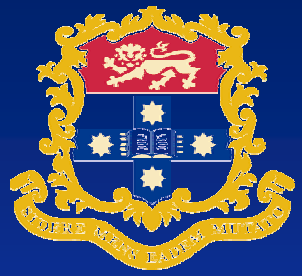

**Auditory Neuroscience Laboratory,
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High Frequencies in Speech and Talker Localization and Segregation

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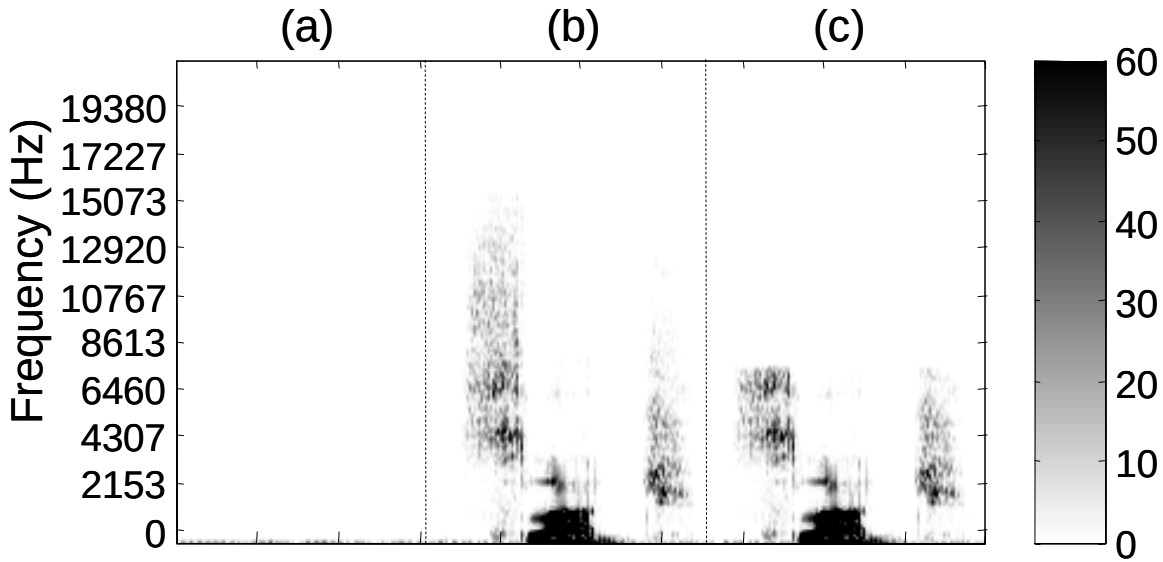
Setting the scene

- The contribution of the various acoustic spatial cues to speech segregation and speech intelligibility?
- Particular focus on frequency bandwidth and the percept of externalisation.
- Using VAS and CRM to measure speech intelligibility with dichotic and virtual listening conditions.

Broadband spectra of speech



- Significant high frequency content – e.g. “sludge”
- Not required for single channel speech intelligibility

  E.g. AI and SII models
- Frequencies > 8 kHz important in accurate localisation of bb noise. What about speech?

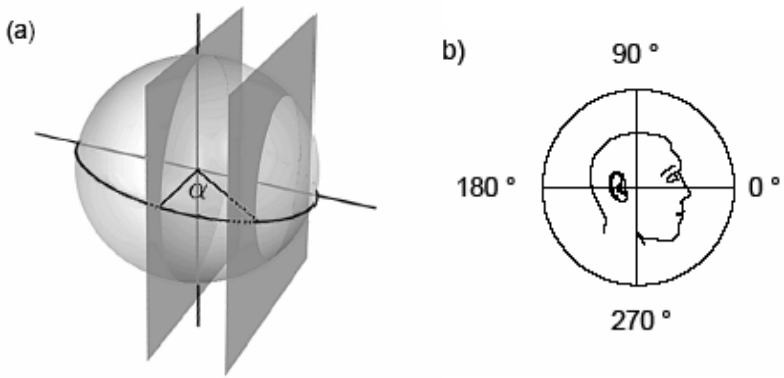
Localisation of speech stimuli

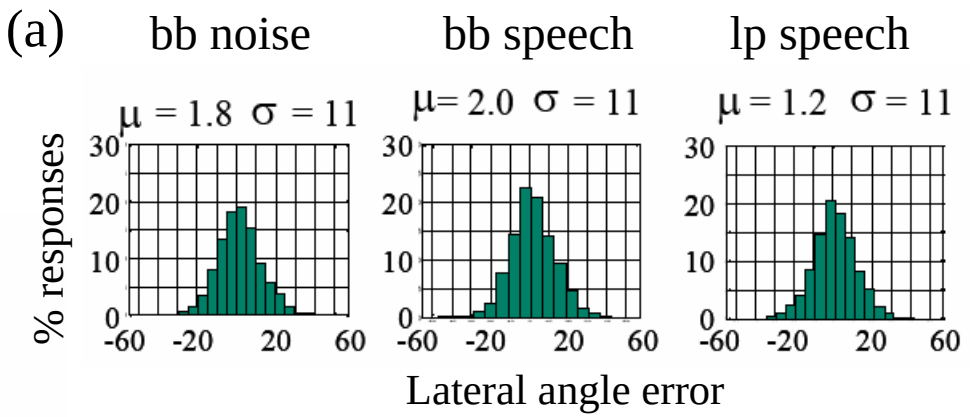
High frequencies & accurate speech localisation

Localisation Errors

Lateral angle error

Polar angle error

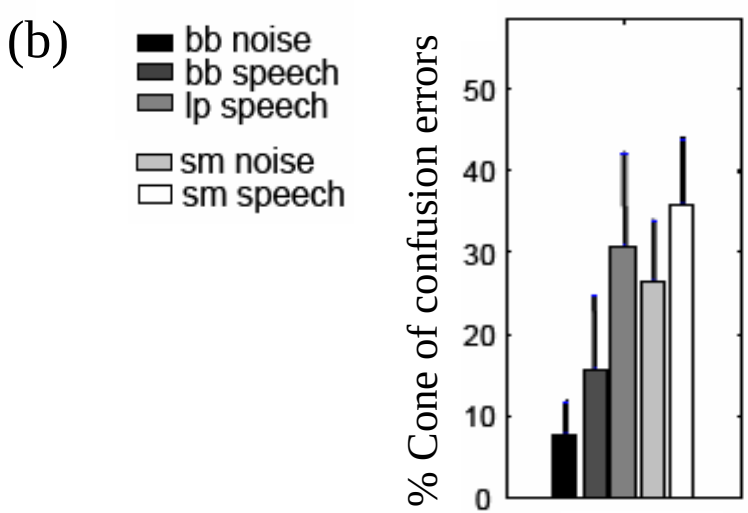




Low pass speech at 8 kHz

(a) No change in lateral angle error

(b) Significant increase in polar angle error (> 30°)

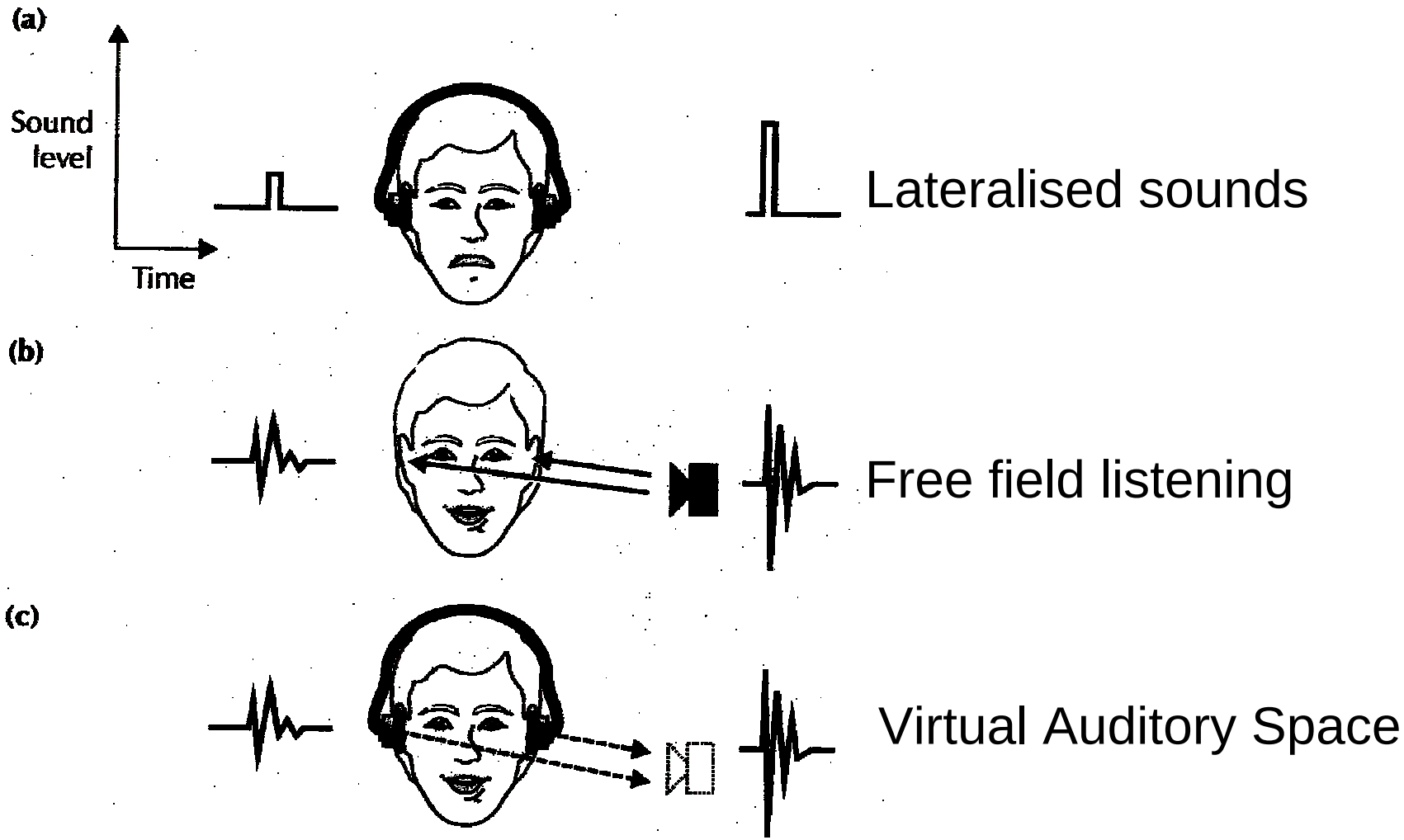


Jin et al 2002

Implications/questions.

- Differences in location an important cue in solving the cocktail party problem (Cherry)
- High frequencies important in accurate localisation of speech sources
- The Question: Does high frequency information in speech contribute to speech intelligibility with multiple concurrent talkers?
- The experiment: Measure speech reception threshold (SRT) with and without high frequency information

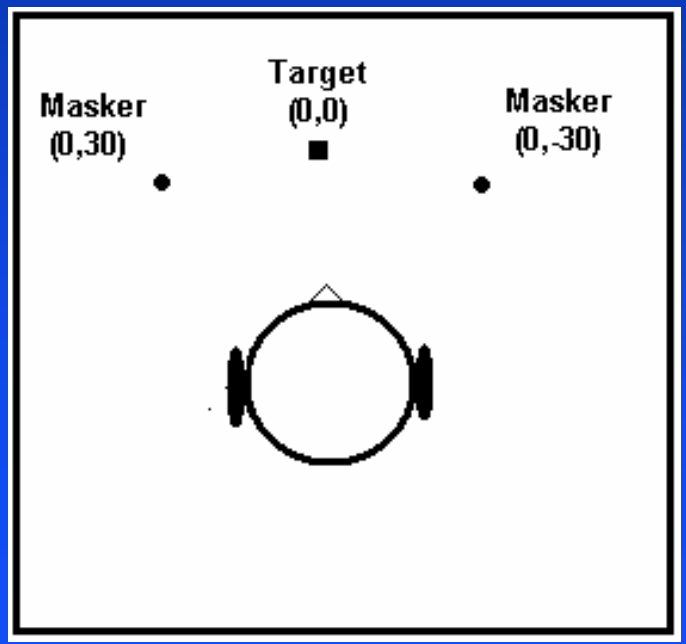
The Presentation Paradigm: Virtual Auditory Space



The intelligibility paradigm

Speech reception threshold measured using Coordinate Response Measure

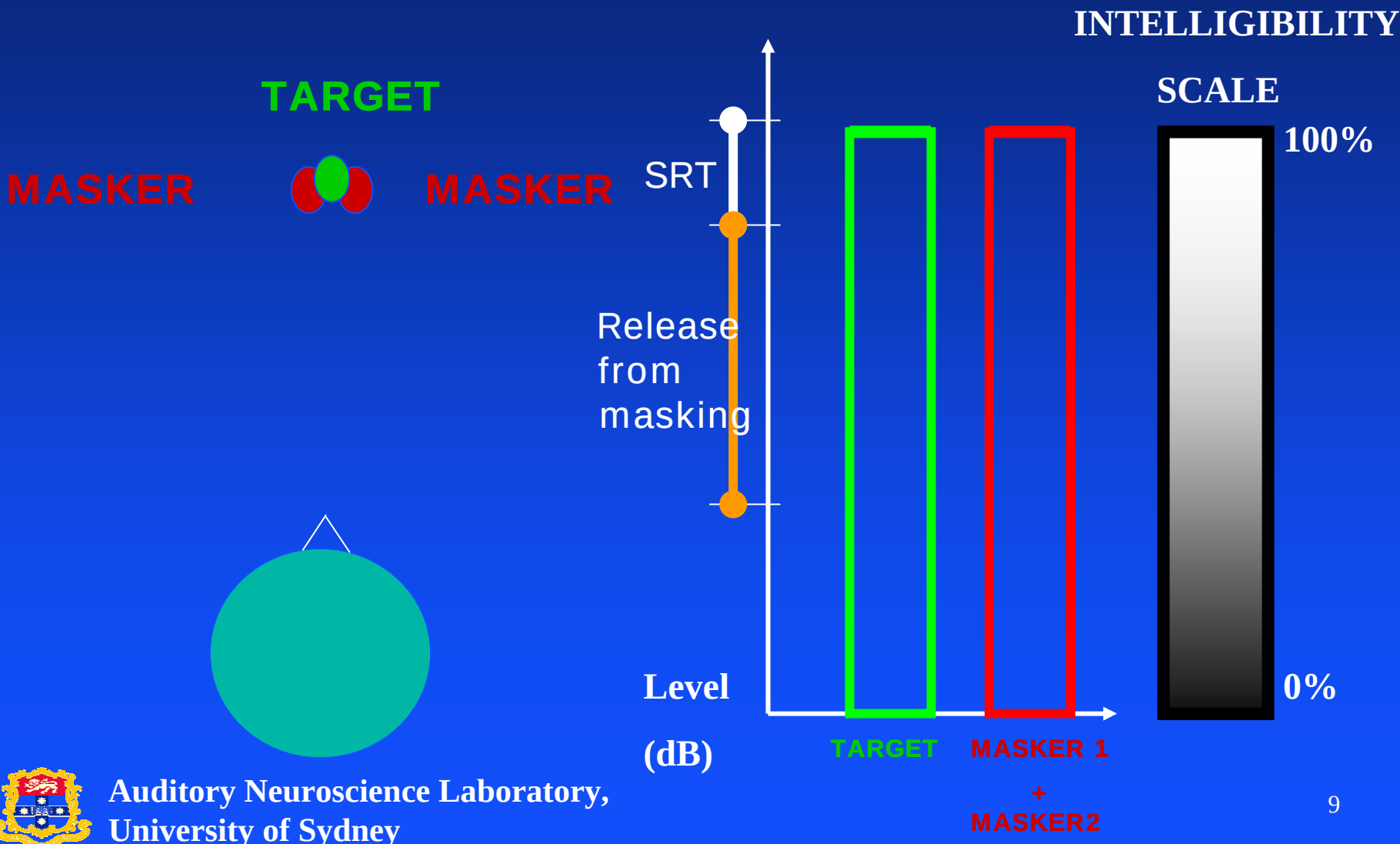
- Target Target+maskers
- Ready *Baron* go to *blue one* now
- Talkers: 4 male 4 female



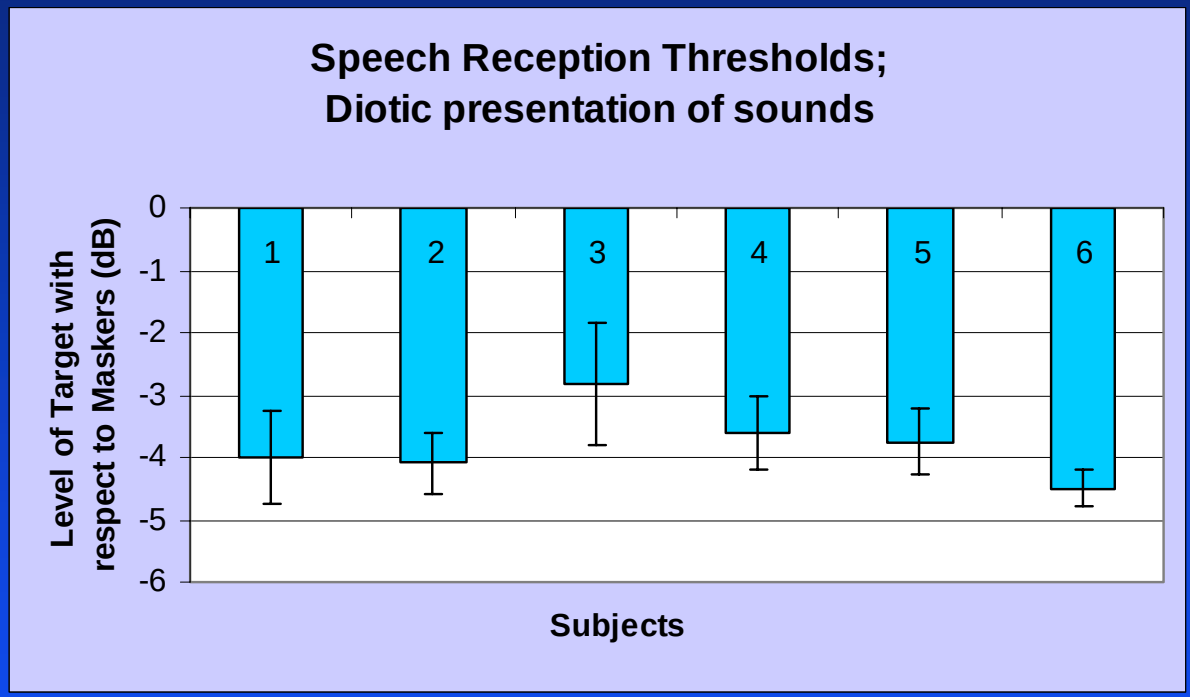
Adaptively vary level of target (Quest) to obtain the signal to masker threshold.

Listening model: The “Dinner table” problem

Measuring Speech Intelligibility: the “dining table” model



Diotic listening

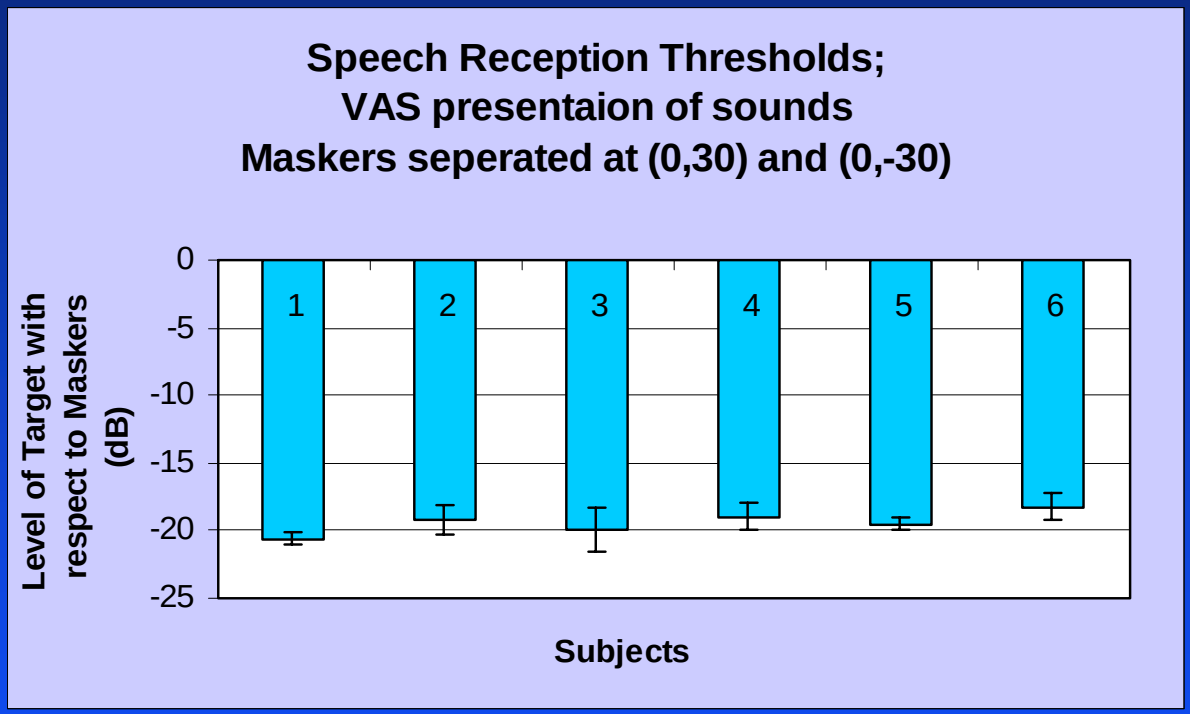


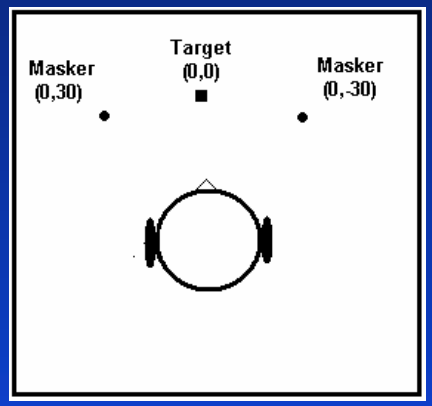
Mean -3.8dB

- No spatial separation of sound sources
- Internalisation of sound sources

Same result when co-located stimuli are externalised to directly ahead.

Spatialised (VAS) listening

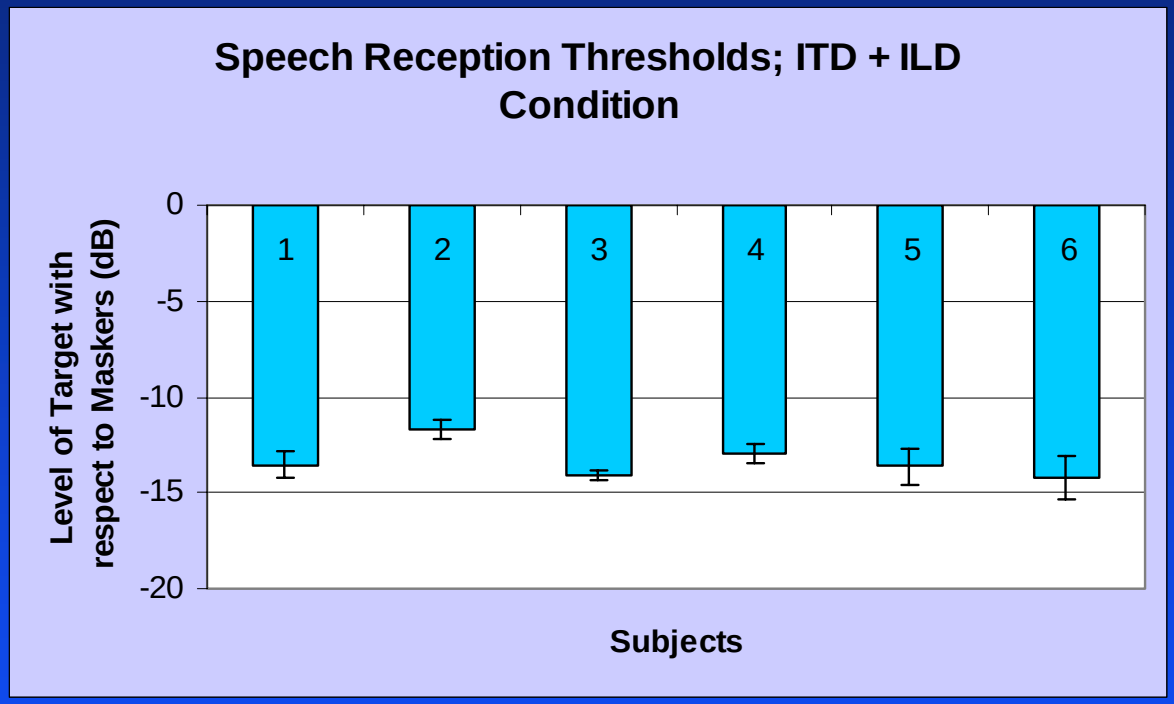


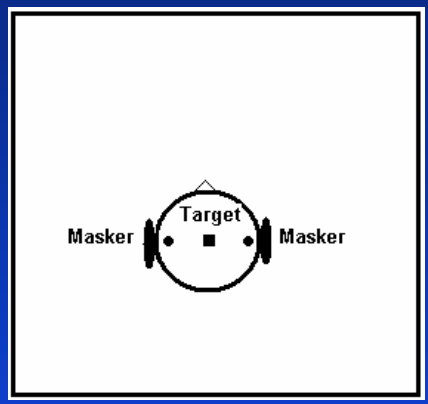


Mean -19.4dB

- Sound sources spatially separated
- Sound sources perceived in external space

Binaural listening

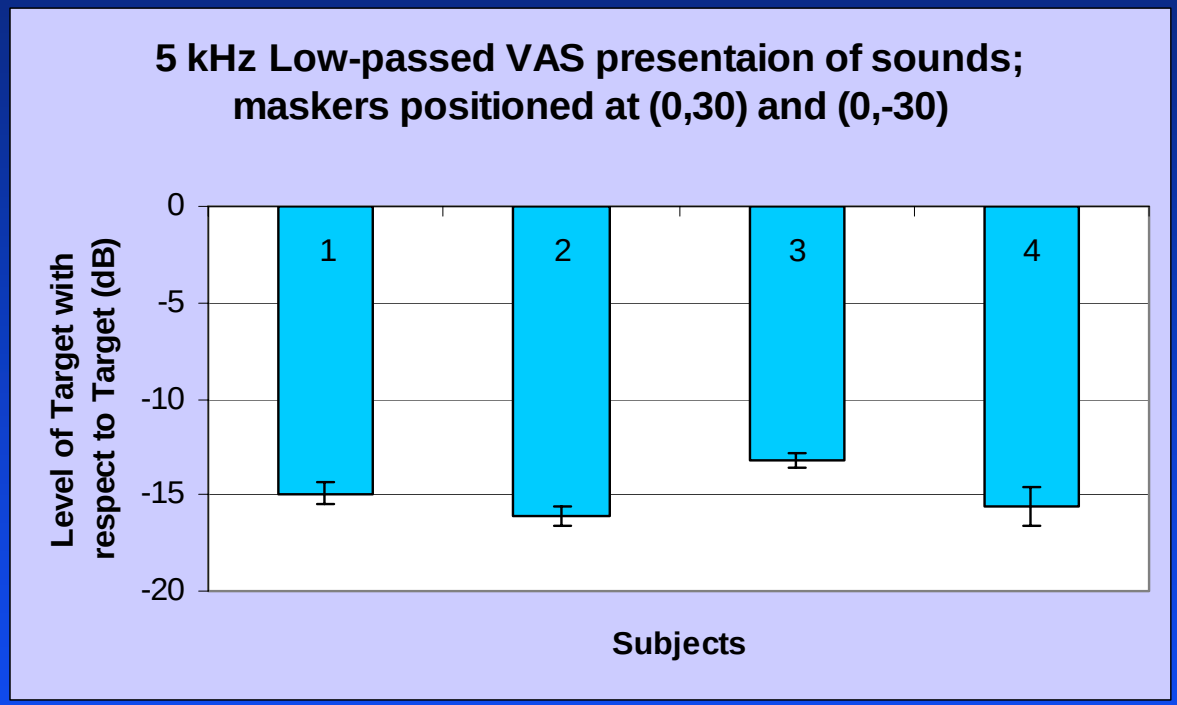


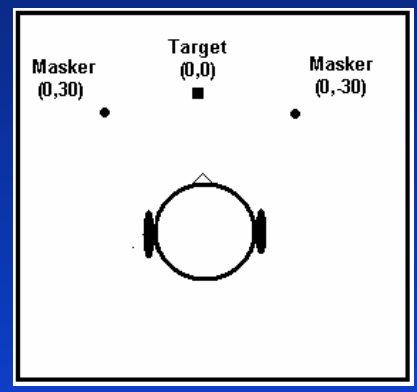


Mean -13.4 dB

- Sounds sources separated by differences in the binaural cues
- Sound sources lateralised within the head

5 kHz low pass VAS listening

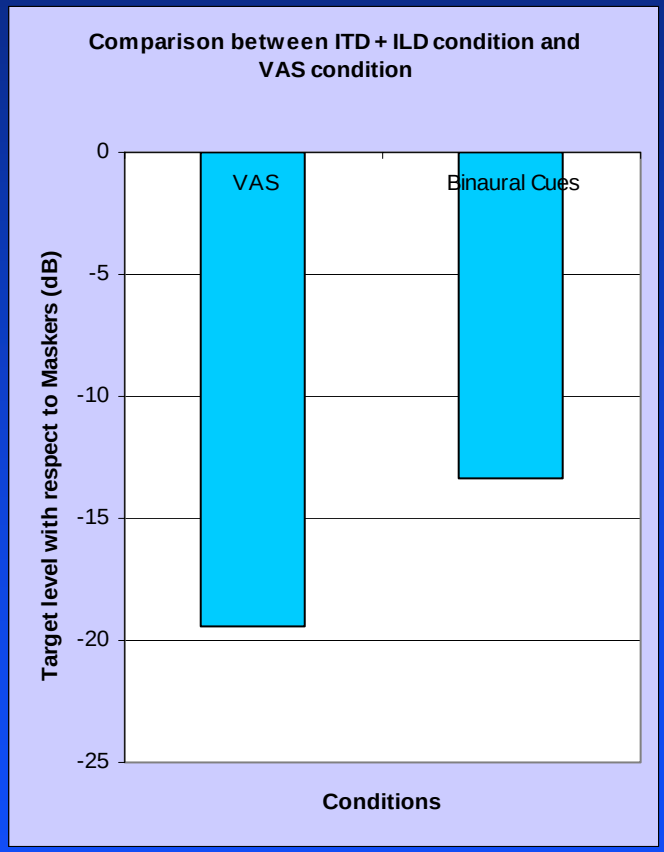


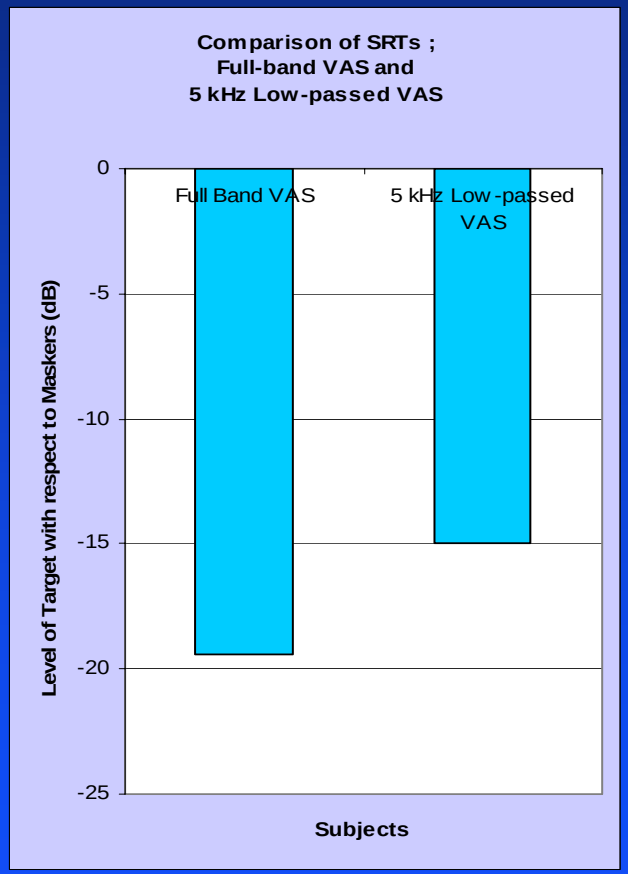


Mean -15 dB

- Sounds sources spatially separated
- Sound sources incompletely externalised

Results summary





Conclusions

- Percept of spatialisation supports significant speech unmasking and improved speech intelligibility.
  - Is this mediated through selective attention and streaming?
- Speech energy >5 kHz plays a significant role in multi-talker spatial listening
  - Implications for multi-channel communications, virtual reality displays, hearing aid design and bio-inspired ASR.