The impact of adding a contralateral cochlear implant to a normal hearing ear

in terms of spatial hearing abilities and listening effort during speech perception

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Single-sided deafness + CI: a growing population

• Reasons to add a CI when the other ear is (near-) normal:
  • Intractable tinnitus
  • Bilateral hearing
  • Environmental sound awareness
Background information

• Normal hearing in left ear

• Brainstem surgery resulted in severe tinnitus and deafness in right ear

• Cochlear implant on right ear
  activated July 2012 (Advanced Bionics)

• Satisfied with treatment thus far
  • Tinnitus is much less severe
Is it worth it?

How do we measure benefit?
What are the benefits for hearing?
Speech intelligibility in quiet is not affected very much

Scores for AZBio sentences in quiet
Test 2:
Is *listening effort* reduced when adding the implant to a single acoustic ear?
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Bilateral listening reduces effort for this patient.
If you really want to show the benefit of two ears, test spatial hearing and noise!

Ruth Litovsky

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Alan Kan
Spatial hearing

• Question: does the addition of the cochlear implant help in situations where the speech and noise are spatially separated?
Spatial hearing conditions

Collocated:
No spatial separation  No advantage for either ear
Spatial hearing conditions

Masker left: 

Spatial separation

Advantage for CI ear
Spatial hearing conditions

Advantage for acoustic ear

Spatial separation

Masker right:
Spatial hearing conditions

Masker symmetrical:

*Spatial separation*,  *But NO advantage for either ear*
Spatial separation $\rightarrow$ better word recognition
There is a benefit of spatial separation between speech and noise even with no ear advantage ...and an overall bilateral benefit.
Better performance when CI ear is masked

But there are distinct bilateral benefits
Does the CI reduce listening effort in these spatial conditions?
**Summary**

- Bilateral listening can reduce listening effort.

**Major benefit of spatial separation**

![Graph showing the comparison of bilateral benefit, bilateral interference, and bilateral benefit with different conditions: Collocated, Left, Right, and Symmetrical. The Y-axis represents Average Pupil Dilation (mm), with lower values indicating better performance. The graph indicates that bilateral benefit is higher under symmetrical conditions compared to the other setups.](image-url)
Summary

• There are some benefits to a CI + acoustic hearing
• In terms of:
  • Reduction in listening effort
  • Spatial hearing abilities

• But... there could also be interference in some cases

• These benefits complement the potential utility in managing tinnitus and aiding environmental sound awareness
Thanks to our team

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Samuel Gubbels  Ruth Litovsky  Matt Winn

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