Overview

- Why do we need perception tests?
- Types of test
- Running a test
- Analysis of test results
- Examples

What is a perception test?
- Experimental procedure to find which aspects of the signal are used by listeners in decoding speech
  - either to find out more about the signal
  - or to find out more about the listener
- Typically ask listeners to identify a word or to discriminate between pairs of words.
- Often use synthetic or manipulated speech signals to get control over exact sound

Finding out more about the signal
- Studying spectrograms only raises hypotheses for acoustic cues
  - Need to know what aspects of the spectrographic pattern listeners actually use
- Multiple cues to any contrast
  - Need to know which cues are most important
- Building a speech processing system
  - Need to know if contrasts affected

Finding out more about the listener
- Tests on normal listeners
  - language development, individual differences, L2 learners, bilingualism,
- Tests on disordered listeners
  - effect of hearing impairment on communication
  - phonological disorder/delay
  - differentiate types of impairment (peripheral/central)

Word Intelligibility Tests
- To obtain an overall measure of subject performance in listening to speech
- Standard lists
  - e.g. PBK (phonetically-balanced kindergarten) lists
  - e.g. BKB sentence lists
- Mark % words identified correctly
- Compare across signal conditions
  - e.g. dBSP, SNR, type of hearing aid
- Compare with normative results
  - e.g. by chronological age
Phoneme-level Testing

- Not always easy to use word intelligibility to find out about specific cues or contrasts
- Influence of higher linguistic levels:
  - knowledge of possible words
  - frequency of possible words
  - likelihood of words in context
- In some situations, better to focus on individual phonemes

Two types of phoneme test

1. Analyse how phonemes are confused with each other
   - Ask listeners to identify phonemes, e.g. syllables presented in poor listening conditions so as to force errors
   - Look for patterns among the errors: what are common phoneme confusions?
2. Analyse how a single acoustic cue affects one contrast
   - Generate some artificial sounds with manipulated values of some acoustic cue, e.g. /ba/ changing to /pa/ with VOT
   - Ask listeners to choose between two phonemes
   - Analyse how different values of the cue affects choice

Type 1: Phonemic Confusions

- E.g. Miller & Nicely experiment, 1955
- VCVs played to listeners under many different conditions of SNR and filtering
- Listeners choose from 1 of 16 consonants only
- “Confusion matrix” shows how often each consonant was confused with others
- Analysis shows confusions about place more common than confusions about voicing

Example confusion matrix

![Confusion Matrix](image)


Type 2: Phonemic Contrast

- E.g. Lisker & Abramson VOT experiment, 1967
- Used to investigate how one particular cue is used by listeners to discriminate between phoneme categories
- Synthetic CVs varying only in Voice Onset Time are played to listeners
- Listeners choose b/p, or d/t or g/k only
- Analysis shows how CVs fall into two clear categories along the VOT dimension

Example Stimuli

- Voice Onset Time /ba/ - /pa/
  - Vary VOT across continuum

![Example Stimuli](image)
Running an identification test
- Multiple, random presentations of each stimulus
- Record forced choice responses

Analysis of test results
- Labelling graph

Analysis of test results
- Describe labelling behaviour
- Estimate phoneme boundary
- Estimate confidence from steepness

Tracking Development
- For this subject, performance on a task developed over 12 months
- As task becomes easier, stimuli are labelled more reliably and curve becomes steeper at boundary

Other example contrasts
- Spectral peak frequency
  - /a/ to /sa/
- F2 Locus Frequency
  - /ba/ - /da/ - /ga/
- Voice Onset Time
Discrimination Tests

- Judgements of similarity rather than identification of phonological category
- Used to show how perceptual system adapts to aid identification of language-specific categories

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<tr>
<th>Different</th>
<th>Same</th>
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<tbody>
<tr>
<td><img src="image.png" alt="Image of discrimination test" /></td>
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Summary

- Why do we need speech perception tests?
  - find out about signal vs. find out about listener
  - overall word intelligibility vs. phonetic detail
  - phonetic confusions vs. phonetic contrast
- Design of phonetic tests and stimuli
- Running of tests and analysis of results

Lab Experiment

- Two Perceptual experiments
  - Phonetic confusions in noise
  - Labelling of VOT dimension
- We’ll do listening task first
- Then stimuli will be explained
- Then you’ll analyse your own performance
- We’ll also calculate a class average