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

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

- Radio: [Approximately 30%]
- Television: I can see the talker: [Approximately 70%]
- Television: I cannot see the talker: [Approximately 40%]
- Another person who I can see: [Approximately 90%]
- Telephone conversations: [Approximately 60%]
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

A cocktail party

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

Target = female

Male 1

CI

Male 2

+ 32 points

Percent Correct

CI

CI + V
• 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?
A cocktail party

Target = female

Male 1

Male 2

CI

CI + V

Percent Correct

0 10 20 30 40 50 60 70 80 90 100

CI CI + V
Bimodal patients

Target = female

Male 1

Male 2

n = 4

n = 6

n = 7
Bilateral patients

Target = female

Male 1  Male 2

Percent Correct

Better CI  Bilateral CI  Better CI + V  Bilateral CI + V
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

Male 1

Male 2

+38 pts (n=10)

+18 pts (n=11)
Speech understanding in a cocktail party

Target = female

Male 1

Male 2

One ear

Two ears

Better CI

Both Cls

CI

CI + beam

+38 pts (n=10)

+18 pts (n=11)

+27 pts (n=10)

Percent Correct

One ear

Two ears

Better CI

Both Cls

CI

CI + beam

normal hearing

bilateral CI

with beamformer

single ear
Speech understanding in a cocktail party

Target = female

Male 1

Male 2

+38 pts (n=10)
+18 pts (n=11)
+27 pts (n=10)
+39 pts (n=10)

Percent Correct

One ear Two ears Better CI Both CIs CI CI + beam CI + vision

normal hearing bilateral CI with beamformer with vision

single ear
Speech understanding in a cocktail party

Target = female

Male 1

Male 2

+38 pts (n=10)
+18 pts (n=11)
+27 pts (n=10)
+39 pts (n=10)
+14 pts (n=10)

Percent Correct

0 10 20 30 40 50 60 70 80 90 100

One ear Two ears Better CI Both CIs CI CI + beam CI CI + vision CI + V CI+V+ beam

normal hearing bilateral CI with beamformer with vision with beam and vision single ear single ear
A continuum of hearing sensitivity for ‘bimodal’ patients
Single-sided deaf patient with CI
Single-sided deaf patient with CI

clean signal
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.