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# Factors Influencing Future Auditory Function and Human Development in Infants with Hearing Loss"

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## Abstract

Hearing loss is invisible and therefore historically has not been given the attention needed. If hearing loss is undetected and/or "rehabilitative" or intervention efforts are not begun as soon after birth as possible then a child's language, emotional, and cognitive development will be affected which will contribute to literacy and other academic difficulties later. This is the second article of a two-part series that discusses the importance of early identification of hearing loss and the implications, discussed in the context of human development. Part 1 discussed hearing loss in general and its relation to human development in detail. Part 1 also briefly discussed the terms "Deaf", "hard-of-hearing", and "deaf". This present article will discuss these terms in greater detail, and how early identification is important for all three groups when considered in the context of human development.

**Keywords:** Human development; Self-actualization; Residual hearing; Deaf; Hard of hearing; Early identification; Universal screening

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## Introduction

In Part 1 of this 2-part series evidence was presented that hearing loss arguably is one of the most prevalent "disabilities" in the United States. It was also discussed how hearing loss is invisible and therefore can easily go undetected. Therefore intervention may not occur that is necessary for a child's development in language, cognition, emotional health, socialization, and academic success. If a child does not develop maximally in these areas then the most important goal of the child achieving self-actualization may not be reached.

As discussed in Part 1, it is important to know that hearing is not an "all-or-none" event. It is not that someone can hear or not hear at all. There are very numerous amounts (degrees) of hearing loss ranging from a mild amount to a severe amount with very little hearing remaining (called residual hearing). There are also different pitches that can be affected, again all with different amounts of hearing loss. The most typical pattern is for someone to have a greater loss of hearing for the high pitches than the low pitches of speech, often with normal hearing for the low pitches. The impact of this is that the vowel sounds in speech are primarily composed of low pitches while the consonant sounds are primarily composed of high pitches. This means that when someone is talking to a person with this pattern of hearing loss the person will be able to hear the vowels in speech but often

will not hear the consonants. As a result, the person will be experiencing an incomplete message. And more than that, of the 2 categories of sounds it is the consonants that are more responsible for making speech clear. For example, someone might say to a person with this pattern of hearing loss "So, do you want to go out and have some fun?", and the person with the hearing loss might answer "No, I don't want to go out in the sun. It's too hot". Therefore children, and also adults, will be able to "hear" that someone is talking but they might not "understand" correctly what the person is saying. It is particularly important to note in terms of language development that the /s, z/ sounds are made up of very high pitches and are not heard by children who have a hearing loss for the high pitches. This is especially important to note because /s, z/ are the most important sounds grammatically in the English language. For example, one must be able to hear these sounds because they serve as markers for such things as plurals, possessives, and past tense.

In Part 1 it was discussed that related to the idea that hearing is not an all-or-none event it is important to understand terminology. The most common terms that refer to people who have hearing loss are "Deaf", "deaf", and "hard of hearing" (standard professional term although it is used for lack of a better term). The most important factor in the use of these terms is to consider a person's and family's cultural attachment and identity irrespective of the amount of hearing loss. The term "Deaf" is

used for people who are part of a Deaf Culture which has a rich cultural identity with the art, writing, entertainment media, and social history of other Deaf people.

The terms “hard of hearing” and “deaf” are best differentiated by how someone actually functions. “Hard of hearing” refers to those people who possess enough remaining (residual) hearing so that they are able to use their auditory system as the primary modality for the development and/or use of spoken language. For people who function as if they are “hard of hearing” vision is useful, as in speechreading (lipreading) or could be useful as in using signs to supplement hearing. However, the key point is that vision is still secondary and supplemental to hearing.

The term “deaf” refers to those people whose auditory system is so damaged so that it prevents the development and/or use of spoken language even with the best hearing aid or cochlear implant. For people who function as if they are deaf, vision is the primary modality and hearing is secondary and supplemental to vision. This does not necessarily mean that hearing is unimportant (although for many Deaf people it does). Hearing can still be used to give people auditory awareness of the world around them which can be important for safety reasons. It can also allow people to communicate using spoken language to at least some extent.

But regardless of whether a child eventually ends up functioning as if they are “deaf”, “hard of hearing”, or part of a Deaf culture, it is imperative that children who have a hearing loss be identified as soon after birth as possible for the reasons discussed in Part 1. However, it is also important to examine what determines whether a child ends up functioning as if they are “deaf” or “hard-of-hearing” and to further discuss the relationship to human development.

### **Factors determining if a child functions as “deaf” or “hard of hearing”**

There are many factors that will influence this outcome. Discussion of these factors is not meant to advocate for a child functioning one way or the other. It is the parents'/caregivers' responsibility to make the decision about which path to follow based on their particular culture and their consideration of the importance of human development and the concept of self-actualization that were discussed in Part 1.

One factor that will influence whether a child functions as “deaf” or “hard of hearing” is the amount (degree) of hearing loss. This is an important factor, but it is not the only one. In general, as the amount (degree) of hearing loss increases there is a greater possibility that a child will function as if they are “deaf” rather than “hard-of-hearing”. For decades attempts have been made to identify a specific decibel level that could demarcate between the 2 levels of functioning. This is impossible to do because of the importance of other contributing factors. However, if a family wishes their child to function as if they are “hard-of-hearing” there would be significant concern about whether they would be able to do this when a child's hearing loss reaches approximately 70 dB HL, with the concern increasing as the hearing loss increases above this.

A second factor is the age of onset of the hearing loss. The earlier in life that a hearing loss develops there is a greater probability that a child will function as if they are “deaf”. If there are two children with the exact same amount of hearing loss (shown on an audiogram, which is a plot of hearing test results) with all other factors discussed in this article being equal, a child who has a hearing loss at birth will have a greater probability of functioning as if they are “deaf” than a child who developed a hearing loss at age 3 years of age. This consideration is important in terms of months, not years.

A third factor is the age of detection of the hearing loss. Children can be identified at significantly different ages because of various socioeconomic, cultural, and psychological reasons. Although in the United States, and elsewhere, there are laws that mandate that all children have their hearing loss screened at birth (“Universal Screening”) [1] children can slip through the cracks. Thus, two children might be equivalent in terms of amount of hearing loss, and the age of onset of the hearing loss, but if “Child number 1” has their hearing loss detected at birth and “Child #2” does not have their hearing loss detected until they are 9 months of age, “Child #1” has a greater probability of functioning as “hard of hearing”. This is one reason why the Joint Committee on Infant Hearing [2,3] has stated that infants should have their hearing screened before leaving the hospital and no later than 1 month of age, that the hearing loss should be diagnosed no later than 3 months of age, and that children with significant hearing loss should be enrolled in early intervention programs no later than 6 months of age. Fortunately we now have tests that can be used to assess an infant's hearing shortly after birth. These were discussed in Part 1.

A fourth factor is the age of intervention. Just because two children have their hearing losses detected at the same age does not necessarily mean that they will begin receiving “help” at the same age. This applies both if we are talking about developing language and emotional bonds through the use of signs or through the use of spoken language. The possible delay in receiving help is again due to various socioeconomic, cultural, and psychological reasons. To put this into a human development perspective, if there are two children with the same age of onset of the hearing loss, the same amount of hearing loss, and the same age of detection of the hearing loss, but one child is enrolled in some form of intervention before the other child, then the child who is enrolled in some form of intervention sooner has a greater probability of reaching self-actualization and proceeding successfully through the crises that Erikson discussed [4] and were presented in some detail in Part 1. From the perspective of parents/caregivers wanting to develop their child's spoken speech and language abilities, the child who is enrolled in an intervention plan that focuses on the development of auditory skills and speech/language production at 3 months of age, for example, has a higher probability as functioning as “hard of hearing” than a child who is enrolled in a similar intervention plan at even as short a time delay as 9 months of age. Time is critical. There is evidence which supports that diminishment of auditory skills and physiological atrophy will occur with sound deprivation [5]. Once this auditory atrophy has occurred it cannot be reversed.

A fifth factor that will make a difference in terms of whether a child functions as “deaf” or “hard of hearing” is the age at which the child receives a hearing aid or a cochlear implant. This should be the same as the age of intervention, but sometimes it is not. Professionals must realize that all forms of spoken language intervention will be very significantly impacted negatively or even rendered ineffective if a child is not wearing a hearing aid or cochlear implant, or if the device is not working properly. The point has been made elsewhere that the greatest problem facing children with hearing loss is that they cannot hear, and therefore the greatest rehabilitative tool we have for children whose families wish them to function as “hard of hearing” is a personal listening device [6]. The second greatest problem facing children with hearing loss is being able to understand speech when there is background noise. There are devices available called FM Auditory Trainers that significantly reduce background noise. A parent or teacher can wear a directional microphone about 4.5 inches from their mouth with essentially a radio transmitter sending a radio signal to a “radio receiver” built into the child’s hearing aid. This reduces background noise significantly as well as creating a situation where it is as though the parent/teacher is always standing 4.5 inches away from the child’s ear. Therefore if the goal of the family is for a child to function as “hard of hearing” a child who receives a hearing aid or cochlear implant sooner, who has a plan in place to ensure that it is working properly, and who has an FM system has a higher probability of functioning as “hard of hearing”. There is research evidence that even children with very limited hearing (i.e. a severe to profound hearing loss) who are identified early in life, and provided with good quality auditory-linguistic input early in life can achieve equivalent speech-language skills and academic performance as their peers who do not have hearing loss [7,8] particularly if this is done before six months of age [9].

A sixth factor that will make a difference in the child’s overall development as well making a difference as to whether a child functions as “deaf” or “hard of hearing” is the quality of intervention provided to the child. Related to this is the importance of high quality language input to the child, whether that is through spoken language or sign language. Parents differ in their ability to use language to communicate with their child. They also differ in their ability to improve their language/communication skills with children if these skills are not part of what comes naturally to them as human beings. In addition, the quality of language input to their child will usually be negatively affected if there are other difficulties in the home such as depression, mourning, other emotional difficulties, other siblings requiring considerable attention, financial problems, substance abuse

problems, or significant-other difficulties. If parents/caregivers are in a difficult situation in their own lives then no matter how much they might want to help their child it will be difficult for them to do so. Therefore, support for the parents, whether it be in the form of support groups, counseling, or in some other manner is important. A classic story in clinical psychology is that of a homeless person coming to someone’s back door. The person who lives in the house opens the door and sees a worn, haggard person who says “I’m starving. I’m so thirsty. Please help me”. The person living in the house feels deeply for the homeless person and wants to help them desperately. So they go to their refrigerator and open the door but there is nothing there. They open all the cupboards and they all are bare. Thus no matter how much they want to help the homeless person, if they physically have nothing, they cannot give anything to the homeless person. So too, if parents/caregivers have nothing in their “emotional refrigerator or cupboards” then they will have nothing to give to their child no matter how much they might want to. Finally, the parents’/caregivers’ own hearing status and signing or speaking models will influence the quality of either the sign language or spoken language given to the child and hence will influence both the child’s overall development as well as whether they function as if they are “hard of hearing” or “deaf”.

## Summary and Conclusions

In summary, there is a possibility that many children may end up functioning as if they are either “deaf” or “hard of hearing” and this outcome is dependent upon the complex interaction of the factors discussed in this article, as well as other ones not discussed. Historically the amount (degree) of hearing loss has been deemed to be the primary factor affecting the outcome, and in some unfortunate cases, the only factor determining whether a child eventually functions as “deaf” or “hard of hearing”. This is an incorrect supposition. However, it also should not be overlooked that the amount (degree) of hearing loss still is an important factor. But it still is not as important as what the child’s functional hearing is like when wearing a hearing aid or a cochlear implant. However, a key point is that ultimately it is the family’s decision about which avenue to pursue based on their cultural beliefs, because the penultimate goal is for the child to achieve their maximum human development and reach a level of self-actualization. This can only be done if there is very significant interaction and communication between families and their children which will lead to healthy and deep emotional bonds. This can occur maximally only if the direction in which families decide to go is decided as soon as possible after birth, which is only possible with the early identification of the hearing loss.

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