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Analysis of the Audio Home Environment of Children with Normal vs. Impaired Hearing

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Purpose

The purpose is to assess the differences between the audio home environments of children who are normally hearing and those who have hearing loss.

Rationale

The research has shown that the quality of the auditory environment in the home (e.g. type and frequency of auditory exposure to care-giver, TV, noise, siblings etc) impacts language production in children. For example, the language development of children whose home environment has a high proportion of TV use is negatively impacted significantly compared to those who do not use TV (parents talk less). Thus the impact of the home environment is crucial during the years of hearing and speech development. Studies have shown that speech performance is influenced by perceptual abilities and that auditory deprivation prevents the development of normal speech. Children with hearing impairments have a different language development pattern than that of children with normal hearing due to delayed and diminished auditory access to the speech signal. Therefore, one wonders if the auditory environment of children with hearing impairment differs from the environment of hearing children. The purpose of the proposed study is to determine if communication and audio differences in the home environment exist between children with normal and impaired hearing.

Population

Two groups of five children (5 children with normal hearing, and 5 with hearing loss), between the ages of 3-6 years will participate. The children with normal hearing will be typically developing children with no known developmental or motor delays. Children with hearing loss will have hearing loss ranging from mild to severe-to-profound sensorineural hearing loss. They will be using either cochlear implants or hearing aids. All children with hearing loss will come from Auditory-Oral language homes to ensure equal focus on spoken language. They will have no known severe motor or neurological delays.

Design

A between subjects design will be used. The study will examine the audio home environment between children who have hearing loss compared to that of child with normal hearing using a Language Environment Analysis recording system (LENA) . The results from the LENA recording will be compared to determine any differences between the home environments of the two groups.

Procedure

The study will consist of two parts, (1) initial caregiver interview and (2) vocalization recording.

For the caregiver interview, the participants and their families will visit the University of Tennessee Hearing Clinic, with the session lasting approximately half an hour. The session will include establishing criteria for participation. The informed consent will be obtained. Additionally, instructions on use of the Language Environment Analysis (LENA) recorder will be given. Finally, the caregiver will complete the Developmental Snapshot questionnaire. The Developmental Snapshot questionnaire is a 52-question parent administered questionnaire regarding expressive and receptive language skills to provide an estimate of the child's developmental age from 2 months to 36 months. This information will be compared to the audio home environment of the child to see if there is a relationship between the audio home environment and the developmental age of the child.

After the caregiver interview, the caregiver will be instructed how to use the LENA and how it fits into the vest to be worn by the child. The LENA recorder will be worn by the child in a specially made vest that does not interfere with movement. The LENA recorder has no cables or small parts that may be accessed by the child. It fits into an internal pocket sewn into the vest and cannot be accessed by the infant. The use of the LENA will be demonstrated and will be given to the caregiver. Approximately six hours of child-parent interactions will be recorded in the home environment. The instructions to the caregiver will be to put the LENA recorder in the vest and put it on their child, adjusting the vest to a comfortable fit. They will be instructed to use the LENA recorder for approximately six hours of continuous recording time. The parent should continue with typical conversation used throughout their normal daily routines.

The second session takes place in the infant's home. The caregiver will be asked to return the LENA recorder at the next therapy session or when they have completed the 6 hour recording.

Outcome Measures

The LENA system automatically categorizes infant speech from adult speech, and determines length of utterance and number of utterances over the time-period for which the sample was taken. It provides a tabulation of parent-infant conversational turns as well. The recordings will be analyzed in the lab using the LENA computer software for the percentages of audio information of meaningful sound, distant sound, TV, noise, in the audio environment. Categorical Data Analyses will be used to determine group differences. The count data for each of the above mentioned variables will be the dependent variable and the group will be the independent variable.

The LENA recordings will be analyzed in terms the audio environment by the following breakdown: the percentage of meaningful sound, distant sound, TV use, and noise.

Participants

The group of typically developing children consisted of two boys and three girls. The age ranges were from three year and three months to five years and ten months. The first participant (TD-1) was female and was five years and ten months old. The second participant (TD-2) was also female and was four years old. The third participant (TD-3) was male and was three years and three months old. The fourth participant (TD-4) was male and was three year and four months old. The fifth participant (TD-5) was female and was four years and three months old.

The group of children with hearing impairments consisted of four boys and one girl. The age ranges for this group were from three years and seven months to six years and eleven months. The degree of hearing impairments ranged from moderate to profound and three participants used cochlear implants (CI) while the other two used hearing aids (HA). The first participant (HI-3) was male and was four year and eight months of age. He was identified at four months as having a profound hearing loss. He received amplification though a CI in one ear at one year followed by

the second year at two years of age. The second participant (HI-4) was male and was four years and nine months old. He was identified at age two as having moderate hearing loss and received hearing aids bilaterally at age two and a half. The third participant (HI-5) was male and was six years and eleven months old. He was identified as having severe hearing loss at birth. He received amplification through hearing aids bilaterally at age one and a half. The fourth participant (HI-6) was female and age three year and seven months. She was identified as having profound hearing loss at birth and received amplification through hearing aids at five months. She later received a cochlear implant at 25 months. The fifth participant (HI-7) was male and was five years and six months old. He was identified at one year as having profound hearing loss and received bilateral cochlear implants at 15 months.

Table 1: **Participant Descriptions**

	Gender	Age	AGE of ID	PTA	Device (HA/CI)
TD-1	F	5;10	N/A	< 25 dB HL	N/A
TD-2	F	4	N/A	< 25 dB HL	N/A
TD-3	M	3;3	N/A	< 25 dB HL	N/A
TD-4	M	3;4	N/A	< 25 dB HL	N/A
TD-5	F	4;3	N/A	< 25 dB HL	N/A
HI-3	M	4;8	4 months	AIDED 28db	CI
HI-4	M	4;9	2 years	UNAIDED RE:58dB LE:56dB	HA

HI-5	M	5;11	Birth	UNAIDED 90dB	HA
HI-6	F	3;7	Birth	AIDED 23Db	CI
HI-7	M	5;6	12 months	AIDED RE:18dB LE:21dB	CI

The audiograms of the participants with hearing loss were obtained and interpreted to help with the analysis of the data results. The two participants who used hearing aids were HI-4 and HI-5. HI-5 had an unaided pure tone average (PTA) of 90 dB, making his hearing loss severe. HI-4 had an unaided PTA at his right ear of 58 dB and at his left ear of 56 dB. For the participants with CI, only the aided audiograms were available. It can be assumed that these children had unaided PTA's in the severe to profound range before their implantation. HI-3's aided PTA was 28. HI-6's aided PTA was 23 and HI-7 had a PTA of 18 at his right ear and 21 at his left ear. Even with amplification, these children had PTA scores in the mild range.

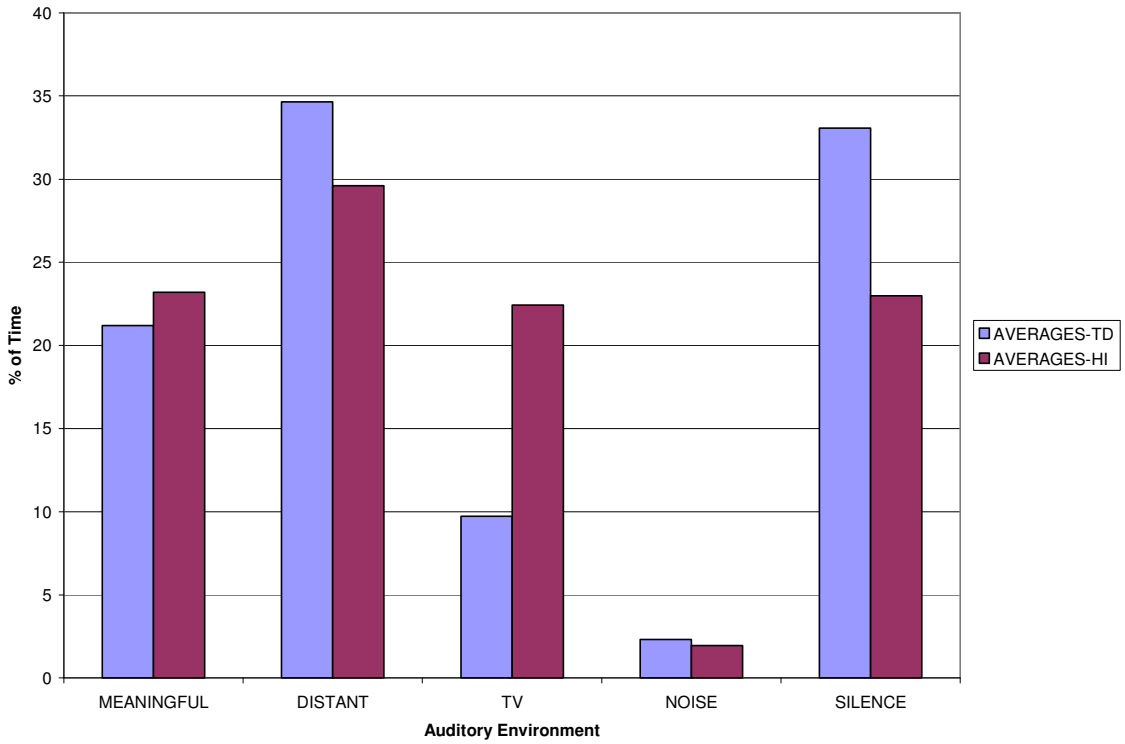
Results

The averages for each category of sound in the audio environment (meaningful speech, distant sounds, TV, noise and silence) were calculated for each group. This average was compared to the average duration of the recording. The average recording time for the TD group was 6 hours, 15 minutes and 42 seconds. The average recording time for the HI group was 5 hours, 49 minutes and 27 seconds. The percentage for each sound category of the total recording time was calculated to determine any differences between the two groups. The percentage of time spent in meaningful speech was higher in the HI group (23%) than in the TD group (21%). This is an encouraging finding since children with hearing impairments need more meaningful auditory input to help maximize their listening abilities and their speech and language development. The percentage of distant noise was higher in the TD group

(34%) than in the HI group (29%). This is another positive finding since it points to parents using listening strategies to promote their child's hearing. For example, it could mean that parents are not speaking to their children from a different room and are making sure their children can see their face when they talk for additional visual cues. The percentage of television was double in the HI group (22%) when compared to the TD group (9.7%). This finding is interesting since usually the trend is that meaningful speech decreases when television viewing increase which was not the case in the present study. The percentage of noise was similar for the two groups, 2.3% for the TD group and 1.9% for the HI group. For the last category, silence, the percentage was higher in the TD group (33%) than in the HI group (23%). This finding is also encouraging since the absence of sound is not an optimal environment in which to develop hearing and language.

Table 2. Audio Environment for both groups.

	Meaningful Speech	Distant Noise	Television	Noise	Silence
TD Group	21.2%	34.6%	9.7%	2.3%	33%
HI Group	23.2%	29.6%	22.4%	1.9%	23%



Future studies

The results of the present study shed an interesting light on the differences and similarities of the home audio environment of children with hearing impairments and typically developing. This preliminary investigation suggests that the audio home environment of children with hearing loss does not seem to differ drastically from that of typical developing children. The need for further studies investigating similar variables would increase the existing research on the importance of the audio environment for children with hearing impairments. Future studies would be strengthened by using a larger number of participants, longer samples, and having participants complete the recording on a standard day of the week.