Voice Characteristics of the Elderly with Hearing Loss

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4/25/08
Student Research Day

Introduction

- **Topic:** Voice characteristics of elderly people who wear hearing aids.
- **Purpose:** Determine if there is a relationship between voice changes and hearing loss as people age.

Changes in the Cochlea

- Multiple age-related changes of the cochlea have been observed.
  - Damage to the base of the cochlea
  - Loss of hair cells and spiral ganglion cells (Gleeson & Felix, 1987; Jorgensen, 1961; Nelson & Hinojosa, 2006)
  - Stria vascularis atrophy (Johnsson & Hawkins, 1972; Pauler et al., 1988)

Levels of Hearing Loss

![Graph showing changes in hearing threshold over age and noise exposure.](Gates et al., 1990)

Changes in the Larynx

- As we age, the anatomy and physiology of the larynx changes.
  - Calcification and ossification (Kahane, 1987)
  - Reduced blood supply (Kahane, 1988)
  - Muscle atrophy (Mueller et al., 1985)

Acknowledgements

- Research Committee
  - Dr. Elaine Stathopoulos
  - Dr. JoAnn Hammer
- Technical Assistance
  - Ken Johnson
Voice Characteristics

The numerous age-related changes of the larynx appear to contribute to the phonatory characteristics typically associated with many older persons.

- Breathy and hoarse (Mueller et al., 1984)
- Pitch changes (Mueller et al., 1984; McGlone & Hollien, 1983; Honjo & Isshiki, 1980)
- Tremor (Pontes et al., 2006)
- Reduced intensity (Baker et al., 2001)

Voice & Hearing Loss

- As hearing loss increases, people have less auditory feedback.
- It is well known that articulation changes, especially with profound hearing loss.
- Does voice change with hearing loss?

Hypotheses

- The more hearing loss a person has, the more deviant their voice will be from normal.
- The older a person is, the more deviant their voice will be from normal.

Subjects

- Normal Hearing:
  - 5 men, 5 women; 30-37 years old
- Mild Hearing Loss:
  - 3 men, 0 women; 76-82 years old
- Moderate Hearing Loss:
  - 6 men, 2 women; 72-87 years old
- Moderately Severe Hearing Loss:
  - 0 men, 3 women; 84-87 years old

Subjects were obtained from the University at Buffalo Speech Language & Hearing Clinic and the Hearing & Speech Center of Western New York.

Methods

- The subjects were 9 men and 5 women between the ages of 72 to 87 years who wear hearing aids.
- 10 additional normal hearing 30 year olds were taken from a previous study.
- The subjects were divided into 4 groups based on hearing loss.
  - Normal hearing: 0-25 dB
  - Mild hearing loss: 26-39 dB
  - Moderate hearing loss: 40-54 dB
  - Moderately severe hearing loss: 55-69 dB

Methods

- Questionnaires
  - General health
  - Otologic history
  - Voice-Related Quality of Life (University of Michigan, 1999)
- Speech Task: Sustained /a/
- Recording Procedures
  - Headset microphone, pre-amplifier, laptop computer
### Analysis

- Analysis of the voice recordings included:
  - Sound pressure level (SPL) and standard deviation
  - Fundamental frequency (F0) and standard deviation
  - 1st and 2nd formant frequencies (F1 and F2)
  - % jitter and % shimmer
  - Signal to noise ratio (SNR)

### Does Age Affect Voice?

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### Does Hearing Loss Affect Voice?

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### Conclusion

- According to my data, there seems to be more vocal tremor in subjects with a higher level of hearing loss.
- It also appears that subjects with more hearing loss speak louder.
- The remaining results are probably due to age.
- This study should be repeated with a larger number of subjects to determine if hearing loss has a more significant effect on voice.

### References