International Journal of Thesis Projects and Dissertations (IJTPD)
Vol. 4, Issue 1, pp: (40-44), Month: January - March 2016, Available at: www.researchpublish.com

Perception of Monosyllabic Words Containing High Frequency Sounds in Children with Hearing Aid and Cochlear Implant

Sushant G. Gupta

Abstract: **Perception of Monosyllabic Words Containing High Frequency Sounds in Children with Hearing Aid and Cochlear Implant.**

Introduction: Word recognition is a complex process, involving the integration acoustic-phonetic signal, and contextual information. Children perceive familiar words more accurately than unfamiliar words which get distorted in hearing impaired (HI) population. This study aims to compare the performance of HI i.e. in hearing aid users and cochlear implant users for high frequency sounds.

Methodology: The study included, 20 children in two group with hearing impairment (70- 90dBHL), age ranging 6-12 years. (Group I- hearing aid users and Group II- cochlear implantee), with at least of 2 years of experiencing a device and intensive therapy. Tests included a closed set of meaningful and monosyllabic words containing high frequency sounds like /s/, /sh/, /f/, /th/, /k/ (Northern and Downs, 1984). Performances of children were compared by t-test analysis.

Results: Significant difference was present between perception of hearing aid users and cochlear implantee on monosyllabic words in both groups at levels of 0.05 & 0.01.

Discussion: Hearing aid amplifies sound, strongly stimulating the low frequency hair cells deep inside the cochlea, and improving the perception. If high frequency hair cells are nonfunctioning, the brain will miss out the high frequency elements of the sound as in case of hearing aid user where as cochlear implantee has all the frequency stimulated by electrode array.

Keywords: **Monosyllabic Words Containing, Word recognition.**

1. INTRODUCTION

Perception of speech is a complex process, involving the integration of both the sensory input, or acoustic-phonetic signal, and contextual information. School age children process continuous speech in an adult-like way, making use of context to aid in the interpretation of the acoustic signal. Children perceive familiar words more accurately than unfamiliar words. Hearing aids are very different from cochlear implant. Hearing aid just amplifies sound. Sound still travels through all the parts of ear-the outer ear, middle ear and inner ear- to the hearing nerve. A cochlear implant bypasses the damage that we have in cochlea (hearing organ) in the inner ear. An electrode array is inserted during surgery directly into the cochlea, and the hearing nerve is directly stimulated using electrical energy. This stimulation results in sounds that are more audible and clearer than hearing aid. High frequencies deliver the additional vital details of sound as they enable to identify and differentiate words so that better able to understand speech, especially at a distance or in noisy places. The high frequencies also add a pleasant quality and clarity to the hearing sounds. Sound is richer, fuller and crisper in everyway. Both low and high frequencies are essential for a complete hearing experience (Ching, Dillon and Byrne, 1998).

When there is high frequency loss, the low frequency sounds merge together and make words indistinguishable from one to the next. Brain relies extensively on high frequency sounds to clearly decipher and understand spoken words (Turner and Cummings, 1999).

There was a clear pattern in the results of previous studies suggesting that as the degree of hearing loss at a given frequency increased beyond 55 dBHL, the efficacy of providing additional audibility to that frequency region was diminished, especially when this degree of hearing loss was present at frequencies, of 4KHz and above (Cynthia A. Hogan, Christopher W. Turner, 1998). Recent studies have suggested that amplification at 4 KHz and above fails to improve speech recognition and may even degrade performance when high frequency thresholds exceed 50-60 dBHL (Patricia G. Stelmachowicz, Andrea L. Pittman, Hoover, Dawna E. Lewis, 2001). Some previous research also show that word recognition was better for multisyllabic than for monosyllabic stimuli. For those with profound hearing loss, the cochlear implant is likely the prosthetic device of preferred choice so as to learn natural auditory-verbal communication. For those with severe to profound hearing loss, most will do better with implants. For those with severe hearing loss, hearing aids are typically the preferred choice of prosthetic devices providing aided thresholds in the 30-35 dB range (or better). These thresholds can be attained at least in the low-to-mid frequency range as a result of assertive amplification and ongoing effective audiological management (Ellen A. Rhoades, 2000-2001).

The review studies clearly shown that on the high frequency hearing loss there is recognition problem present and there is need for the study to check the recognition on monosyllabic words. The present study examined perception of high frequency sounds by pediatric Cochlear Implant users and hearing aid users. Word lists were constructed having monosyllabic words with high frequency sounds to allow systematic examination on the identification of high frequency sound. High frequency sounds perception outcomes in young children with Cochlear implant are affected by the age of implantation and duration of implantation.

Differences between hearing aid and cochlear implant:

Hearing aid	Cochlear implant
• With an aided severe hearing loss, understanding men on the telephone may be easier as compared to understanding them with a cochlear implant	• Understanding women on the telephone may be easier as compared to understanding them with a hearing aid for a severe-profound loss
• For those with severe hearing loss, may be greater ease in discriminating of low frequency sounds, *Eg.* /m/, /ee/ and may better enjoy bass sounds of music	• Greater ease in high frequency consonant perception, *Eg.* /sh/, /s/, /f/, /k/
• Distance hearing is poor	• Distance hearing is likely better than with hearing aids
• Loud noises are bothersome for those using linear amplification	• May be greater potential for incidental learning
• Limited hearing assistance in high frequency range	• Low frequency consonant discrimination for placement cues may be more difficult

Need of the study:

The need of this study is to compare the performance of hearing aid users and cochlear implant users for acquisition of high frequency sounds.

Aim:

The aim of this study is to examine the difference between perception of high frequency sounds in hearing aid children and cochlear implant children of age between 6-12 years.

Objectives of the study:

- Comparison of monosyllabic high frequency words between hearing aid users and cochlear implant users.
- Comparison of each high frequency sound between hearing aid users and cochlear implant users.

2. METHOD

Subjects selection:

The study included 2 groups, 10 children in each group age between 6-12 years with hearing impairment upto 70 to 90dBHL. 10 children using hearing aid and 10 children using cochlear implant were taken as subjects for the study. The

subjects involved in the study got amplification device (hearing aid or cochlear implant) at least 2 years back and speech therapy or auditory verbal therapy is being provided since 2 years.

Procedure:

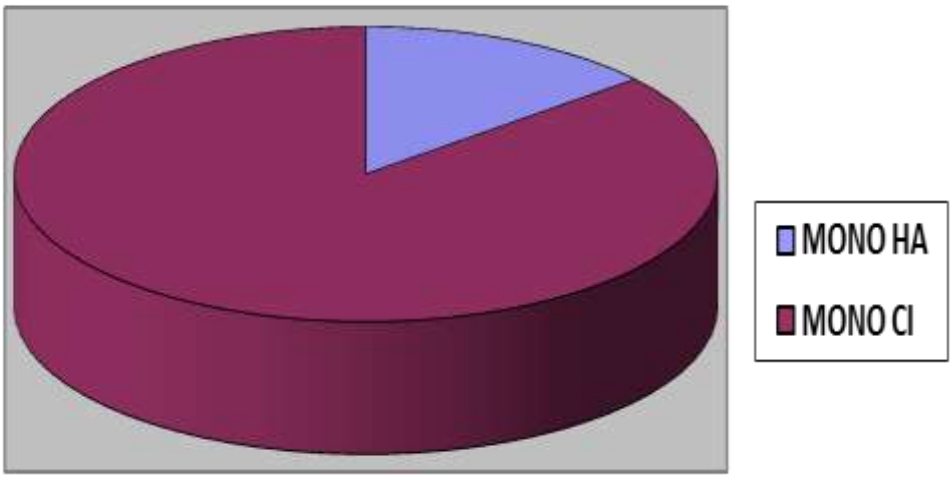
The words taken were meaningful and monosyllabic containing high frequency sounds like /s/, /sh/, /f/, /th/, /k/ (Northern and Downs, 1984). This was a closed set test. 10 words of each high frequency sound, total 50 words were written on a paper and patient was asked to read it. After reading, examiner asked patient to sit in front of him at a distance of 3-5ft. to avoid lip-reading and other facial cues. The examiner used a randomized order. The score was given as 1 for each correct identification. Performance of children with hearing aid was compared with the children with cochlear implant.

Statistical Analysis:

t-test was used for the statistical analysis for checking significant difference.

COMPARISON BETWEEN MONOSYLLABIC WORDS BY HEARING AID v/s MONOSYLLABIC WORDS BY COCHLEAR IMPLANT

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	MONOSYLLABIC WORD OF HA	5.90	10	1.912	.605
	MONOSYLLABIC WORDSOF CI	36.60	10	6.222	1.968



CORRELATIONS BETWEEN MONOSYLLABIC WORDS BY HEARING AID v/s MONOSYLLABIC WORDS BY COCHLEAR IMPLANT

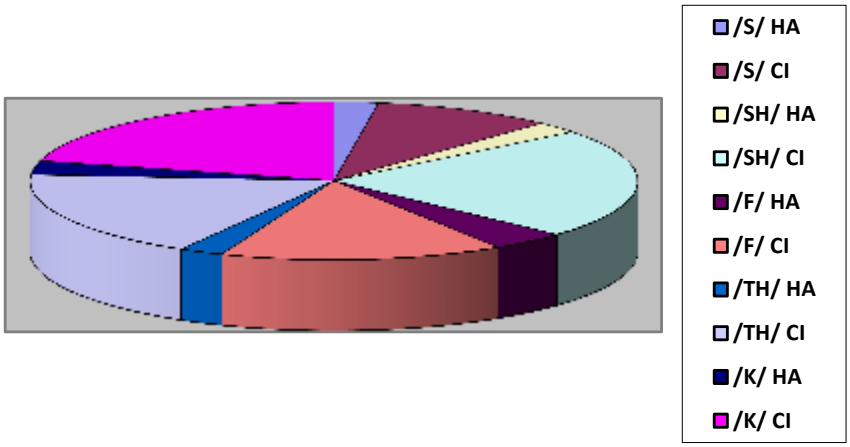
		N	Correlation	Sig.
Pair 1	MONOSYLLABIC WORD OF HA & MONOSYLLABIC WORDSOF CI	10	.445	.198

t- Test OF MONOSYLLABIC WORDS BY HEARING AID v/s MONOSYLLABIC WORDS BY COCHLEAR IMPLANT

		Paired Differences			t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	MONOSYLLABIC WORD OF HA - MONOSYLLABIC WORDSOF CI	-30.700	5.638	1.783	17.219	**9**	.000

COMPARISON BETWEEN PAIRS (/s/_HA VS /s/_CI); (/sh/_HA VS. /sh/_CI); (/f/_HA VS. /f/_CI); (/th/ _HA vs. /th/_CI); (/k/_HA vs. /k/_CI)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SOUND OF /S/ OF HA	1.00	10	.000	.000
	SOUND OF /S/ OF CI	4.10	10	4.095	1.295
Pair 2	SOUND OF /sh/ OF HA	1.00	10	.000	.000
	SOUND OF /sh/ OF CI	9.60	10	.966	.306
Pair 3	SOUND OF /f/ OF HA	1.70	10	1.889	.597
	SOUND OF /f/ OF CI	6.40	10	2.716	.859
Pair 4	SOUND OF /th/ OF HA	1.00	10	.000	.000
	SOUND OF /th/ OF CI	7.60	10	1.350	.427
Pair 5	SOUND OF /k/ OF HA	1.20	10	.632	.200
	SOUND OF /k/ OF CI	8.90	10	1.197	.379



PAIRED SAMPLES CORRELATIONS

		N	Correlation	Sig.
Pair 1	SOUND OF /S/ OF HA & SOUND OF /S/ OF CI	10	.	.
Pair 2	SOUND OF /sh/ OF HA & SOUND OF /sh/ OF CI	10	.	.
Pair 3	SOUND OF /f/ OF HA & SOUND OF /f/ OF CI	10	.134	.711
Pair 4	SOUND OF /th/ OF HA & SOUND OF /th/ OF CI	10	.	.
Pair 5	SOUND OF /k/ OF HA & SOUND OF /k/ OF CI	10	-.558	.094

Paired Samples Test

		Paired Differences			T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	SOUND OF /S/ OF HA - SOUND OF /S/ OF CI	-3.100	4.095	1.295	-2.394	9	.040
Pair 2	SOUND OF /sh/ OF HA - SOUND OF /sh/ OF CI	-8.600	.966	.306	-28.150	9	.000
Pair 3	SOUND OF /f/ OF HA - SOUND OF /f/ OF CI	-4.700	3.093	.978	-4.805	9	.001
Pair 4	SOUND OF /th/ OF HA - SOUND OF /th/ OF CI	-6.600	1.350	.427	-15.461	9	.000
Pair 5	SOUND OF /k/ OF HA - SOUND OF /k/ OF CI	-7.700	1.636	.517	-14.880	9	.000

3. RESULTS

Result revealed significant differences between perception of hearing aid users and cochlear implant users. On monosyllabic words both groups have marked significant differences at both the levels (at 0.05 & 0.01 on t-test).

While the test done on each high frequency sound, result revealed that the comparison of /s/ sound in hearing aid users with cochlear implant users do not have significant difference at 0.01 level at 'df-9'. Rest all the high frequency sounds (/sh/, /f/, /th/, /k/) show significant difference in perception of hearing aid users and cochlear implant users.

4. DISCUSSION

Low frequency sounds stimulate hair cells deep within the cochlea, while high frequencies stimulate those that are close to the entrance. A hearing aid amplifies sound, strongly stimulating the low frequency hair cells deep inside the cochlea, and improving the perception of low frequency hair cells. If high frequency hair cells are damaged and non-functioning, the brain will miss out on the high frequency elements of the sound in case of hearing aid user client. In cochlear implant the surgically implanted electrode array covers the cochlea from its entrance to deep inside it and stimulates both high frequencies and low frequencies hair cells. In present study it has been clearly shown that high frequency sounds are more easily perceived by cochlear implant than hearing aids. Cochlear implant stimulates /sh/, /f/, /th/, /k/ sounds which are placed at the entrance of the cochlea though stimulates more monosyllabic words containing high frequency sounds. Hearing aids don't have much effect on high frequency sounds.

5. CONCLUSION

The reviewed studies and results from the study suggest that (1) Monosyllabic words containing high frequency sounds are better perceived by cochlear implant users than hearing aid users. (2) The perception of high frequency sounds like /sh/, /f/, /th/, /k/ is delay in hearing aid children than children using cochlear implant. (3) The perception of /s/ sound in both the devices does not show much difference, there are slightly better results for cochlear implants users than hearing aid users.

REFERENCES

[1] Ching, T., Dillon, H., & Byrne, D. (1998) Speech recognition of hearing- impaired listeners: Predictions from audibility and the limited role of high- frequency amplification. Journal of Acoustical Society of America, 103, 1128-1140.

[2] Cynthia A. Hogan, Christopher W. Turner, (1998) High frequency audibility- Benefits for hearing- impaired listeners, Journal of Acoustical Society of America, 104(1)

[3] HybridTM completing your hearing experience. Retrieved from http://www.cochlear.com

[4] Jerry, N. L., & Downs, M. P., (1984). Hearing in children. The University of Michigan: Williams & Wilkins

[5] Oohashi, T., Nishina, E., Honda, M., Yonekura, Y., Fuwamoto, Y., Kawai, N., Shibasaki, H., (2000). Inaudible high-frequency sounds affect brain activity: hypersonic effect. Journal of Neurophsiology, 83, 3548-3558

[6] Rhoades, E. A., (2000-2001) Advantages and disadvantages: hearing aids vs. Cochlear implants for those with severe hearing loss. Retrieved from http://www.auditoryverbaltraining.com/ha-ci.htm

[7] Stelmachowicz P. G., Pittman, A. L., Hoover, B. M., Lewis, D. E., & Moeller, M. P., (2004) The importance of high-frequency audibility in the speech and language development of children with hearing loss. Retrieved from http://www.archoto.com

[8] Stelmachowicz, P. G., Pittman, A. L., Hoover, B. M., & Lewis, D. E. (2001) Effect of stimulus bandwidth on the perception of /s/ in normal- and hearing- impaired children and adults. Journal of Acoustical Society of America, 110(4), 2183-2190

[9] Turner, C. W. & Cummings, K. J. (1999) Speech Audibility for listeners with high- frequency hearing loss. American Journal of Audiology, 8, 47-56.