example, we can pay attention to areas in the visual field (spatial attention) or allocate our attention for a period of time (temporal attention). A series of studies conducted by VL2 researchers have demonstrated how these abilities change throughout development in deaf individuals.

Most studies that report a visual attention deficit in deaf children have examined *temporal* visual attention in children who have cochlear implants

and who are also learning English. In contrast, VL2 researchers, Dye, Hauser, and Bavelier looked at changes in temporal *and* spatial visual attention at different stages of development of deaf native signers.

Tests of temporal visual attention are important in assessing one's ability to monitor the environment and remain alert, even after one's attention has been used on something else. These tasks measure important abilities for everyday skills like driving or navigating in a busy scene. Early in development, native signing children (up to age 10) are less able than age-matched hearing controls to monitor and identify specific predetermined targets when they appear in a constant stream of objects.⁵ However, this deaf-hearing difference is not observed in adulthood (ages 18-40). In another test of temporal visual attention, participants were required to identify the second of two objects presented *extremely* quickly in succession (a test of *recovering* attention in time); in this test, there were no group differences between deaf and hearing individuals in either age group. These studies highlight the specificity of changes in visual attention: difficulties are limited to early childhood and are only observed when identifying pre-specified targets in a rapid stream of visual information.

Studies of spatial visual attention tell a different story. Enhanced spatial visual attention, or the redistribution of attention towards the periphery of the visual field, occurs quite slowly. When asked to focus on the center of the screen and to respond as quickly as possible to a target near the center or the periphery, elementary school age deaf children (7-10 years old) still perform similarly to their hearing peers.¹¹ The redistribution is observed around 11-13 years old and becomes marked around 14-17 years of age.¹¹ At that age, deaf individuals have a selective enhancement for detecting static or moving stimuli in the periphery.^{12,13} Accordingly, they are also more affected by distracters in the periphery.^{14,15} While greater distractibility typically reflects an attention deficit, in

the case of deaf individuals it arises from greater processing resources allocated to the periphery.

Deaf individuals are not necessarily more distractible but are more distracted by peripheral events; hearing individuals are more distracted by central events.¹⁴ These effects of enhanced peripheral attention in deaf individuals may even be intuitive. In order to adapt to the environment, a redistribution of visual attention to the periphery can compensate for the lack of peripheral auditory cues, such as what a hearing person would experience when a car approaches or someone opens a door.¹⁶

When using deaf native signers as the target population, it is always important to be able to dissociate potentially separate effects of deafness and sign language use. By comparing both deaf and hearing native signers, it has been confirmed that the peripheral attention benefits seen in deaf native signers are due to deafness and not sign language use; hearing native signers do not show the same effects of greater visual attention in the periphery, but deaf non-signers do.^{11, 14, 17, 18}

The reasons for possible early deficits in visual attention are harder to determine. Possible explanations include poor early access to a natural language, a situation that produces complex cognitive effects, but determining this would require comparing native signing children to deaf children with a language delay. Perhaps a more likely explanation is an early period of reorganization of the visual system. During this period, attention to the central visual field is sacrificed for peripheral attention, with later development leading to an improvement in the central visual field resources--to typical functioning level--all the while maintaining the peripheral advantage. Ongoing research, supported by VL2, is testing this latter hypothesis by looking in detail at visual selective attention across time and space in 6-13 year-old deaf, signing children and their hearing peers.

Cross-modal Plasticity and the Brain: How Deafness and Sign Language Change Brain Organization

Cross-modal plasticity refers to neural reorganization that occurs due to sensory deprivation. Reorganization due to deafness could take place in the “deprived” parts (e.g. auditory areas) or the non-deprived parts (e.g. visual areas) of the brain. Because enhanced peripheral visual attention is observed in deaf individuals, researchers have investigated how these differences are realized in the brain. Neurological data does, in fact, mirror behavioral evidence that there are differences between deaf and hearing for visual attention tasks in the periphery, but only for *attended* stimuli. For example, when told to pay attention to motion in the periphery, deaf individuals display greater neural responses¹⁹ and greater recruitment of motion processing areas in the brain,¹⁸ whereas deaf and hearing have equivalent neural responses to *unattended* moving objects.²⁰

There are several theories as to how the brain might reorganize that could account for the behavioral data. The *first* theory is that there could actually be changes in early visual areas, those parts of the brain that process perceptual visual information received from the eye (and thus not necessarily affected by attention). However, the literature does not support this notion,²¹ as deaf and hearing individuals show no difference in size or activity level in such areas. The fact that there are no purely perceptual behavioral differences between deaf and hearing individuals is consistent with these results.

A *second* theory is that the areas of the brain where information from different modalities is integrated may get greater input from vision. This gains some

support from data showing changes in such 'multimodal' areas in deaf individuals,¹⁸ but more research is needed to strengthen this view.

A *third* theory is that the deprived auditory brain areas reorganize in order to better process visual information. Greater activation in auditory brain regions has been reported in deaf individuals for visual, tactile and sign language processing.^{22,23} Moving visual stimuli activate right hemisphere 'auditory processing areas' in deaf individuals²³ in a region that is specialized for processing auditory motion in hearing individuals.²⁴ The idea is that the same brain area that is typically involved in a distinct function in one modality (e.g. processing of motion in the environment through the auditory modality) can be used for the same function, but in a different modality (e.g. motion, but this time in the visual modality). This shift happens after sensory deprivation--a hypothesis supported by animal literature.²⁵



Relevance to Parents and Educators

There are several take-home messages here for those interacting with deaf individuals on a daily basis.

Ideal Learning Environment

Current research proposes that deaf children have a difference in attentional allocation that is slow to develop. For that reason, the classroom environment that is good for one grade level may not be appropriate for another. Problems could arise when demands of the environment or task (e.g., looking at a teacher or interpreter) conflict with the default allocation of attention for whatever stage of development a deaf child is in. For example, later in development (starting around age 11) more allocation is given to the periphery when the timing and location of distractions are unknown. For this age group, placing students in areas where distractions are unlikely, but inconsistent, may

actually be counter-productive because they would be constantly using attentional resources to monitor the periphery. A beneficial learning environment for such students would be one with predictable and consistent surroundings. Additionally, small class sizes and having the students sit in a semi-circle may also be beneficial.¹⁶

Effects of Changes to Visual Attention on Reading

In addition to the multitude of reasons why reading English is a complicated challenge for deaf children, changes to visual attention in deaf individuals may also have implications for how they read.²⁶ Research in hearing individuals tells us that reading involves using the center of our visual field to fixate on words. If deaf individuals naturally pay more attention to items in the periphery, this may result in confusion in identifying letters and words, longer fixations, and slower reading times. This extra time may also result in taxing other cognitive processes like memory in order to fully integrate all of the information in a complicated sentence. A 'windowed reading' technique, where words are visually presented in smaller chunks, has been suggested as a good technique for limiting distracting information in the periphery. While more research is needed, it is useful to keep in mind possible additional challenges for deaf readers that are related to changes in visual attention.

Unanswered Questions and Future Research

- Taking into account new knowledge of what is normal attentional development in deaf signers, how should psychological evaluations in the deaf population be conducted and/or altered?
- How can teachers and educational administrators for deaf individuals take into consideration the unique strengths of deaf individuals when developing teaching strategies and curricula?
- Because this research brief has focused on the deaf native signing population, it is important to research how generalizable the reorganization

observed in deaf signers is to the remaining 95% of the deaf community who are born to hearing parents. Typically, this larger percentage of deaf individuals are not raised with access to fluent users of ASL during infancy and early childhood.

Integration of Research in Education

VL² publishes research briefs as a resource for educators and parents. The goal is to inform the education community of research findings, to summarize relevant scholarship, and to present recommendations that educators and parents can use when addressing the multifaceted challenges of educating deaf and hard of hearing children.

Research briefs are available under Publications & Products at vl2.gallaudet.edu.

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VISUAL LANGUAGE & VISUAL LEARNING RESEARCH BRIEF:



READING RESEARCH & DEAF CHILDREN

JUNE 2011

LEARNING FROM RESEARCH

4

Key Findings on Reading Research and Deaf Children:

- Early diagnosis and intervention support better reading outcomes.
- A strong language foundation (regardless of the language or modality) is important for reading success.
- Parental fluency in the language or communication mode of the child is critical.
- Parental involvement in the child's academic environment is important for academic success.
- In order to read, a child must develop word recognition, and there are multiple routes for relating print to meaning.
- In developing advanced reading skills, phonology appears to be important for some, but not all, deaf children.
- Phonological coding and awareness skills are a low-to-moderate predictor of reading achievement in deaf individuals.
- Deaf children with deaf parents tend to have an enriched language environment. In consequence, deaf children of deaf parents tend to read better, but given consistent and rich language access, deaf children from hearing parents can catch up.

“Why can’t Johnny read?”

This question has been asked, time and time again, about American children in general, but it is even more relevant when talking about deaf children, whose average reading level by age 18 has remained relatively stable at the third to fourth grade level for more than half a century.^{1,2,3,4,5,6,7} Most studies have shown that children with more residual hearing tend to have better reading and academic outcomes than those with less hearing, but that even a mild hearing loss affects reading outcomes.^{8,9} Nevertheless, despite these depressing statistics, many deaf people do become skilled readers, earning bachelors’ degrees and graduate degrees.

These conflicting outcomes suggest two questions. First, why do most deaf children struggle to learn to read and develop such limited literacy in English? Second, given this situation, how are other deaf children able to develop advanced reading skills? It is possible that answering these two questions will help us to understand how to bring the first group closer to the outcomes of the second. The goal of this brief is to summarize the research related to deaf readers and to identify key findings that impact the development of fluent reading skills in deaf children and particularly those findings that involve alternate pathways to reading success.

It is estimated that over 90 percent of deaf children are born to hearing parents and as few as four percent of deaf children have at least one deaf parent.¹⁰ Despite early exposure to hearing parents’ spoken English, intervention programs, and technology such as digital hearing aids and cochlear implants, the majority of deaf children continue to struggle to develop age-appropriate English skills, particularly in the area of complex grammar and syntax.^{11,12} Much of the research suggests that deaf children parallel hearing children in early literacy skills, but many do not make the transition to later stages of literacy development.

13,14

Sound versus Print-based Word Recognition

Much of the research related to reading and deaf children (and adults) has focused on the child’s ability to recognize, or decode, individual words. Relating words to meaning is important, as it is difficult to understand what is being read if even 10 to 20 percent of the words in the text are not recognized. Research with hearing readers has suggested a dual route to single word decoding.¹⁵ The indirect phonological, or sound-based, route involves the relationship of the letters in the word to sounds (e.g., “sounding out” the word). This process is slower, but allows the child to recognize words they have never seen before in print (or don’t know well).

The direct lexical, or print-based, route depends on whole word recognition. It is fast and works with words that do not follow phonological rules (e.g., “yacht”), but the child must already know the word in its printed form for this route to work. The general assumption is that hearing children use the phonological route for unfamiliar words and the direct route for familiar words.¹⁶

Do Deaf Children Use Phonological, or Sound-based, Decoding?

Many researchers have focused on phonological awareness (PA) and decoding as a key component of reading even for deaf readers, and a number of reviews of the literature have concluded that adult deaf readers can and do use phonology to support decoding of print.^{17,18,19,20,21,22} Deaf and hard of hearing children have been found to access phonological awareness and decoding skills through speech-reading, Total Communication, reading, and kinesthetic feedback associated with fingerspelling and speech movements.^{21,23,24,25,26,27,28}

Studies of cochlear implant users have suggested that the child’s early English language skills predicted development of both PA and later reading skills.²⁹ This suggests that for at least some deaf children, spoken language skill drives both PA and later reading skills. However, research with

cochlear implant users has also indicated that even those who rely on their hearing are able to access English better with sign (or as the case may be, visual supports for speech).³⁰

The relative benefit of the different routes of access appears to depend on the child's intrinsic abilities and needs, the language or communication methods used with and by the child, the educational focus, and so forth. Nonetheless, all children need early exposure to a rich, accessible first language, and for deaf children--even those who have access to auditory input through cochlear implants or hearing aids--this, by necessity, includes visual access.

Reading Comprehension Versus Word Decoding

Another study found that although some oral deaf children who use cochlear implants develop adequate English skills, in which case single word skills were generally strong, many children still had weaknesses in the complex language forms.¹² Because they involve more advanced word formation, grammar, and syntax, these complex language skills are important for advanced reading.
¹²

Even researchers who support a phonemic decoding approach to reading acknowledge that deaf children of deaf parents fluent in American Sign Language (ASL) have an early and rich language environment; this environment provides a foundation for reading, with the consequence that deaf children from deaf families generally read better than deaf children of hearing and non-signing parents.¹⁷ They note that literacy depends on the individual's skills with the morphology, semantics, and syntax of their primary language, *even when the primary language happens to be in the visual modality, as is the case with ASL*.¹⁷ Indeed, deaf children of hearing parents who attend sign-based schools and who develop ASL skills comparable to those of the children with deaf parents also appear to develop comparable reading skills.³¹

Alternate Routes to Reading Success

The data suggest that that while some deaf individuals may rely on PA, others use an alternate route to reading success. The preferential use of one or the other route may be driven by the child's language and educational history. For example, in one study in which all of the groups had comparable reading skills, deaf adults raised orally or using Cued Speech demonstrated PA comparable to hearing peers, and their PA skills were associated with their level of reading comprehension.³² Despite having comparable reading skill, the deaf participants who were raised using ASL did not show the same association between PA and reading comprehension seen in the other groups.³² This suggests that the ASL-fluent group is using an alternate route to reading success.

A consistent finding in the research is that a strong first language (L1) foundation (regardless of the language used for L1) is critical to reading success. A strong positive correlation has been found between bilingual abilities (in American Sign Language and English) and morphological knowledge (in both languages); indeed, VL² researchers have found that higher levels of syntactic and semantic knowledge are important for the acquisition of reading ability.³³ In the bilingual approach to reading, parents and teachers use American Sign Language (ASL) as the L1, and then the teaching of English literacy is based upon complex linguistic knowledge accessed through the first language.^{8,34,35}

Other studies have indicated that many deaf children demonstrate use of approaches based on fingerspelling, sign, or print-based (orthographic) codes.^{33,36,37,38,39,40,41,42} For example, some children may not recognize a word in print until they fingerspell it for themselves, at which point they are able to recognize the word and associate it with meaning. Other children directly associate the printed word with signs, which they then relate to meaning, and can be seen to "read out loud" by signing the text. Still others use the lexical route and relate the printed word directly to meaning.

Review articles have discussed various alternate decoding routes and the potential benefits and limitations of each for deaf readers.^{20,43}

Furthermore, a recent meta-analysis of the literature on phonological coding and awareness—a study supported by VL²—discovered that half of the studies found statistically significant evidence for PA, but half did not.³⁴ However, this figure was complicated by the fact that some of the studies that found evidence of PA did not include a measure of reading but only rhyme judgments or some other measure of phonology or, alternately, the studies did not fully account for the possibility of orthographic overlap.³⁴ This meta-analysis also suggested that PA only accounts for 11% of the variance in reading proficiency in deaf participants. When the relationship with reading outcomes was investigated, the child's language skill (either ASL or English) was the best predictor of reading success.^{34,44}

Other Factors in Reading Success

Studies that have investigated the factors important for reading success beyond single word decoding have found a number of factors to be critical for advanced reading skill development in deaf individuals. Clearly, having a strong foundation in a first language is critical, and studies investigating factors that predict better reading skills have also found that children with earlier diagnoses and greater vocabulary tend to read better.^{9,45}

Two factors that are commonly ignored are parental involvement in education and the child's comfort in communicating with teachers and peers; both affect academic and reading outcomes in deaf children.⁹ Parental involvement in the child's education has been cited as important for hearing as well as deaf children, and in the deaf child's case it may also reflect parental fluency in the primary language of the child, a critical skill for providing the child with an ongoing and enriched language environment. In addition, children need to be able to communicate freely with teachers and peers to participate fully in the classroom. This engagement with teacher and peers will affect motivation and involvement in learning, both of which are critical to academic

attainment. In an accessible classroom environment, the child is then more likely to develop both language and academic skill.

Regardless of the primary language of the child, a strong knowledge of the vocabulary and the syntax and grammar of the language of print are both (independently) critical for reading success.^{20,28,46,47,48} Deaf readers must be able to perform basic reading processes such as single word decoding automatically (without needing to spend effort thinking about it) in order to have the cognitive resources available to perform more advanced reading processes.⁴⁹ In deaf adults, even for weaker readers, the amount of reading completed for personal reasons predicts text comprehension, and intrinsic motivation was the best predictor of the amount of reading done.⁵⁰ Thus, an interactive relationship exists between the amount of reading and reading comprehension. This reinforces the need to encourage reading regardless of the level of reading skills of the individual.

Ongoing Research on Reading

While a wide range of issues impact reading skills, two of the most important factors for reading competence appear to be a strong first language and consistent and ongoing practice reading. Other factors continue to be debated and studied.

VL² researchers are increasing our understanding of the processes involved in reading skill development through research such as the Early Education Longitudinal Study (EELS). The EELS study investigates parental, school, teacher, and child variables that affect early reading skill development. Over a three year period, EELS researchers are collecting data on the children's attention, language, memory, and reading and pre-reading skills, in addition to collecting and evaluating information about their family and school environment.

There remain many questions to be answered, and continued research is crucial to improving reading outcomes for deaf children.

Integration of Research in Education

VL² publishes research briefs as a resource for educators and parents. The goal is to inform the education community of research findings, to summarize relevant scholarship, and to present recommendations that educators and parents can use when addressing the multifaceted challenges of educating deaf and hard of hearing children.

Research briefs are available under Publications & Products at vl2.gallaudet.edu.

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