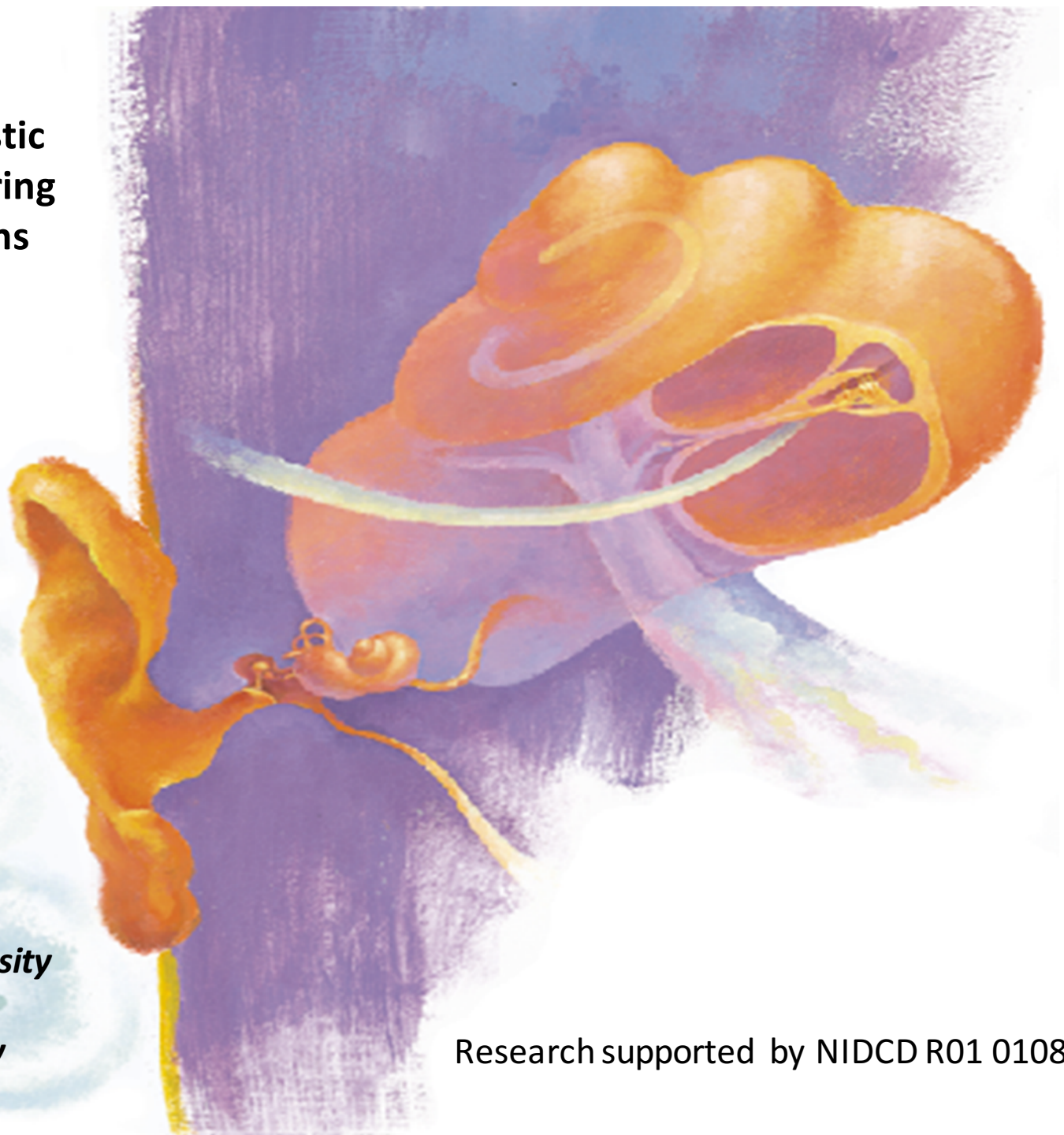


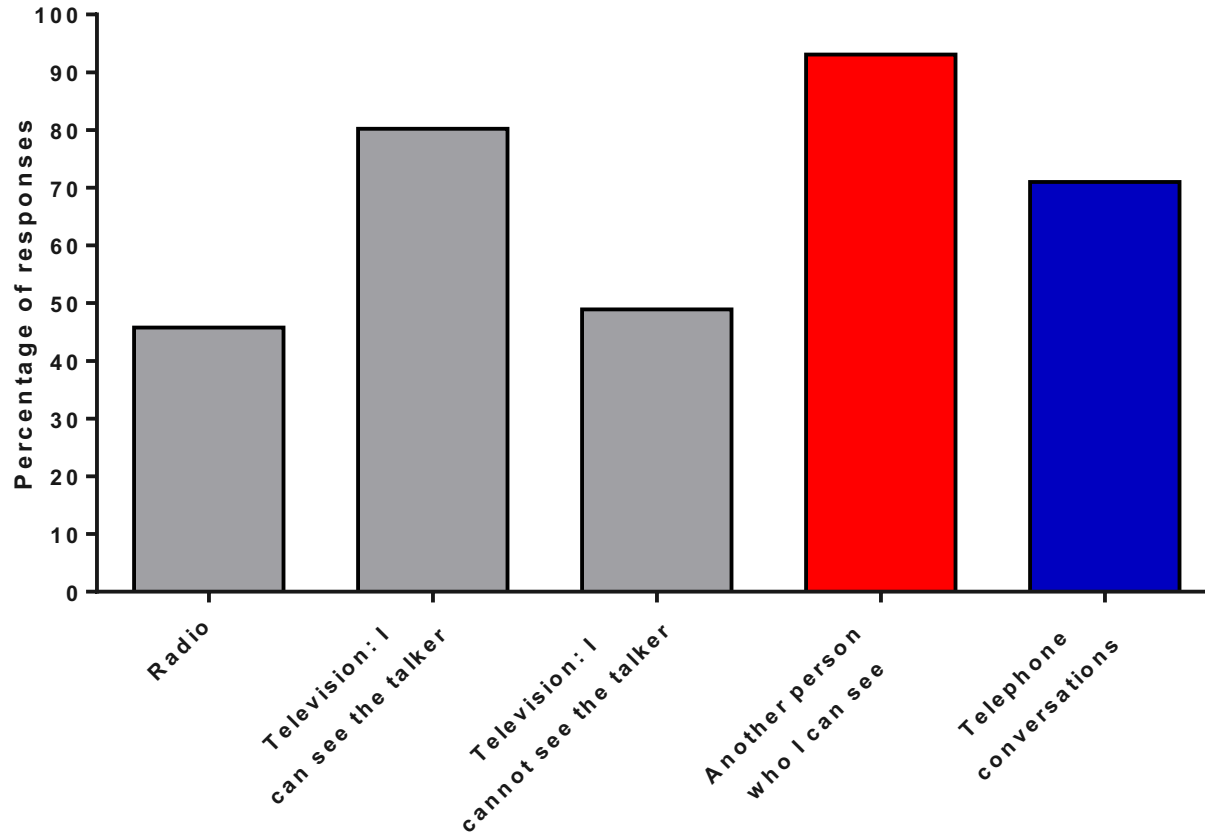
**The benefits of
combining acoustic
and electric hearing
in approximations
of real-world
listening
environments.**

Michael F. Dorman
Sarah Natale
Louise Loiselle
Shuai Wang
Arizona State University
Rene Gifford
Vanderbilt University

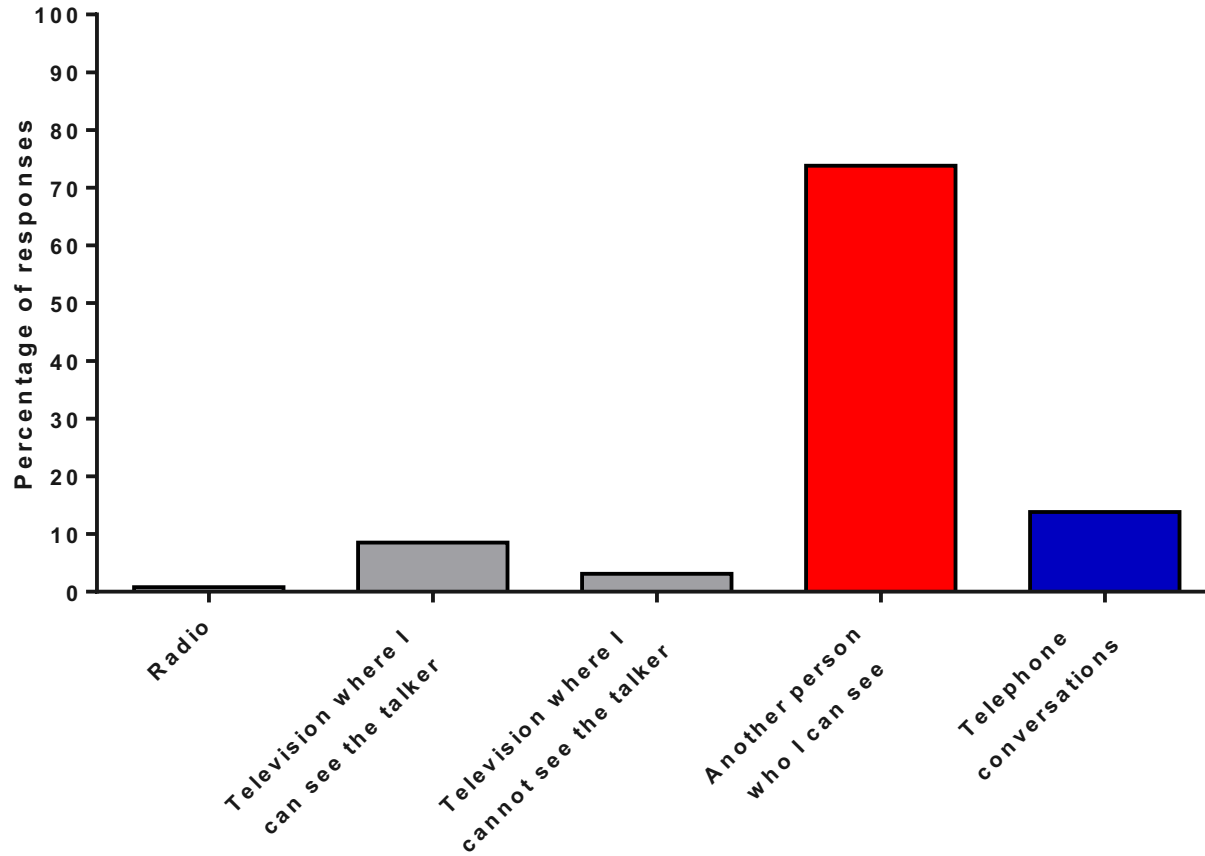
Research supported by NIDCD R01 010821



b. What sources of speech do you encounter on most days?



c. The most common sources of speech I hear come from :



- There is a massive amount of data to suggest that the cortex is wired to *integrate* auditory, visual and tactile information when computing the identity of a speech signal.
- Visual information is not an 'add on' to auditory information. Rather, it is an inherent part of the information normally evaluated for speech recognition.

A cocktail party



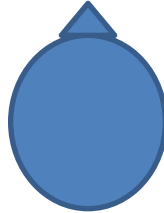
Target = female



Male 1



CI



Male 2





Target = female



Male 1



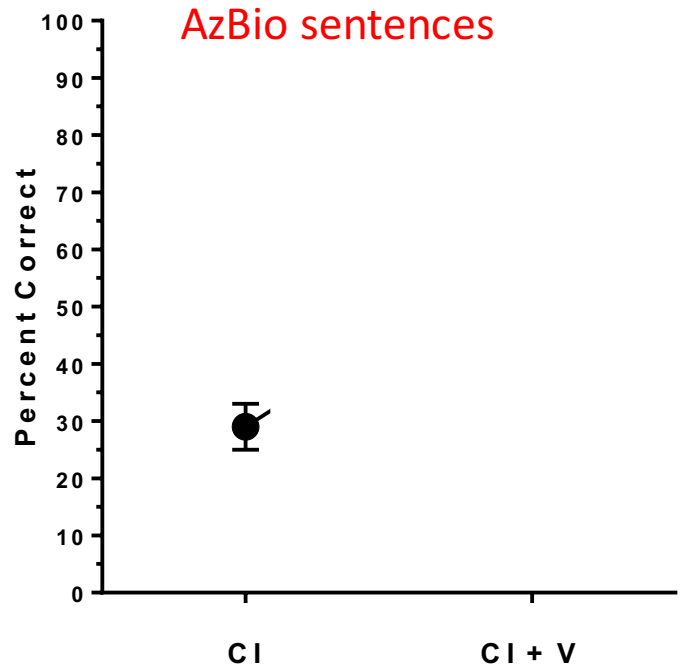
CI



Male 2



Drive performance with CI alone to ~30% correct on AzBio sentences





Target = female



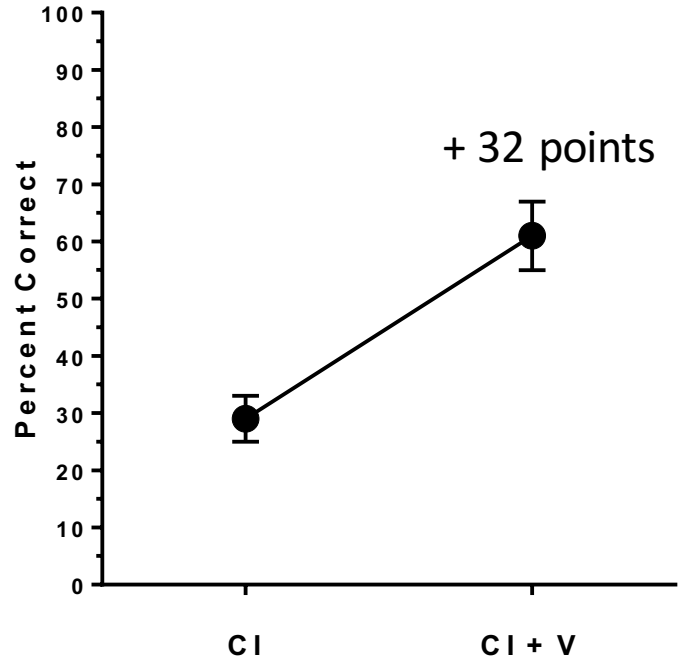
Male 1



CI



Male 2



- When we test in ***auditory-only*** environments, it is relatively easy to show that bilateral CIs, bimodal CIs and hearing preservation CIs provide benefit relative to a single CI.
- What happens to the value of these interventions when referenced to a single CI plus vision?
- Have we overstated the value of these interventions because we only test in auditory-only environments?



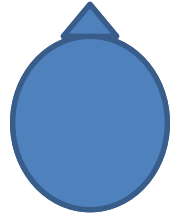
Target = female



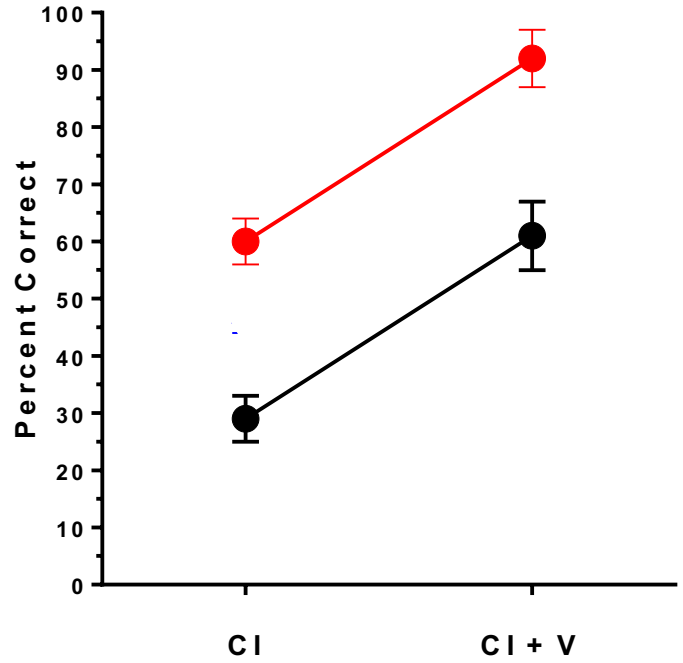
Male 1



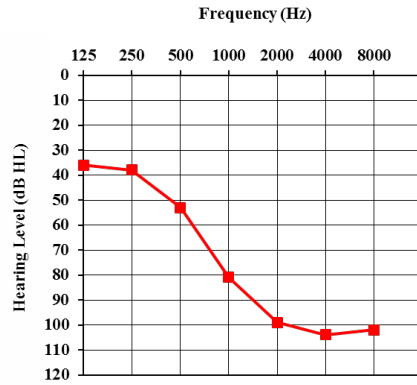
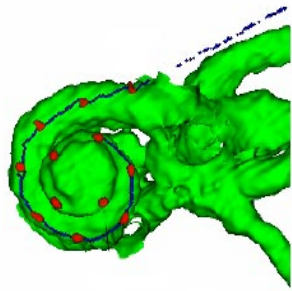
CI



Male 2



Bimodal patients



Target = female



Male 1

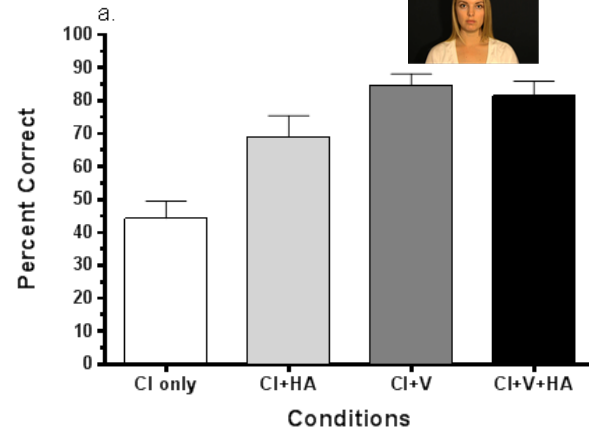


CI

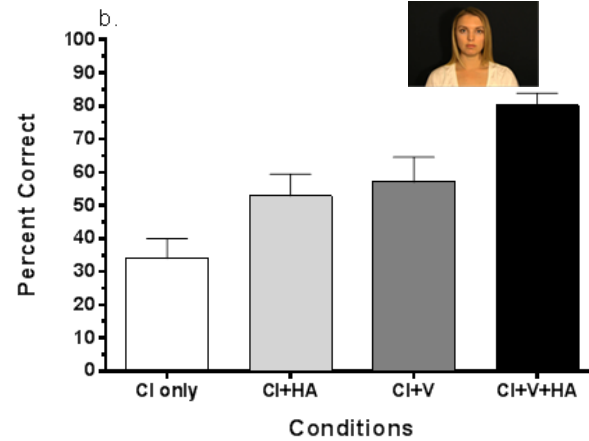


HA

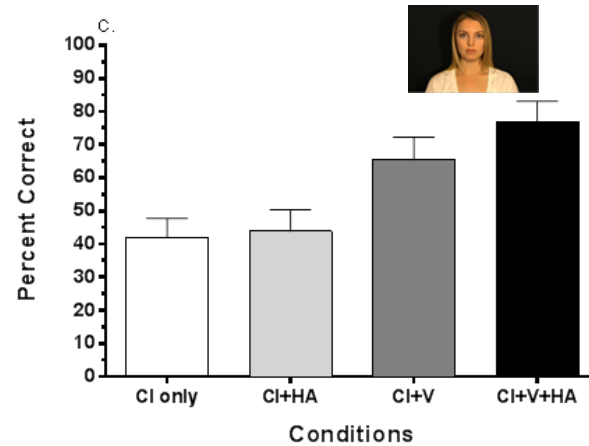
Male 2



n = 4

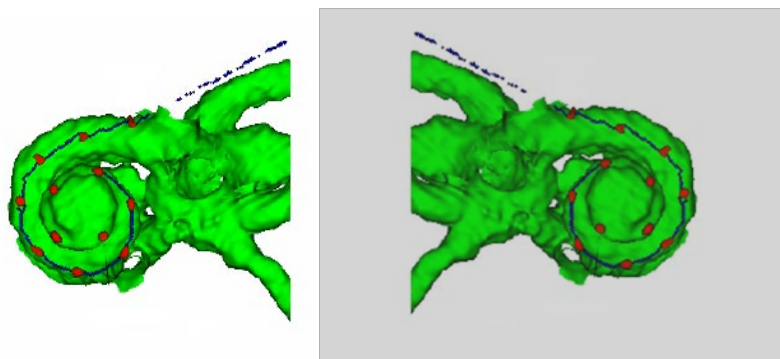


n = 6



n = 7

Bilateral patients



Target = female



Male 1

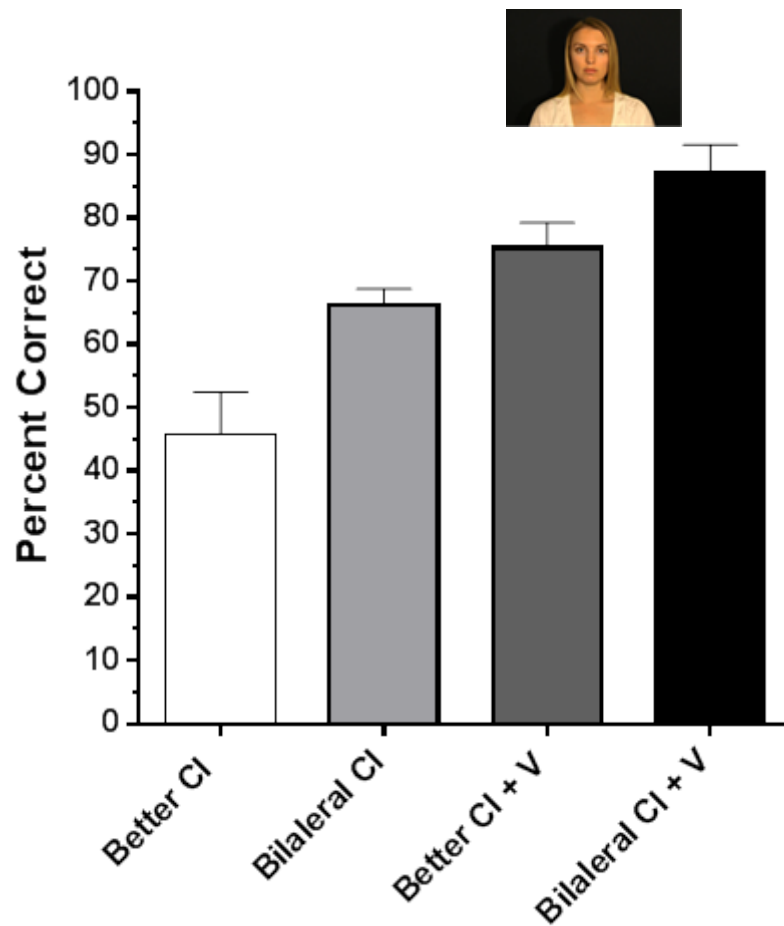


CI



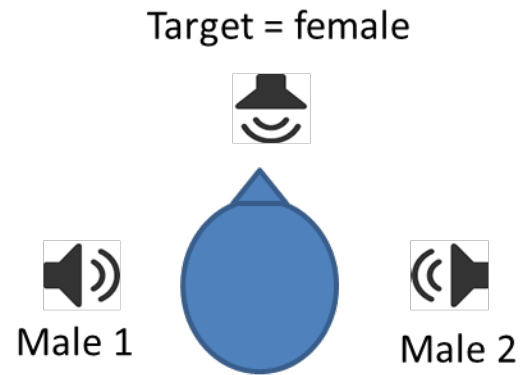
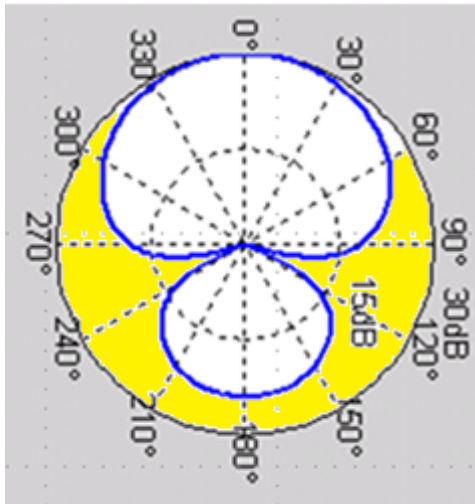
CI

Male 2



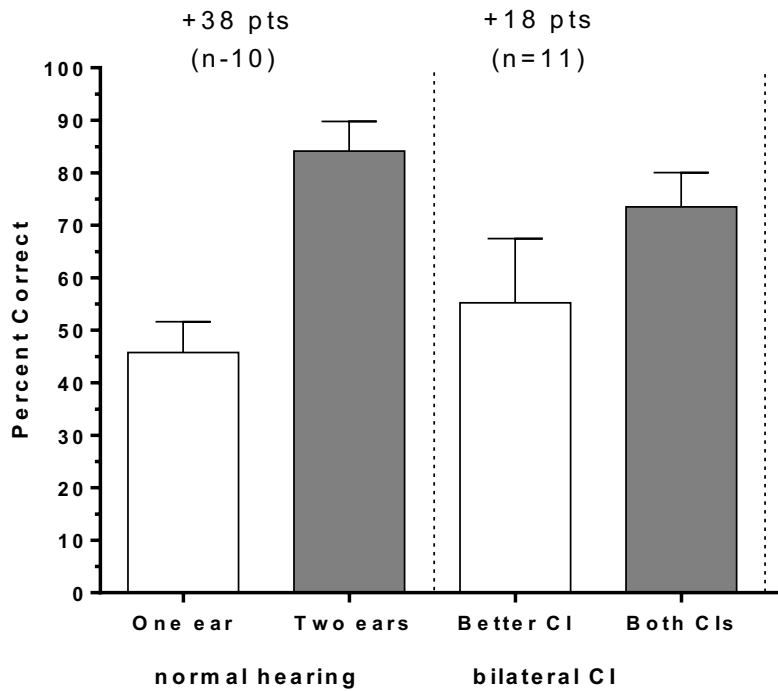
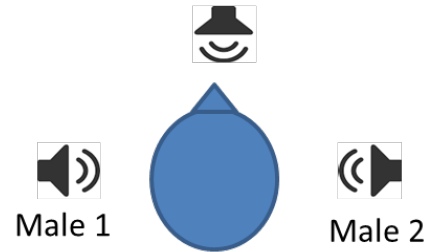
Do you need two ears to do well in the cocktail party, or is there a technology for a single ear that will provide an equal degree of improvement ?

Beam former microphone pattern



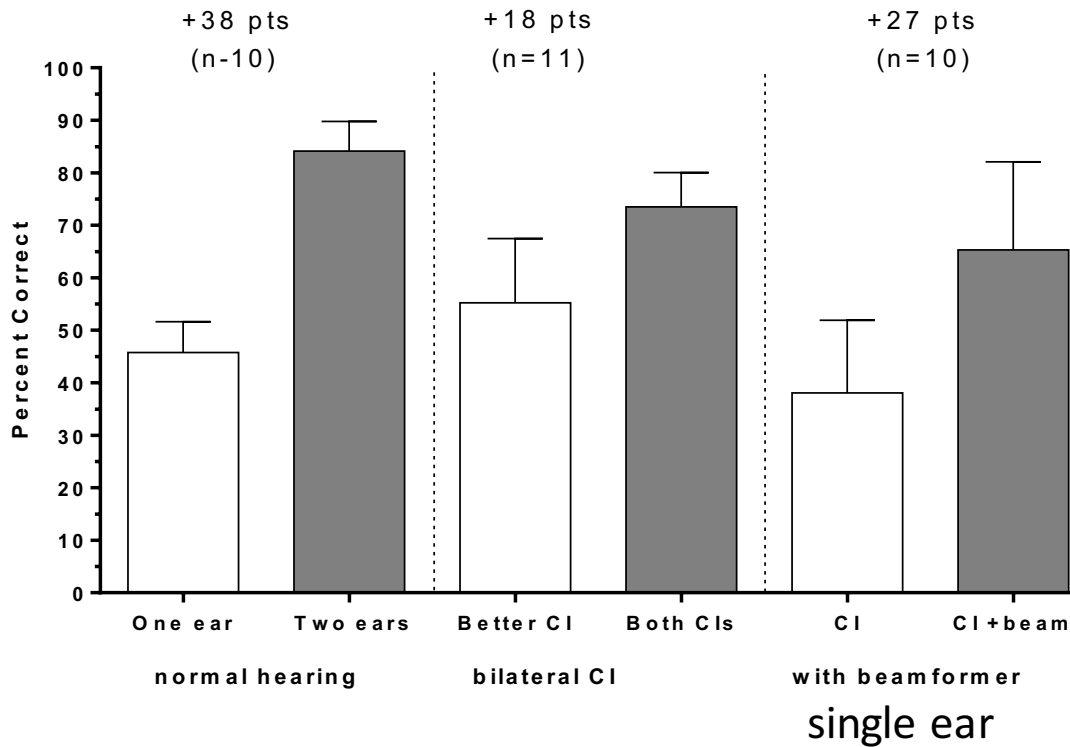
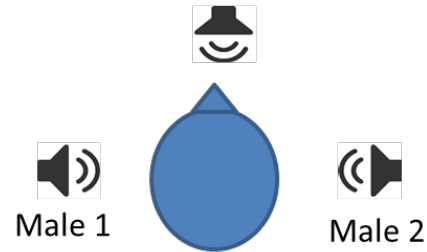
Speech understanding in a cocktail party

Target = female



Speech understanding in a cocktail party

Target = female



Speech understanding in a cocktail party



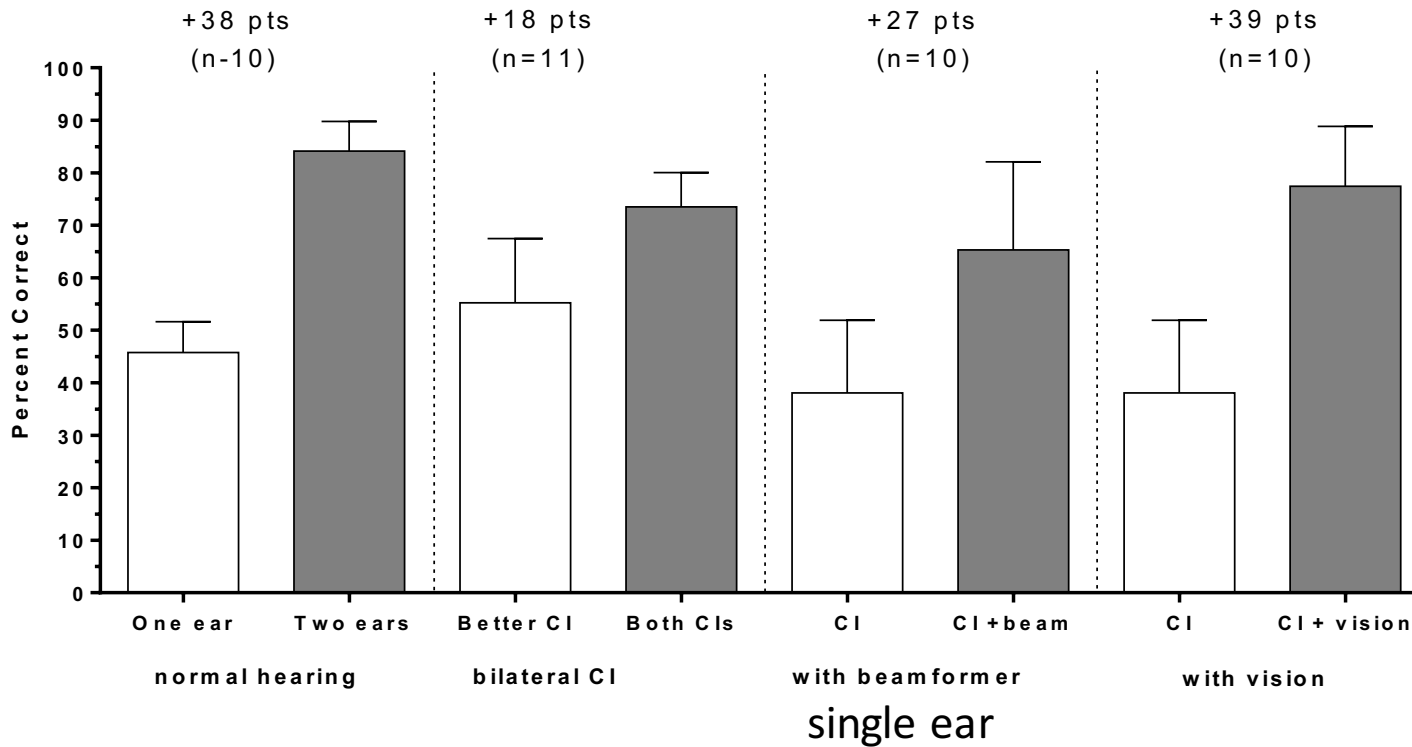
Target = female



Male 1



Male 2



Speech understanding in a cocktail party



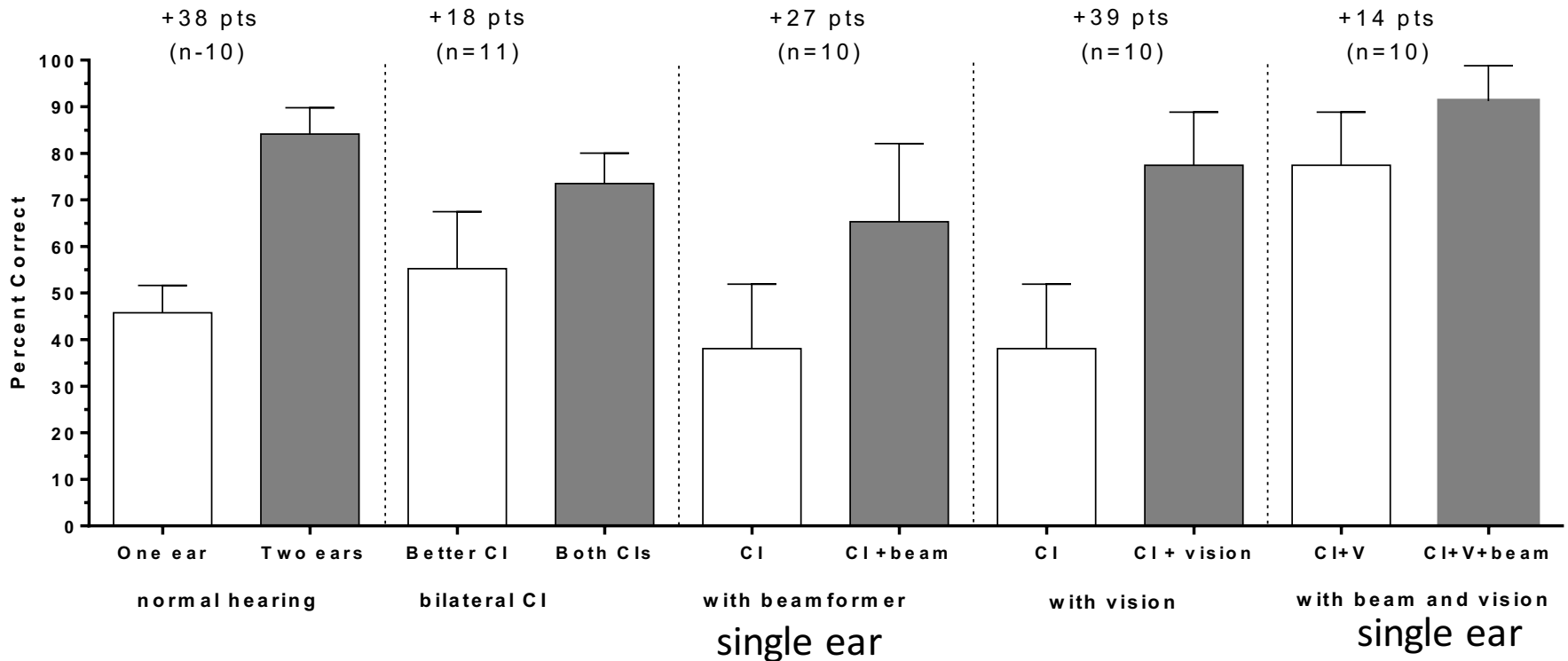
Target = female



Male 1



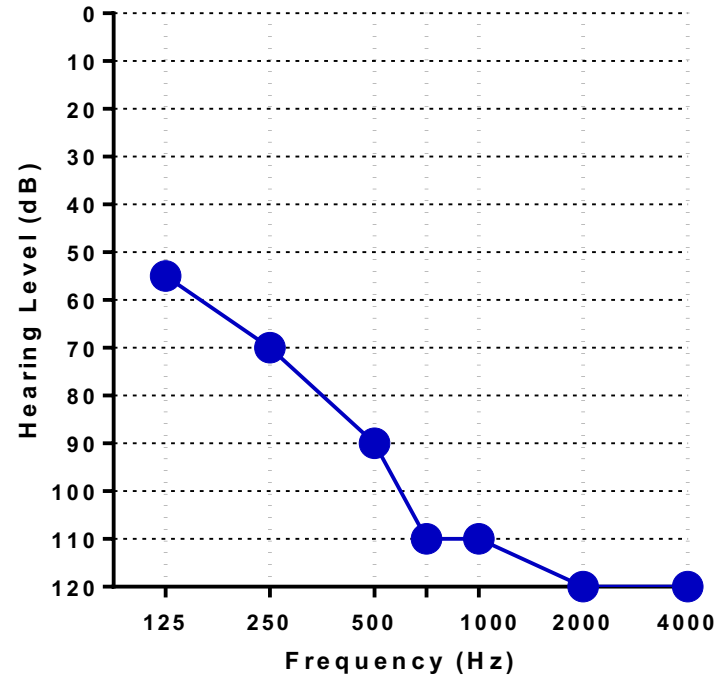
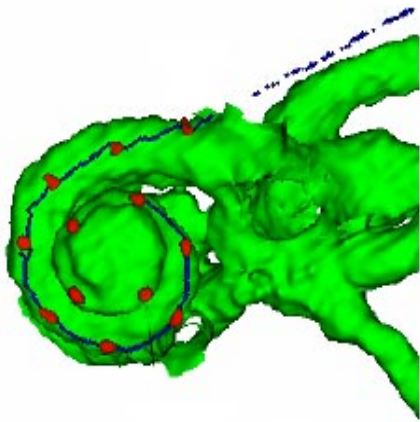
Male 2

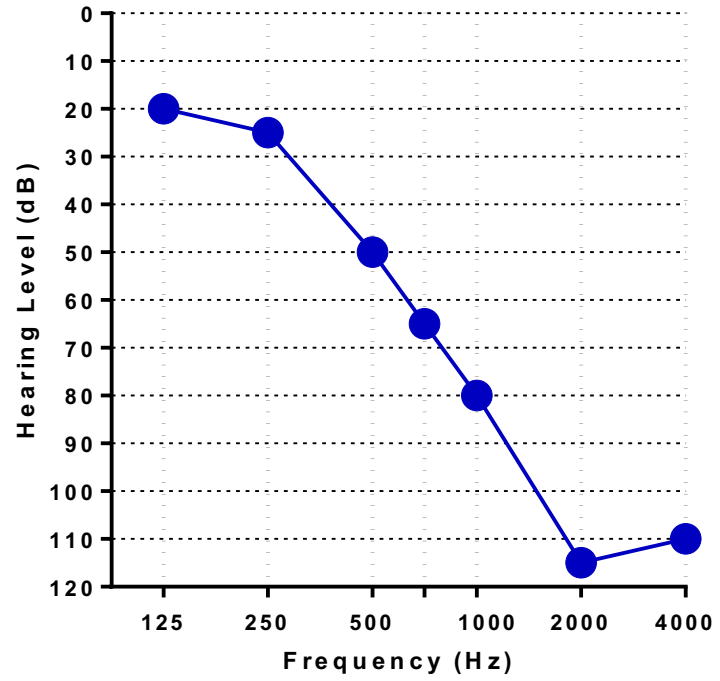
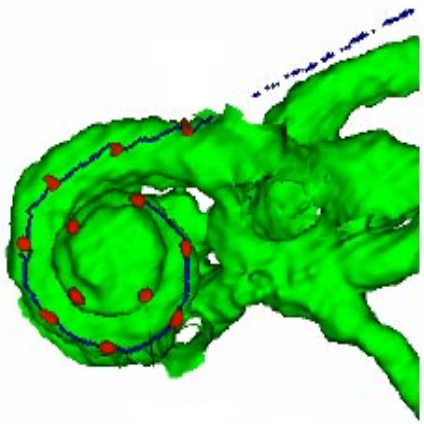


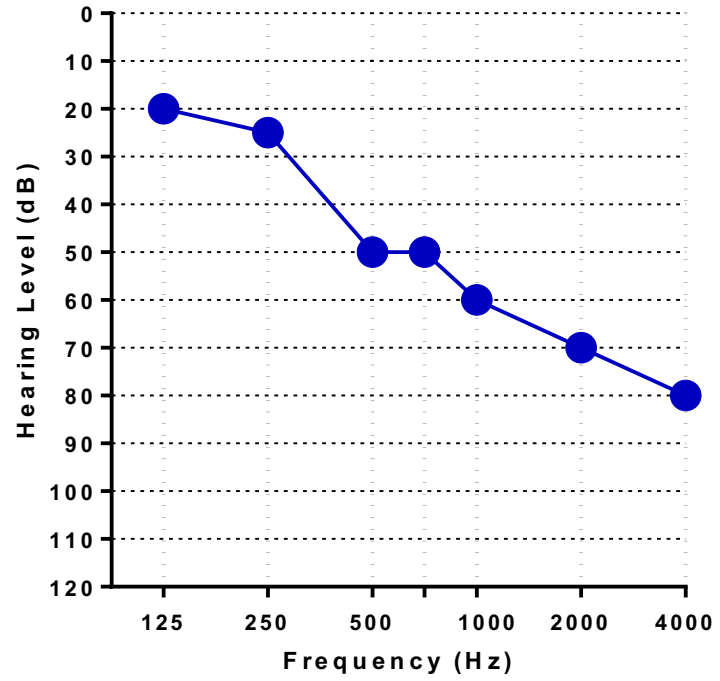
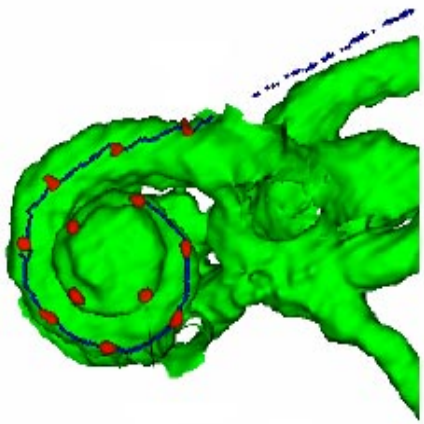


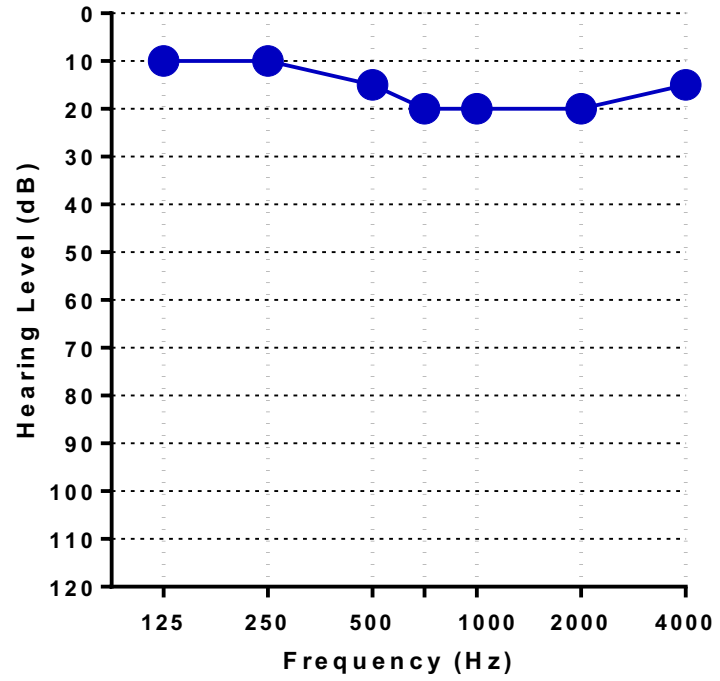
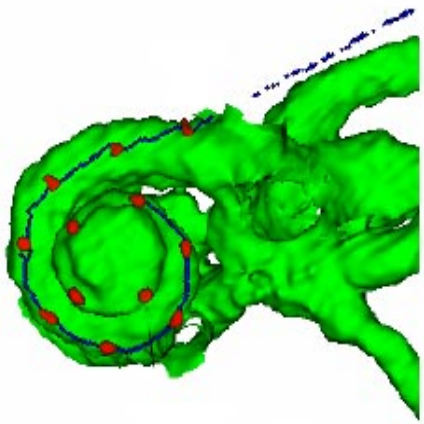
River Çoruh - Turkey 1992

A continuum of hearing sensitivity for 'bimodal' patients

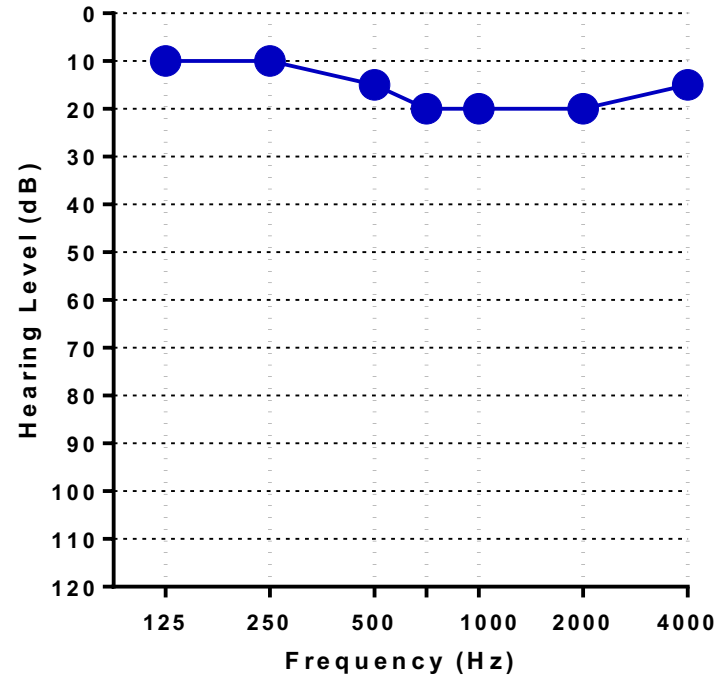
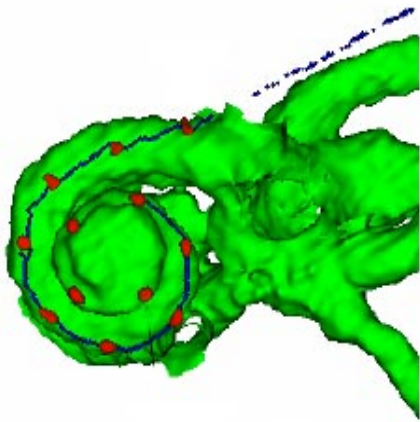




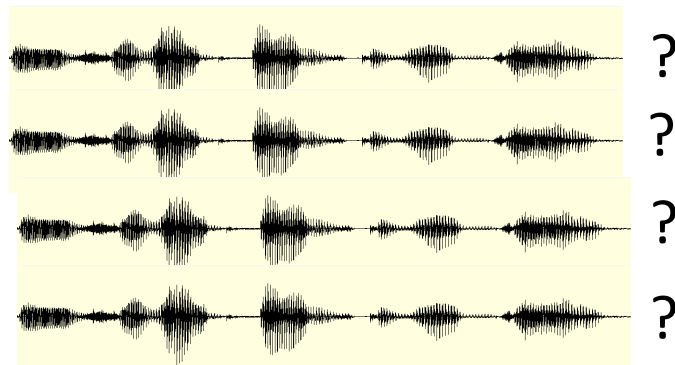
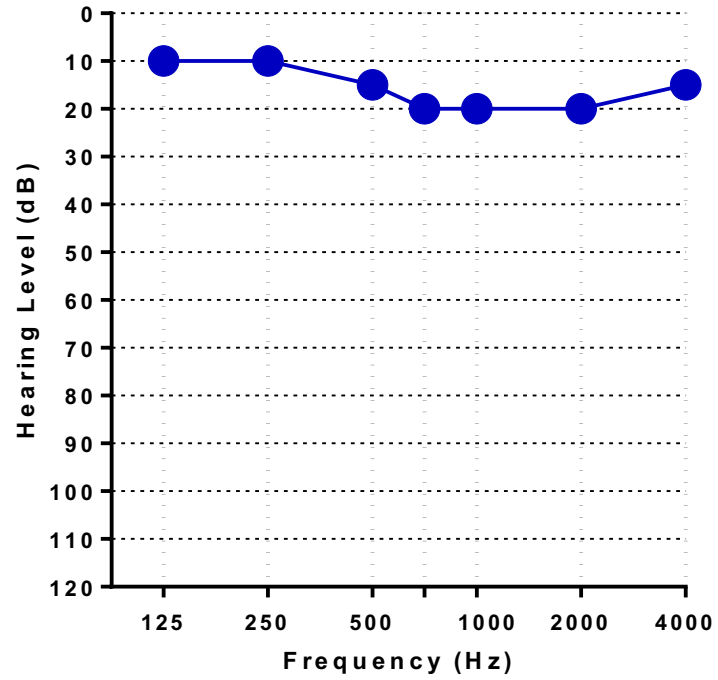
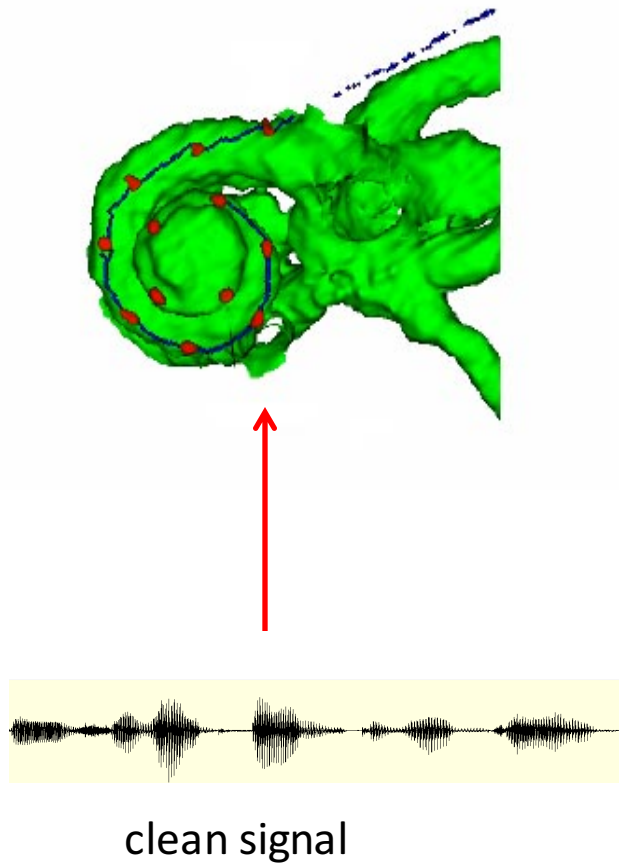




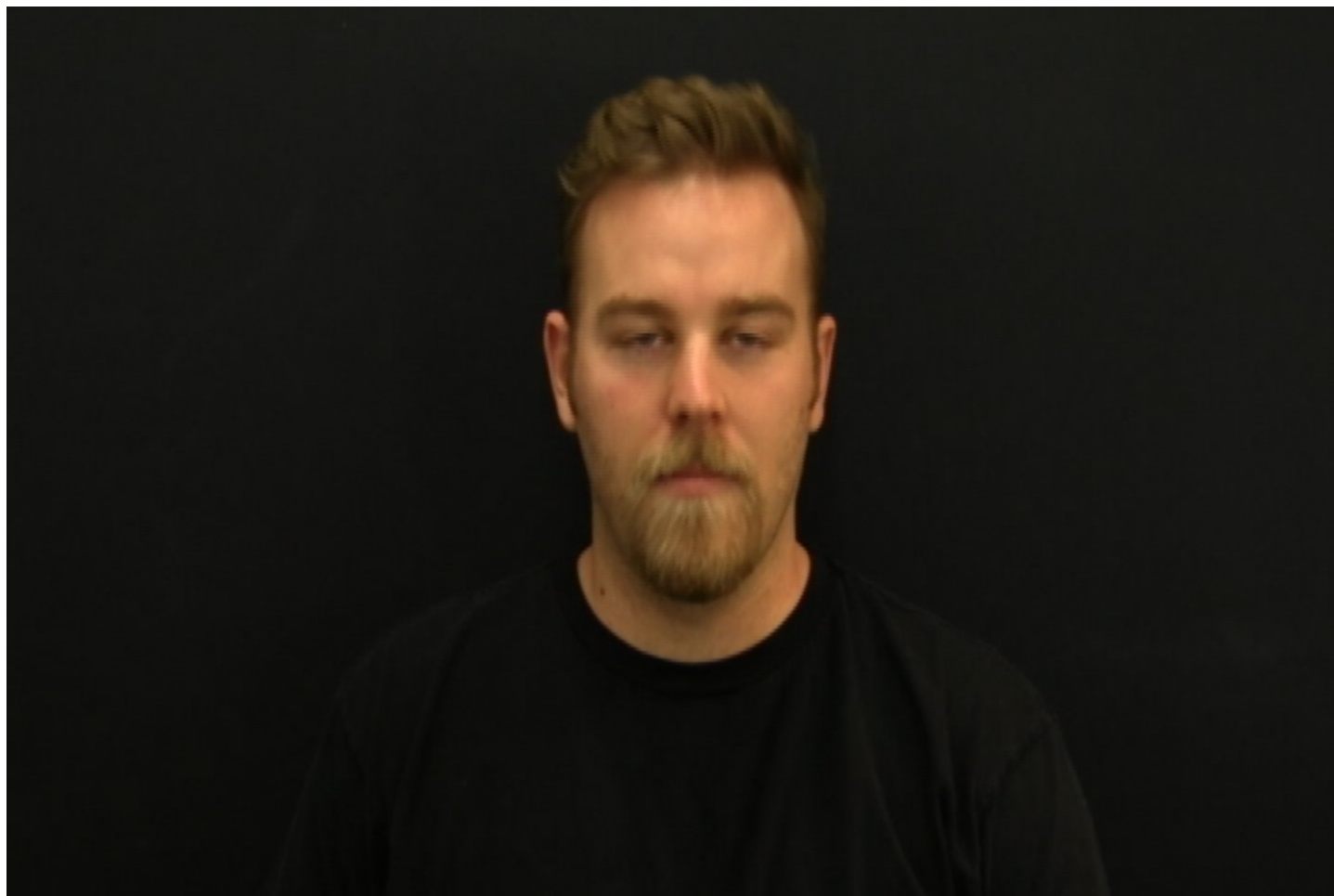
Single-sided deaf patient with CI



Single-sided deaf patient with CI



original sentence



Noise vocoder



sine vocoder



Darth Vader



Pitch shifted upward



Formants shifted upward: a Munchkin



Examples of CI sound quality for SSD patients 2-3 months post fitting

Patient 1033 at 2.3 months



Patient 2290 at 2.5 months
18 % correct CI-alone AzBio Pediatric Lists



Patient 2331 at 3.8 months
95% correct CI-alone AzBio Pediatric Lists



Examples of CI sound quality for SSD patients 9 - 73 months post fitting

Patient 2205 at 32.4 months

95% correct CI-only AzBio sentences



Patient 2295 at 9.7 months

92% correct CI-only AzBio sentences



Patient 2284 at 73.2 months

96% correct CI-only HSM sentences



Patient 2135 at 22.1 months

89% correct CI-only on AzBio sentences



Most CI listeners, most of the time, have access to both auditory and visual information for the purpose of understanding speech.

Visual information adds 30-45 percentage points to performance in noise for CI patients – when CI-alone performance is less than 50 % correct.

The value of visual information is so great that, in complex listening environments, for some bimodal CI patients, low-frequency acoustic hearing adds little or nothing to speech understanding.

For bilateral CI patients, the second ear assists in speech understanding even when visual information is available (this depends on the level of CI + vision, of course)

A beamformer microphone system on a single ear can add as much or more benefit in a complex listening environment as two CIs or hearing preservation CIs.

A beamformer microphone system can add to speech understanding even when visual information is available.