

# The Composition of the Auditory Profile

Prof Mark E Lutman

Institute of Sound and Vibration Research  
University of Southampton, UK

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Rationale for Auditory Profile

- Vast majority of hearing impairments in adults are sensorineural (SNHL) - typically due to degeneration of hair cell function in cochlea
- Affecting at least 17% of general adult population (>100m adults in Europe)
- Commonly measured in terms of sensitivity to quiet sounds (the audiogram)
- Wide variety of self-rated disability and performance on speech recognition tasks among people with similar audiograms
- Need for better characterisation of hearing abilities, beyond simply the audiogram

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Characterisation of SNHL

- Plomp model components A and D
- Attenuation or Audibility component (A)
  - Speech may be inaudible because it is below absolute threshold, or masked by noise to a normal extent
- Distortion component (D)
  - Speech may be distorted or excessively masked by noise (supra-threshold hearing deficits)
- *There are opposing views in the literature on whether the A or D component is more important - for mild, moderate and severe hearing losses*

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Research questions

- What are the important components of D?
- How do these vary with severity of hearing loss?
- Does D component vary independently of A (alternatively, can we predict D from A)
- Can we identify distinct sub-types of SNHL, based on combinations A and D?

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Potential applications

- Can measurement of Auditory Profile be achieved within typical clinical constraints?
  - Modest time expenditure
  - With sufficient accuracy/reliability
  - Feasible equipment set-up
  - Minimal staff training and need for expertise

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Auditory Profile tests

1. Audiogram (a-c + bc; 0.25 – 8 kHz)
  2. Spectral and temporal resolution (0.5, 3 kHz)
  3. Loudness perception (0.5, 3 kHz)
  4. Speech recognition in quiet
  5. Speech recognition in stationary and fluctuating noise *without* directional cues
- ...

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Auditory Profile tests (continued)

6. Speech recognition in stationary and fluctuating noise *with* directional (monaural and binaural) cues
7. Self-reported disability (speech, spatial hearing) and handicap (behaviour and social relationships): Gothenburg Profile
8. Cognitive function: Lexical Decision test

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Implementation of AP tests

- Common test platform based on Personal Computer, sound card and headphones
- Four languages for speech tests and questionnaire
- Five centres: Amsterdam (AMC, VUMC), Linköping, Oldenburg, Southampton
- Benchmarking to assure similar set-ups

Workshop Hearing Screening and Technology, Brussels 28 January 2009





# Development and validation

- 30 normal hearing (NH) participants
- 73 hearing-impaired (HI) participants (fairly symmetrical hearing)
- Measures of test-retest repeatability
- Distributions for NH and HI groups
- Correlation analysis (redundancy)
- Preliminary factor analysis

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Outcome of validation stage

- Measures appropriately differentiated NH and HI groups
- Satisfactory repeatability
- Equivalence across centres, except for speech tests (adjusted according to reference values)
- Elimination of redundant measures reduced time required for AP to approximately 60-90 minutes
- Factor analysis supported multi-factorial concept of AP

Workshop Hearing Screening and Technology, Brussels 28 January 2009



# Evaluation of Auditory Profile

- Study data collection (virtually) complete
- 25 NH and 100 HI participants
- Data checking complete
- Analysis commencing ..... results available in February 2009

Workshop Hearing Screening and Technology, Brussels 28 January 2009

