


**NIH Toolbox**  
Assessment of Neurological and Behavioral Function

# Audition

Steven G. Zecker, Ph.D.  
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For more information, please visit [www.nihtoolbox.org](http://www.nihtoolbox.org)  
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# The Audition Team



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# Audition Subdomains



- **Pure Tone Audiometry:** A behavioral test used to measure hearing sensitivity. PTA involves both the peripheral and central systems and assesses the softest sound at various frequencies audible 50% of the time.
- **Speech in Noise:** A behavioral test that assesses an individual's ability to understand spoken language under quiet listening conditions and in the presence of various levels of background noise.
- **Self-Report of Hearing Function:** Measures (through a subjective rating scale) an individual's self-reported hearing abilities under a variety of real-world listening conditions.
- **Tympanometry:** An objective test of middle ear function which measures energy transmission through the middle ear and mobility of the tympanic membrane (eardrum) by creating variations of air pressure in the ear canal.

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## Specific Tools for the Subdomains



- ◆ Pure Tone Audiometry: Automated Measure for Testing Auditory Sensitivity (AMTAS) (Margolis and Morgan, 2008)
- ◆ Speech in Noise Test: Words-In-Noise (WIN) (Wilson, 2003)
- ◆ Self-report of Hearing Function: Hearing Handicap Inventory for Adults (HHIA) (Newman et al, 1990)
- ◆ Tympanometry: Earscan (Microaud, Inc.)

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## AMTAS



- ◆ Utilizes 1) sound-reducing headphones, 2) small box that serves as an audiometer and 3) a touch screen PC
- ◆ Obtains thresholds at six (250 Hz, 500 Hz, 1 KHz, 2 KHz, 4 KHz and 8KHz) frequencies. A screening version utilizes three frequencies: 1 KHz, 2 KHz and 4 KHz). Depending on time considerations, can be customized to any number of frequencies
- ◆ A children's version uses animated characters to provide feedback and facilitate attention.

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## WIN



- ◆ Presents monosyllabic words in seven signal-to-babble (S/B) ratios (0 dB to 24 dB) of multi-talker babble.
- ◆ Stimuli are high frequency words (e.g., red, mouse, gun, pick) taken from the Northwestern University Auditory Test Number 6 (NU-6) materials.
- ◆ Threshold is defined as the S/B ratio corresponding to 50% correct recognition.

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## HHIA



- Requires the respondent (or proxy) to answer each of 25 items describing possible difficulties in hearing under various conditions.
- There is a short version consisting of 10 items.
- Respondents answer on a three point scale (Yes/Sometimes/No) the extent to which a statement applies to them.
- Sample Items: "Do you feel that a hearing problem causes you difficulty when listening to the TV or radio?"
- "Do you feel that any difficulty with your hearing limits or hampers your social life?"

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## Earscan



- ♦ Can be controlled by a PC or administered manually.
- ♦ Utilizes a standard three second sweep rate (or a one second rate more suitable for younger children).
- ♦ Achieving a fast, complete seal is facilitated by the 'Ear-cuffs' specifically made for the unit.

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## Validation of the Tools



AMTAS: Correlation with the current 'Gold standard': conventional pure tone assessment conducted by an audiologist.

WIN: Comparison to other measures of listening in noise and to self-reported difficulty in hearing under noisy listening conditions. Assessment of the contribution of auditory short-term and working memory to WIN performance to evaluate the cognitive component of the task.

HHIA: Evaluation of the relation of self-reported hearing ability to performance on established behavioral measures of hearing function.

Earscan: Correlation with conventional desktop tympanometer, evaluation of test-retest reliability

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# Tryout

## Concerns/Considerations



- ◆ Appropriateness of each task with the youngest (age 3-6) and oldest (age 75 and above) individuals (AMTAS, WIN and the HHIA).
- ◆ Limitations in cognitive development in youngest children and cognitive function in older adults (e.g., memory, attention, and linguistic/literacy skills) will require modifications of existing materials. Oversampling of young children and older adults will be required to evaluate the modifications.
- ◆ The automated tasks utilizing unfamiliar technology may pose significant difficulty for a subset of our younger and older participants.

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