



# Directional Microphone Strategies for Adults with Dual Sensory Impairments

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# Dual Sensory Impairment Defined

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- Program designed for adults with visual impairment and significant hearing loss.
- An increasing number of our patients present with dual sensory impairments.
- Recent studies show that 1 in every 5 adults age 70 and older reported both visual and hearing impairment (Brennan,2002).



# Amplification Goals for Dual Sensory Impaired Populations :

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- Improve speech recognition ability
- Provide acoustic cues necessary for orientation and mobility

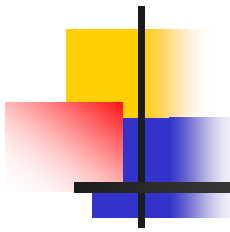


# Amplification Options that may Improve Speech Recognition Ability

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- A. Noise Suppression Technology
  1. Digital Noise reduction
  2. Digital Feedback Suppression
  3. Digital Speech Enhancement
- B. Directional Microphones
- C. DSP combined with Directional Microphones=enhanced speech recognition in a background of noise and improved patient comfort.

# Amplification Options that may Improve Speech Recognition Ability



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DSP gives the audiologist an increased number of controls with which to meet the specific needs of a patient. The combined use of Digital Noise reduction, Digital Feedback Suppression, and Digital Speech Enhancement may improve patient comfort with amplification resulting in greater hearing aid benefit as perceived by the patient.

# Amplification Options that may Improve Speech Recognition Ability



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Directional Microphone Technology can provide benefit for hearing-impaired listeners in both laboratory and real-world situations.

(Hawkins & Yacullo, 1984; Ricketts & Dhar, 1999; Walden et al., 2000, Killion et al., 1998, Preves et al., 1999).



# Omni-directional vs. Directional microphones

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Factors that influence microphone choice:

- A. Location of the signal of interest
- B. Presence or absence of background noise
- C. Type of background noise
- D. Environment



# Omni-directional vs. Directional microphones

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- Directional advantage when signal of interest is in front of the listener and a directional disadvantage when the signal of interest is behind the listener.
- Bilateral directional microphone hearing aids may enhance speech understanding in noise conditions where speech is in front of the listener and the noise sources are to the side of the listener in a moderately reverberant environment.  
(Hornsby and Ricketts, 2007).



# Amplification options-user strategies

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- A. Toggle switch or memory button- allows the wearer to easily adjust between directional and omnidirectional modes.
- B. Automatic switching-instrument that automatically switches to directional when the user is in a noisy situation and automatically switches back to omnidirectional when the user is in a quiet environment.

# Populations that may not require Directional Microphone Hearing Aids



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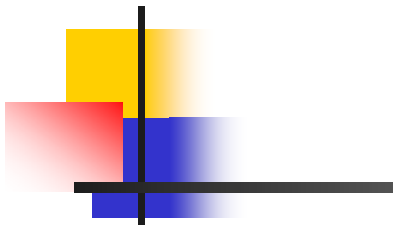
- A. Directional benefit may be absent or minimal in quiet listening situations.
- B. Reverberant situation with large listener-to-speaker distance. Example: houses of worship.
- C. Listening to music.
- D. A driver who needs to hear things in back of him or her.
- E. Previous successful user of omnidirectional hearing aids.



# Hearing Cues for Orientation and Mobility

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- A. Localization
  - 1. ITDs
  - 2. ILDs
- B. Spatial Hearing
- C. Echolocation
- D. Auditory distance perception





# Hearing Cues for Orientation and Mobility

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- Localization in the horizontal plane is critical for blind travelers and depends primarily on ILDs and ITDs.
- Low frequencies are localized primarily on the ITDs and the high frequencies on the basis of ILDs.
- However, when wideband stimuli produce conflicting ILD and ITD cues, individuals will follow the direction of the ITD cue as long as low frequencies are present.

(Wightman et al., 1992).



# Hearing Cues for Orientation and Mobility

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## **Unaided Localization of sound-**

- impaired in patients with sensorineural hearing loss.
- correlation between severity of hearing loss and horizontal localization difficulty (Bryne & Dirks, 1996; Noble et al., 1994).

## **Aided Localization of sound-**

- fit bilaterally to improve localization (Simon, 2005).



# Hearing Cues for Orientation and Mobility

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Spatial Hearing is a phrase used to describe the localization or perception of space via auditory cues.

Echolocation is one component of spatial hearing and may play an important role in the independent travel of people who are blind.

Echolocation involves locating objects by means of sound waves that are produced and reflected back to the individual by objects in the environment. Example: footsteps, cane taps, and verbally produced sounds.

Auditory distance perception is based on differences in intensity and time of arrival between direct and reflected sounds. Requires knowledge of the source or listening environment. Listeners often underestimate the source distance when it is more than one meter away (Brugart, 1999).



# Hearing aid parameters for Orientation and Mobility

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- A. Single-channel linear hearing aids to reduce interaural distortions that may be produced with wide dynamic range compression (WDRC).
  
- B. Provide WDRC in the high frequencies where it is most useful with sloping sensorineural hearing losses due to decreased dynamic ranges and set low frequencies to a linear configuration for low frequency ITD cues important for sound localization.  
(Simon & Levitt, 2007).



# Hearing Technology for Those with Dual Sensory Impairments

A. Multiple programs- one program that reduces low frequency noise and maximizes speech cues through a high frequency response program and another program with low frequency cues for environmental sounds necessary for travel.

B. Compression-may impair distance judgment. Intense sounds originating in close proximity to the listener might be transmitted at a softer level due to compression and incorrectly judged by the individual as being farther away.

C. Venting with directional microphones-the directivity in the low frequencies diminishes with increasing vent size.  
(Ricketts, 2000).



# Audiologic Management

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- A. Counseling- critical for patients with automatic directional systems.
  
- B. Training-
  1. Manipulation of the environment
  2. Facing the speaker of choice
  3. Placing background noise behind the listener
  4. Moving closer to the target source
  5. Discuss the potential reduction in important traffic sounds to the back and sides of the patient when employing directional microphones.

# Seamless intervention of services between Audiology and Blind Rehabilitation



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- VIST
- Audiology Services
- Blind Rehabilitation Services



# Audiology Services

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- Referral Process
- Audiology's Timely Intervention-ideally fit patients with hearing aids prior to Blind Rehab. Program.
- Audiogram
- ENT Evaluation as needed
- Hearing aid fitting
- Acclimatization
- Follow-up



# Blind Rehabilitation Services

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- Low Vision
- Living Skills
- Mobility
- Manual Skills



# Factors that separate Blind Rehab. from Audiology

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- Goal of Blind Rehab.:  
Independence
- Goal of Audiology:  
Improved Communication

# Hands On Practical Considerations for Fitting Hearing Aids to Blind Patients



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- A. Style of Hearing aids
  - 1. BTE
  - 2. ITE
  - 3. CIC
- B. Special Features
  - 1. Memory Button
  - 2. Volume Wheel
  - 3. Remote Control
  - 4. Battery doors and battery size
- C. Color vs. tactile cues – depends on level of visual impairment
- D. Verbal communication to describe direction
- E. Body Language



# Hands On Practical Considerations Continued

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## Assistive Devices:

- CCTV
- Magnifiers
- Hearing Aids vs. Headset Amplifiers
- Phones and other home alerting devices



# Conclusion

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Amplification strategies for dual sensory impaired patients should improve speech recognition ability and provide acoustic cues necessary for orientation and mobility.



# Future Concerns

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- Cross specialty issues
- In-service training
- Future investigation-whether or not hearing aids with automatic omni-directional/directional microphone arrangements are appropriate for individuals with dual sensory impairments in terms of providing speech recognition in noise as well as environmental cues necessary for mobility.