Key Findings:

- For deaf children with cochlear implants, a visual language such as American Sign Language (ASL) can provide advantages for the child's linguistic, communicative, cognitive, academic, literacy, and psychosocial development.
- Studies in neuroscience confirm that the brain has the ability to learn both visual and spoken languages. Furthermore, learning both a visual and a spoken language does not harm the development of either language.
- The development of early competence in a visual language can effectively facilitate a child's spoken language development.
- A bimodal bilingual language and communication approach—which addresses acquisition and use of both a visual and a spoken language—has the potential to foster early language through the child's vision while also stimulating the child's audition through a cochlear implant.
- Interaction with members of the Deaf community can be beneficial for the deaf child or adolescent's identity formation and social-emotional development.
- With systematic individualized planning, a rich spoken language environment can be provided within a bimodal bilingual setting.
Advantages of Visual Language for Children with Cochlear Implants

A review of the research in neuroscience demonstrates that the brain has the ability to acquire both a visual and spoken language without harm to the development of either language. In addition, there is no evidence that visual language inhibits long-range spoken language outcomes. There is increasing evidence that early competence in a visual language can then be effectively used to support and facilitate a child’s spoken language development. In addition, there are numerous studies documenting the advantages of visual language for the linguistic, communicative, cognitive, academic, literacy, and psycho-social development of children and adolescents with cochlear implants.

This research brief provides an overview of the key findings related to visual language and its advantages for young deaf learners with cochlear implants. Additionally, this brief discusses the implications of bimodal bilingual approaches for young deaf learners. Bimodal bilingual approaches promote the development and use of both a natural signed language and a spoken language. This approach is “additive,” meaning that it builds upon a child's strength in one language while also addressing the development and use of a second language. In other words, prior to getting a cochlear implant a deaf child accesses language primarily through the visual modality. The bimodal bilingual approach facilitates the child’s development and use of visual language while adding the development and use of a spoken language.

Why is it important for parents and educators to learn more about visual language and its role in the language and communication development of deaf learners with cochlear implants?

One significant and important reason for parents and educators to learn more about visual language and its role in the language and communication development of deaf learners with cochlear implants is that studies indicate that many implanted deaf children do not develop the ability to use spoken language solely for learning and communication. Difficulties in developing spoken language are due to many interrelated factors specific to the child, the family, and the cochlear implant technology itself.

As spoken language outcomes are unpredictable for all children who are deaf or hard of hearing, there is a risk of language delay if an accessible visual language is not used as early as possible. This risk also applies to children who do not have quality access to spoken language prior to implantation, who are just beginning to develop spoken language skills following implantation, or who for any number of reasons may not develop competence in spoken language following implantation.

Visual language also benefits those children who receive their implants after the typical language learning years. Research on the cortical development of children with cochlear implants indicates that the plasticity of the central auditory system begins to decline after 3.5 years of age, making it more difficult for them to acquire a spoken language. Evidence also shows that after 7 years of age, a deaf child’s auditory system begins to reorganize, and implantation after this time is no longer optimal for the development of spoken language. This reinforces the need for those children to have proficiency in visual language for access to communication and learning.
The Evidence for a Bimodal Bilingual Approach

A review of the evidence indicates that there are no clear disadvantages to the use of visual language and many added benefits to the use of a bimodal bilingual approach for children with cochlear implants.

Regarding the advantages of early visual language:

- There is a strong body of evidence documenting the linguistic advantages of early visual language for all deaf and hard of hearing children, including children with cochlear implants.43

- There is increasing evidence documenting that—regardless of the child’s hearing status—early bilingual language exposure to both a visual and a spoken language can change the brain’s neural circuitry in advantageous ways; these changes positively impact linguistic and other higher cognitive capacities.44

- There is evidence showing that the use of a visual language and interaction with native users of a visual language are beneficial for the identity and social-emotional development of children and adolescents using a cochlear implant.45 Based on the evidence documenting the advantages of early visual language, a bimodal bilingual approach—which incorporates philosophies, beliefs, and practices to foster the development and use of both a visual and a spoken language—is strongly supported for children with cochlear implants.

A brief review of the history of bilingual practices in deaf education will help place bimodal bilingualism in context. During the 1980s, deaf education teachers and language specialists began developing bilingual practices for teaching deaf students. These bilingual practices addressed the needs of deaf learners, particularly in relation to language accessibility and cultural and identity development. These practices are referred to as the bilingual-bicultural (“Bi-Bi”) approach. In the Bi-Bi approach in the United States, development of a visual language—ASL—is promoted as a first language and used as the medium of instruction and communication; English is addressed primarily through reading and writing.46,47,48,49 More recently, bilingual educators have included the development of spoken English as appropriate for and consistent with a child’s potential for oral/aural development.47,50 Now that growing numbers of deaf children access spoken language through digital hearing aids and cochlear implants, many bilingual educational programs have incorporated additional strategies and opportunities for children to develop and use a spoken language. This type of bilingual approach, which may provide auditory access at certain times during the school day, can be referred to as a bimodal bilingual approach.24

The Bimodal Bilingual Advantage for Children and Adolescents with Cochlear Implants

There are numerous benefits to a bimodal bilingual approach for children and adolescents with cochlear implants. In contrast to a monolingual/oral approach, this approach has the advantage of:

- providing the proven benefits of bilingualism (i.e., communicative and cognitive flexibility, enhanced metalinguistic awareness and problem-solving skills, and greater cultural access and knowledge) to children with cochlear implants.24,25,46,51

- providing an environment in which two languages are interdependent and learning one language facilitates the learning of the other language.10,24,51,52
• promoting linguistic competence without compromising cognitive development, academic learning, and social-emotional growth.\textsuperscript{53}

• safeguarding language acquisition and learning through a deaf child’s intact visual modality while stimulating, using, and evaluating spoken language. This safeguarding is especially important during the critical period of a child’s linguistic development.\textsuperscript{24,37,38,40,51,54}

• expanding opportunities for early vocabulary expansion\textsuperscript{39,55,56,57} and phonologic development in both languages\textsuperscript{58,59} (which have been found to have a positive influence on the development of literacy skills).

• providing language foundations in both visual and spoken languages so that the deaf learner has options for communication in social interactions in addition to options for access to learning in academic environments.\textsuperscript{24,50,60}

• providing an environment that allows the learner to interact with members of the Deaf community. Interaction with those who are native users of a visual language and who share common experiences, beliefs, and values\textsuperscript{61} is beneficial to the identity formation and social-emotional development of a deaf child or adolescent.\textsuperscript{15,18,19,36,53,62,63,64,65,66,67,68,95}

• facilitating linguistic competence in both a visual and a spoken language provides expanded opportunities for direct and accessible communication between a child and his or her family members. This has been shown to increase a child’s perception of self as well as overall quality of life.\textsuperscript{69}

• providing accessible language and communication so that the child has options when, for example, he or she has limited spoken language skills or is unable to use the cochlear implant or hearing aid, is in a challenging listening environment (as is the case when a device malfunctions), or is interacting with deaf peers without a cochlear implant.\textsuperscript{5,17,24}

### Implications for Family and Professional Education

While many hearing families embrace some form of sign use for their children with cochlear implants, sign language is typically viewed as a bridge to or support for spoken language. Few families and professionals are aware of the implications and advantages of full access to a visual language.\textsuperscript{4,15,70,71,72,73,74,75,76,77,78,79,80,81,82,83} Evidence suggests that with appropriate education, hearing families are open to learning about the benefits of a visual language and the value of interaction with a Deaf community and culture.\textsuperscript{15,16,17,68,82,84,85}

There is an increasing population of culturally Deaf families who choose cochlear implants for their children. Many of these families state that the objective for their child is to be linguistically fluent in ASL and written English in addition to being competent in spoken English. Their aim is for their child to develop social and academic proficiency in both visual and spoken languages and for him or her to have the opportunity to participate in both the Deaf and the hearing communities.\textsuperscript{85,86,87,96}

Within the Deaf community, there is increasing acceptance of the use of cochlear implant technology as a tool, one of several in the range of possibilities for children who are deaf. Some members of the Deaf community continue to cite concern about cochlear implants in general and specifically pediatric implantation.\textsuperscript{63,95}

In order to foster increased awareness of bilingualism and support for a bimodal bilingual approach, family and professional education should include:
• providing research documenting the advantages of visual language for the overall development of children with cochlear implants.

• research from linguistics and neuroscience demonstrating that bilingualism does not cause language delay or confusion. 88

• concrete strategies about how this approach can effectively be designed to facilitate development of spoken language. 4,14,71,85,89

• discussion of the sequence of typical bimodal bilingual development. Given a fully accessible language environment, there are similar developmental milestones for ASL and spoken English. 24,97

• discussion of the value in promoting a child’s use of both a visual language and a spoken language from the start rather than adding a visual language only when the spoken language fails to develop. 17,24,51

Bimodal Bilingual Planning and Implementation

Each child’s path to becoming bilingual is unique; therefore, systematic individualized planning and monitoring of the development and use of each language is central to implementing a bimodal bilingual approach. 90 With individualized planning, use of a visual and a spoken language can be tailored to reflect the varied characteristics of children prior to implantation and following implantation. This planning process can be applied to children with varied demographic characteristics, including those with additional disabilities, those obtaining implants in the early language development stages, and those obtaining implants beyond the early language development years and during adolescence. 50,60 Planning and implementation include the development of an individualized profile and assessment of the child, which then are used to guide learning activities and how and when each language is used in the classroom and at home as well as to provide recommendations for support services. 50,60,90

When designing a bimodal bilingual approach to address the development and use of a spoken and a visual language, it is important that the child’s environment include evidence-based strategies and techniques integral to each language. For spoken language, this includes an environment that promotes consistent use of the cochlear implant device, availability of rich spoken language models, consistent valuation and use of spoken language, and the presence of professionals and families knowledgeable with strategies and techniques to facilitate spoken language development and use. 13,35,36,72,76,80,91,92,93 Similarly, for visual language it is crucial to provide an environment that includes rich visual language models and professionals and families knowledgeable in the strategies and techniques to facilitate development and use of visual language. 45,50,90

Issues in Cochlear Implant Research

While researching and writing this brief, a number of issues emerged for the writers when they reviewed the literature related to the use of visual language for children with cochlear implants. Early language acquisition and cochlear implantation research is generally clinical in nature, related predominantly to the development of speech perception and speech production skills. This research often does not reflect all aspects of language development. 94

Additionally, when discussed in the literature, “sign” is rarely defined, and the quantity and quality of sign use is typically not discussed. When sign-inclusive approaches were studied, it was generally in Total Communication settings. Researchers in these settings were often investigating the use of
sign as a support to spoken language. The writers of this brief found no longitudinal studies that looked at the development and the use of both a full visual language and a spoken language. Furthermore, the writers found that many researchers did not consider the complexities of language modality and how modality interacts with a multitude of factors impacting spoken language outcomes and implant outcomes in a variety of other domains, such as psychosocial development, literacy, and academic achievement. There was also only limited attention paid to cochlear implant user perspectives on how modality use (visual as opposed to auditory) related to quality of life.

Further Research

Research is needed that looks beyond spoken language outcomes as a measure of a child’s success with a cochlear implant and explores:

- the impact of early visual language acquisition and learning on the linguistic, cognitive, social-emotional, and academic development of early implanted children.

- the impact of visual language use on the linguistic, cognitive, social-emotional, and academic development of late-implanted children and adolescents.

- the longitudinal outcomes comparing orally educated implanted children and those educated using an ASL/English bimodal bilingual approach.

- effective practices to facilitate development of both a visual and a spoken language for implanted children within a bimodal bilingual program.

- family and child/adolescent perspectives on the use of the cochlear implant, bimodal bilingual development, and quality of life.

Translating VL2 Research to Practice

The National Science Foundation-funded Science of Learning Center on Visual Language and Visual Learning (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 explain the advantages of bimodal bilingual approaches for young deaf children with cochlear implants or hearing aids.

Research briefs are available at vl2.gallaudet.edu.

This research brief is co-sponsored by the Laurent Clerc National Deaf Education Center and the VL2 Center.

For more information on visual language and cochlear implants, see the Clerc Center Cochlear Implant Education Center webpage: www.gallaudet.edu/Clerc_Center/Information_and_Resources/Cochlear_Implant_Education_Center.html.

VL2 Center Mission Statement

The Center’s primary mission is to improve learning through an understanding of the behavioral and brain mechanisms of learning primarily through vision and visual processes, with our scientific questions being motivated and informed by an exciting balance of advances and questions in science and advances and questions in learning and social environments. Our mission is to create a science of learning using a two-way discovery model in which practitioners and scientists
exchange ideas freely and mutually identify core questions in educational and social practice that would be fundamentally advanced with knowledge from the behavioral and brain sciences. The mission involves the advancement of two overarching complementary groups.

**Clerc Center Mission Statement**

The Clerc Center, a federally funded national deaf education center, ensures that the diverse population of deaf and hard of hearing students (birth through age 21) in the nation are educated and empowered and have the linguistic competence to maximize their potential as productive and contributing members of society. This is accomplished through early access to and acquisition of language, excellence in teaching, family involvement, research, identification and implementation of best practices, collaboration, and information sharing among schools and programs across the nation.

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