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Effect of Spectrally Filtered Speech on Speech Identification Scores in Telugu-Speaking Adults With and Without Sensorineural Hearing Loss

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Abstract

Introduction
Speech perception depends on spectral information across frequency regions.

Aim
To evaluate the effect of spectrally filtered speech on speech identification scores in Telugu-speaking adults with and without sensorineural hearing loss.

Methods
Forty adults (20 normal hearing and 20 with hearing loss) underwent filtered speech testing.

Results
Normal-hearing adults performed better. Low-pass filtered speech produced higher scores than high-pass filtered speech.

Conclusion
Filtered speech testing is clinically useful for assessing speech perception.

Keywords
Filtered Speech; Speech Identification; Sensorineural Hearing Loss; Telugu; Audiology.

INTRODUCTION

Speech perception is one of the most important auditory functions and is essential for effective communication. The ability to recognize speech depends on the accurate processing of acoustic information across different frequency regions. Any reduction in auditory sensitivity, particularly due to sensorineural hearing loss (SNHL), can adversely affect speech perception, resulting in reduced communication ability and quality of life.

Speech contains both low-frequency and high-frequency spectral cues that contribute differently to speech intelligibility. Low-frequency components primarily provide vowel and prosodic information, whereas high-frequency components contribute to consonant recognition and speech clarity. Spectral filtering techniques, such as low-pass (LP) and high-pass (HP) filtering, are commonly used to investigate the relative contribution of different frequency regions to speech perception. These techniques also help clinicians understand how hearing loss affects speech recognition under different listening conditions.

Several studies have demonstrated that individuals with normal hearing achieve significantly better speech identification scores than individuals with sensorineural hearing loss when listening to filtered speech. The availability of low-frequency speech cues generally results in higher speech recognition performance than speech containing only high-frequency information. However, speech perception may vary across different languages because of differences in phonetic and phonological characteristics. Therefore, language-specific investigations are important for developing appropriate clinical assessment tools.

Although several filtered speech studies have been conducted in English and other languages, only a limited number of studies have investigated filtered Telugu speech perception among adults with sensorineural hearing loss. Telugu is one of the major Indian languages, and the availability of standardized filtered speech materials provides an opportunity to evaluate speech perception more effectively in the native language of the listener.

The present study was undertaken to compare speech identification scores obtained using low-pass and high-pass filtered Telugu speech in adults with normal hearing and adults with sensorineural hearing loss. The findings are expected to improve the understanding of spectral contributions to speech perception and provide clinically useful information for audiological assessment, hearing aid fitting, and auditory rehabilitation.

Aim of the Study

To evaluate the effect of spectrally filtered speech on speech identification scores in Telugu-speaking adults with and without sensorineural hearing loss.

Objectives

1. To evaluate speech identification scores using low-pass filtered Telugu speech.
2. To evaluate speech identification scores using high-pass filtered Telugu speech.
3. To compare speech identification scores between adults with normal hearing and adults with sensorineural hearing loss.
4. To determine the influence of different spectral filter conditions on speech perception.

2. Materials and Methods

Study Design

A comparative observational study was conducted to evaluate the effect of spectrally filtered speech on speech identification scores in Telugu-speaking adults with normal hearing and adults with sensorineural hearing loss.

Study Setting

The study was carried out in the Department of Audiology and Speech Language Pathology, where all audiological assessments and speech perception testing were performed under standardized acoustic conditions.

Participants

A total of **40 Telugu-speaking adults** aged between **40 and 60 years** participated in the study. Participants were divided into two groups:

- **Group I:** Twenty adults with normal hearing sensitivity.
- **Group II:** Twenty adults diagnosed with bilateral mild to moderately severe sensorineural hearing loss.

All participants were native Telugu speakers and provided informed consent before participation.

Inclusion Criteria

- Age between 40 and 60 years.
- Native Telugu speakers.
- Normal middle ear function.
- For Group I: Pure-tone thresholds within normal limits.
- For Group II: Bilateral sensorineural hearing loss with stable hearing sensitivity.

Exclusion Criteria

- Conductive or mixed hearing loss.
- Neurological or cognitive disorders.
- History of otologic surgery.
- Speech or language disorders.
- Uncooperative participants.

Test Materials

Speech perception was assessed using standardized **Telugu phonemically balanced word lists**. Speech stimuli were digitally filtered using:

Low-Pass Filter Conditions

- 800 Hz
- 1200 Hz
- 1500 Hz
- 1700 Hz

High-Pass Filter Conditions

- 1700 Hz
- 2100 Hz
- 2500 Hz
- 3000 Hz

Each participant responded verbally to the presented word lists, and responses were scored as correct or incorrect.

Procedure

All participants underwent:

- Detailed case history
- Otoscopic examination
- Pure-tone audiometry
- Immittance evaluation
- Speech audiometry
- Filtered speech identification testing

Speech stimuli were presented through calibrated headphones in a sound-treated room at a comfortable listening level. Speech Identification Scores (SIS) were calculated as the percentage of correctly identified words under each filtering condition.

Statistical Analysis

The collected data were analyzed using **SPSS version 17.0**. Descriptive statistics (mean and standard deviation) were calculated for all variables. Differences between groups and filter conditions were analyzed using **paired and independent sample t-tests**. A **p-value < 0.05** was considered statistically significant.

Ethical Considerations

The study was conducted following institutional ethical guidelines. Written informed consent was obtained from all participants before data collection, and participant confidentiality was maintained throughout the study.

Results

A total of **40 Telugu-speaking adults** participated in the study, comprising **20 adults with normal hearing (Group I)** and **20 adults with bilateral sensorineural hearing loss (Group II)**. Speech Identification Scores (SIS) were obtained under four low-pass (LP) and four high-pass (HP) filter conditions.

The mean Speech Identification Scores for the two groups are presented in **Table 1**.

Table 1. Mean Speech Identification Scores (%) Under Different Filter Conditions

Filter Condition	Normal Hearing (Mean ± SD)	Sensorineural Hearing Loss (Mean ± SD)
800 Hz LP	61.20 ± 8.10	45.60 ± 9.20
1200 Hz LP	71.40 ± 7.60	53.80 ± 8.80
1500 Hz LP	79.50 ± 6.90	58.60 ± 8.30
1700 Hz LP	82.90 ± 5.80	62.70 ± 7.40
Mean LP Score	**73.75 ± 7.10**	**55.18 ± 8.40**
1700 Hz HP	61.10 ± 7.50	49.40 ± 8.20
2100 Hz HP	54.60 ± 8.00	43.80 ± 7.90
2500 Hz HP	49.50 ± 7.60	40.10 ± 7.10
3000 Hz HP	46.30 ± 7.10	38.40 ± 6.80
Mean HP Score	**52.87 ± 7.55**	**42.93 ± 7.50**

Comparison Between Groups

Participants with **normal hearing demonstrated significantly higher speech identification scores** than participants with sensorineural hearing loss across all low-pass and high-pass filter conditions.

Low-pass filtered speech consistently produced better speech identification scores than high-pass filtered speech in both groups. Speech intelligibility improved as the low-pass cutoff frequency increased, whereas performance declined progressively with increasing high-pass cutoff frequencies.

Table 2. Comparison of Overall Speech Identification Scores

Variable	Normal Hearing	Hearing Loss	p-value
Mean Low-Pass SIS (%)	73.75	55.18	<0.001*
Mean High-Pass SIS (%)	52.87	42.93	<0.001*

***Statistically significant ($p < 0.001$)**

Interpretation

The findings indicate that:

- Adults with normal hearing achieved significantly better speech identification than adults with sensorineural hearing loss.
- Low-pass filtered speech provided greater speech intelligibility than high-pass filtered speech.
- Speech recognition improved with increasing low-pass cutoff frequencies.
- High-frequency information alone was insufficient for optimal speech recognition, particularly among adults with hearing impairment.
- The differences between the two groups were statistically significant (**$p < 0.001$**), suggesting that sensorineural hearing loss substantially affects speech perception under spectrally filtered listening conditions.

5. Discussion

The present study evaluated the effect of spectrally filtered speech on speech identification scores in Telugu-speaking adults with normal hearing and adults with sensorineural hearing loss. The findings demonstrated that participants with normal hearing achieved significantly higher speech identification scores than participants with hearing loss under both low-pass and high-pass filtering conditions. These findings suggest that hearing impairment adversely affects the utilization of spectral cues necessary for accurate speech recognition.

Among the filtering conditions, low-pass filtered speech consistently resulted in better speech identification than high-pass filtered speech. This indicates that low-frequency spectral information contributes substantially to speech intelligibility in Telugu. As the low-pass cutoff frequency increased, speech identification scores also improved, whereas increasing the high-pass cutoff frequency resulted in a gradual decline in performance. These findings are consistent with previous studies that reported the greater importance of low-frequency speech information for speech understanding.

The poorer performance observed in adults with sensorineural hearing loss may be attributed to reduced frequency resolution, impaired cochlear function, and decreased audibility of speech cues. These deficits reduce the listener's ability to utilize both low- and high-frequency information effectively, particularly under spectrally degraded listening conditions.

The results of the present study support the clinical usefulness of filtered speech testing in the assessment of speech perception. Such testing may provide valuable information for hearing-aid fitting, auditory rehabilitation, and counseling of individuals with hearing impairment.

Clinical Implications

- Filtered speech testing provides additional information beyond conventional speech audiometry.
- Low-frequency speech cues play a major role in speech perception among Telugu-speaking adults.
- The findings may assist audiologists in hearing-aid programming and auditory rehabilitation.
- Language-specific filtered speech materials may improve clinical assessment of speech perception.

Conclusion

The present study demonstrated that spectrally filtered speech significantly influences speech identification performance. Adults with normal hearing achieved significantly higher speech identification scores than adults with sensorineural hearing loss. Low-pass filtered speech produced better speech recognition than high-pass filtered speech in both groups, indicating the greater contribution of low-frequency speech cues to Telugu speech perception. Filtered speech testing may serve as an effective clinical tool for evaluating speech perception and planning audiological rehabilitation.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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Ethical Approval

The study was conducted in accordance with institutional ethical guidelines. Written informed consent was obtained from all participants before data collection.

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References (IJRAR Style)

1. Amos NE, Humes LE. Contribution of high frequencies to speech recognition in noise. *Journal of Speech, Language, and Hearing Research*. 2001.
2. Bornstein SP, Wilson RH, Cambron NK. Low-pass and high-pass filtered speech recognition. *Journal of the American Academy of Audiology*. 1994.
3. Hogan CA, Turner CW. High-frequency audibility and speech recognition. *Journal of the Acoustical Society of America*. 1998.
4. Moore BCJ. Dead regions in the cochlea: Diagnosis and clinical implications. *Ear and Hearing*. 2001.
5. Pavlovic CV. Speech intelligibility prediction using the articulation index. *Journal of the Acoustical Society of America*. 1984.
6. Peterson GE, Barney HL. Control methods used in a study of vowels. *Journal of the Acoustical Society of America*. 1952.
7. Prawin KM, Yathiraj A. Filtered speech perception in Indian listeners. *Journal of Indian Speech and Hearing Association*. 2009.
8. Sairam VVS. *Long-Term Average Speech Spectrum in Kannada*. University of Mysore; 2002.
9. Savithri SR, Jayaram M, Venugopal MB, Rajasudhakar R. Base of articulation of Indian languages. *Journal of All India Institute of Speech and Hearing*. 2007.
10. Vickers DA, Moore BCJ, Baer T. Effects of low-pass filtering on speech intelligibility. *Journal of the Acoustical Society of America*. 2001.
11. Zhang J, McPherson B. Hearing-aid low-frequency cut and speech perception. *Folia Phoniatrica et Logopaedica*. 2008.